

# IGCSE CLASSIFIED PAST PAPERS MR.YASSER ELSAYED

Cambridge International Education CIE  
Extended mathematics 0580

## PAPER 4

Part 1

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# MATHS

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# Paper 4 (1)

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# Numbers

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1 A school has 220 boys and 280 girls.

(a) Find the ratio of boys to girls, in its simplest form.

Answer(a) ..... : ..... [1]

(b) The ratio of students to teachers is 10 : 1.  
Find the number of teachers.

Answer(b) ..... [2]

(c) There are 21 students on the school's committee.  
The ratio of boys to girls is 3 : 4.  
Find the number of girls on the committee.

Answer(c) ..... [2]

(d) The committee organises a disco and sells tickets.  
35% of the school's students each buy a ticket. Each ticket costs \$1.60.  
Calculate the total amount received from selling the tickets.

Answer(d) \$ ..... [3]

(e) The cost of running the disco is \$264.  
This is an increase of 10% on the cost of running last year's disco.  
Calculate the cost of running last year's disco.

Answer(e) \$ ..... [2]

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2) June 2010 V2

1 Alberto and Maria share \$240 in the ratio 3 : 5.

(a) Show that Alberto receives \$90 and Maria receives \$150.

Answer(a)

[1]

(b) (i) Alberto invests his \$90 for 2 years at  $r\%$  per year **simple** interest.  
At the end of 2 years the amount of money he has is \$99.  
Calculate the value of  $r$ .

Answer(b)(i)  $r =$  ..... [2]

(ii) The \$99 is 60% of the cost of a holiday.  
Calculate the cost of the holiday.

Answer(b)(ii) \$ ..... [2]

(c) Maria invests her \$150 for 2 years at 4% per year **compound** interest.  
Calculate the exact amount Maria has at the end of 2 years.

Answer(c) \$ ..... [2]

(d) Maria continues to invest her money at 4% per year **compound** interest.  
After 20 years she has \$328.67.

(i) Calculate exactly how much more this is than \$150 invested for 20 years at 4% per year **simple** interest.

Answer(d)(i) \$ ..... [3]

(ii) Calculate \$328.67 as a percentage of \$150.

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Answer(d)(ii) ..... % [2]

5

3) June 2010 V3

1 Daniella is 8 years old and Edward is 12 years old.

(a) Their parents give them some money in the ratio of their ages.

(i) Write the ratio Daniella's age : Edward's age in its simplest form.

Answer(a)(i) ..... : ..... [1]

(ii) Daniella receives \$30.  
Show that Edward receives \$45.

Answer(a)(ii)

[1]

(iii) What percentage of the total amount of money given by their parents does Edward receive?

Answer(a)(iii) ..... % [2]

(b) Daniella invests her \$30 at 3% per year, **compound** interest.  
Calculate the amount Daniella has after 2 years.  
Give your answer correct to 2 decimal places.

Answer(b) \$ ..... [3]

(c) Edward also invests \$30.  
He invests this money at a rate of  $r\%$  per year, **simple** interest.  
After 5 years he has a total amount of \$32.25.  
Calculate the value of  $r$ .

Answer(c)  $r =$  ..... [2]

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4) November 2010 V1

- 1 (a) In 2008 the total number of tickets sold for an athletics meeting was 3136.  
The ratio child tickets sold : adult tickets sold = 17 : 32.

(i) How many child tickets were sold?

*Answer(a)(i)* ..... [2]

(ii) Child tickets cost \$2 each and adult tickets cost \$4.50 each.

Show that the total amount received from the sale of the tickets in 2008 was \$11 392.

*Answer(a)(ii)*

[2]

(b) In 2009 the amount received from the sale of tickets for the athletics meeting was \$12 748.

Calculate the percentage increase in the amount received from 2008 to 2009.

*Answer(b)* ..... % [3]

(c) In 2008 the amount of \$11 392 was 28% more than the amount received in 2007.

Calculate how much was received in 2007.

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*Answer(c)* \$ ..... [3]

7

5) November 2010 V2

- 1 (a) Hansi and Megan go on holiday.  
The costs of their holidays are in the ratio Hansi : Megan = 7 : 4.  
Hansi's holiday costs \$756.  
Find the cost of Megan's holiday.

Answer(a) \$ ..... [2]

- (b) In 2008, Hansi earned \$7800.  
(i) He earned 15% more in 2009.  
Calculate how much he earned in 2009.

Answer(b)(i) \$ ..... [2]

- (ii) In 2010, he earns 10% more than in 2009.  
Calculate the percentage increase in his earnings from 2008 to 2010.

Answer(b)(ii) ..... % [3]

- (c) Megan earned \$9720 in 2009. This was 20% more than she earned in 2008.  
How much did she earn in 2008?

Answer(c) \$ ..... [3]

- (d) Hansi invested \$500 at a rate of 4% per year **compound** interest.  
Calculate the final amount he had after three years.

Answer(d) \$ ..... [3]

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6) November 2010 V3

1 Thomas, Ursula and Vanessa share \$200 in the ratio

$$\text{Thomas : Ursula : Vanessa} = 3 : 2 : 5.$$

(a) Show that Thomas receives \$60 and Ursula receives \$40.

*Answer(a)*

[2]

(b) Thomas buys a book for \$21.  
What percentage of his \$60 does Thomas have left?

*Answer(b)* ..... % [2]

(c) Ursula buys a computer game for \$36.80 in a sale.  
The sale price is 20% less than the original price.  
Calculate the original price of the computer game.

*Answer(c)* \$ ..... [3]

(d) Vanessa buys some books and some pencils.  
Each book costs \$12 **more** than each pencil.  
The total cost of 5 books and 2 pencils is \$64.20.  
Find the cost of one pencil.

*Answer(d)* \$ ..... [3]

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- 1 A school has a sponsored swim in summer and a sponsored walk in winter.  
In 2010, the school raised a total of \$1380.  
The ratio of the money raised in summer winter = 62 : 53.

(a) (i) Show clearly that \$744 was raised by the swim in **summer**.

*Answer (a)(i)*

[1]

(ii) Alesha's swim raised \$54.10. Write this as a percentage of \$744.

*Answer(a)(ii)* ..... %[1]

(iii) Bryan's swim raised \$31.50.  
He received 75 cents for each length of the pool which he swam.

Calculate the number of lengths Bryan swam.

*Answer(a)(iii)* ..... [2]

(c) The total amount, \$1380, raised in 2010 was 8% **less** than the total amount raised in 2009.

Calculate the total amount raised in 2009.

*Answer(c)* \$ ..... [3]

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8) June 2011 V2

1 (a) Work out the following.

(i)  $\frac{1}{0.2^2}$

Answer(a)(i) ..... [1]

(ii)  $\sqrt{5.1^2 + 4 \times 7.3^2}$

Answer(a)(ii) ..... [1]

(iii)  $25^{\frac{1}{2}} \times 1000^{-\frac{2}{3}}$

Answer(a)(iii) ..... [2]

(b) Mia invests \$7500 at 3.5% per year **simple** interest.  
Calculate the total amount she has after 5 years.

Answer(b) \$ ..... [3]

(c) Written as the product of prime factors  $48 = 2^4 \times 3$ .

(i) Write 60 as the product of prime factors.

Answer(c)(i) ..... [2]

(ii) Work out the highest common factor (HCF) of 48 and 60.

Answer(c)(ii) ..... [2]

(iii) Work out the lowest common multiple (LCM) of 48 and 60.

Answer(c)(iii) ..... [2]

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1 Lucy works in a clothes shop.

(a) In one week she earned \$277.20.

(i) She spent  $\frac{1}{8}$  of this on food.

Calculate how much she spent on food.

Answer(a)(i) \$ ..... [1]

(ii) She paid 15% of the \$277.20 in taxes.  
Calculate how much she paid in taxes.

Answer(a)(ii) \$ ..... [2]

(iii) The \$277.20 was 5% more than Lucy earned in the previous week.  
Calculate how much Lucy earned in the previous week.

Answer(a)(iii) \$ ..... [3]

(b) The shop sells clothes for men, women and children.

(i) In one day Lucy sold clothes with a total value of \$2200 in the ratio

$$\text{men : women : children} = 2 : 5 : 4.$$

Calculate the value of the women's clothes she sold.

Answer(b)(i) \$ ..... [2]

(ii) The \$2200 was  $\frac{44}{73}$  of the total value of the clothes sold in the shop on this day.

Calculate the total value of the clothes sold in the shop on this day.

Answer(b)(ii) \$ ..... [2]

- 1 (a) Abdullah and Jasmine bought a car for \$9000.  
Abdullah paid 45% of the \$9000 and Jasmine paid the rest.

(i) How much did Jasmine pay towards the cost of the car?

Answer(a)(i) \$ ..... [2]

(ii) Write down the ratio of the payments Abdullah : Jasmine in its simplest form.

Answer(a)(ii) ..... : ..... [1]

- (b) Last year it cost \$2256 to run the car.  
Abdullah, Jasmine and their son Henri share this cost in the ratio 8 : 3 : 1.  
Calculate the amount each paid to run the car.

Answer(b) Abdullah \$ .....

Jasmine \$ .....

Henri \$ ..... [3]

- (c) (i) A new truck costs \$15 000 and loses 23% of its value **each year**.  
Calculate the value of the truck after three years.

Answer(c)(i) \$ ..... [3]

(ii) Calculate the overall percentage loss of the truck's value after three years.

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Answer(c)(ii) ..... % [3]  
**13**

9 (a)  $72 = 2 \times 2 \times 2 \times 3 \times 3$  written as a product of prime factors.

(i) Write the number 126 as a product of prime factors.

*Answer(a)(i)*  $126 =$  ..... [2]

(ii) Find the value of the highest common factor of 72 and 126.

*Answer(a)(ii)* ..... [1]

(iii) Find the value of the lowest common multiple of 72 and 126.

*Answer(a)(iii)* ..... [2]

- (b) John wants to estimate the value of  $\pi$ .  
He measures the circumference of a circular pizza as 105 cm and its diameter as 34 cm, both correct to the nearest centimetre.

Calculate the lower bound of his estimate of the value of  $\pi$ .  
Give your answer correct to 3 decimal places.

*Answer(b)* ..... [4]

- (c) The volume of a cylindrical can is  $550 \text{ cm}^3$ , correct to the nearest  $10 \text{ cm}^3$ .  
The height of the can is 12 cm correct to the nearest centimetre.

Calculate the upper bound of the radius of the can.  
Give your answer correct to 3 decimal places.

*Answer(c)* ..... cm [5]

1 Children go to camp on holiday.

(a) Fatima buys bananas and apples for the camp.

(i) Bananas cost \$0.85 per kilogram.

Fatima buys 20kg of bananas and receives a discount of 14%.

How much does she spend on bananas?

Answer(a)(i) \$ ..... [3]

(ii) Fatima spends \$16.40 on apples after a discount of 18%.

Calculate the original price of the apples.

Answer(a)(ii) \$ ..... [3]

(iii) The ratio number of bananas : number of apples = 4 : 5.

There are 108 bananas.

Calculate the number of apples.

Answer(a)(iii) ..... [2]

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(b) The cost to hire a tent consists of two parts.

$$\boxed{\$c} + \boxed{\$d \text{ per day}}$$

The total cost for 4 days is \$27.10 and for 7 days is \$34.30.

Write down two equations in  $c$  and  $d$  and solve them.

*Answer(b)*  $c =$  .....

$d =$  ..... [4]

(c) The children travel 270 km to the camp, leaving at 07 43 and arriving at 15 13.

Calculate their average speed in km/h.

*Answer(c)* ..... km/h [3]

(d) Two years ago \$540 was put in a savings account to pay for the holiday.

The account paid **compound** interest at a rate of 6% per year.

How much is in the account now?

*Answer(d)* \$ ..... [2]

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- 1 Anna, Bobby and Carl receive a sum of money.  
They share it in the ratio 12:7:8.  
Anna receives \$504.

(a) Calculate the **total** amount.

Answer(a) \$ ..... [3]

- (b) (i) Anna uses 7% of her \$504 to pay a bill.  
Calculate how much she has left.

Answer(b)(i) \$ ..... [3]

- (ii) She buys a coat in a sale for \$64.68.  
This was 23% less than the original price.  
Calculate the original price of the coat.

Answer(b)(ii) \$ ..... [3]

- (c) Bobby uses \$250 of his share to open a bank account.  
This account pays compound interest at a rate of 1.6% per year.  
Calculate the amount in the bank account after 3 years.  
Give your answer correct to 2 decimal places.

Answer(c) \$ ..... [3]

- (d) Carl buys a computer for \$288 and sells it for \$324.  
Calculate his percentage profit.

Answer(d) ..... % [3]

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- 2 (a) In a sale, Jen buys a laptop for \$351.55.  
This price is 21% less than the price before the sale.

Calculate the price before the sale.

Answer(a) \$ ..... [3]

- (b) Alex invests \$4000 at a rate of 8% per year simple interest for 2 years.  
Bob invests \$4000 at a rate of 7.5% per year compound interest for 2 years.

Who receives more interest and by how much?

Mr. Yasser Elsayed ..... receives \$ ..... more interest. [6]

- 5 (a) In Portugal, Miguel buys a book about planets.  
The book costs €34.95.  
In England the same book costs £27.50.  
The exchange rate is £1 = €1.17.

Calculate the difference in pounds (£) between the cost of the book in Portugal and England.

Answer(a) £ ..... [2]

- (b) In the book, the distance between two planets is given as  $4.07 \times 10^{12}$  kilometres.  
The speed of light is  $1.1 \times 10^9$  kilometres per hour.

Calculate the time taken for light to travel from one of these planets to the other.  
Give your answer in days and hours.

Answer(b) ..... days ..... hours [3]

- (c) In one of the pictures in the book, a rectangle is drawn.  
The rectangle has length 9.3 cm and width 5.6 cm, both correct to one decimal place.

- (i) What is the lower bound for the length?

Answer(c)(i) ..... cm [1]

- (ii) Work out the lower and upper bounds for the area of the rectangle.

Answer(c)(ii) Lower bound = .....  $\text{cm}^2$

Upper bound = .....  $\text{cm}^2$  [2]

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1 A train travels from Paris to Milan.

(a) The train departs from Paris at 20 28 and the journey takes 9 hours 10 minutes.

(i) Find the time the train arrives in Milan.

Answer(a)(i) ..... [1]

(ii) The distance between Paris and Milan is 850 km.

Calculate the average speed of the train.

Answer(a)(ii) ..... km/h [2]

(b) The total number of passengers on the train is 640.

(i) 160 passengers have tickets which cost \$255 each.  
330 passengers have tickets which cost \$190 each.  
150 passengers have tickets which cost \$180 each.

Calculate the mean cost of a ticket.

Answer(b)(i) \$ ..... [3]

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(ii) There are men, women and children on the train in the ratio

$$\text{men : women : children} = 4 : 3 : 1.$$

Show that the number of women on the train is 240.

*Answer(b)(ii)*

[2]

(iii) 240 is an increase of 60% on the number of women on the train the previous day.

Calculate the number of women on the train the previous day.

*Answer(b)(iii)* ..... [3]

(c) The length of the train is 210 m.

It passes through a station of length 340 m, at a speed of 180 km/h.

Calculate the number of seconds the train takes to pass completely through the station.

*Answer(c)* ..... s [3]

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- 9 Distances from the Sun can be measured in astronomical units, AU.  
 Earth is a distance of 1 AU from the Sun.  
 One AU is approximately  $1.496 \times 10^8$  km.

The table shows distances from the Sun.

Name	Distance from the Sun in AU	Distance from the Sun in kilometres
Earth	1	$1.496 \times 10^8$
Mercury	0.387	.....
Jupiter	.....	$7.79 \times 10^8$
Pluto	.....	$5.91 \times 10^9$

(a) Complete the table. [3]

(b) Light travels at approximately 300 000 kilometres per second.

- (i) How long does it take light to travel from the Sun to Earth?  
 Give your answer in seconds.

Answer(b)(i) ..... s [2]

- (ii) How long does it take light to travel from the Sun to Pluto?  
 Give your answer in minutes.

Answer(b)(ii) ..... min [2]

(c) One light year is the distance that light travels in one year (365 days).

How far is one light year in kilometres?  
 Give your answer in standard form.

Answer(c) ..... km [3]

(d) How many astronomical units (AU) are equal to one light year?

Answer(d) ..... AU [2]

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1 A factory produces bird food made with sunflower seed, millet and maize.

(a) The amounts of sunflower seed, millet and maize are in the ratio

$$\text{sunflower seed} : \text{millet} : \text{maize} = 5 : 3 : 1.$$

(i) How much millet is there in 15 kg of bird food?

*Answer(a)(i)* ..... kg [2]

(ii) In a small bag of bird food there is 60 g of sunflower seed.

What is the mass of bird food in a small bag?

*Answer(a)(ii)* ..... g [2]

(b) Sunflower seeds cost \$204.50 for 30 kg from Jon's farm or €96.40 for 20 kg from Ann's farm.  
The exchange rate is \$1 = €0.718.

Which farm has the cheapest price per kilogram?

**You must show clearly all your working.**

*Answer(b)* ..... [4]

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(c) Bags are filled with bird food at a rate of 420 grams per second.

How many 20 kg bags can be **completely** filled in 4 hours?

*Answer(c)* ..... [3]

(d) Brian buys bags of bird food from the factory and sells them in his shop for \$15.30 each. He makes 12.5% profit on each bag.

How much does Brian pay for each bag of bird food?

*Answer(d)* \$ ..... [3]

(e) Brian orders 600 bags of bird food.

The probability that a bag is damaged is  $\frac{1}{50}$ .

How many bags would Brian expect to be damaged?

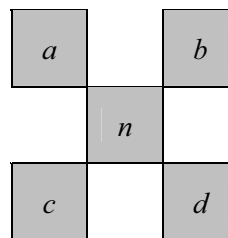
*Answer(e)* ..... [1]

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10 Consecutive integers are set out in rows in a grid.

(a) This grid has 5 columns.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35



The shape drawn encloses five numbers 7, 9, 13, 17 and 19. This is the  $n = 13$  shape.

In this shape,  $a = 7$ ,  $b = 9$ ,  $c = 17$  and  $d = 19$ .

(i) Calculate  $bc - ad$  for the  $n = 13$  shape.

Answer(a)(i) ..... [1]

(ii) For the 5 column grid,  $a = n - 6$ .

Write down  $b$ ,  $c$  and  $d$  in terms of  $n$  for this grid.

Answer(a)(ii)  $b =$  .....

$c =$  .....

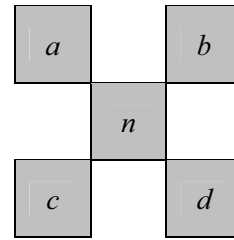
$d =$  ..... [2]

(iii) Write down  $bc - ad$  in terms of  $n$ .  
Show clearly that it simplifies to 20.

Answer(a)(iii)

(b) This grid has 6 columns. The shape is drawn for  $n = 10$ .

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36



(i) Calculate the value of  $bc - ad$  for  $n = 10$ .

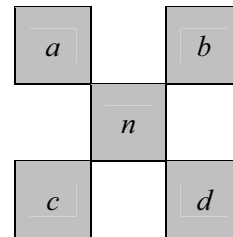
*Answer(b)(i)* ..... [1]

(ii) Without simplifying, write down  $bc - ad$  in terms of  $n$  for this grid.

*Answer(b)(ii)* ..... [2]

(c) This grid has 7 columns.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35



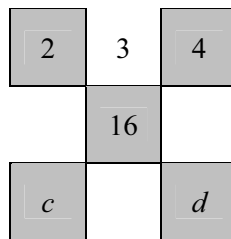
Show clearly that  $bc - ad = 28$  for  $n = 17$ .

*Answer(c)*

(d) Write down the value of  $bc - ad$  when there are  $t$  columns in the grid.

Answer(d) ..... [1]

(e) Find the values of  $c, d$  and  $bc - ad$  for this shape.



Answer (e)  $c =$  .....

$d =$  .....

$bc - ad =$  ..... [2]

1 (a) The Martinez family travels by car to Seatown.  
The distance is 92 km and the journey takes 1 hour 25 minutes.

(i) The family leaves home at 07.50.  
Write down the time they arrive at Seatown.

Answer(a)(i) ..... [1]

(ii) Calculate the average speed for the journey.

Answer(a)(ii) ..... km/h [2]

(iii) During the journey, the family stops for 10 minutes.  
Calculate 10 minutes as a percentage of 1 hour 25 minutes.

Answer(a)(iii) ..... % [1]

(iv) 92 km is 15% more than the distance from Seatown to Deecity.  
Calculate the distance from Seatown to Deecity.

Answer(a)(iv) ..... km [3]  
29

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(b) The Martinez family spends \$150 in the ratio

fuel : meals : gifts = 11 : 16 : 3 .

(i) Show that \$15 is spent on gifts.

*Answer (b)(i)*

[2]

(ii) The family buys two gifts.  
The first gift costs \$8.25.

Find the ratio

cost of first gift : cost of second gift.

Give your answer in its simplest form.

*Answer(b)(ii)* ..... : ..... [2]

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21) June 2013 V1

1 (a) One day, Maria took 27 minutes to walk 1.8 km to school.  
She left home at 07:48.

(i) Write down the time Maria arrived at school.

Answer(a)(i) ..... [1]

(ii) Show that Maria's average walking speed was 4 km/h.

Answer(a)(ii)

[2]

(b) Another day, Maria cycled the 1.8 km to school at an average speed of 15 km/h.

(i) Calculate the percentage **increase** that 15 km/h is on Maria's walking speed of 4 km/h.

Answer(b)(i) ..... % [3]

(ii) Calculate the percentage **decrease** that Maria's cycling time is on her walking time of 27 minutes.

Answer(b)(ii) ..... % [3]

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- (iii) After school, Maria cycled to her friend's home.  
This took 9 minutes, which was 36% of the time Maria takes to walk to her friend's home.

Calculate the time Maria takes to walk to her friend's home.

*Answer(b)(iii)* ..... min [2]



22) June 2013 V2

1 A tennis club has 560 members.

(a) The ratio men : women : children = 5 : 6 : 3.

(i) Show that the club has 240 women members.

Answer(a)(i)

[2]

(ii) How many members are children?

Answer(a)(ii) ..... [1]

(b)  $\frac{5}{8}$  of the 240 women members play in a tournament.

How many women members do **not** play in the tournament?

Answer(b) ..... [2]

(c) The annual membership fee in 2013 is \$198 for each adult and \$75 for each child.

(i) Calculate the total amount the 560 members pay in 2013.

Answer(c)(i) \$ ..... [2]

(ii) The adult fee of \$198 in 2013 is 5.6% more than the fee in 2012.

Calculate the adult fee in 2012.

Answer(c)(ii) \$ ..... [3]

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(d) The club buys 36 tennis balls for \$9.50 and sells them to members for \$0.75 each.

Calculate the percentage profit the club makes.

*Answer(d)* ..... % [3]

(e) A tennis court is a rectangle with length 23.7 m and width 10.9 m, each correct to 1 decimal place.

Calculate the upper and lower bounds of the perimeter of the court.

*Answer(e)* Upper bound ..... m

Lower bound ..... m [3]

- 1 (a) Ali and Ben receive a sum of money.  
They share it in the ratio 5 : 1.  
Ali receives \$2345.

Calculate the total amount.

Answer(a) \$ ..... [2]

- (b) Ali uses 11% of his \$2345 to buy a television.

Calculate the cost of the television.

Answer(b) \$ ..... [2]

- (c) A different television costs \$330.

- (i) Ben buys one in a sale when this cost is reduced by 15%.

How much does Ben pay?

Answer(c)(i) \$ ..... [2]

- (ii) \$330 is 12% less than the cost last year.

Calculate the cost last year.

Answer(c)(ii) \$ ..... [3]

- (d) Ali invests \$1500 of his share in a bank account.  
The account pays compound interest at a rate of 2.3% per year.

Calculate the total amount in the account at the end of 3 years.

*Answer(d)* \$ ..... [3]

- (e) Ali also buys a computer for \$325.  
He later sells this computer for \$250.

Calculate Ali's percentage loss.

*Answer(e)* ..... % [3]

1 David sells fruit at the market.

(a) In one week, David sells 120kg of tomatoes and 80kg of grapes.

(i) Write 80kg as a fraction of the total mass of tomatoes and grapes.  
Give your answer in its lowest terms.

Answer(a)(i) ..... [1]

(ii) Write down the ratio mass of tomatoes : mass of grapes.  
Give your answer in its simplest form.

Answer(a)(ii) ..... : ..... [1]

(b) (i) One day he sells 28kg of oranges at \$1.56 per kilogram.  
He also sells 35 kg of apples.  
The total he receives from selling the oranges and the apples is \$86.38 .

Calculate the price of 1 kilogram of apples.

Answer(b)(i) \$ ..... [2]

(ii) The price of 1 kilogram of oranges is \$1.56 .  
This is 20% more than the price two weeks ago.

Calculate the price two weeks ago.

Answer(b)(ii) \$ ..... [3]

(c) On another day, David received a total of \$667 from all the fruit he sold.  
The cost of the fruit was \$314.20 .  
David worked for  $10\frac{1}{2}$  hours on this day.

Calculate David's rate of profit in dollars per hour.

Answer(c) ..... dollars/h [2]

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25) November 2013 V2

- 1 Last year Mukthar earned \$18 900 .  
He did not pay tax on \$5500 of his earnings.  
He paid 24% tax on his remaining earnings.

(a) (i) Calculate how much tax Mukthar paid last year.

*Answer(a)(i)* \$ ..... [2]

(ii) Calculate how much Mukthar earned each month after tax had been paid.

*Answer(a)(ii)* \$ ..... [2]

(b) This year Mukthar now earns \$19750.50 .

Calculate the percentage increase from \$18 900.

*Answer(b)* ..... % [2]

(c) Mukthar has \$1500 to invest in one of the following ways.

- **Account A** paying **simple** interest at a rate of 4.1% per year
- **Account B** paying **compound** interest at a rate of 3.3% per year

Which account will be worth more after **3 years** and by how much?

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*Answer(c)* Account ..... by \$ ..... [5]

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- 7 Noma flies from Johannesburg to Hong Kong.  
Her plane leaves Johannesburg at 1845 and arrives in Hong Kong 13 hours and 25 minutes later.  
The local time in Hong Kong is 6 hours ahead of the time in Johannesburg.

(a) At what time does Noma arrive in Hong Kong?

Answer(a) ..... [2]

- (b) Noma sleeps for part of the journey.  
The time that she spends sleeping is given by the ratio

$$\text{sleeping : awake} = 3 : 4 .$$

Calculate how long Noma sleeps during the journey.  
Give your answer in hours and minutes.

Answer(b) ..... h ..... min [2]

- (c) (i) The distance from Hong Kong to Johannesburg is 10 712 km.  
The time taken for the journey is 13 hours and 25 minutes.

Calculate the average speed of the plane for this journey.

*Answer(c)(i)* ..... km/h [2]

- (ii) The plane uses fuel at the rate of 1 litre for every 59 metres travelled.

Calculate the number of litres of fuel used for the journey from Johannesburg to Hong Kong.  
Give your answer in standard form.

*Answer(c)(ii)* ..... litres [4]

- (d) The cost of Noma's journey is 10 148 South African Rand (R).  
This is an increase of 18% on the cost of the journey one year ago.

Calculate the cost of the same journey one year ago.

*Answer(d)* R ..... [3]

Mr. Yasser Elsayed  
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- 1 (a) (i) In a camera magazine, 63 pages are used for adverts.  
The ratio number of pages of adverts : number of pages of reviews = 7 : 5 .  
Calculate the number of pages used for reviews.

Answer(a)(i) ..... [2]

- (ii) In another copy of the magazine, 56 pages are used for reviews and for photographs.  
The ratio number of pages of reviews : number of pages of photographs = 9 : 5 .  
Calculate the number of pages used for photographs.

Answer(a)(ii) ..... [2]

- (iii) One copy of the magazine costs \$4.90 .  
An annual subscription costs \$48.80 for 13 copies.  
Calculate the percentage discount by having an annual subscription.

Answer(a)(iii) ..... % [3]

- (b) In a car magazine, 25% of the pages are used for selling second-hand cars,  $62\frac{1}{2}\%$  of the **remaining** pages are used for features, and the other 36 pages are used for reviews.

Work out the total number of pages in the magazine.

*Answer(b)* ..... [4]

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28) June 2014 V2

1 Jane and Kate share \$240 in the ratio 5:7.

(a) Show that Kate receives \$140.

Answer(a)

[2]

(b) Jane and Kate each spend \$20.

Find the new ratio Jane's remaining money : Kate's remaining money.  
Give your answer in its simplest form.

Answer(b) ..... : ..... [2]

(c) Kate invests \$120 for 5 years at 4% per year simple interest.

Calculate the total amount Kate has after 5 years.

Answer(c) \$ ..... [3]

(d) Jane invests \$80 for 3 years at 4% per year compound interest.

Calculate the total amount Jane has after 3 years.  
Give your answer correct to the nearest cent.

Answer(d) \$ ..... [3]

(e) An investment of \$200 for 2 years at 4% per year compound interest is the same as an investment of \$200 for 2 years at  $r\%$  per year simple interest.

Find the value of  $r$ .

Answer(e)  $r =$  ..... [3]

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29) June 2014 V3

1 In July, a supermarket sold 45 981 bottles of fruit juice.

(a) The cost of a bottle of fruit juice was \$1.35 .

Calculate the amount received from the sale of the 45 981 bottles.  
Give your answer correct to the nearest hundred dollars.

Answer(a) \$ ..... [2]

(b) The number of bottles sold in July was 17% more than the number sold in January.

Calculate the number of bottles sold in January.

Answer(b) ..... [3]

(c) There were 3 different flavours of fruit juice.

The number of bottles sold in each flavour was in the ratio apple : orange : cherry = 3 : 4 : 2.

The total number of bottles sold was 45 981.

Calculate the number of bottles of orange juice sold.

Answer(c) ..... [2]

(d) One bottle contains 1.5 litres of fruit juice.

Calculate the number of 330 ml glasses that can be filled completely from one bottle.

Answer(d) ..... [3]

(e)  $\frac{5}{9}$  of the 45 981 bottles are recycled.

Calculate the number of bottles that are recycled.

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Answer(e) ..... [2]  
44

1 (a) A company makes compost by mixing loam, sand and coir in the following ratio.

$$\text{loam} : \text{sand} : \text{coir} = 7 : 2 : 3$$

(i) How much loam is there in a 72 litre bag of the compost?

Answer(a)(i) ..... litres [2]

(ii) In a small bag of the compost there are 13.5 litres of coir.

How much compost is in a small bag?

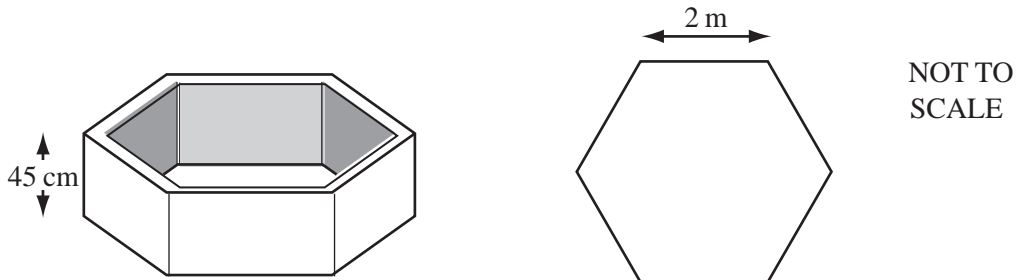
Answer(a)(ii) ..... litres [2]

(iii) The price of a large bag of compost is \$8.40 .  
This is an increase of 12% on the price last year.

Calculate the price last year.

Answer(a)(iii) \$ ..... [3]

(b) Teresa builds a raised garden bed in the shape of a hexagonal prism.



The garden bed has a height of 45 cm.

The cross section of the inside of the garden bed is a regular hexagon of side 2 m.

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- (i) Show that the area of the cross section of the inside of the garden bed is  $10.4\text{m}^2$ , correct to 3 significant figures.

*Answer(b)(i)*

[3]

- (ii) Calculate the volume of soil needed to fill the garden bed.

*Answer(b)(ii)* .....  $\text{m}^3$  [2]

- (iii) Teresa wants to fill the garden bed with organic top soil. She sees this advertisement in the local garden centre.

ORGANIC TOP SOIL	Number of tonnes purchased		
	1 to 5	6 to 10	Over 10
Cost per tonne	\$47.00	\$45.50	\$44.00

Organic top soil is sold in one tonne bags.  
 $1\text{m}^3$  of organic top soil has a mass of 1250 kg.

Calculate the cost of the organic top soil needed to fill the garden bed completely.  
 [1 tonne = 1000kg]

*Answer(b)(iii)* \$ ..... [4]

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31) November 2014 V2

1 (a) Alfonso has \$75 to spend on the internet.  
He spends some of the money on music, films and books.

(i) The money he spends on music, films and books is in the ratio

$$\text{music : films : books} = 5 : 3 : 7.$$

He spends \$16.50 on music.

Calculate the **total** amount he spends on music, films and books.

Answer(a)(i) \$ ..... [3]

(ii) Find this total amount as a percentage of the \$75.

Answer(a)(ii) ..... % [1]

(b) The download times for the music, films and books are in the ratio

$$\text{music : films : books} = 2 : 9 : 1.$$

The **total** download time is 3 hours and 33 minutes.

Calculate the download time for the films.

Give your answer in hours, minutes and seconds.

Answer(b) ..... hours ..... minutes ..... seconds [3]

(c) The cost of \$16.50 for the music was a reduction of 12% on the original cost.

Calculate the original cost of the music.

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Answer(c) \$ ..... [3]

32) November 2014 V3

2 There are three different areas, A, B and C, for seating in a theatre.  
The numbers of seats in each area are in the ratio  $A : B : C = 11 : 8 : 7$ .  
There are 920 seats in area B.

(a) (i) Show that there are 805 seats in area C.

Answer(a)(i)

[1]

(ii) Write the number of seats in area B as a percentage of the total number of seats.

Answer(a)(ii) ..... % [2]

(b) The cost of a ticket for a seat in each area of the theatre is shown in the table.

Area A	\$11.50
Area B	\$15
Area C	\$22.50

For a concert 80% of area B tickets were sold and  $\frac{3}{5}$  of area C tickets were sold.  
The total amount of money taken from ticket sales was \$35 834.

Calculate the number of area A tickets that were sold.

Answer(b) ..... [5]

(c) The total ticket sales of \$35 834 was 5% less than the ticket sales at the previous concert.

Calculate the ticket sales at the previous concert.

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Answer(c) \$..... 48 [3]



33) June 2015 V1

- 1 12 000 vehicles drive through a road toll on one day.  
The ratio cars : trucks : motorcycles = 13 : 8 : 3.

- (a) (i) Show that 6500 cars drive through the road toll on that day.

*Answer(a)(i)*

[1]

- (ii) Calculate the number of trucks that drive through the road toll on that day.

*Answer(a)(ii)* ..... [1]

- (b) The toll charges in 2014 are shown in the table.

Vehicle	Charge
Cars	\$2
Trucks	\$5
Motorcycles	\$1

Show that the total amount paid in tolls on that day is \$34 500.

*Answer(b)*

[2]

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(c) This total amount is a decrease of 8% on the total amount paid on the same day in 2013.

Calculate the total amount paid on that day in 2013.

*Answer(c)* \$ ..... [3]

(d) 2750 of the 6500 car drivers pay their toll using a credit card.

Write down, in its simplest terms, the fraction of car drivers who pay using a credit card.

*Answer(d)* ..... [2]

(e) To the nearest thousand, 90 000 cars drive through the road toll in one week.

Write down the lower bound for this number of cars.

*Answer(e)* ..... [1]

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- 1 (a) Last year a golf club charged \$1650 for a family membership.  
This year the cost increased by 12%.

Calculate the cost of a family membership this year.

Answer(a) \$ ..... [2]

- (b) The golf club runs a competition.  
The total prize money is shared in the ratio 1st prize:2nd prize = 9:5.  
The 1st prize is \$500 more than the 2nd prize.

- (i) Calculate the total prize money for the competition.

Answer(b)(i) \$ ..... [2]

- (ii) What percentage of the total prize money is given as the 1st prize?

Answer(b)(ii) .....% [1]

- (c) For the members of the golf club the ratio men:children = 11:2.  
The ratio women:children = 10:3.

- (i) Find the ratio men:women.

Answer(c)(i) ..... : ..... [2]

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(ii) The golf club has 24 members who are children.

Find the total number of members.

*Answer(c)(ii)* ..... [3]

(d) The club shop sold a box of golf balls for \$20.40 .  
The shop made a profit of 20% on the cost price.

Calculate the cost price of the golf balls.

*Answer(d)* \$ ..... [3]

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2 (a) (i) Eduardo invests \$640 at a rate of 2% per year compound interest.

Show that, at the end of 6 years, Eduardo has \$721, correct to the nearest dollar.

*Answer(a)(i)*

[2]

(ii) Manuela also invests \$640.  
At the end of 4 years, Manuela has \$721.

Find the yearly compound interest rate.

*Answer(a)(ii)* ..... % [4]

(b) Carlos buys a motor scooter for \$1200.  
Each year the value of the scooter decreases by 10% of its value at the beginning of that year.

Find the value of the scooter after 3 years.

*Answer(b)* \$ ..... [2]

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36) November 2015 V1

- 1 (a) Luc is painting the doors in his house.  
He uses  $\frac{3}{4}$  of a tin of paint for each door.

Work out the least number of tins of paint Luc needs to paint 7 doors.

Answer(a) ..... [3]

- (b) Jan buys tins of paint for \$17.16 each.  
He sells the paint at a profit of 25%.

For how much does Jan sell each tin of paint?

Answer(b) \$ ..... [2]

- (c) The cost of \$17.16 for each tin of paint is 4% more than the cost in the previous year.

Work out the cost of each tin of paint in the previous year.

Answer(c) \$ ..... [3]

- (d) In America a tin of paint costs \$17.16 .  
In Italy the same tin of paint costs €13.32 .  
The exchange rate is \$1 = €0.72 .

Calculate, in dollars, the difference in the cost of the tin of paint.

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Answer(d) \$ ..... [2]

(e) Paint is sold in cylindrical tins of height 11 cm.  
Each tin holds 750 ml of paint.

(i) Write 750 ml in  $\text{cm}^3$ .

Answer(e)(i) .....  $\text{cm}^3$  [1]

(ii) Calculate the radius of the tin.  
Give your answer correct to 1 decimal place.

Answer(e)(ii) ..... cm [3]

(iii) A mathematically similar tin has a height of 22 cm.  
How many **litres** of paint does this tin hold?

Answer(e)(iii) ..... litres [2]

(f) The mass of a tin of paint is 890 grams, correct to the nearest 10 grams.  
Work out the upper bound of the total mass of 10 tins of paint.

Answer(f) ..... g [1]

(g) The probability that a tin of paint is dented is 0.07 .  
Out of 3000 tins of paint, how many would you expect to be dented?

Answer(g) ..... [2]

(h) Tins of paint are filled at the rate of  $2 \text{ m}^3$  per minute.  
How many 750 ml tins of paint can be filled in 1 hour?

Answer(h) ..... [3]

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37) November 2015 V2

1 A film company uses 512 actors in a film.  
The actors are in the ratio men : women : children = 7 : 11 : 14.

(a) (i) Show that there are 224 children in the film.

Answer(a)(i)

[2]

(ii) Find the number of men in the film.

Answer(a)(ii) ..... [1]

(b) Every working day, each child is given \$1 to spend.  
Each child works for 45 days.

Calculate the total amount that the film company gives the children to spend.  
Give your answer correct to the nearest \$100.

Answer(b) \$..... [2]

(c) The children have lessons every day in groups of no more than 12.

Calculate the smallest possible number of groups.

Answer(c) ..... [2]

(d) The film costs four million and ninety three thousand dollars to make.

(i) Write this number in figures.

Answer(d)(i) ..... [1]

(ii) Write your answer to part (d)(i) in standard form.

Answer(d)(ii) ..... [1]

(e) A DVD copy of the film costs \$2.75 to make.  
The selling price is \$8.20 .

Calculate the percentage profit.

Answer(e) ..... [3]

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1 (a) Kolyan buys water for \$2.60 .  
He also buys biscuits.

(i) The ratio cost of biscuits : cost of water = 3 : 2.

Find the cost of the biscuits.

*Answer(a)(i) \$..... [2]*

(ii) Kolyan has \$9 to spend.

Work out the total amount Kolyan spends on water and biscuits as a fraction of the \$9.  
Give your answer in its lowest terms.

*Answer(a)(ii) ..... [2]*

(iii) The \$9 is 62.5% less than the amount Kolyan had to spend last week.

Calculate the amount Kolyan had to spend last week.

*Answer(a)(iii) \$..... [3]*

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- (b) Priya buys a bicycle for \$250.  
Each year the value of the bicycle decreases by 8% of its value at the beginning of that year.

Calculate the value of Priya's bicycle after 10 years.  
Give your answer correct to the nearest dollar.

*Answer(b)* \$..... [3]

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1 Jaideep builds a house and sells it for \$450000.

(a) He pays a tax of 1.5% of the selling price of the house.

Show that he pays \$6750 in tax.

*Answer(a)*

[1]

(b) \$6750 is 12.5% more than the tax Jaideep paid on the first house he built.

Calculate the tax Jaideep paid on the first house he built.

*Answer(b)* \$..... [3]

(c) The house is built on a rectangular plot of land, 21 m by 17 m, both correct to the nearest metre.

Calculate the upper bound for the area of the plot.

*Answer(c)* ..... m<sup>2</sup> [2]

(d) On a plan of the house, the area of the kitchen is 5.6 cm<sup>2</sup>.  
The scale of the plan is 1:200.

Calculate the actual area of the kitchen in square metres.

*Answer(d)* ..... m<sup>2</sup> [2]

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(e) The house was built using cuboid blocks each measuring 12 cm by 16 cm by 27 cm.

Calculate the volume of one block.

*Answer(e)* ..... cm<sup>3</sup> [2]

(f) Jaideep changes \$12 000 into euros (€) to buy land in another country.

The exchange rate is €1 = \$1.33 .

Calculate the number of euros Jaideep receives.

Give your answer correct to the nearest euro.

*Answer(f)* €..... [3]

Mr. Yasser Elsayed  
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1 Aasha, Biren and Cemal share \$640 in the ratio 8 : 15 : 9.

(a) Show that Aasha receives \$160.

[1]

(b) Calculate the amount that Biren and Cemal receive.

Biren \$ .....

Cemal \$ ..... [2]

(c) Aasha uses her \$160 to buy some books.  
Each book costs \$15.25 .

Find the greatest number of books that she can buy.

..... [2]

(d) Biren spends  $\frac{3}{8}$  of his share on clothes and  $\frac{1}{3}$  of his share on a computer.

Find the fraction of his share that he has left.  
Write your fraction in its lowest terms.

..... [3]

- 5 (a) Meena sells her car for \$6000.  
This is a loss of 4% on the price she paid.

Calculate the price Meena paid for the car.

\$ ..... [3]

- (b) Eisha changes some euros (€) into dollars (\$) when the exchange rate is €1 = \$1.351 .  
She receives \$6000.

Calculate how many euros Eisha changes.  
Give your answer correct to the nearest euro.

€ ..... [3]

- (c) Meena and Eisha both invest their \$6000.  
Meena invests her \$6000 at a rate of 1.5% per year compound interest.  
Eisha invests her \$6000 in a bank that pays simple interest.  
After 8 years, their investments are worth the same amount.

Calculate the rate of simple interest per year that Eisha received.

..... % [5]

1 (a) Kristian and Stephanie share some money in the ratio 3 : 2.  
Kristian receives \$72.

(i) Work out how much Stephanie receives.

\$ ..... [2]

(ii) Kristian spends 45% of his \$72 on a computer game.

Calculate the price of the computer game.

\$ ..... [1]

(iii) Kristian also buys a meal for \$8.40 .

Calculate the fraction of the \$72 Kristian has left after buying the computer game and the meal.  
Give your answer in its lowest terms.

..... [2]

(iv) Stephanie buys a book in a sale for \$19.20 .  
This sale price is after a reduction of 20%.

Calculate the original price of the book.

\$ ..... [3]

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(b) Boris invests \$550 at a rate of 2% per year simple interest.

Calculate the amount Boris has after 10 years.

\$ ..... [3]

(c) Marlene invests \$550 at a rate of 1.9% per year compound interest.

Calculate the amount Marlene has after 10 years.

\$ ..... [2]

(d) Hans invests \$550 at a rate of  $x\%$  per year compound interest.

At the end of 10 years he has a total amount of \$638.30, correct to the nearest cent.

Find the value of  $x$ .

$x =$  ..... [3]

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1 Mr Chan flies from London to Los Angeles, a distance of 8800 km.  
The flight takes 11 hours and 10 minutes.

- (a) (i) His plane leaves London at 0935 local time.  
The local time in Los Angeles is 8 hours behind the time in London.

Calculate the local time when the plane arrives in Los Angeles.

..... [2]

- (ii) Work out the average speed of the plane in km/h.

..... km/h [2]

(b) There are three types of tickets, economy, business and first class.  
The price of these tickets is in the ratio economy : business : first class = 2 : 5 : 9.

- (i) The price of a business ticket is \$2350.

Calculate the price of a first class ticket.

\$..... [2]

- (ii) Work out the price of an economy ticket as a percentage of the price of a first class ticket.

.....% [1]

(c) The price of a business ticket for the same journey with another airline is \$2240.

- (i) The price of a first class ticket is 70% more than a business ticket.

Calculate the price of this first class ticket.

\$..... [2]

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- (ii) The price of a business ticket is 180% **more** than an economy ticket.

Calculate the price of this economy ticket.

\$..... [3]

- (d) Mr Chan hires a car in Los Angeles.  
The charges are shown below.

Car Hire

\$28.00 per day plus \$6.50 per day insurance.

\$1.25 for every kilometre travelled after the first 800 km.  
The first 800 km are included in the price.

Mr Chan hired the car for 12 days and paid \$826.50 .

- (i) Find the number of kilometres Mr Chan travelled in this car.

..... km [4]

- (ii) The car used fuel at an average rate of 1 litre for every 10 km travelled.  
Fuel costs \$1.30 per litre.

Calculate the cost of the fuel used by the car during the 12 days.

\$..... [2]

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44) June 2016 V3

1 A football club sells tickets at different prices dependent on age group.

(a) (i) At one game, the club sold tickets in the ratio

$$\text{under 18} : \text{18 to 60} : \text{over 60} = 2 : 7 : 3.$$

There were 6100 tickets sold for people aged under 18.

Calculate the **total** number of tickets sold for the game.

..... [3]

(ii) Calculate the percentage of tickets sold for people aged under 18.

.....% [1]

(b) The table shows the football ticket prices for the different age groups.

Age	Price
Under 18	\$15
18 to 60	\$35
Over 60	\$18

At a **different** game there were 42 600 tickets sold.

- 14% were sold to people aged under 18
- $\frac{2}{3}$  of the tickets were sold to people aged 18 to 60
- The remainder were sold to people aged over 60

Calculate the total amount the football club receives from ticket sales for this game.

\$ ..... [5]

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- (c) In a sale, the football club shop reduced the price of the football shirts to \$23.80 .  
An error was made when working out this sale price.  
The price was reduced by 30% instead of 20%.

Calculate the correct sale price for the football shirt.

\$ ..... [5]

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45) June 2017 V1

1 An energy company charged these prices in 2013.

Electricity price	Gas price
23.15 cents per day plus 13.5 cents for each unit used	24.5 cents per day plus 5.5 cents for each unit used

(a) (i) In 90 days, the Siddique family used 1885 units of **electricity**.

Calculate the total cost, in dollars, of the electricity they used.

\$ ..... [2]

(ii) In 90 days, the **gas** used by the Khan family cost \$198.16 .

Calculate the number of units of gas used.

..... units [3]

(b) In 2013, the price for each unit of electricity was 13.5 cents.  
Over the next 3 years, this price increased exponentially at a rate of 8% per year.

Calculate the price for each unit of electricity after 3 years.

..... cents [2]

(c) Over these 3 years, the price for each unit of gas increased from 5.5 cents to 7.7 cents.

(i) Calculate the percentage increase from 5.5 cents to 7.7 cents.

..... % [3]

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- (ii) Over the 3 years, the 5.5 cents increased exponentially by the same percentage each year to 7.7 cents.

Calculate the percentage increase **each year**.

..... % [3]

- (d) In 2015, the energy company divided its profits in the ratio  
shareholders : bonuses : development = 5 : 2 : 6.

In 2015, its profits were \$390 million.

Calculate the amount the company gave to shareholders.

\$ ..... million [2]

- (e) The share price of the company in June 2015 was \$258.25 .  
This was an increase of 3.3% on the share price in May 2015.

Calculate the share price in May 2015.

\$ ..... [3]

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46) November 2017 V1

- 1 (a) A library has a total of 10 494 fiction and non-fiction books.  
The ratio fiction books : non-fiction books = 13 : 5.

Find the number of non-fiction books the library has.

[2]

- (b) The library has DVDs on crime, adventure and science fiction.  
The ratio crime : adventure : science fiction = 11 : 6 : 10.  
The library has 384 **more** science fiction DVDs than adventure DVDs.

Calculate the number of crime DVDs the library has.

..... [2]

- (c) Every Monday, Sima travels by car to the library.  
The distance is 20km and the journey takes 23 minutes.

- (i) Calculate the average speed for the journey in kilometres per hour.

..... km/h [2]

- (ii) One Monday, she is delayed and her average speed is reduced to 32 km/h.

Calculate the percentage increase in the journey time.

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.....71 [5]

- (d) In Spain, the price of a book is 11.99 euros.  
In the USA, the price of the same book is \$12.99 .  
The exchange rate is \$1 = 0.9276 euros.

Calculate the difference between these prices.  
Give your answer in dollars, correct to the nearest cent.

\$ ..... [3]

- (e) 7605 books were borrowed from the library in 2016.  
This was 22% less than in 2015.

Calculate the number of books borrowed in 2015.

..... [3]

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47) June 2018 V1

1 Adele, Barbara and Collette share \$680 in the ratio 9 : 7 : 4.

(a) Show that Adele receives \$306.

[1]

(b) Calculate the amount that Barbara and Collette each receives.

Barbara \$ .....

Collette \$ ..... [3]

(c) Adele changes her \$306 into euros (€) when the exchange rate is €1 = \$1.125 .

Calculate the number of euros she receives.

€ ..... [2]

(d) Barbara spends a total of \$17.56 on 5 kg of apples and 3 kg of bananas.  
Apples cost \$2.69 per kilogram.

Calculate the cost per kilogram of bananas.

\$ ..... [3]

(e) Collette spends half of her share on clothes and  $\frac{1}{5}$  of her share on books.

Calculate the amount she has left.

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\$ ..... 73<sup>[3]</sup>

- 3 (a) The price of a house decreased from \$82 500 to \$77 500.

Calculate the percentage decrease.

..... % [3]

- (b) Roland invests \$12 000 in an account that pays compound interest at a rate of 2.2% per year.

Calculate the value of his investment at the end of 6 years.  
Give your answer correct to the nearest dollar.

\$ ..... [3]

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1 (a) Here is a list of ingredients to make 20 biscuits.

260g of butter 500g of sugar 650g of flour 425g of rice
--

(i) Find the mass of rice as a percentage of the mass of sugar.

..... % [1]

(ii) Find the mass of butter needed to make 35 of these biscuits.

..... g [2]

(iii) Michel has 2 kg of each ingredient.

Work out the greatest number of these biscuits that he can make.

..... [3]

(b) A company makes these biscuits at a cost of \$1.35 per packet.  
These biscuits are sold for \$1.89 per packet.

(i) Calculate the percentage profit the company makes on each packet.

..... % [3]

(ii) The selling price of \$1.89 has increased by 8% from last year.

Calculate the selling price last year.

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\$

75 [3]

- (c) Over a period of 3 years, the company's sales of biscuits increased from 15.6 million packets to 20.8 million packets.  
The sales increased exponentially by the same percentage each year.

Calculate the percentage increase **each year**.

..... % [3]

- (d) The people who work for the company are in the following age groups.

Group A	Group B	Group C
Under 30 years	30 to 50 years	Over 50 years

The ratio of the number in group A to the number in group B is 7 : 10.

The ratio of the number in group B to the number in group C is 4 : 3.

- (i) Find the ratio of the number in group A to the number in group C.  
Give your answer in its simplest form.

..... : ..... [3]

- (ii) There are 45 people in group C.

Find the total number of people who work for the company.

..... [3]

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- 1 (a) The price of a newspaper increased from \$0.97 to \$1.13 .

Calculate the percentage increase.

..... % [3]

- (b) One day, the newspaper had 60 pages of news and advertisements.

The ratio number of pages of news : number of pages of advertisements = 5 : 7.

- (i) Calculate the number of pages of advertisements.

..... [2]

- (ii) Write the number of pages of advertisements as a percentage of the number of pages of news.

..... % [1]

- (c) On holiday Maria paid 2.25 euros for the newspaper when the exchange rate was \$1 = 0.9416 euros.  
At home Maria paid \$1.13 for the newspaper.

Calculate the difference in price.

Give your answer in dollars, correct to the nearest cent.

\$ ..... [3]

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- (d) The number of newspapers sold decreases exponentially by  $x\%$  each year.  
Over a period of 21 years the number of newspapers sold decreases from 1 763 000 to 58 000.

Calculate the value of  $x$

$$x = \dots\dots\dots [3]$$

- (e) Every page of the newspaper is a rectangle measuring 43cm by 28 cm, both correct to the nearest centimetre.

Calculate the upper bound of the area of a page.

$$\dots\dots\dots \text{cm}^2 [2]$$

1 (a) (i) Divide \$24 in the ratio 7 : 5.

\$ ..... , \$ ..... [2]

(ii) Write \$24.60 as a fraction of \$2870.  
Give your answer in its lowest terms.

..... [2]

(iii) Write \$1.92 as a percentage of \$1.60 .

..... % [1]

(b) In a sale the original prices are reduced by 15%.

(i) Calculate the sale price of a book that has an original price of \$12.

\$ ..... [2]

(ii) Calculate the original price of a jacket that has a sale price of \$38.25 .

\$ ..... [2]

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- (c) (i) Dean invests \$500 for 10 years at a rate of 1.7% per year simple interest.

Calculate the total interest earned during the 10 years.

\$ ..... [2]

- (ii) Ollie invests \$200 at a rate of 0.0035% **per day** compound interest.

Calculate the value of Ollie's investment at the end of 1 year.

[1 year = 365 days.]

\$ ..... [2]

- (iii) Edna invests \$500 at a rate of  $r\%$  per year compound interest.

At the end of 6 years, the value of Edna's investment is \$559.78 .

Find the value of  $r$ .

$r =$  ..... [3]

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52) November 2020 V1

2 (a) A plane has 14 First Class seats, 70 Premium seats and 168 Economy seats.

Find the ratio First Class seats : Premium seats : Economy seats.  
Give your answer in its simplest form.

..... : ..... : ..... [2]

(b) (i) For a morning flight, the costs of tickets are in the ratio

$$\text{First Class} : \text{Premium} : \text{Economy} = 14 : 6 : 5.$$

The cost of a Premium ticket is \$114.

Calculate the cost of a First Class ticket and the cost of an Economy ticket.

First Class \$ .....

Economy \$ ..... [3]

(ii) For an afternoon flight, the cost of a Premium ticket is reduced from \$114 to \$96.90 .

Calculate the percentage reduction in the cost of a ticket.

..... % [2]

(c) When the local time in Athens is 09 00, the local time in Berlin is 08 00.

A plane leaves Athens at 13 15.

It arrives in Berlin at 15 05 local time.

(i) Find the flight time from Athens to Berlin.

..... h ..... min [1]

(ii) The distance the plane flies from Athens to Berlin is 1802 km.

Calculate the average speed of the plane.

Give your answer in kilometres per hour.

..... km/h [2]

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53) November 2020 V3

3 (a) Beth invests \$2000 at a rate of 2% per year compound interest.

(i) Calculate the value of this investment at the end of 5 years.

\$ ..... [2]

(ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

..... % [2]

(iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from \$2000 to more than \$2500.

..... [3]

(b) The population of a village decreases exponentially at a rate of 4% each year. The population is now 255.

Calculate the population 16 years ago.

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..... [3]

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# Algebra

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9 (a) Solve the following equations.

(i)  $\frac{5}{w} = \frac{3}{w+1}$

Answer(a)(i)  $w = \dots\dots\dots$  [2]

(ii)  $(y+1)^2 = 4$

Answer(a)(ii)  $y = \dots\dots\dots$  or  $y = \dots\dots\dots$  [2]

(iii)  $\frac{x+1}{3} - \frac{x-2}{5} = 2$

Answer(a)(iii)  $x = \dots\dots\dots$  [3]

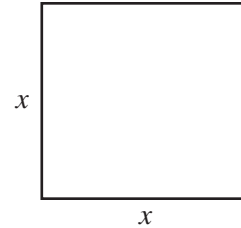
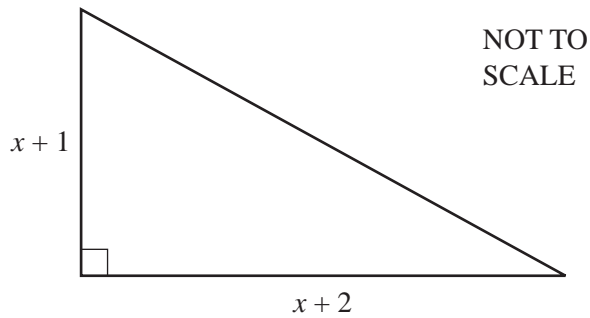
(b) (i) Factorise  $u^2 - 9u - 10$ .

Answer(b)(i)  $\dots\dots\dots$  [2]

(ii) Solve the equation  $u^2 - 9u - 10 = 0$ .

Answer(b)(ii)  $u = \dots\dots\dots$  or  $u = \dots\dots\dots$  [1]

(c)



The area of the triangle is equal to the area of the square.  
All lengths are in centimetres.

(i) Show that  $x^2 - 3x - 2 = 0$ .

*Answer(c)(i)*

[3]

(ii) Solve the equation  $x^2 - 3x - 2 = 0$ , giving your answers correct to 2 decimal places.  
Show all your working.

*Answer(c)(ii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

- 8 (a)  $y$  is 5 less than the square of the sum of  $p$  and  $q$ .

Write down a formula for  $y$  in terms of  $p$  and  $q$ .

*Answer(a)*  $y =$  ..... [2]

- (b) The cost of a magazine is  $\$x$  and the cost of a newspaper is  $\$(x - 3)$ .

The total cost of 6 magazines and 9 newspapers is  $\$51$ .

Write down and solve an equation in  $x$  to find the cost of a magazine.

*Answer(b)*  $\$$  ..... [4]

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(c) Bus tickets cost \$3 for an adult and \$2 for a child.

There are  $a$  adults and  $c$  children on a bus.

The total number of people on the bus is 52.

The total cost of the 52 tickets is \$139.

Find the number of adults and the number of children on the bus.

*Answer(c)* Number of adults = .....

Number of children = ..... [5]

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- 9 (a) The cost of a bottle of water is \$ $w$ .

The cost of a bottle of juice is \$ $j$ .

The total cost of 8 bottles of water and 2 bottles of juice is \$12.

The total cost of 12 bottles of water and 18 bottles of juice is \$45.

Find the cost of a bottle of water and the cost of a bottle of juice.

*Answer(a)* Cost of a bottle of water = \$ .....

Cost of a bottle of juice = \$ ..... [5]

- (b) Roshni cycles 2 kilometres at  $y$  km/h and then runs 4 kilometres at  $(y - 4)$  km/h.  
The whole journey takes 40 **minutes**.

- (i) Write an equation in  $y$  and show that it simplifies to  $y^2 - 13y + 12 = 0$ .

*Answer(b)(i)*

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[4]



(ii) Factorise  $y^2 - 13y + 12$ .

Answer(b)(ii) ..... [2]

(iii) Solve the equation  $y^2 - 13y + 12 = 0$ .

Answer(b)(iii)  $y =$  ..... or  $y =$  ..... [1]

(iv) Work out Roshni's running speed.

Answer(b)(iv) ..... km/h [1]

(c) Solve the equation

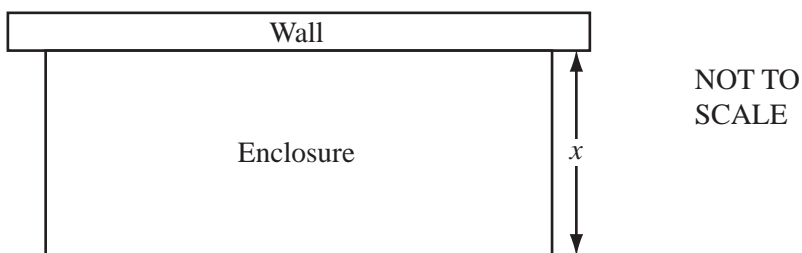
$$u^2 - u - 4 = 0.$$

Show all your working and give your answers correct to 2 decimal places.

Answer(c)  $u =$  ..... or  $u =$  ..... [4]

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3



A farmer makes a rectangular enclosure for his animals.  
He uses a wall for one side and a total of 72 metres of fencing for the other three sides.

The enclosure has width  $x$  metres and area  $A$  square metres.

(a) Show that  $A = 72x - 2x^2$ .

*Answer (a)*

[2]

(b) Factorise completely  $72x - 2x^2$ .

*Answer(b)* ..... [2]

(c) Complete the table for  $A = 72x - 2x^2$ .

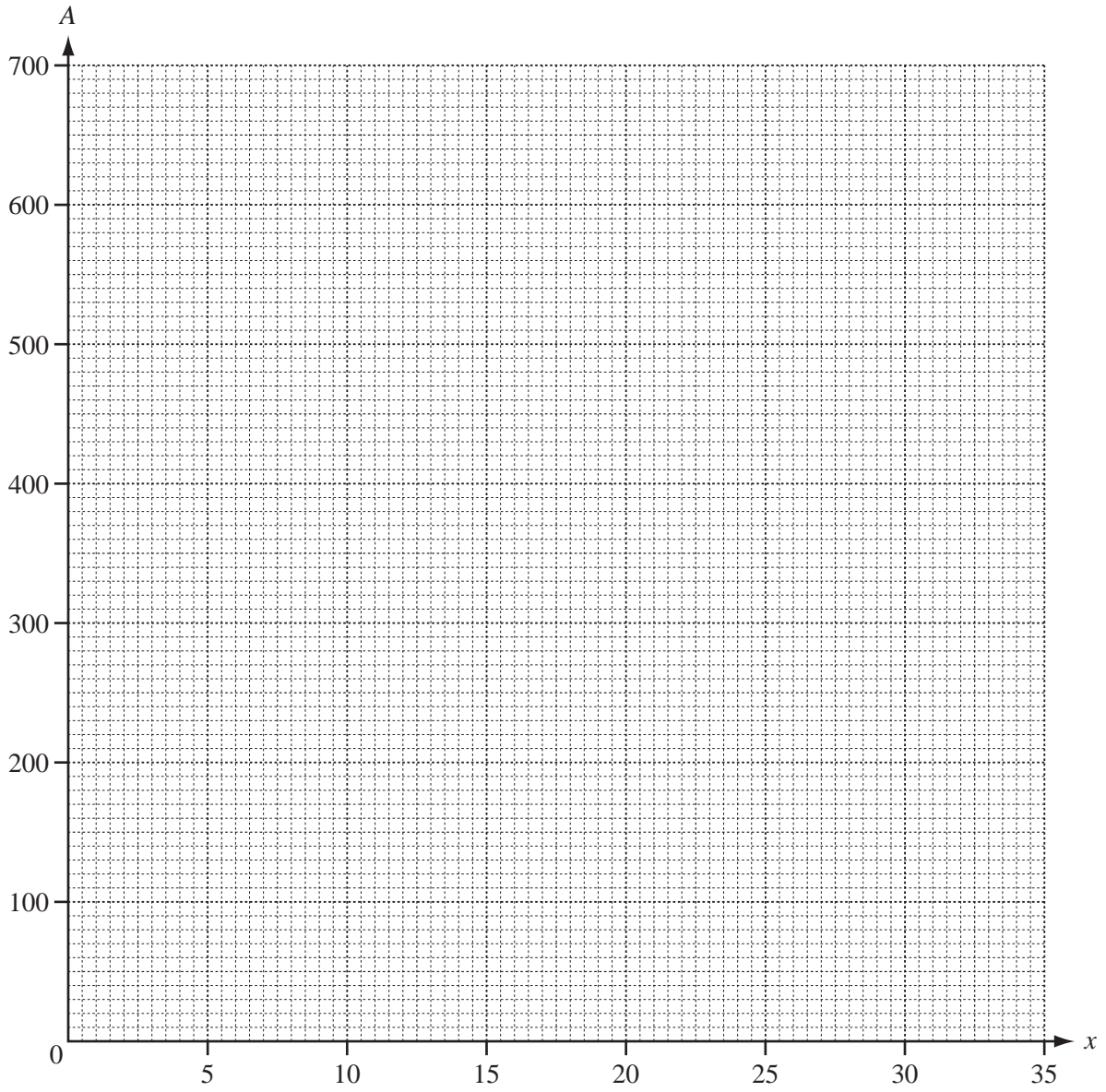
$x$	0	5	10	15	20	25	30	35
$A$	0	310	520			550	360	

[3]

(d) Draw the graph of  $A = 72x - 2x^2$  for  $0 \leq x \leq 35$  on the grid opposite.

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[4]

(e) Use your graph to find

(i) the values of  $x$  when  $A = 450$ ,

Answer(e)(i)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(ii) the maximum area of the enclosure.

Answer(e)(ii)  $\dots\dots\dots$   $m^2$  [1]

(f) Each animal must have at least  $12 m^2$  for grazing.

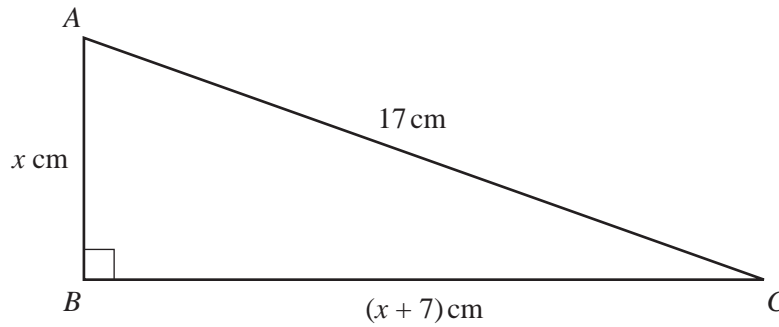
Calculate the greatest number of animals that the farmer can keep in an enclosure which has an area of  $500 m^2$ .

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Answer(f)  $\dots\dots\dots$  [2]

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5 (a)



NOT TO SCALE

In the right-angled triangle  $ABC$ ,  $AB = x$  cm,  $BC = (x + 7)$  cm and  $AC = 17$  cm.

(i) Show that  $x^2 + 7x - 120 = 0$ .

*Answer(a)(i)*

[3]

(ii) Factorise  $x^2 + 7x - 120$ .

*Answer(a)(ii)* ..... [2]

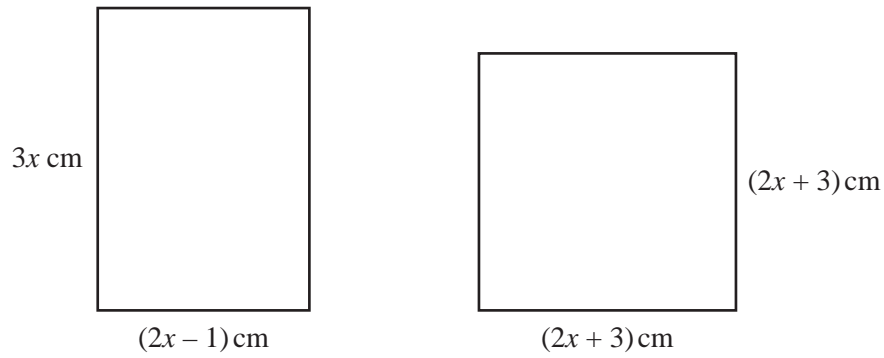
(iii) Write down the solutions of  $x^2 + 7x - 120 = 0$ .

*Answer(a)(iii)*  $x =$  ..... or  $x =$  ..... [1]

(iv) Write down the length of  $BC$ .

*Answer(a)(iv)*  $BC =$  ..... cm [1]

(b)



The rectangle and the square shown in the diagram above have the same area.

(i) Show that  $2x^2 - 15x - 9 = 0$ .

*Answer(b)(i)*

[3]

(ii) Solve the equation  $2x^2 - 15x - 9 = 0$ .

**Show all your working** and give your answers correct to 2 decimal places.

*Answer(b)(ii)*  $x =$  ..... or  $x =$  ..... [4]

(iii) Calculate the perimeter of the square.

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*Answer(b)(iii)* ..... cm [1]

**93**

3 (a) Expand the brackets and simplify.

$$x(x+3)+4x(x-1)$$

Answer(a) ..... [2]

(b) Simplify  $(3x^3)^3$ .

Answer(b) ..... [2]

(c) Factorise the following completely.

(i)  $7x^7 + 14x^{14}$

Answer(c)(i) ..... [2]

(ii)  $xy + xw + 2ay + 2aw$

Answer(c)(ii) ..... [2]

(iii)  $4x^2 - 49$

Answer(c)(iii) ..... [1]

(d) Solve the equation.

$$2x^2 + 5x + 1 = 0$$

Show all your working and give your answers correct to 2 decimal places.

*Answer(d)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

3 (a)  $p$  varies **inversely** as  $(m + 1)$ .

When  $p = 4$ ,  $m = 8$ .

Find the value of  $p$  when  $m = 11$ .

Answer(a)  $p =$  ..... [3]

(b) (i) Factorise  $x^2 - 25$ .

Answer(b)(i) ..... [1]

(ii) Simplify  $\frac{2x^2 + 11x + 5}{x^2 - 25}$ .

Answer(b)(ii) ..... [3]

(c) Solve the inequality  $5(x - 4) < 3(12 - x)$ .

Answer(c) ..... [3]



5 (a) Solve  $9 < 3n + 6 \leq 21$  for integer values of  $n$ .

Answer(a) ..... [3]

(b) Factorise completely.

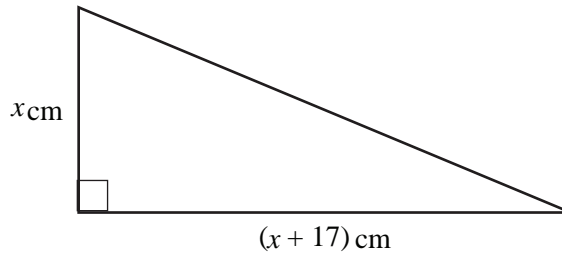
(i)  $2x^2 + 10xy$

Answer(b)(i) ..... [2]

(ii)  $3a^2 - 12b^2$

Answer(b)(ii) ..... [3]

(c)



NOT TO SCALE

The area of this triangle is  $84\text{cm}^2$ .

(i) Show that  $x^2 + 17x - 168 = 0$ .

Answer (c)(i)

[2]

(ii) Factorise  $x^2 + 17x - 168$ .

Answer(c)(ii) ..... [2]

(iii) Solve  $x^2 + 17x - 168 = 0$ .

Answer(c)(iii)  $x =$  ..... or  $x =$  ..... [1]

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(d) Solve

$$\frac{15 - x}{2} = 3 - 2x.$$

*Answer(d)*  $x =$  ..... [3]

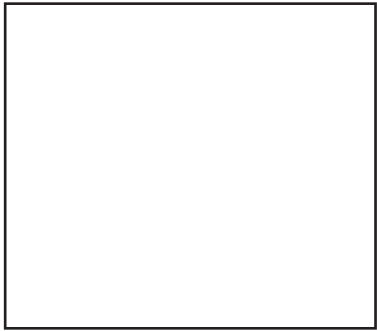
(e) Solve  $2x^2 - 5x - 6 = 0$ .

Show all your working and give your answers correct to 2 decimal places.

*Answer(e)*  $x =$  ..... or  $x =$  ..... [4]

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3



$(x + 5)$  cm



$x$  cm

$2x$  cm

NOT TO  
SCALE

The diagram shows a square of side  $(x + 5)$  cm and a rectangle which measures  $2x$  cm by  $x$  cm.

The area of the square is  $1 \text{ cm}^2$  more than the area of the rectangle.

(a) Show that  $x^2 - 10x - 24 = 0$ .

*Answer(a)*

[3]

(b) Find the value of  $x$ .

*Answer(b)*  $x =$  ..... [3]

(c) Calculate the acute angle between the diagonals of the rectangle.

*Answer(c)* ..... [3]

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- 2 (a) Find the integer values for  $x$  which satisfy the inequality  $-3 < 2x - 1 \leq 6$ .

Answer(a) ..... [3]

(b) Simplify  $\frac{x^2 + 3x - 10}{x^2 - 25}$ .

Answer(b) ..... [4]

(c) (i) Show that  $\frac{5}{x-3} + \frac{2}{x+1} = 3$  can be simplified to  $3x^2 - 13x - 8 = 0$ .

Answer(c)(i)

[3]

(ii) Solve the equation  $3x^2 - 13x - 8 = 0$ .

Show all your working and give your answers correct to two decimal places.

Answer(c)(ii)  $x =$  ..... or  $x =$  ..... [4]

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- 5 (a) The cost of a bottle of juice is 5 cents more than the cost of a bottle of water.  
Mohini buys 3 bottles of water and 6 bottles of juice.  
The total cost is \$5.25.

Find the cost of a bottle of water.  
Give your answer in cents.

Answer(a) ..... cents [4]

- (b) The cost of a biscuit is  $x$  cents.  
The cost of a cake is  $(x + 3)$  cents.  
The number of biscuits Roshni can buy for 72 cents is 2 more than the number of cakes she can buy for 72 cents.

- (i) Show that  $x^2 + 3x - 108 = 0$ .

Answer(b)(i)

[3]

- (ii) Solve the equation  $x^2 + 3x - 108 = 0$ .

Answer(b)(ii)  $x =$  ..... or  $x =$  ..... [3]

- (iii) Find the total cost of 2 biscuits and 1 cake.

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Answer(b)(iii) ..... cents [1]  
102

- 6 (a) A parallelogram has base  $(2x - 1)$  metres and height  $(4x - 7)$  metres.  
The area of the parallelogram is  $1 \text{ m}^2$ .

(i) Show that  $4x^2 - 9x + 3 = 0$ .

*Answer (a)(i)*

[3]

(ii) Solve the equation  $4x^2 - 9x + 3 = 0$ .

Show all your working and give your answers correct to 2 decimal places.

*Answer(a)(ii)*  $x =$  ..... or  $x =$  ..... [4]

(iii) Calculate the height of the parallelogram.

(b) (i) Factorise  $x^2 - 16$ .

*Answer(b)(i)* ..... [1]

(ii) Solve the equation  $\frac{2x+3}{x-4} + \frac{x+40}{x^2-16} = 2$ .

*Answer(b)(ii)*  $x =$  ..... [4]



6

(c) Simplify  $\frac{x^2 - 16}{2x^2 + 7x - 4}$ .

Answer(c) ..... [4]

10 (a) Simplify

(i)  $(2x^2y^3)^3$ ,

Answer(a)(i) ..... [2]

(ii)  $\left(\frac{27}{x^6}\right)^{-\frac{1}{3}}$ .

Answer(a)(ii) ..... [3]

(b) Multiply out and simplify.

$$(3x - 2y)(2x + 5y)$$

Answer(b) ..... [3]

(c) Make  $h$  the subject of

(i)  $V = \pi r^3 + 2\pi r^2 h$ ,

Answer(c)(i)  $h =$  ..... [2]

(ii)  $V = \sqrt{3h}$ .

Answer(c)(ii)  $h =$  ..... [2]

(d) Write as a single fraction in its simplest form.

$$\frac{x}{2} + \frac{5x}{3} - \frac{7x}{4}$$

Answer(d) ..... [2]

12 (a) The cost of 1 kg of tomatoes is \$ $x$  and the cost of 1 kg of onions is \$ $y$ .

Ian pays a total of \$10.70 for 10 kg of tomatoes and 4 kg of onions.

Jao pays a total of \$10.10 for 8 kg of tomatoes and 6 kg of onions.

Write down simultaneous equations and solve them to find  $x$  and  $y$ .

Answer(a)  $x =$  .....

$y =$  ..... [6]

(b) Solve  $2x^2 - 5x - 8 = 0$ .

Give your answers correct to 2 decimal places.  
Show all your working.

Mr. Yasser Elsayed Answer(b)  $x =$  ..... or  $x =$  ..... [4]

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- 10 (a) Rice costs \$x per kilogram.  
 Potatoes cost \$(x + 1) per kilogram.  
 The total cost of 12 kg of rice and 7 kg of potatoes is \$31.70.

Find the cost of 1 kg of rice.

Answer(a) \$ ..... [3]

- (b) The cost of a small bottle of juice is \$y.  
 The cost of a large bottle of juice is \$(y + 1).  
 When Catriona spends \$36 on small bottles only, she receives 25 more bottles than when she spends \$36 on large bottles only.

- (i) Show that  $25y^2 + 25y - 36 = 0$ .

Answer(b)(i)

[3]

- (ii) Factorise  $25y^2 + 25y - 36$ .

Answer(b)(ii) ..... [2]

- (iii) Solve the equation  $25y^2 + 25y - 36 = 0$ .

Answer(b)(iii)  $y =$  ..... or  $y =$  ..... [1]

- (iv) Find the total cost of 1 small bottle of juice and 1 large bottle of juice.

Answer(b)(iv) \$ ..... [1]

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4 (a) Solve the equations.

(i)  $4x - 7 = 8 - 2x$

Answer(a)(i)  $x =$  ..... [2]

(ii)  $\frac{x-7}{3} = 2$

Answer(a)(ii)  $x =$  ..... [2]

(b) Simplify the expressions.

(i)  $(3xy^4)^3$

Answer(b)(i) ..... [2]

(ii)  $(16a^6b^2)^{\frac{1}{2}}$

Answer(b)(ii) ..... [2]

(iii)  $\frac{x^2 - 7x - 8}{x^2 - 64}$

Answer(b)(iii) ..... [4]

3 (a) (i) Factorise completely the expression  $4x^2 - 18x - 10$ .

Answer(a)(i) ..... [3]

(ii) Solve  $4x^2 - 18x - 10 = 0$ .

Answer(a)(ii)  $x =$  ..... or  $x =$  ..... [1]

(b) Solve the equation  $2x^2 - 7x - 10 = 0$ .

Show all your working and give your answers correct to two decimal places.

Answer(b)  $x =$  ..... or  $x =$  ..... [4]

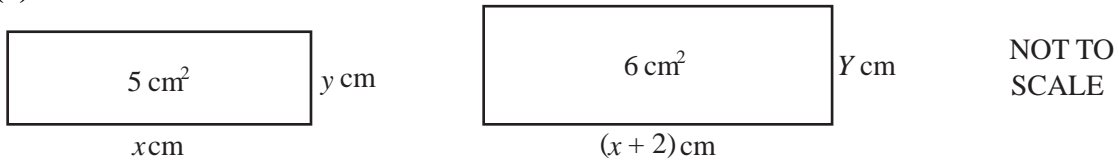
(c) Write  $\frac{6}{3x-1} - \frac{2}{x-2}$  as a single fraction in its simplest form.

Answer(c) ..... [3]

- 5 (a) Marcos buys 2 bottles of water and 3 bottles of lemonade.  
 The total cost is \$3.60.  
 The cost of one bottle of lemonade is \$0.25 more than the cost of one bottle of water.  
 Find the cost of one bottle of water.

Answer(a) \$ ..... [4]

(b)



The diagram shows two rectangles.  
 The first rectangle measures  $x$  cm by  $y$  cm and has an area of  $5 \text{ cm}^2$ .  
 The second rectangle measures  $(x + 2)$  cm by  $Y$  cm and has an area of  $6 \text{ cm}^2$ .

- (i) When  $y + Y = 1$ , show that  $x^2 - 9x - 10 = 0$

Answer (b)(i)

[4]

- (ii) Factorise  $x^2 - 9x - 10$ .

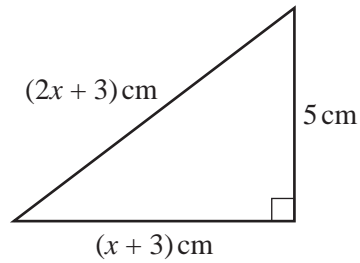
Answer(b)(ii) ..... [2]

- (iii) Calculate the perimeter of the first rectangle.

Answer(b)(iii) ..... cm [2]

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(c)



NOT TO SCALE

The diagram shows a right-angled triangle with sides of length 5 cm,  $(x + 3)$  cm and  $(2x + 3)$  cm.

(i) Show that  $3x^2 + 6x - 25 = 0$ .

*Answer (c)(i)*

[4]

(ii) Solve the equation  $3x^2 + 6x - 25 = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

*Answer(c)(ii)*  $x =$  ..... or  $x =$  ..... [4]

(iii) Calculate the area of the triangle.

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*Answer(c)(iii)* .....  $\text{cm}^2$  [2]  
112



5 Paul buys a number of large sacks of fertiliser costing \$ $x$  each.

He spends \$27.

(a) Write down, in terms of  $x$ , an expression for the number of large sacks which Paul buys.

Answer(a) ..... [1]

(b) Rula buys a number of small sacks of fertiliser.  
Each small sack costs \$2 less than a large sack.  
Rula spends \$25.

Write down, in terms of  $x$ , an expression for the number of small sacks which Rula buys.

Answer(b) ..... [1]

(c) Rula buys 4 more sacks than Paul.

Write down an equation in  $x$  and show that it simplifies to  $2x^2 - 3x - 27 = 0$ .

Answer(c)

[4]

(d) Solve  $2x^2 - 3x - 27 = 0$ .

Answer(d)  $x =$  ..... or  $x =$  ..... [3]

(e) Calculate the number of sacks which Paul buys.

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Answer(e) ..... [1]  
113

10 (a) Write as a single fraction

(i)  $\frac{5}{4} - \frac{2x}{5}$ ,

Answer(a)(i) ..... [2]

(ii)  $\frac{4}{x+3} + \frac{2x-1}{3}$ .

Answer(a)(ii) ..... [3]

(b) Solve the simultaneous equations.

$$\begin{aligned} 9x - 2y &= 12 \\ 3x + 4y &= -10 \end{aligned}$$

Answer(b)  $x =$  .....

$y =$  ..... [3]

(c) Simplify  $\frac{7x + 21}{2x^2 + 9x + 9}$ .

*Answer(c)* ..... [4]

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10 (a) (i) Solve  $2(3x - 7) = 13$ .

Answer(a)(i)  $x = \dots\dots\dots$  [3]

(ii) Solve by factorising  $x^2 - 7x + 6 = 0$ .

Answer(a)(ii)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(iii) Solve  $\frac{3x - 2}{5} + \frac{x + 2}{10} = 4$ .

Answer(a)(iii)  $x = \dots\dots\dots$  [4]

- 8 (a) Solve the equation  $8x^2 - 11x - 11 = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

Answer(a)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

- (b)  $y$  varies directly as the square root of  $x$ .  
 $y = 18$  when  $x = 9$ .

Find  $y$  when  $x = 484$ .

Answer(b)  $y = \dots\dots\dots$  [3]

- (c) Sara spends  $\$x$  on pens which cost  $\$2.50$  each.  
She also spends  $\$(x - 14.50)$  on pencils which cost  $\$0.50$  each.  
The **total** of the number of pens and the number of pencils is 19.

Write down and solve an equation in  $x$ .

*Answer(c)*  $x = \dots\dots\dots$  [6]

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3 (a) Write as a single fraction in its simplest form.

$$\frac{2x-1}{2} - \frac{3x+1}{5}$$

Answer(a) ..... [3]

(b) Expand and simplify.

$$(2x-3)^2 - 3x(x-4)$$

Answer(b) ..... [4]

(c) (i) Factorise.

$$2x^2 + 5x - 3$$

Answer(c)(i) ..... [2]

(ii) Simplify.

$$\frac{2x^2 + 5x - 3}{2x^2 - 18}$$

Answer(c)(ii) ..... [3]

8 (a) Rearrange  $s = ut + \frac{1}{2}at^2$  to make  $a$  the subject.

Answer(a)  $a = \dots\dots\dots$  [3]

(b) The formula  $v = u + at$  can be used to calculate the speed,  $v$ , of a car.

$u = 15$ ,  $a = 2$  and  $t = 8$ , each correct to the nearest integer.

Calculate the upper bound of the speed  $v$ .

Answer(b)  $\dots\dots\dots$  [3]



10 (a) Simplify.

$$\frac{x^2 - 3x}{x^2 - 9}$$

Answer(a) ..... [3]

(b) Solve.

$$\frac{15}{x} - \frac{20}{x+1} = 2$$

Answer(b)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [7]

8 The distance a train travels on a journey is 600 km.

(a) Write down an expression, in terms of  $x$ , for the average speed of the train when

(i) the journey takes  $x$  hours,

Answer(a)(i) ..... km/h [1]

(ii) the journey takes  $(x + 1)$  hours.

Answer(a)(ii) ..... km/h [1]

(b) The difference between the average speeds in **part(a)(i)** and **part(a)(ii)** is 20 km/h.

(i) Show that  $x^2 + x - 30 = 0$ .

Answer(b)(i)

[3]

(ii) Find the average speed of the train for the journey in **part(a)(ii)**.  
Show all your working.

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Answer(b)(ii) ..... km/h [4]  
122

8 (a) (i) Show that the equation  $\frac{7}{x+4} + \frac{2x-3}{2} = 1$  can be simplified to  $2x^2 + 3x - 6 = 0$ .

Answer(a)(i)

[3]

(ii) Solve the equation  $2x^2 + 3x - 6 = 0$ .

Show all your working and give your answers correct to 2 decimal places.

Answer(a)(ii)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(b) The **total** surface area of a cone with radius  $x$  and slant height  $3x$  is equal to the area of a circle with radius  $r$ .

Show that  $r = 2x$ .

[The curved surface area,  $A$ , of a cone with radius  $r$  and slant height  $l$  is  $A = \pi rl$ .]

Answer(b)

[4]

- 2 (a) Rearrange the formula  $v^2 = u^2 - 2as$  to make  $u$  the subject.

Answer(a)  $u = \dots\dots\dots$  [2]

- (b) Chuck cycles along Skyline Drive.  
He cycles 60 km at an average speed of  $x$  km/h.  
He then cycles a further 45 km at an average speed of  $(x + 4)$  km/h.  
His total journey time is 6 hours.

- (i) Write down an equation in  $x$  and show that it simplifies to  $2x^2 - 27x - 80 = 0$ .

Answer(b)(i)

[4]

- (ii) Solve  $2x^2 - 27x - 80 = 0$  to find the value of  $x$ .

Answer(b)(ii)  $x = \dots\dots\dots$  [3]

4 (a) Expand and simplify.

(i)  $4(2x - 1) - 3(3x - 5)$

Answer(a)(i) ..... [2]

(ii)  $(2x - 3y)(3x + 4y)$

Answer(a)(ii) ..... [3]

(b) Factorise.

$$x^3 - 5x$$

Answer(b) ..... [1]

(c) Solve the inequality.

$$\frac{2x + 1}{3} \leq \frac{5x - 8}{4}$$

Answer(c) ..... [3]

(d) (i)  $x^2 - 9x + 12 = (x - p)^2 - q$

Find the value of  $p$  and the value of  $q$ .

Answer(d)(i)  $p = \dots\dots\dots$

$q = \dots\dots\dots$  [3]

(ii) Write down the minimum value of  $x^2 - 9x + 12$ .

Answer(d)(ii)  $\dots\dots\dots$  [1]

(iii) Write down the equation of the line of symmetry of the graph of  $y = x^2 - 9x + 12$ .

Answer(d)(iii)  $\dots\dots\dots$  [1]

2 (a) Solve the inequality.

$$7x - 5 > 3(2 - 5x)$$

Answer(a) ..... [3]

(b) (i) Factorise completely.

$$pq - 2q - 8 + 4p$$

Answer(b)(i) ..... [2]

(ii) Factorise.

$$9p^2 - 25$$

Answer(b)(ii) ..... [1]

(c) Solve this equation by factorising.

$$5x^2 + x - 18 = 0$$

Answer(c)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

6 (a) Simplify.

(i)  $x^3 \div \frac{3}{x^5}$

Answer(a)(i) ..... [1]

(ii)  $5xy^8 \times 3x^6y^{-5}$

Answer(a)(ii) ..... [2]

(iii)  $(64x^{12})^{\frac{2}{3}}$

Answer(a)(iii) ..... [2]

(b) Solve  $3x^2 - 7x - 12 = 0$ .

Show your working and give your answers correct to 2 decimal places.

Answer(b)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

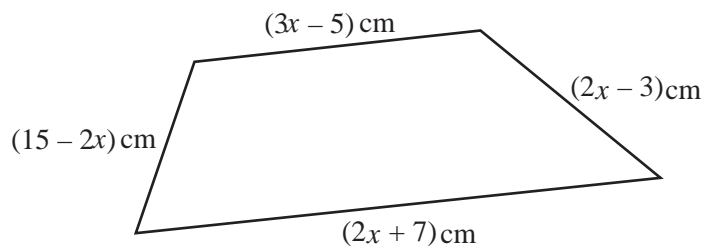
(c) Simplify  $\frac{x^2 - 25}{x^3 - 5x^2}$ .

Answer(c) ..... [3]

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10 (a)



NOT TO  
SCALE

- (i) Write an expression, in terms of  $x$ , for the perimeter of the quadrilateral.  
Give your answer in its simplest form.

Answer(a)(i) ..... cm [2]

- (ii) The perimeter of the quadrilateral is 32 cm.

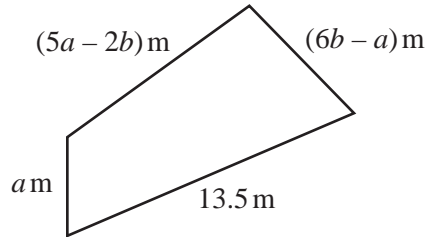
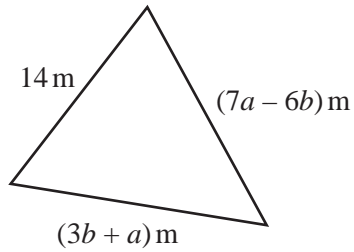
Find the length of the longest side of the quadrilateral.

Answer(a)(ii) ..... cm [3]

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(b)



NOT TO  
SCALE

The triangle has a perimeter of  $32.5\text{ m}$ .  
The quadrilateral has a perimeter of  $39.75\text{ m}$ .

Write two equations in terms of  $a$  and  $b$  and simplify them.  
Use an algebraic method to find the values of  $a$  and  $b$ .  
Show all your working.

Answer(b)  $a = \dots\dots\dots$

$b = \dots\dots\dots$  [6]

- 8 (a) Jamil, Kiera and Luther collect badges.  
Jamil has  $x$  badges.  
Kiera has 12 badges more than Jamil.  
Luther has 3 times as many badges as Kiera.  
Altogether they have 123 badges.

Form an equation and solve it to find the value of  $x$ .

Answer(a)  $x = \dots\dots\dots$  [3]

- (b) Find the integer values of  $t$  which satisfy the inequalities.

$$4t + 7 < 39 \leq 7t + 2$$

Answer(b)  $\dots\dots\dots$  [3]

- (c) Solve the following equations.

(i)  $\frac{21-x}{x+3} = 4$

Answer(c)(i)  $x = \dots\dots\dots$  [3]

(ii)  $3x^2 + 7x - 5 = 0$

Show all your working and give your answers correct to 2 decimal places.

*Answer(c)(ii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

11 (a) Make  $x$  the subject of the formula.

$$A - x = \frac{xr}{t}$$

Answer(a)  $x = \dots\dots\dots$  [4]

(b) Find the value of  $a$  and the value of  $b$  when  $x^2 - 16x + a = (x + b)^2$ .

Answer(b)  $a = \dots\dots\dots$

$b = \dots\dots\dots$  [3]

(c) Write as a single fraction in its simplest form.

$$\frac{6}{x-4} - \frac{5}{3x-2}$$

Answer(c)  $\dots\dots\dots$  [3]

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3 On the first part of a journey, Alan drove a distance of  $x$  km and his car used 6 litres of fuel.

The rate of fuel used by his car was  $\frac{600}{x}$  litres per 100 km.

(a) Alan then drove another  $(x + 20)$  km and his car used another 6 litres of fuel.

- (i) Write down an expression, in terms of  $x$ , for the rate of fuel used by his car on this part of the journey.  
Give your answer in litres per 100 km.

*Answer(a)(i)* ..... litres per 100 km [1]

(ii) On this part of the journey the rate of fuel used by the car **decreased** by 1.5 litres per 100 km.

Show that  $x^2 + 20x - 8000 = 0$ .

*Answer(a)(ii)*

[4]

(b) Solve the equation  $x^2 + 20x - 8000 = 0$ .

*Answer(b)*  $x =$  ..... or  $x =$  ..... [3]

(c) Find the rate of fuel used by Alan's car for the complete journey.  
Give your answer in litres per 100 km.

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*Answer(c)* ..... litres per 100 km [2]

9 (a) Expand and simplify.

$$3x(x - 2) - 2x(3x - 5)$$

Answer(a) ..... [3]

(b) Factorise the following completely.

(i)  $6w + 3wy - 4x - 2xy$

Answer(b)(i) ..... [2]

(ii)  $4x^2 - 25y^2$

Answer(b)(ii) ..... [2]

(c) Simplify.

$$\left(\frac{16}{9x^4}\right)^{-\frac{3}{2}}$$

Answer(c) ..... [2]

(d)  $n$  is an integer.

(i) Explain why  $2n - 1$  is an odd number.

*Answer(d)(i)* .....

..... [1]

(ii) Write down, in terms of  $n$ , the next odd number after  $2n - 1$ .

*Answer(d)(ii)* ..... [1]

(iii) Show that the difference between the squares of two consecutive odd numbers is a multiple of 8.

*Answer(d)(iii)*

[3]



7 (a) The total surface area of a cone is given by the formula  $A = \pi r l + \pi r^2$ .

(i) Find  $A$  when  $r = 6.2$  cm and  $l = 10.8$  cm.

Answer(a)(i) ..... cm<sup>2</sup> [2]

(ii) Rearrange the formula to make  $l$  the subject.

Answer(a)(ii)  $l =$  ..... [2]

(b) (i) Irina walks 10 km at 4 km/h and then a further 8 km at 5 km/h.

Calculate Irina's average speed for the whole journey.

Answer(b)(i) ..... km/h [3]

(ii) Dariella walks  $x$  km at 5 km/h and then runs  $(x + 4)$  km at 10 km/h.  
The average speed of this journey is 7 km/h.

Find the value of  $x$ .  
Show all your working.

Answer(b)(ii)  $x =$  ..... [5]

- (c) (i) Priyantha sells her model car for \$19.80 at a profit of 20%.

Calculate the original price of the model car.

*Answer(c)(i)* \$..... [3]

- (ii) Dev sells his model car for \$ $x$  at a profit of  $y\%$ .

Find an expression, in terms of  $x$  and  $y$ , for the original price of this model car.  
Write your answer as a single fraction.

*Answer(c)(ii)* \$..... [3]

8 (a) Factorise  $x^2 - 3x - 10$ .

Answer(a) ..... [2]

(b) (i) Show that  $\frac{x+2}{x+1} + \frac{3}{x} = 3$  simplifies to  $2x^2 - 2x - 3 = 0$ .

Answer(b)(i)

[3]

(ii) Solve  $2x^2 - 2x - 3 = 0$ .  
Give your answers correct to 3 decimal places.  
Show all your working.

Answer(b)(ii)  $x =$  ..... or  $x =$  ..... [4]

(c) Simplify  $\frac{2x+3}{x+2} - \frac{x}{x+1}$ .

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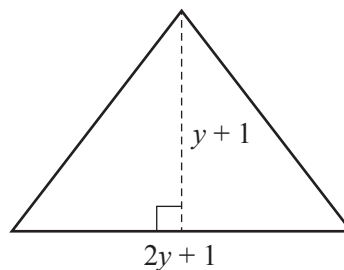
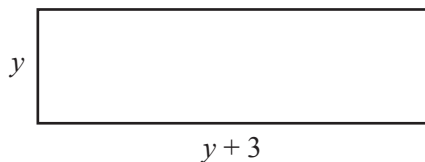
Answer(c) ..... 139 [4]

- 7 (a) The cost of a loaf of bread is  $x$  cents.  
The cost of a cake is  $(x - 5)$  cents.  
The total cost of 6 loaves of bread and 11 cakes is \$13.56 .

Find the value of  $x$ .

Answer(a)  $x = \dots\dots\dots$  [4]

(b)



NOT TO SCALE

The area of the rectangle and the area of the triangle are equal.

Find the value of  $y$ .

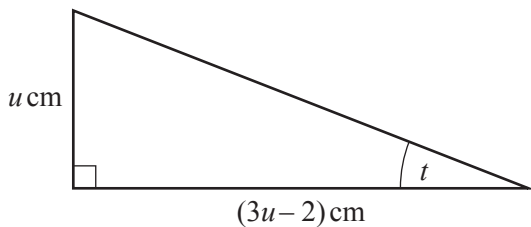
Answer(b)  $y = \dots\dots\dots$  [4]

- (c) The cost of a bottle of water is  $(w - 1)$  cents.  
 The cost of a bottle of milk is  $(2w - 11)$  cents.  
 A certain number of bottles of water costs \$4.80 .  
 The same number of bottles of milk costs \$7.80 .

Find the value of  $w$ .

Answer(c)  $w = \dots\dots\dots$  [4]

(d)



NOT TO SCALE

The area of the triangle is  $2.5 \text{ cm}^2$ .

- (i) Show that  $3u^2 - 2u - 5 = 0$ .

Answer(d)(i)

[2]

- (ii) Factorise  $3u^2 - 2u - 5$ .

Answer(d)(ii)  $\dots\dots\dots$  [2]

- (iii) Find the size of angle  $t$ .

Answer(d)(iii)  $t = \dots\dots\dots$  [3]

4 (a) Factorise  $121y^2 - m^2$ .

Answer(a) ..... [2]

(b) Write as a single fraction in its simplest form.

$$\frac{4}{3x-5} + \frac{x+2}{x-1}$$

Answer(b) ..... [3]

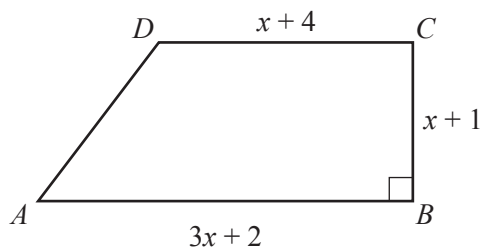
(c) Solve the equation.

$$3x^2 + 2x - 7 = 0$$

Show all your working and give your answers correct to 2 decimal places.

Answer(c)  $x =$  ..... or  $x =$  ..... [4]

(d) In this part, all lengths are in centimetres.



NOT TO  
SCALE

$ABCD$  is a trapezium with area  $15 \text{ cm}^2$ .

(i) Show that  $2x^2 + 5x - 12 = 0$ .

*Answer(d)(i)*

[3]

(ii) Solve the equation  $2x^2 + 5x - 12 = 0$ .

*Answer(d)(ii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(iii) Write down the length of  $AB$ .

*Answer(d)(iii)*  $AB = \dots\dots\dots$  cm [1]

- 8 (a)  $y$  is directly proportional to the positive square root of  $(x + 2)$ .  
When  $x = 7, y = 9$ .

Find  $y$  when  $x = 23$ .

$y = \dots\dots\dots$  [3]

- (b) Simplify.

$$\frac{x^2 + 12x + 36}{x^2 + 4x - 12}$$

$\dots\dots\dots$  [5]



(c) 
$$W = \sqrt{\frac{X-a}{a}}$$

Make  $a$  the subject of the formula.

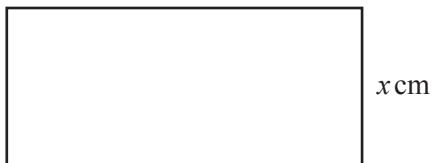
$a = \dots\dots\dots$  [5]

(d) Write as a single fraction in its simplest form.

$$\frac{x-2}{x+1} - \frac{x+3}{x-1}$$

$\dots\dots\dots$  [5]

6 (a)



NOT TO SCALE

The perimeter of the rectangle is 80 cm.  
The area of the rectangle is  $A \text{ cm}^2$ .

(i) Show that  $x^2 - 40x + A = 0$ .

[3]

(ii) When  $A = 300$ , solve, by factorising, the equation  $x^2 - 40x + A = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$ [3]

(iii) When  $A = 200$ , solve, by using the quadratic formula, the equation  $x^2 - 40x + A = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$ [4]

(b) A car completes a 200 km journey with an average speed of  $x$  km/h.  
The car completes the return journey of 200 km with an average speed of  $(x + 10)$  km/h.

(i) Show that the difference between the time taken for each of the two journeys is  $\frac{2000}{x(x+10)}$  hours.

[3]

(ii) Find the difference between the time taken for each of the two journeys when  $x = 80$ .  
Give your answer in **minutes** and **seconds**.

..... min ..... s [3]

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2 (a) Work out the value of  $x$  in each of the following.

(i)  $3^x = 243$

$x = \dots\dots\dots$  [1]

(ii)  $16^x = 4$

$x = \dots\dots\dots$  [1]

(iii)  $8^x = 32$

$x = \dots\dots\dots$  [2]

(iv)  $27^x = \frac{1}{9}$

$x = \dots\dots\dots$  [2]

(b) Solve by factorisation.

$$y^2 - 7y - 30 = 0$$

Show your working.

$y = \dots\dots\dots$  or  $y = \dots\dots\dots$  [3]

2 (a) Solve the inequality.

$$5x - 3 > 9$$

..... [2]

(b) Factorise completely.

(i)  $xy - 18 + 3y - 6x$

..... [2]

(ii)  $8x^2 - 72y^2$

..... [3]

(c) Make  $r$  the subject of the formula.

$$p + 5 = \frac{1 - 2r}{r}$$

$r =$  ..... [4]

- 7 Alfonso runs 10 km at an average speed of  $x$  km/h.  
The next day he runs 12 km at an average speed of  $(x - 1)$  km/h.

The time taken for the 10 km run is 30 minutes less than the time taken for the 12 km run.

- (a) (i) Write down an equation in  $x$  and show that it simplifies to  $x^2 - 5x - 20 = 0$ .

[4]

- (ii) Use the quadratic formula to solve the equation  $x^2 - 5x - 20 = 0$ .  
Show your working and give your answers correct to 2 decimal places.

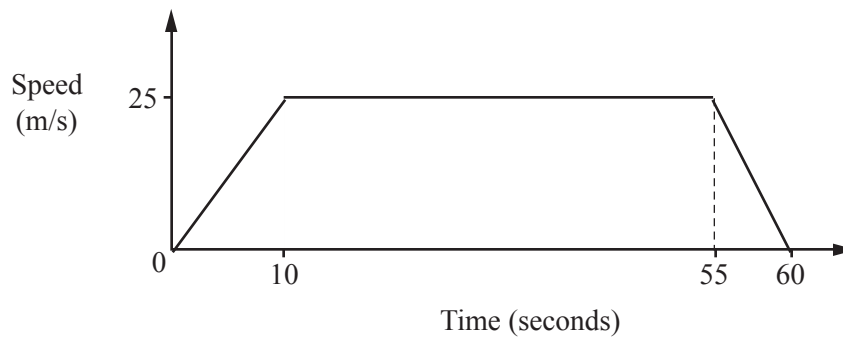
$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

- (iii) Find the time that Alfonso takes to complete the 12 km run.  
Give your answer in hours and minutes correct to the nearest minute.

$\dots\dots\dots$  hours  $\dots\dots\dots$  minutes [2]

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- (b) A cheetah runs for 60 seconds.  
The diagram shows the speed-time graph.



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- (i) Work out the acceleration of the cheetah during the first 10 seconds.

..... m/s<sup>2</sup> [1]

- (ii) Calculate the distance travelled by the cheetah.

m [3]

6 (a) Expand the brackets and simplify.

(i)  $4(2x+5) - 5(3x-7)$

..... [2]

(ii)  $(x-7)^2$

[2]

(b) Solve.

(i)  $\frac{2x}{3} + 5 = 7$

$x =$  ..... [3]

(ii)  $4x+9 = 3(2x-7)$

$x =$  ..... [3]

(iii)  $3x^2 - 1 = 74$

$x =$  ..... or  $x =$  ..... [3]



3 (a) Solve.

$$11x + 15 = 3x - 7$$

$$x = \dots\dots\dots [2]$$

(b) (i) Factorise.

$$x^2 + 9x - 22$$

$$\dots\dots\dots [2]$$

(ii) Solve.

$$x^2 + 9x - 22 = 0$$

$$x = \dots\dots\dots \text{ or } x = \dots\dots\dots [1]$$

(c) Rearrange  $y = \frac{2(x-a)}{x}$  to make  $x$  the subject.

$$x = \dots\dots\dots [4]$$

(d) Simplify.

$$\frac{x^2 - 6x}{x^2 - 36}$$

$$\dots\dots\dots [3]$$

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5 (a) Factorise.

(i)  $2mn + m^2 - 6n - 3m$

[2]

(ii)  $4y^2 - 81$

..... [1]

(iii)  $t^2 - 6t + 8$

..... [2]

(b) Rearrange the formula to make  $x$  the subject.

$$k = \frac{2m - x}{x}$$

$x =$  ..... [4]

4 (a) Simplify.

(i)  $(3p^2)^5$

[2]

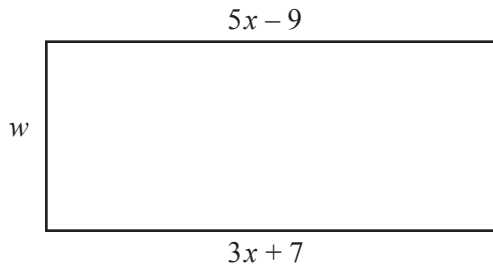
(ii)  $18x^2y^6 \div 2xy^2$

..... [2]

(iii)  $\left(\frac{5}{m}\right)^2$

..... [1]

(b) In this part, all measurements are in metres.



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The diagram shows a rectangle.  
The area of the rectangle is  $310 \text{ m}^2$ .

Work out the value of  $w$ .

$w =$  [4]

6 (a) Expand and simplify.  $(x+7)(x-3)$

..... [2]

(b) Factorise completely.

(i)  $15p^2q^2 - 25q^3$

..... [2]

(ii)  $4fg + 6gh + 10fk + 15hk$

..... [2]

(iii)  $81k^2 - m^2$

..... [2]

(c) Solve the equation.

$$3(x-4) + \frac{x+2}{5} = 6$$

$x =$  ..... [4]

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9 (a) (i) Write  $x^2 + 8x - 9$  in the form  $(x+k)^2 + h$ .

..... [2]

(ii) Use your answer to **part (a)(i)** to solve the equation  $x^2 + 8x - 9 = 0$ .

$x =$  ..... or  $x =$  ..... [2]

(b) The solutions of the equation  $x^2 + bx + c = 0$  are  $\frac{-7 + \sqrt{61}}{2}$  and  $\frac{-7 - \sqrt{61}}{2}$ .

Find the value of  $b$  and the value of  $c$ .

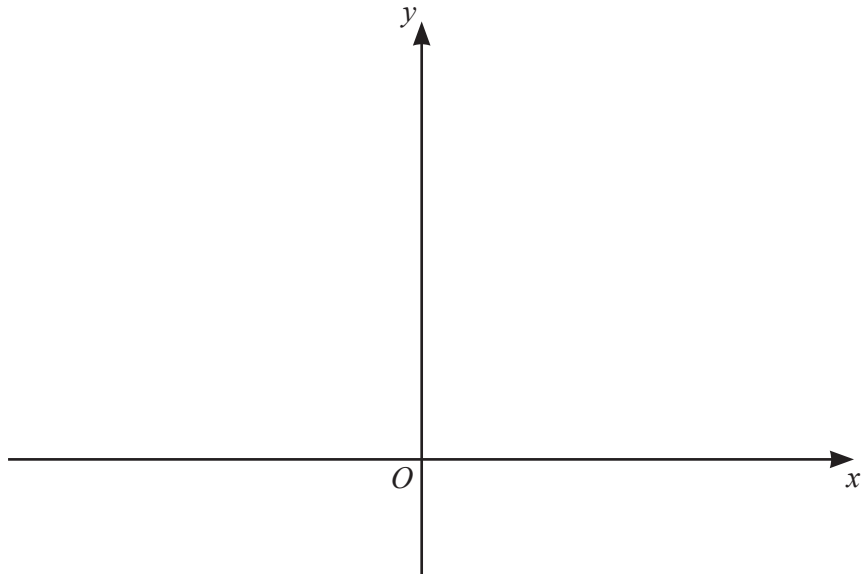
$b =$  .....

$c =$  ..... [3]

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(c) (i)



On the diagram,

(a) sketch the graph of  $y = (x-1)^2$ , [2]

(b) sketch the graph of  $y = \frac{1}{2}x + 1$ . [2]

(ii) The graphs of  $y = (x-1)^2$  and  $y = \frac{1}{2}x + 1$  intersect at  $A$  and  $B$ .

Find the length of  $AB$ .

$AB = \dots\dots\dots$  [7]

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Question 10 is printed on the next page.

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8 (a) Factorise completely.

$$3a^2b - ab^2$$

..... [2]

(b) Solve the inequality.

$$3x + 12 < 5x - 3$$

..... [2]

(c) Simplify.

$$(3x^2y^4)^3$$

..... [2]

(d) Solve.

$$\frac{2}{x} = \frac{6}{2-x}$$

$x =$  ..... [3]

(e) Expand and simplify.

$$(x - 2)(x + 5)(2x - 1)$$

..... [3]

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(f) Alan invests \$200 at a rate of  $r\%$  per year compound interest. After 2 years the value of his investment is \$206.46 .

(i) Show that  $r^2 + 200r - 323 = 0$ .

[3]

(ii) Solve the equation  $r^2 + 200r - 323 = 0$  to find the rate of interest. Show all your working and give your answer correct to 2 decimal places.

$r = \dots\dots\dots$  [3]

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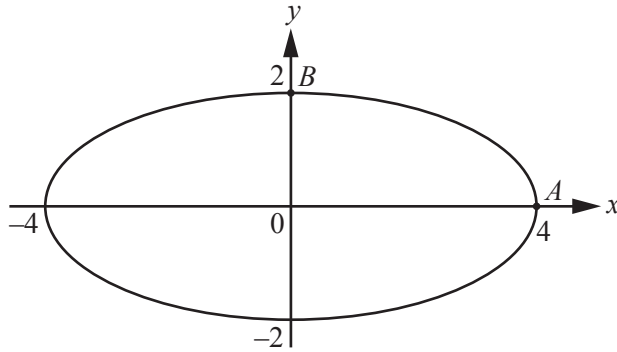
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# Co-ordinate Geometry and Differentiation

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9



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The diagram shows a curve with equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .

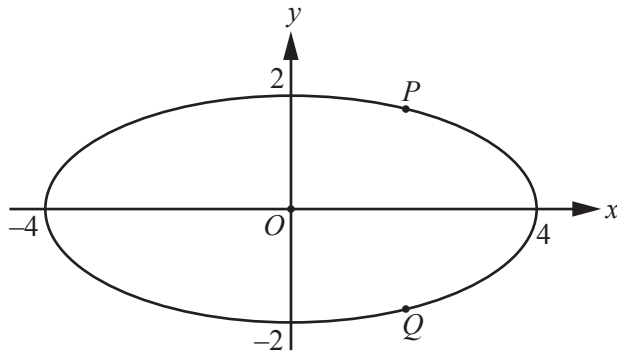
- (a)  $A$  is the point  $(4, 0)$  and  $B$  is the point  $(0, 2)$ .
  - (i) Find the equation of the straight line that passes through  $A$  and  $B$ .  
Give your answer in the form  $y = mx + c$ .

$y = \dots\dots\dots$  [3]

- (ii) Show that  $a^2 = 16$  and  $b^2 = 4$ .

[2]

(b)



NOT TO SCALE

$P(2, k)$  and  $Q(2, -k)$  are points on the curve  $\frac{x^2}{16} + \frac{y^2}{4} = 1$ .

(i) Find the value of  $k$ .

$k = \dots\dots\dots [3]$

(ii) Calculate angle  $POQ$ .

Angle  $POQ = \dots\dots\dots [3]$

(c) The area enclosed by a curve with equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is  $\pi ab$ .

(i) Find the area enclosed by the curve  $\frac{x^2}{16} + \frac{y^2}{4} = 1$ .

Give your answer as a multiple of  $\pi$ .

$\dots\dots\dots [1]$

(ii) A curve, mathematically similar to the one in the diagrams, intersects the  $x$ -axis at  $(12, 0)$  and  $(-12, 0)$ .

Work out the area enclosed by this curve, giving your answer as a multiple of  $\pi$ .

$\dots\dots\dots [2]$

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9 A line joins the points  $A (-2, -5)$  and  $B (4, 13)$ .

(a) Calculate the length  $AB$ .

$AB = \dots\dots\dots [3]$

(b) Find the equation of the line through  $A$  and  $B$ .  
Give your answer in the form  $y = mx + c$ .

$y = \dots\dots\dots [3]$

(c) Another line is parallel to  $AB$  and passes through the point  $(0, -5)$ .

Write down the equation of this line.

$\dots\dots\dots [2]$

(d) Find the equation of the perpendicular bisector of  $AB$ .

$\dots\dots\dots [5]$

3) June 2017 V1

7 A line joins the points  $A(-3, 8)$  and  $B(2, -2)$ .

(a) Find the co-ordinates of the midpoint of  $AB$ .

(....., .....) [2]

(b) Find the equation of the line through  $A$  and  $B$ .  
Give your answer in the form  $y = mx + c$ .

$y =$  ..... [3]

(c) Another line is parallel to  $AB$  and passes through the point  $(0, 7)$ .

Write down the equation of this line.

..... [2]

(d) Find the equation of the line perpendicular to  $AB$  which passes through the point  $(1, 5)$ .  
Give your answer in the form  $ax + by + c = 0$  where  $a, b$  and  $c$  are integers.

..... [4]

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4) June 2019 V2

4 (a) The equation of a straight line is  $2y = 3x + 4$ .

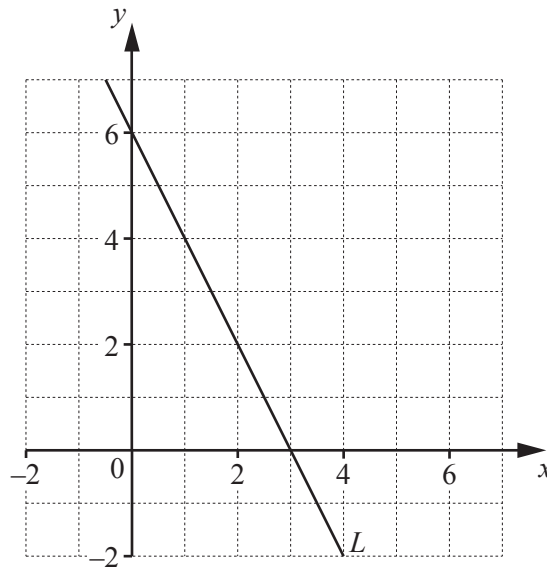
(i) Find the gradient of this line.

..... [1]

(ii) Find the co-ordinates of the point where the line crosses the y-axis.

( ..... , ..... ) [1]

(b) The diagram shows a straight line  $L$ .



(i) Find the equation of line  $L$ .

..... [3]

(ii) Find the equation of the line perpendicular to line  $L$  that passes through  $(9, 3)$ .

..... [3]

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(c)  $A$  is the point  $(8, 5)$  and  $B$  is the point  $(-4, 1)$ .

(i) Calculate the length of  $AB$ .

..... [3]

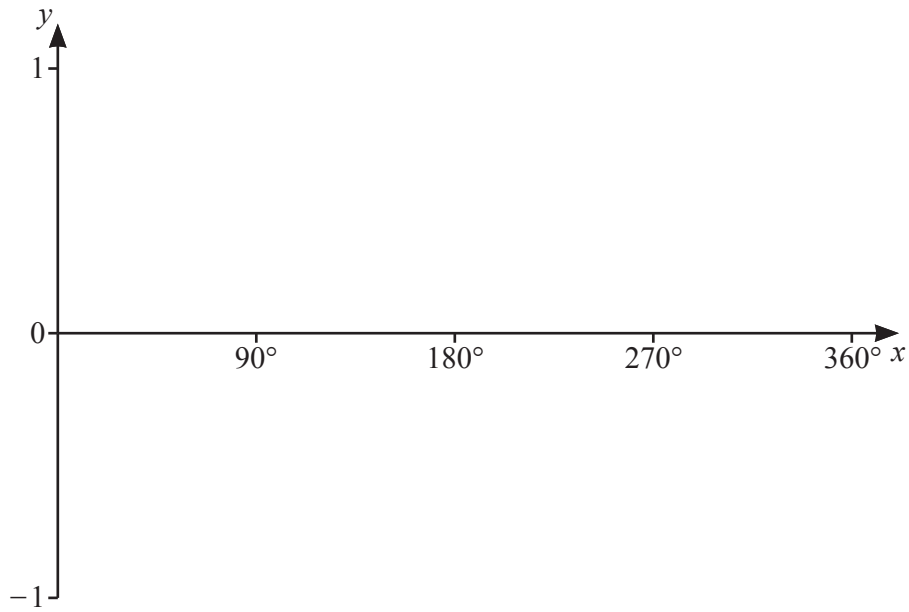
(ii) Find the co-ordinates of the midpoint of  $AB$ .

( ..... , ..... ) [2]

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8 (a) (i) On the axes, sketch the graph of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$ .



[2]

(ii) Describe fully the symmetry of the graph of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$ .

.....

.....

[2]

(b) Solve  $4 \sin x - 1 = 2$  for  $0^\circ \leq x \leq 360^\circ$ .

$x = \dots\dots\dots$  and  $x = \dots\dots\dots$  [3]

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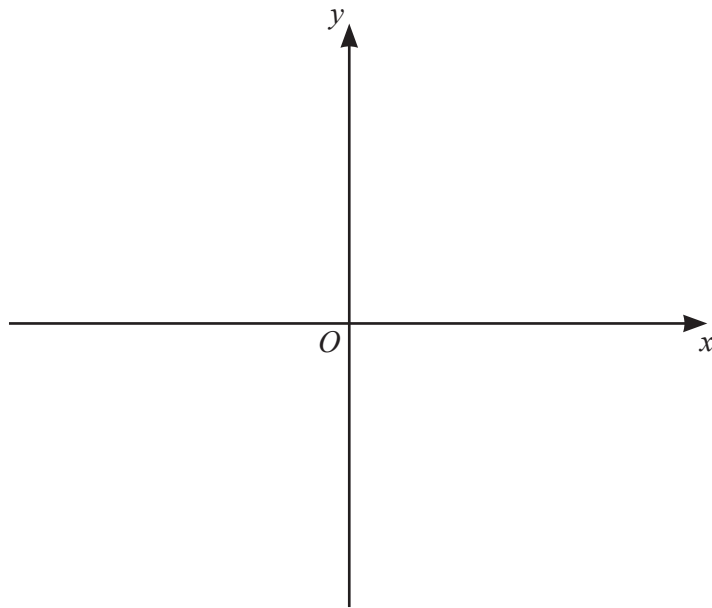
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(c) (i) Write  $x^2 + 10x + 14$  in the form  $(x + a)^2 + b$ .

..... [2]

(ii) On the axes, sketch the graph of  $y = x^2 + 10x + 14$ , indicating the coordinates of the turning point.



[3]

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6) June 2020 V1 \_\_\_\_\_

10 (a) A rhombus  $ABCD$  has a diagonal  $AC$  where  $A$  is the point  $(-3, 10)$  and  $C$  is the point  $(4, -4)$ .

(i) Calculate the length  $AC$ .

..... [3]

(ii) Show that the equation of the line  $AC$  is  $y = -2x + 4$ .

[2]

(iii) Find the equation of the line  $BD$ .

..... [4]

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(b) A curve has the equation  $y = x^3 + 8x^2 + 5x$ .

(i) Work out the coordinates of the two turning points.

(....., .....) and (....., .....) [6]

(ii) Determine whether each of the turning points is a maximum or a minimum.  
Give reasons for your answers.

[3]

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7) June 2020 V2

10 (a)  $y = x^4 - 4x^3$

(i) Find the value of  $y$  when  $x = -1$ .

$y = \dots\dots\dots$  [2]

(ii) Find the two stationary points on the graph of  $y = x^4 - 4x^3$ .

( $\dots\dots\dots$ ,  $\dots\dots\dots$ )

( $\dots\dots\dots$ ,  $\dots\dots\dots$ ) [6]

(b)  $y = x^p + 2x^q$

$\frac{dy}{dx} = 11x^{10} + 10x^4$ , where  $\frac{dy}{dx}$  is the derived function.

Find the value of  $p$  and the value of  $q$ .

$p = \dots\dots\dots$

$q = \dots\dots\dots$  [2]

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8) June 2020 V3 \_\_\_\_\_

9 (a) The equation of line  $L$  is  $3x - 8y + 20 = 0$ .

(i) Find the gradient of line  $L$ .

..... [2]

(ii) Find the coordinates of the point where line  $L$  cuts the  $y$ -axis.

( ..... , ..... ) [1]

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(b) The coordinates of  $P$  are  $(-3, 8)$  and the coordinates of  $Q$  are  $(9, -2)$ .

(i) Calculate the length  $PQ$ .

..... [3]

(ii) Find the equation of the line parallel to  $PQ$  that passes through the point  $(6, -1)$ .

..... [3]

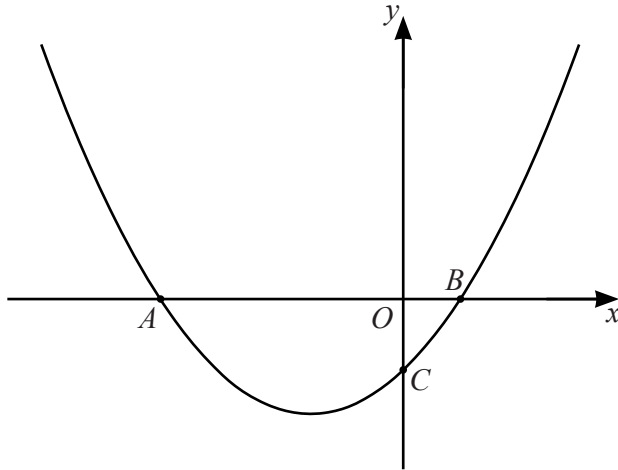
(iii) Find the equation of the perpendicular bisector of  $PQ$ .

..... [4]

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10 (a)



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The diagram shows a sketch of the curve  $y = x^2 + 3x - 4$ .

(i) Find the coordinates of the points  $A$ ,  $B$  and  $C$ .

$A$  (....., .....) )

$B$  (....., .....) )

$C$  (....., .....) [4]

(ii) Differentiate  $x^2 + 3x - 4$ .

..... [2]

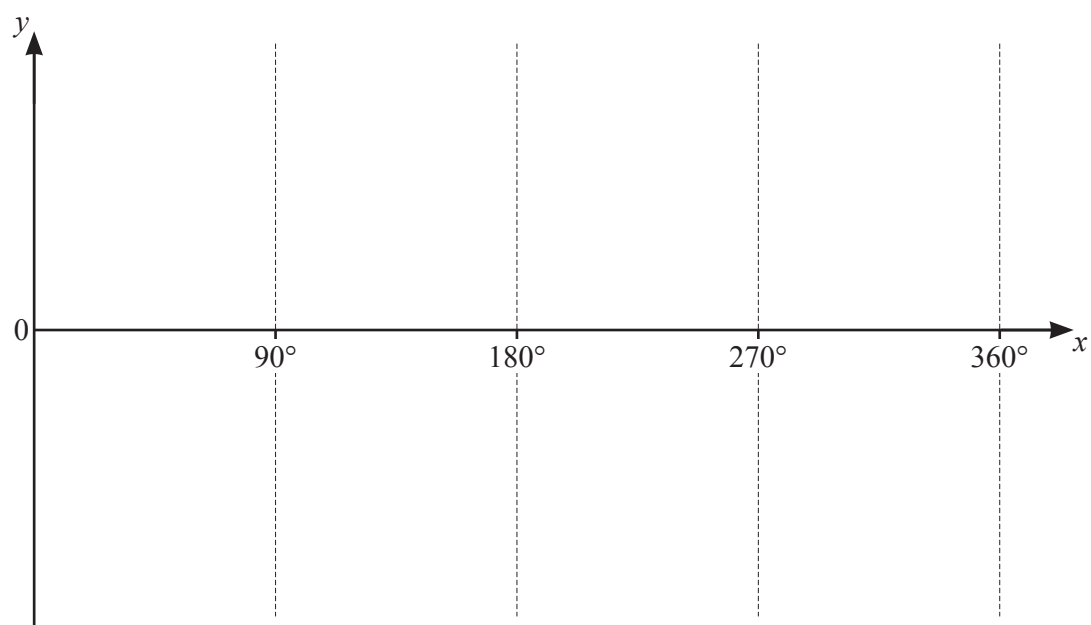
(iii) Find the equation of the tangent to the curve at the point  $(2, 6)$ .

..... [3]

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(b)



(i) On the diagram, sketch the graph of  $y = \tan x$  for  $0^\circ \leq x \leq 360^\circ$ . [2]

(ii) Solve the equation  $5 \tan x = -7$  for  $0^\circ \leq x \leq 360^\circ$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

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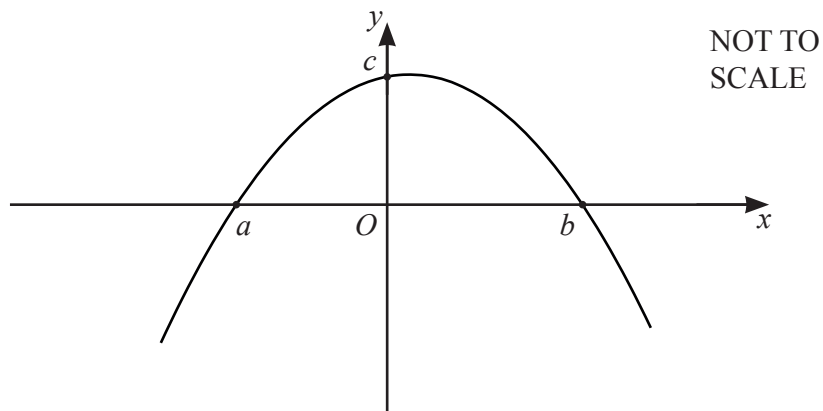
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7 (a) (i) Factorise  $24 + 5x - x^2$ .

..... [2]

(ii) The diagram shows a sketch of  $y = 24 + 5x - x^2$ .



Work out the values of  $a$ ,  $b$  and  $c$ .

$a =$  .....

$b =$  .....

$c =$  ..... [3]

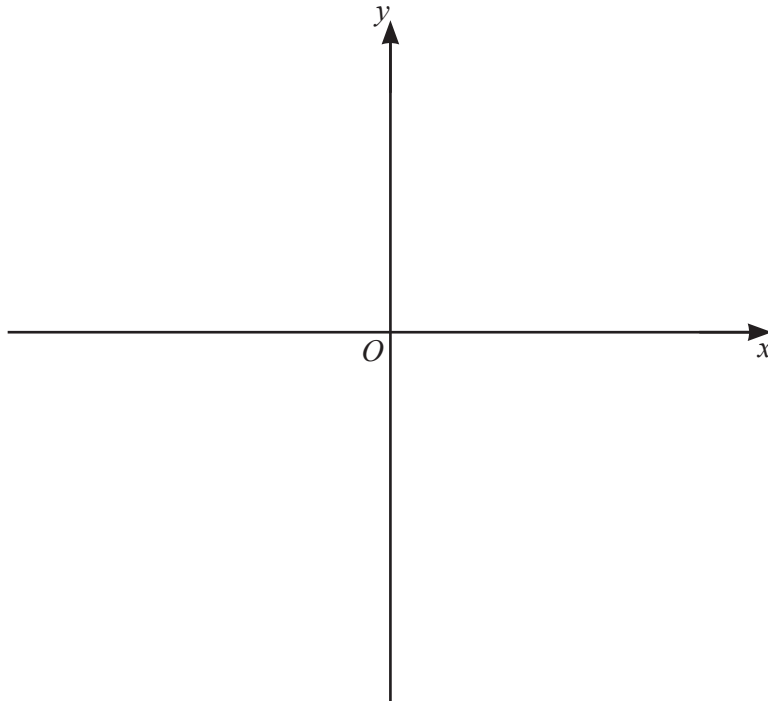
(iii) Calculate the gradient of  $y = 24 + 5x - x^2$  at  $x = -1.5$ .

..... [3]

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- (b) (i) On the diagram, sketch the graph of  $y = (x+1)(x-3)^2$ .  
Label the values where the graph meets the  $x$ -axis and the  $y$ -axis.



[4]

- (ii) Write  $(x+1)(x-3)^2$  in the form  $ax^3 + bx^2 + cx + d$ .

..... [3]

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# Functions

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8 (a)  $f(x) = 2^x$

Complete the table.

$x$	-2	-1	0	1	2	3	4
$y = f(x)$		0.5	1	2	4		

[3]

(b)  $g(x) = x(4 - x)$

Complete the table.

$x$	-1	0	1	2	3	4
$y = g(x)$		0	3		3	0

[2]

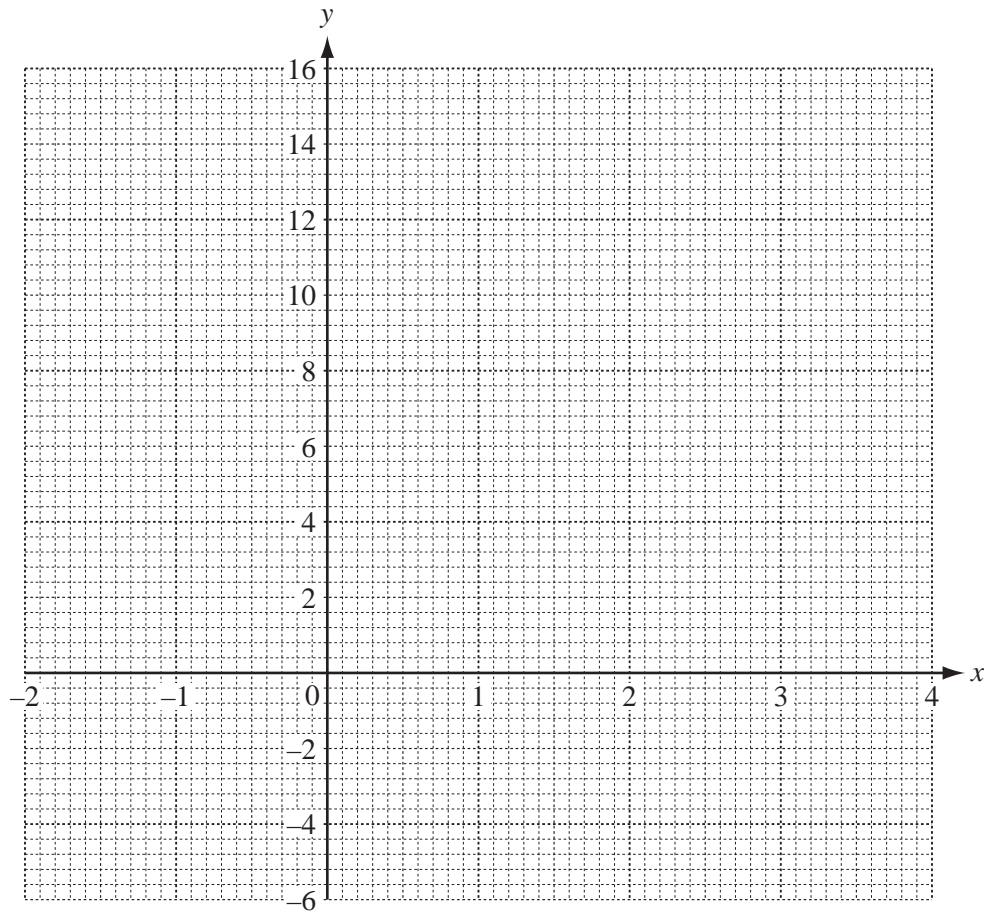
(c) On the grid, draw the graphs of

(i)  $y = f(x)$  for  $-2 \leq x \leq 4$ ,

[3]

(ii)  $y = g(x)$  for  $-1 \leq x \leq 4$ .

[3]



(d) Use your graphs to solve the following equations.

(i)  $f(x) = 10$

Answer(d)(i)  $x = \dots\dots\dots$  [1]

(ii)  $f(x) = g(x)$

Answer(d)(ii)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(iii)  $f^{-1}(x) = 1.7$

Answer(d)(iii)  $x = \dots\dots\dots$  [1]

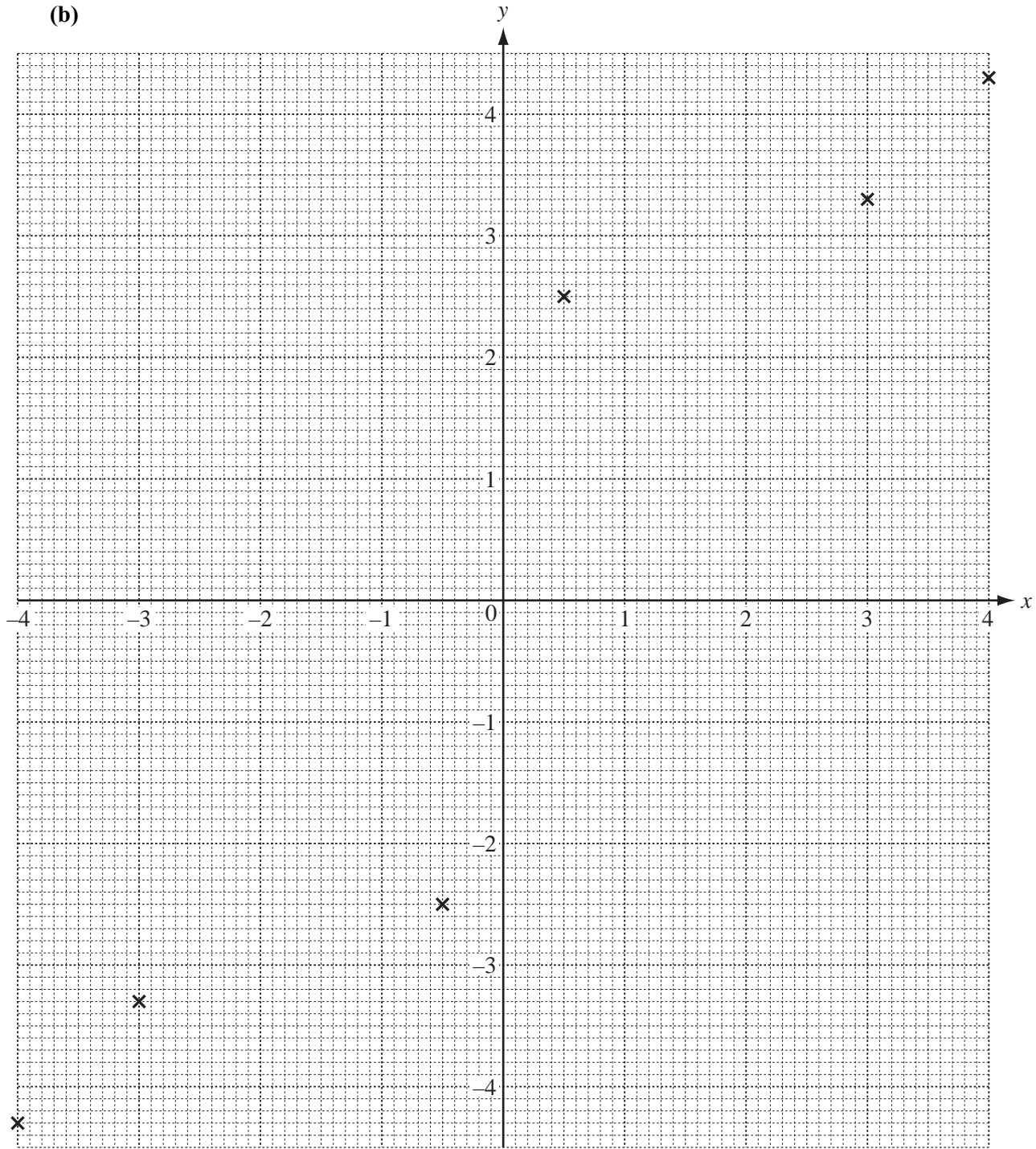
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6 (a) Complete the table of values for  $y = x + \frac{1}{x}$ .

x	-4	-3	-2	-1	-0.5	0.5	1	2	3	4
y	-4.3	-3.3			-2.5	2.5			3.3	4.3

[2]

(b)



On the grid, draw the graph of  $y = x + \frac{1}{x}$  for  $-4 \leq x \leq -0.5$  and  $0.5 \leq x \leq 4$ .  
Six of the ten points have been plotted for you.

[3]

- (c) There are three integer values of  $k$  for which the equation  $x + \frac{1}{x} = k$  has **no** solutions.  
Write down these three values of  $k$ .

*Answer(c)*  $k =$  ..... or  $k =$  ..... or  $k =$  ..... [2]

- (d) Write down the ranges of  $x$  for which the gradient of the graph of  $y = x + \frac{1}{x}$  is positive.

*Answer(d)* ..... [2]

- (e) To solve the equation  $x + \frac{1}{x} = 2x + 1$ , a straight line can be drawn on the grid.

(i) Draw this line on the grid for  $-2.5 \leq x \leq 1.5$ . [2]

(ii) On the grid, show how you would find the solutions. [1]

(iii) Show how the equation  $x + \frac{1}{x} = 2x + 1$  can be rearranged into the form  $x^2 + bx + c = 0$  and find the values of  $b$  and  $c$ .

*Answer(e)(iii)*  $b =$  .....

$c =$  ..... [3]

3) November 2010 V1

8 (a)  $f(x) = 2x - 1$        $g(x) = x^2$

Work out

(i)  $f(2)$ ,

Answer(a)(i) ..... [1]

(ii)  $g(-2)$ ,

Answer(a)(ii) ..... [1]

(iii)  $ff(x)$  in its simplest form,

Answer(a)(iii)  $ff(x) =$  ..... [2]

(iv)  $f^{-1}(x)$ , the inverse of  $f(x)$ ,

Answer(a)(iv)  $f^{-1}(x) =$  ..... [2]

(v)  $x$  when  $gf(x) = 4$ .

Answer(a)(v)  $x =$  ..... or  $x =$  ..... [4]

(b)  $y$  is **inversely** proportional to  $x$  and  $y = 8$  when  $x = 2$ .

Find,

(i) an equation connecting  $y$  and  $x$ ,

Answer(b)(i) ..... [2]

(ii)  $y$  when  $x = \frac{1}{2}$ .

Answer(b)(ii)  $y =$  ..... [1]

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4) November 2010 V2

2

$$f(x) = 6 + x^2$$

$$g(x) = 4x - 1$$

(a) Find

(i)  $g(3)$ ,

Answer(a)(i) ..... [1]

(ii)  $f(-4)$ .

Answer(a)(ii) ..... [1]

(b) Find the inverse function  $g^{-1}(x)$ .

Answer(b)  $g^{-1}(x) =$  ..... [2]

(c) Find  $fg(x)$  in its simplest form.

Answer(c)  $fg(x) =$  ..... [3]

(d) Solve the equation  $gg(x) = 3$ .

Answer(d)  $x =$  ..... [3]

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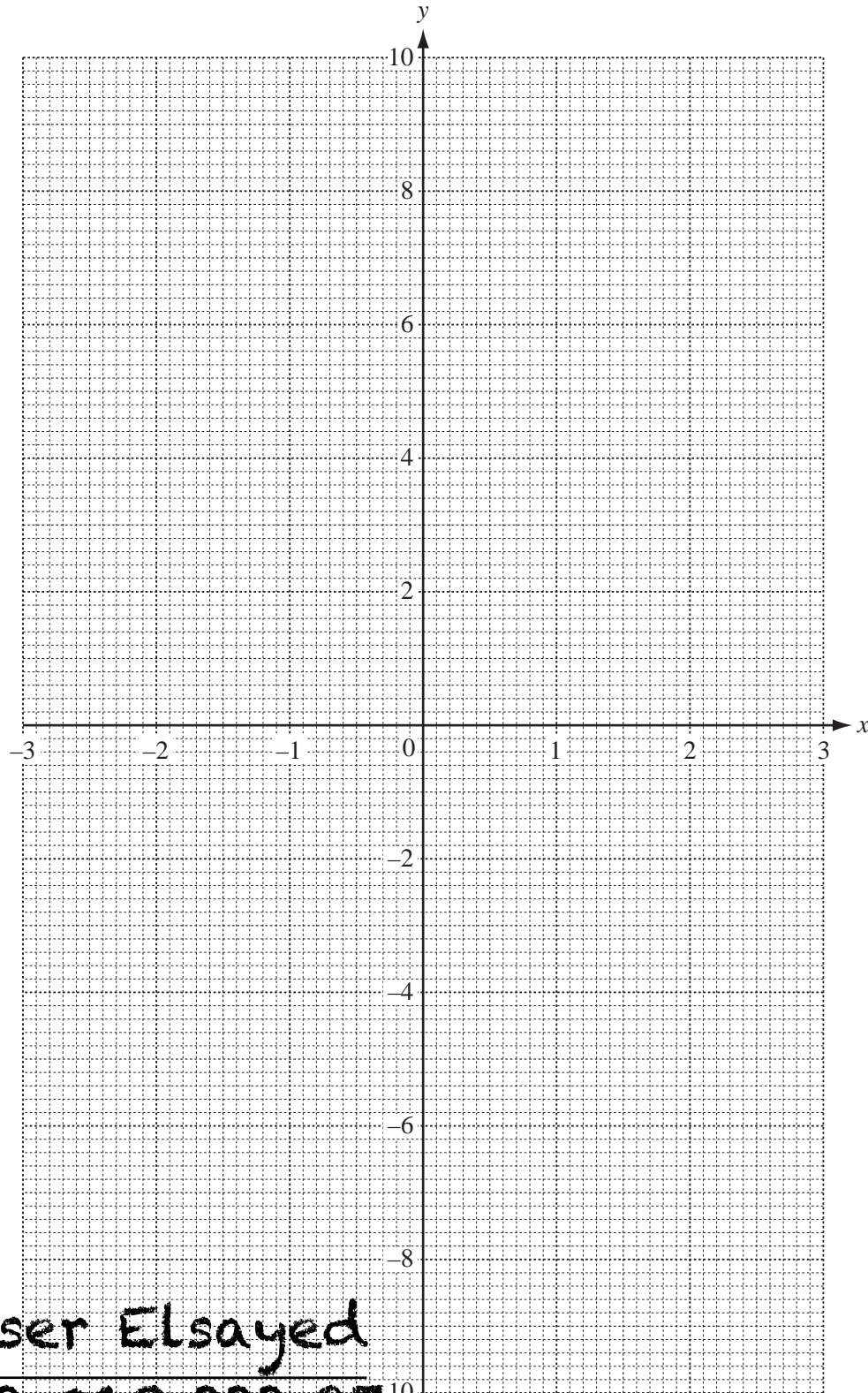
5) November 2010 V2

7 (a) Complete the table for the function  $f(x) = \frac{2}{x} - x^2$ .

$x$	-3	-2	-1	-0.5	-0.2		0.2	0.5	1	2	3
$f(x)$	-9.7	-5			-10.0		10.0	3.75	1		-8.3

[3]

(b) On the grid draw the graph of  $y = f(x)$  for  $-3 \leq x \leq -0.2$  and  $0.2 \leq x \leq 3$ .



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(c) Use your graph to

(i) solve  $f(x) = 2$ ,

*Answer(c)(i)*  $x =$  ..... [1]

(ii) find a value for  $k$  so that  $f(x) = k$  has 3 solutions.

*Answer(c)(ii)*  $k =$  ..... [1]

(d) Draw a suitable line on the grid and use your graphs to solve the equation  $\frac{2}{x} - x^2 = 5x$ .

*Answer(d)*  $x =$  ..... or  $x =$  ..... [3]

(e) Draw the tangent to the graph of  $y = f(x)$  at the point where  $x = -2$ .

Use it to calculate an estimate of the gradient of  $y = f(x)$  when  $x = -2$ .

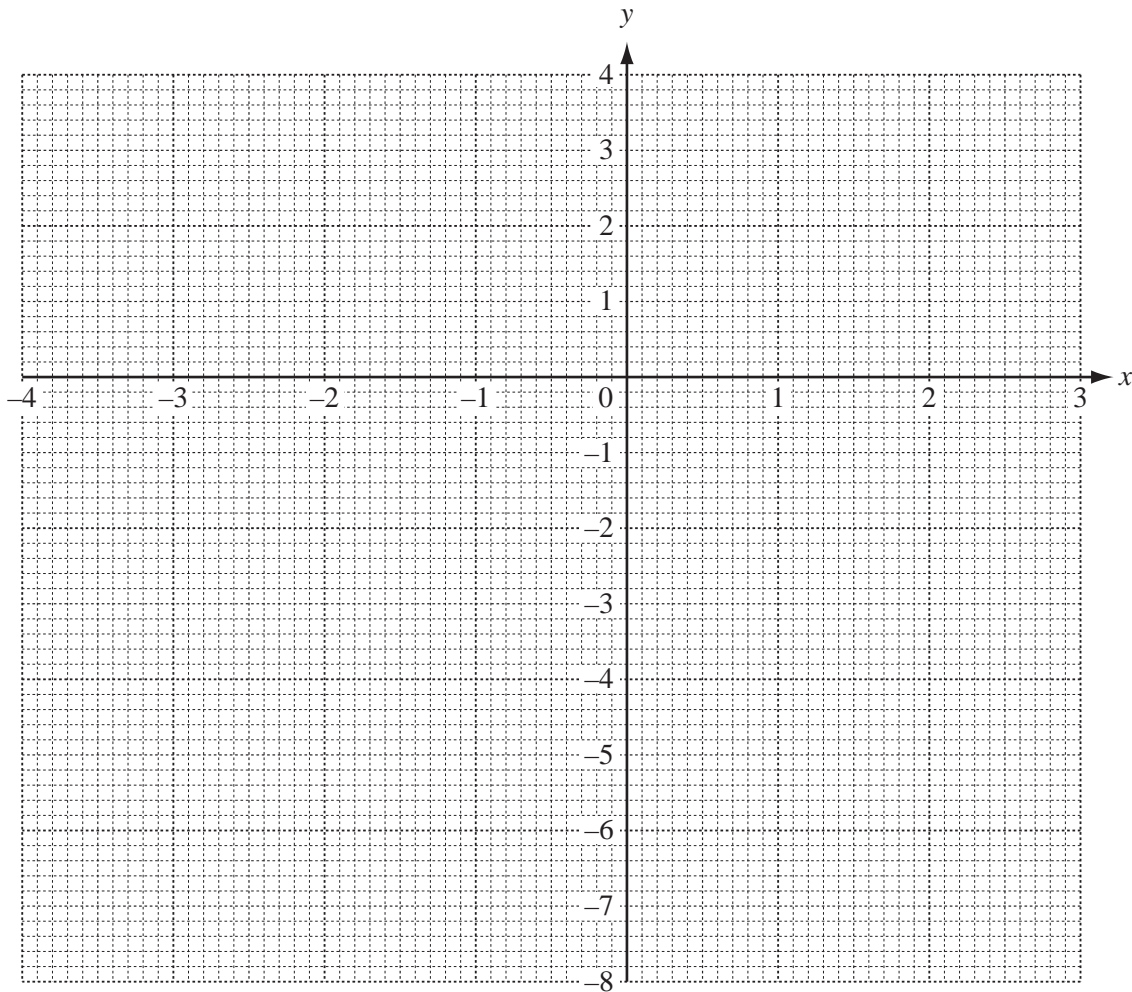
*Answer(e)* ..... [3]

7 (a) Complete the table for the function  $f(x) = \frac{x^3}{10} + 1$ .

$x$	-4	-3	-2	-1	0	1	2	3
$f(x)$		-1.7	0.2	0.9	1	1.1	1.8	

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-4 \leq x \leq 3$ .



[4]

(c) Complete the table for the function  $g(x) = \frac{4}{x}$ ,  $x \neq 0$ .

$x$	-4	-3	-2	-1	1	2	3
$g(x)$	-1	-1.3				2	1.3

[2]

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(d) On the grid, draw the graph of  $y = g(x)$  for  $-4 \leq x \leq -1$  and  $1 \leq x \leq 3$ . [3]

(e) (i) Use your graphs to solve the equation  $\frac{x^3}{10} + 1 = \frac{4}{x}$ .

*Answer(e)(i)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(ii) The equation  $\frac{x^3}{10} + 1 = \frac{4}{x}$  can be written as  $x^4 + ax + b = 0$ .

Find the values of  $a$  and  $b$ .

*Answer(e)(ii)*  $a = \dots\dots\dots$

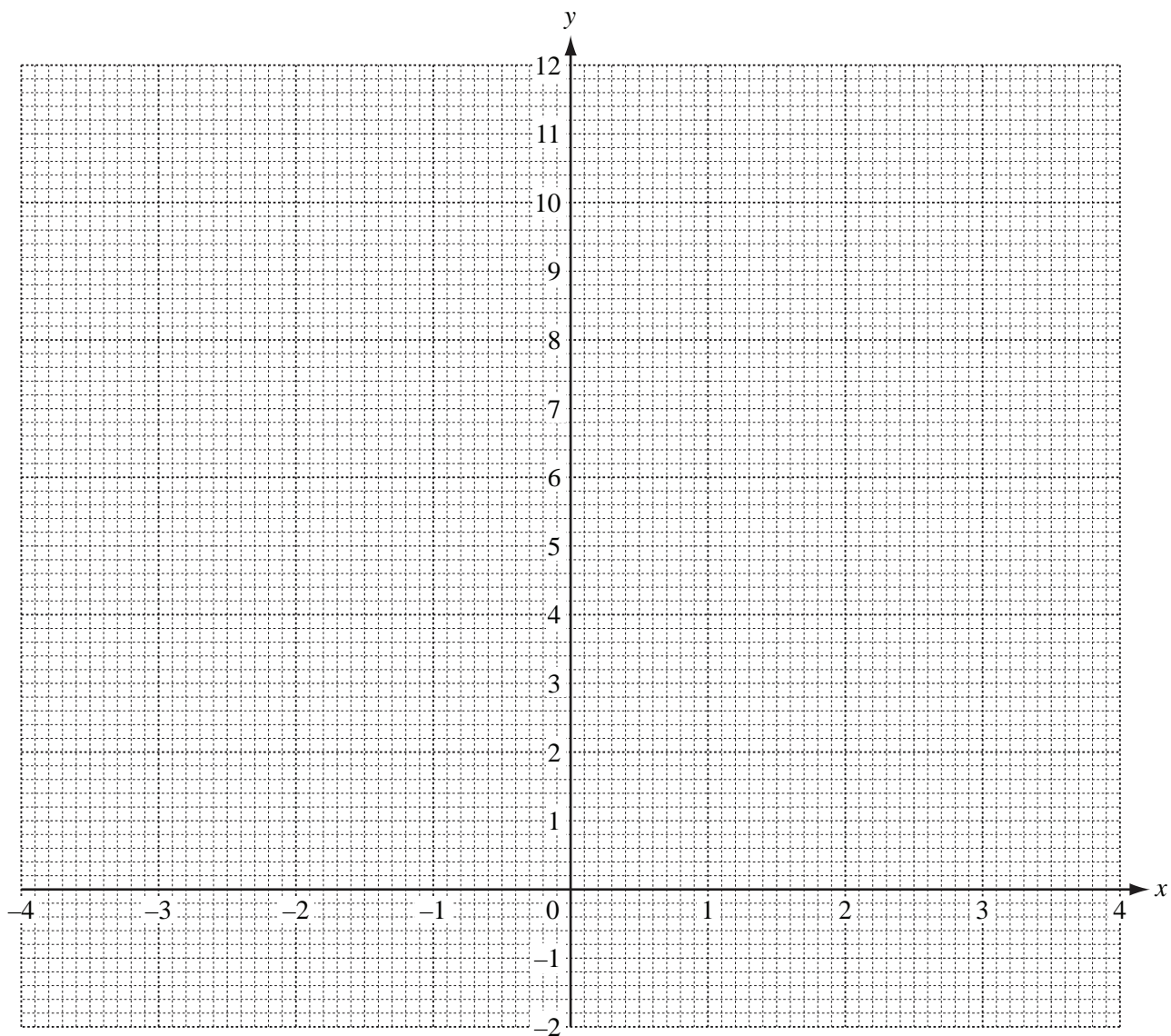
$b = \dots\dots\dots$  [2]

7 (a) Complete the table of values for the equation  $y = \frac{4}{x^2}$ ,  $x \neq 0$ .

$x$	-4	-3	-2	-1	-0.6		0.6	1	2	3	4
$y$	0.25	0.44			11.11			4.00		0.44	

[3]

(b) On the grid, draw the graph of  $y = \frac{4}{x^2}$  for  $-4 \leq x \leq -0.6$  and  $0.6 \leq x \leq 4$ .



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[5]

(c) Use your graph to solve the equation  $\frac{4}{x^2} = 6$ .

*Answer(c)*  $x =$  ..... or  $x =$  ..... [2]

(d) By drawing a suitable tangent, estimate the gradient of the graph where  $x = 1.5$ .

*Answer(d)* ..... [3]

(e) (i) The equation  $\frac{4}{x^2} - x + 2 = 0$  can be solved by finding the intersection of the graph of  $y = \frac{4}{x^2}$  and a straight line.

Write down the equation of this straight line.

*Answer(e)(i)* ..... [1]

(ii) On the grid, draw the straight line from your answer to **part (e)(i)**. [2]

(iii) Use your graphs to solve the equation  $\frac{4}{x^2} - x + 2 = 0$ .

*Answer(e)(iii)*  $x =$  ..... [1]

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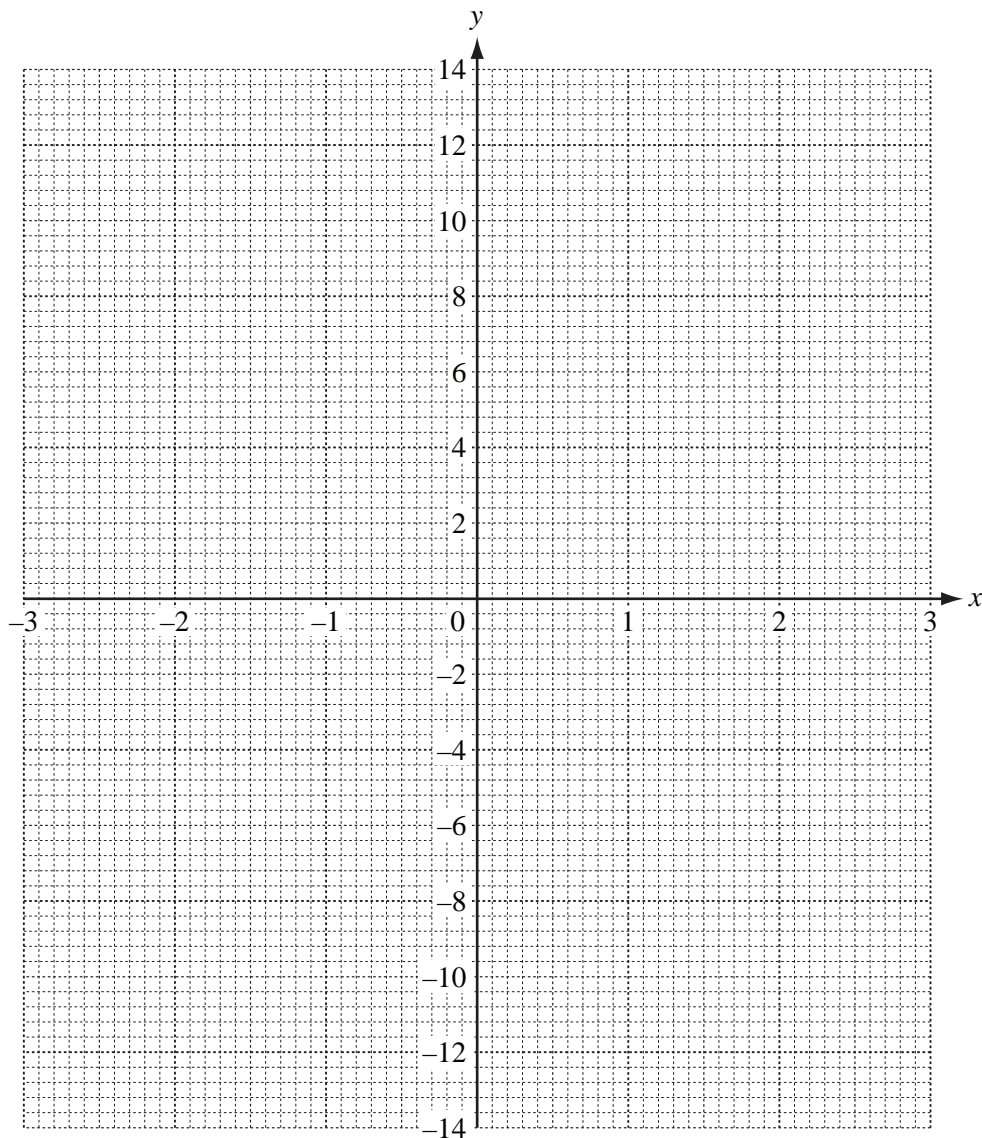
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- 4 (a) Complete the table of values for the function  $y = x^2 - \frac{3}{x}$ ,  $x \neq 0$ .

x	-3	-2	-1	-0.5	-0.25		0.25	0.5	1	2	3
y	10	5.5		6.3	12.1		-11.9			2.5	8

[3]

- (b) Draw the graph of  $y = x^2 - \frac{3}{x}$  for  $-3 \leq x \leq -0.25$  and  $0.25 \leq x \leq 3$ .



[5]

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(c) Use your graph to solve  $x^2 - \frac{3}{x} = 7$ .

*Answer(c)*  $x =$  ..... or  $x =$  ..... or  $x =$  ..... [3]

(d) Draw the tangent to the curve where  $x = -2$ .  
Use the tangent to calculate an estimate of the gradient of the curve where  $x = -2$ .

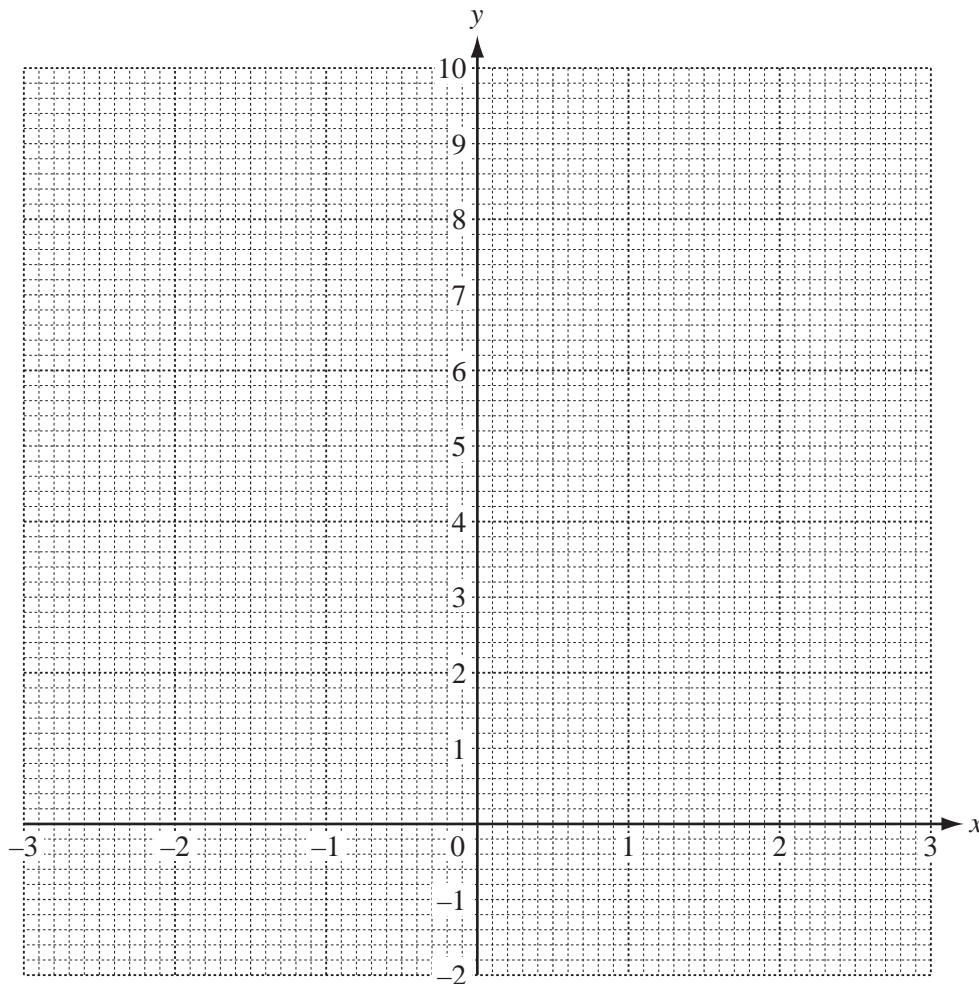
*Answer(d)* ..... [3]

- 5 (a) Complete the table of values for the function  $f(x)$ , where  $f(x) = x^2 + \frac{1}{x^2}$ ,  $x \neq 0$ .

$x$	-3	-2.5	-2	-1.5	-1	-0.5		0.5	1	1.5	2	2.5	3
$f(x)$		6.41		2.69		4.25		4.25		2.69		6.41	

[3]

- (b) On the grid, draw the graph of  $y = f(x)$  for  $-3 \leq x \leq -0.5$  and  $0.5 \leq x \leq 3$ .



[5]

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(c) (i) Write down the equation of the line of symmetry of the graph.

Answer(c)(i) ..... [1]

(ii) Draw the tangent to the graph of  $y = f(x)$  where  $x = -1.5$ .  
Use the tangent to estimate the gradient of the graph of  $y = f(x)$  where  $x = -1.5$ .

Answer(c)(ii) ..... [3]

(iii) Use your graph to solve the equation  $x^2 + \frac{1}{x^2} = 3$ .

Answer(c)(iii)  $x =$  ..... or  $x =$  ..... or  $x =$  ..... or  $x =$  ..... [2]

(iv) Draw a suitable line on the grid and use your graphs to solve the equation  $x^2 + \frac{1}{x^2} = 2x$ .

Answer(c)(iv)  $x =$  ..... or  $x =$  ..... [3]

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9             $f(x) = 3x + 1$              $g(x) = (x + 2)^2$

(a) Find the values of

(i)  $gf(2)$ ,

*Answer(a)(i)* ..... [2]

(ii)  $ff(0.5)$ .

*Answer(a)(ii)* ..... [2]

(b) Find  $f^{-1}(x)$ , the inverse of  $f(x)$ .

*Answer(b)* ..... [2]

(c) Find  $fg(x)$ .

Give your answer in its simplest form.

*Answer(c)* ..... [2]

(d) Solve the equation  $x^2 + f(x) = 0$ .

Show all your working and give your answers correct to 2 decimal places.

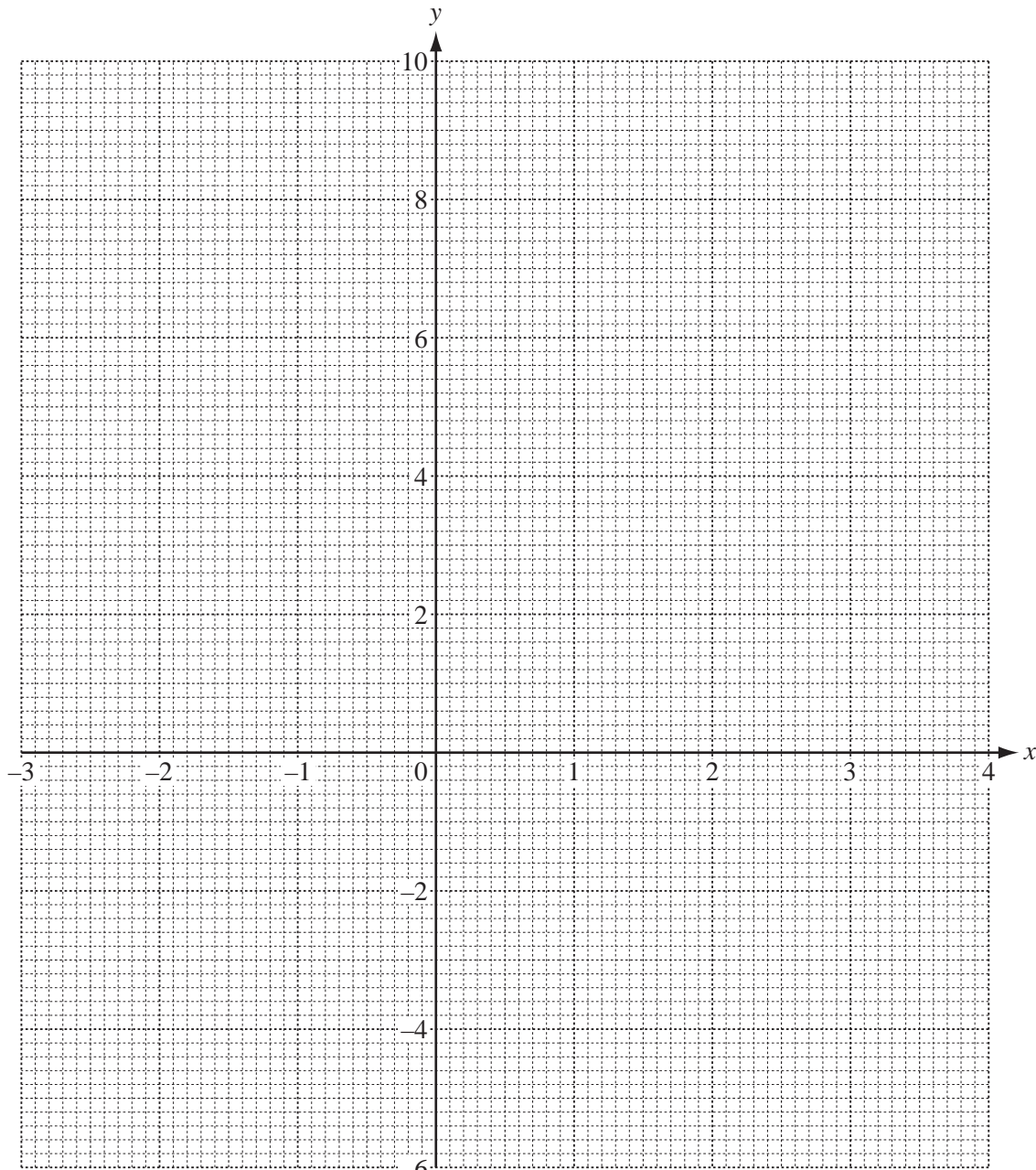
*Answer(d)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

5 (a) Complete the table for the function  $f(x) = \frac{x^3}{2} - 3x - 1$ .

$x$	-3	-2	-1.5	-1	0	1	1.5	2	3	3.5
$f(x)$	-5.5		1.8	1.5		-3.5	-3.8	-3		9.9

[3]

(b) On the grid draw the graph of  $y = f(x)$  for  $-3 \leq x \leq 3.5$ .



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[4]

(c) Use your graph to

(i) solve  $f(x) = 0.5$ ,

*Answer(c)(i)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(ii) find the inequalities for  $k$ , so that  $f(x) = k$  has only 1 answer.

*Answer(c)(ii)*  $k < \dots\dots\dots$   
 $k > \dots\dots\dots$  [2]

(d) (i) On the same grid, draw the graph of  $y = 3x - 2$  for  $-1 \leq x \leq 3.5$ . [3]

(ii) The equation  $\frac{x^3}{2} - 3x - 1 = 3x - 2$  can be written in the form  $x^3 + ax + b = 0$ .  
Find the values of  $a$  and  $b$ .

*Answer(d)(ii)*  $a = \dots\dots\dots$  and  $b = \dots\dots\dots$  [2]

(iii) Use your graph to find the **positive** answers to  $\frac{x^3}{2} - 3x - 1 = 3x - 2$  for  $-3 \leq x \leq 3.5$ .

*Answer(d)(iii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

2

$$f(x) = 4x - 2$$

$$g(x) = \frac{2}{x} + 1$$

$$h(x) = x^2 + 3$$

(a) (i) Find the value of  $hf(2)$ .

*Answer(a)(i)* ..... [2]

(ii) Write  $fg(x)$  in its simplest form.

*Answer(a)(ii)*  $fg(x) =$  ..... [2]

(b) Solve  $g(x) = 0.2$ .

*Answer(b)*  $x =$  ..... [2]

(c) Find the value of  $gg(3)$ .

*Answer(c)* ..... [2]

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(d) (i) Show that  $f(x) = g(x)$  can be written as  $4x^2 - 3x - 2 = 0$ .

*Answer (d)(i)*

[1]

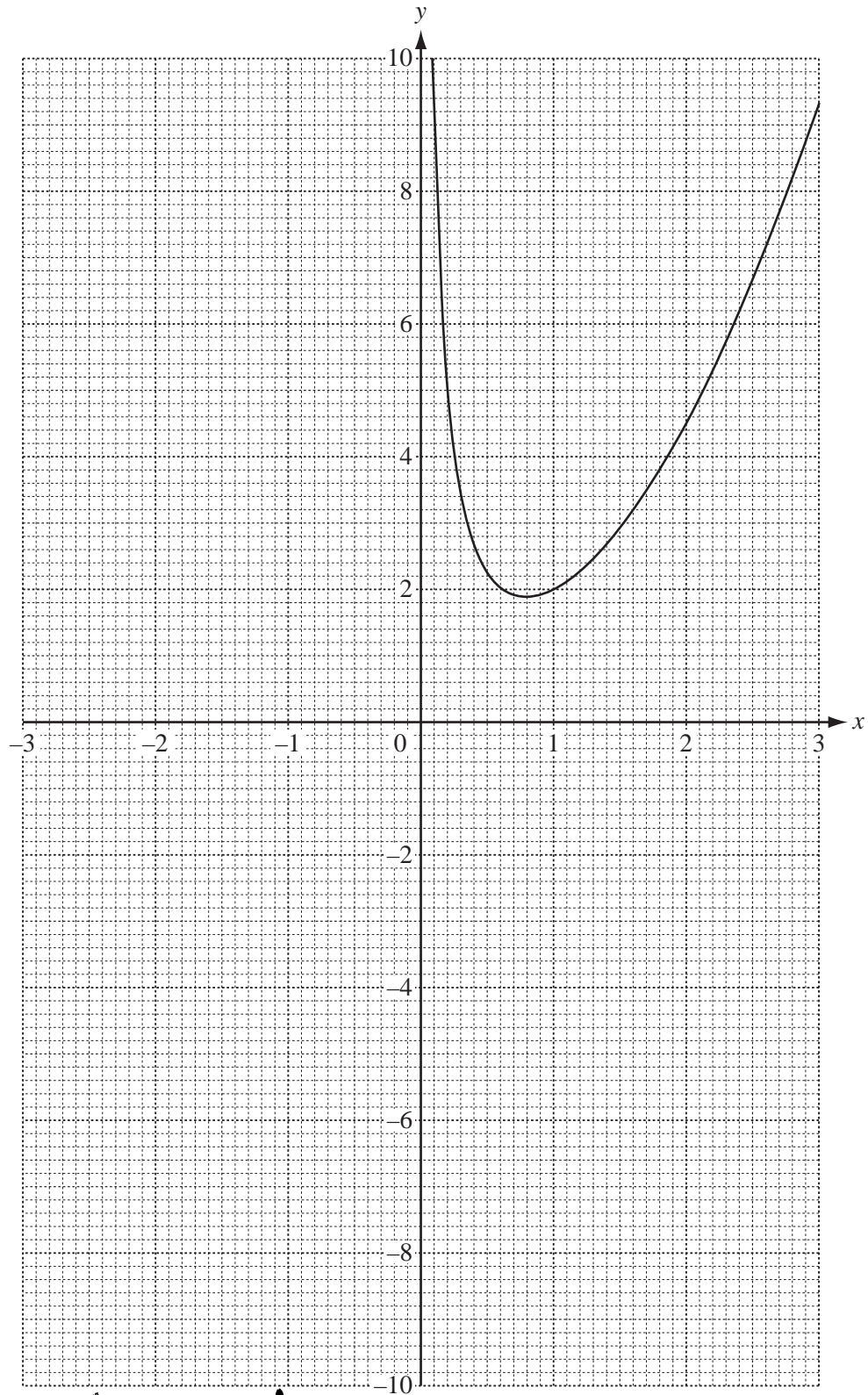
(ii) Solve the equation  $4x^2 - 3x - 2 = 0$ .

Show all your working and give your answers correct to 2 decimal places.

*Answer(d)(ii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

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7 The diagram shows the accurate graph of  $y = f(x)$  where  $f(x) = \frac{1}{x} + x^2$  for  $0 < x \leq 3$ .



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(a) Complete the table for  $f(x) = \frac{1}{x} + x^2$ .

$x$	-3	-2	-1	-0.5	-0.3	-0.1
$f(x)$		3.5	0	-1.8		

[3]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-3 \leq x < 0$ .

[3]

(c) By drawing a tangent, work out an estimate of the gradient of the graph where  $x = 2$ .

Answer(c) .....

[3]

(d) Write down the inequality satisfied by  $k$  when  $f(x) = k$  has three answers.

Answer(d) .....

[1]

(e) (i) Draw the line  $y = 1 - x$  on the grid for  $-3 \leq x \leq 3$ .

[2]

(ii) Use your graphs to solve the equation  $1 - x = \frac{1}{x} + x^2$ .

Answer(e)(ii)  $x =$  .....

[1]

(f) (i) Rearrange  $x^3 - x^2 - 2x + 1 = 0$  into the form  $\frac{1}{x} + x^2 = ax + b$ , where  $a$  and  $b$  are integers.

Answer(f)(i)

[2]

(ii) Write down the equation of the line that could be drawn on the graph to solve  $x^3 - x^2 - 2x + 1 = 0$ .

Answer(f)(ii)  $y =$  .....

[1]

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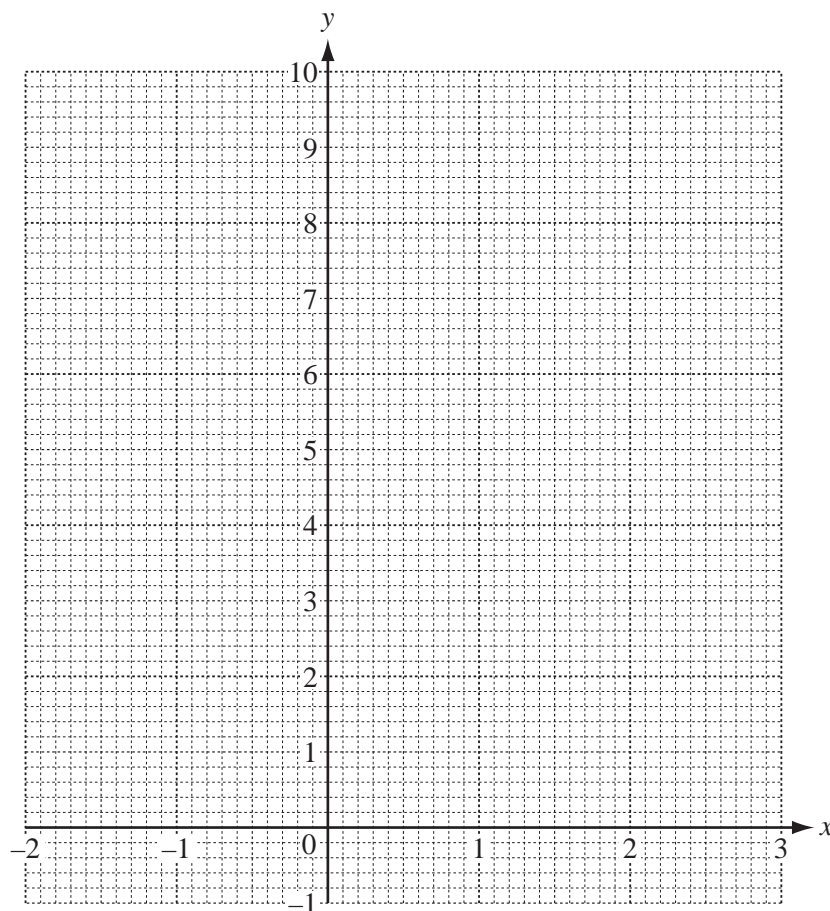
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- 2 (a) Complete the table of values for  $y = 2^x$ .

$x$	-2	-1	0	1	2	3
$y$	0.25		1	2		8

[2]

- (b) On the grid, draw the graph of  $y = 2^x$  for  $-2 \leq x \leq 3$ .



[3]

(c) (i) On the grid, draw the straight line which passes through the points (0, 2) and (3, 8). [1]

(ii) The equation of this line is  $y = mx + 2$ .

Show that the value of  $m$  is 2.

*Answer(c)(ii)*

(iii) One answer to the equation  $2^x = 2x + 2$  is  $x = 3$ . [1]

Use your graph to find the other answer.

*Answer(c)(iii)*  $x =$  ..... [1]

(d) Draw the tangent to the curve at the point where  $x = 1$ .

Use this tangent to calculate an estimate of the gradient of  $y = 2^x$  when  $x = 1$ .

*Answer(d)* ..... [3]

8  $f(x) = x^2 + x - 1$        $g(x) = 1 - 2x$        $h(x) = 3^x$

(a) Find the value of  $hg(-2)$ .

Answer(a) ..... [2]

(b) Find  $g^{-1}(x)$ .

Answer(b)  $g^{-1}(x) =$  ..... [2]

(c) Solve the equation  $f(x) = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

Answer(c)  $x =$  ..... or  $x =$  ..... [4]

(d) Find  $fg(x)$ .  
Give your answer in its simplest form.

Answer(d)  $fg(x) =$  ..... [3]

(e) Solve the equation  $h^{-1}(x) = 2$ .

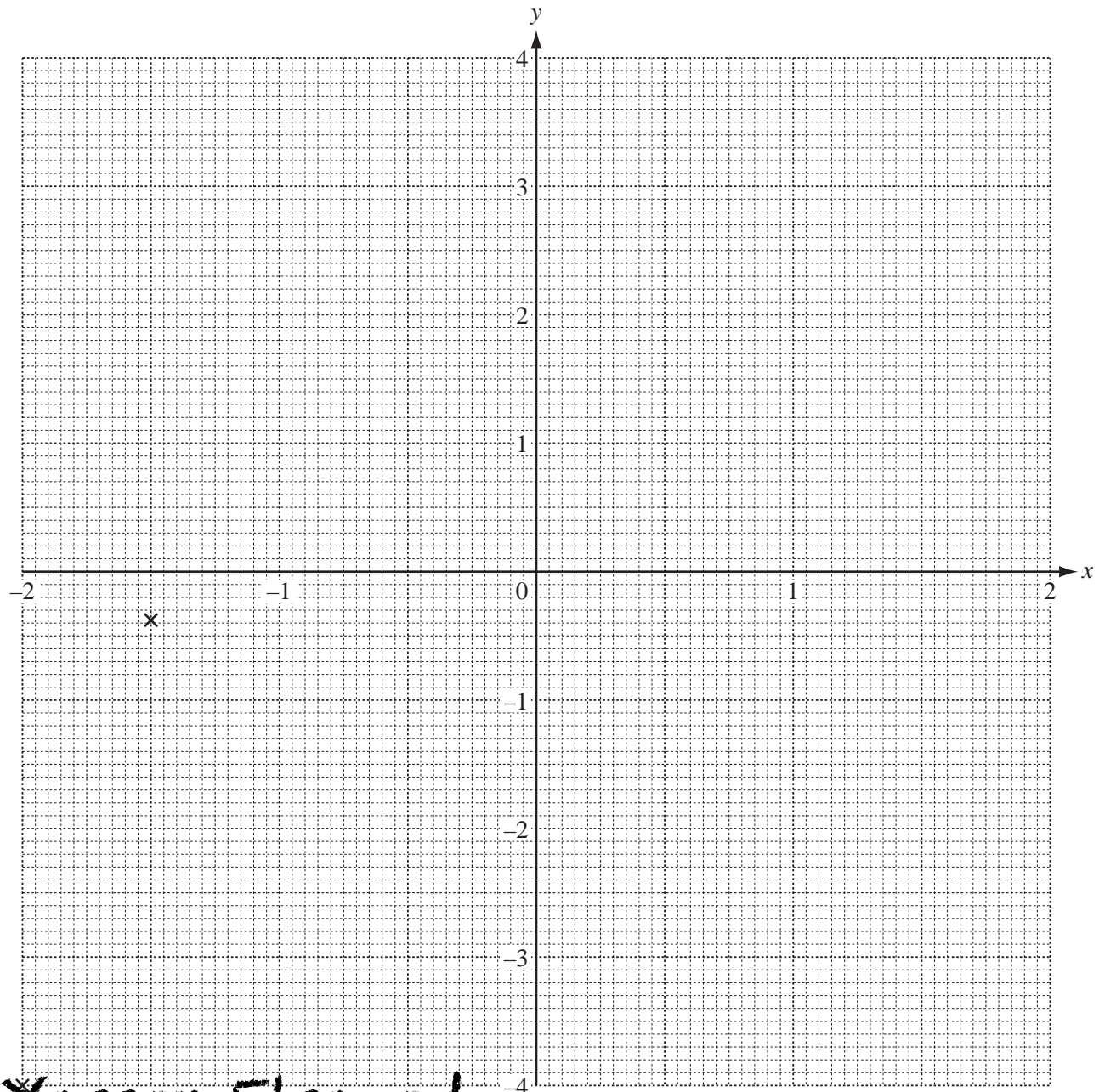
Answer(e)  $x =$  ..... [1]

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- 3 The table shows some values for the equation  $y = x^3 - 2x$  for  $-2 \leq x \leq 2$ .

x	-2	-1.5	-1	-0.6	-0.3	0	0.3	0.6	1	1.5	2
y	-4	-0.38			0.57		-0.57			0.38	4

- (a) Complete the table of values. [3]
- (b) On the grid below, draw the graph of  $y = x^3 - 2x$  for  $-2 \leq x \leq 2$ .  
The first two points have been plotted for you.



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[4]

(c) (i) On the grid, draw the line  $y = 0.8$  for  $-2 \leq x \leq 2$ . [1]

(ii) Use your graph to solve the equation  $x^3 - 2x = 0.8$ .

Answer(c)(ii)  $x =$  ..... or  $x =$  ..... or  $x =$  ..... [3]

(d) By drawing a suitable tangent, work out an estimate for the gradient of the graph of  $y = x^3 - 2x$  where  $x = 1.5$ .

You must show your working.

Answer(d) ..... [3]



9

$f(x) = 3x + 5$

$g(x) = 7 - 2x$

$h(x) = x^2 - 8$

(a) Find

(i)  $f(3)$ ,

Answer(a)(i) ..... [1]

(ii)  $g(x - 3)$  in terms of  $x$  in its simplest form,

Answer(a)(ii) ..... [2]

(iii)  $h(5x)$  in terms of  $x$  in its simplest form.

Answer(a)(iii) ..... [1]

(b) Find the inverse function  $g^{-1}(x)$ .

Answer(b)  $g^{-1}(x) =$  ..... [2]

(c) Find  $hf(x)$  in the form  $ax^2 + bx + c$ .

Answer(c)  $hf(x) =$  ..... [3]

(d) Solve the equation  $ff(x) = 83$ .

Answer(d)  $x =$  ..... [3]

(e) Solve the inequality  $2f(x) < g(x)$ .

Answer(e) ..... [3]

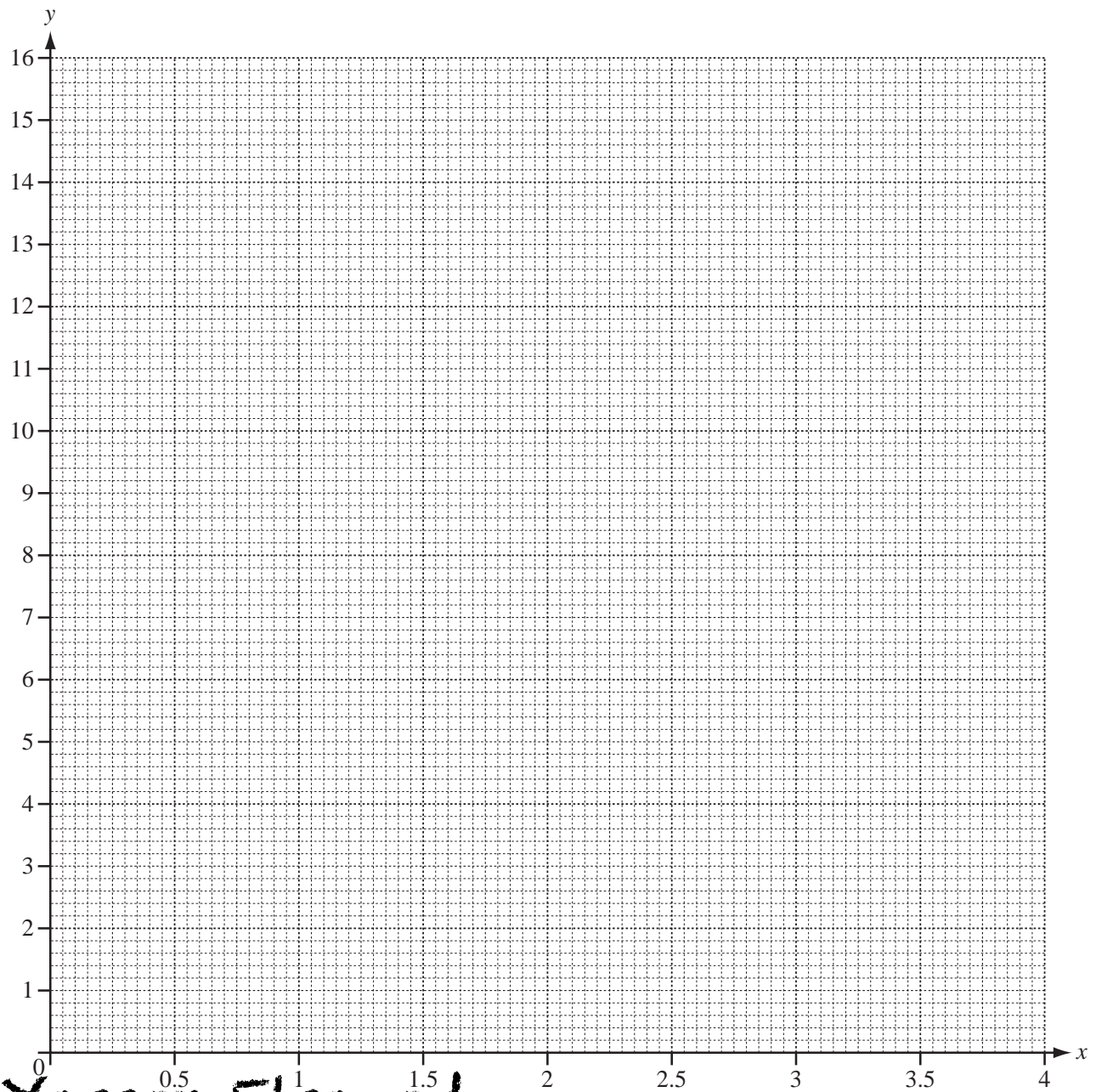
7  $f(x) = 2^x$

(a) Complete the table.

$x$	0	0.5	1	1.5	2	2.5	3	3.5	4
$f(x)$		1.4	2	2.8	4	5.7	8		

[3]

(b) Draw the graph of  $y = f(x)$  for  $0 \leq x \leq 4$ .



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[4]  
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(c) Use your graph to solve the equation  $2^x = 5$ .

*Answer(c)*  $x =$  ..... [1]

(d) Draw a suitable straight line and use it to solve the equation  $2^x = 3x$ .

*Answer(d)*  $x =$  ..... or  $x =$  ..... [3]

(e) Draw a suitable tangent and use it to find the co-ordinates of the point on the graph of  $y = f(x)$  where the gradient of the graph is 3.

*Answer(e)* ( ..... , ..... ) [3]

9

$$f(x) = 1 - 2x$$

$$g(x) = \frac{1}{x}, x \neq 0$$

$$h(x) = x^3 + 1$$

(a) Find the value of

(i)  $gf(2)$ ,

*Answer(a)(i)* ..... [2]

(ii)  $h(-2)$ .

*Answer(a)(ii)* ..... [1]

(b) Find  $fg(x)$ .

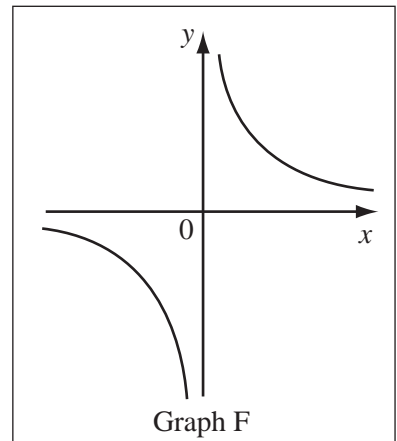
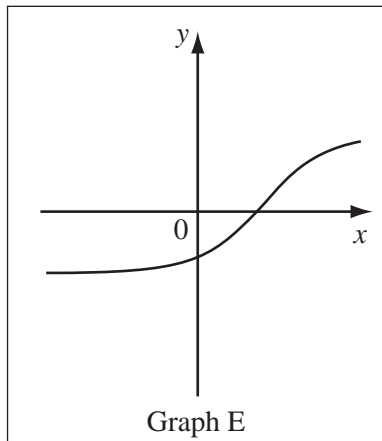
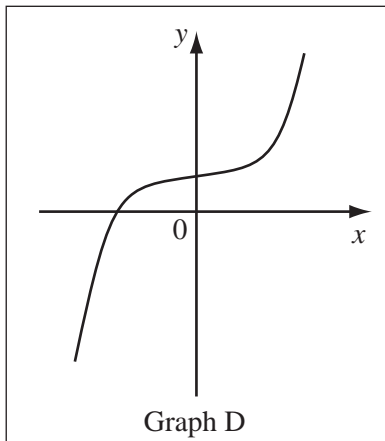
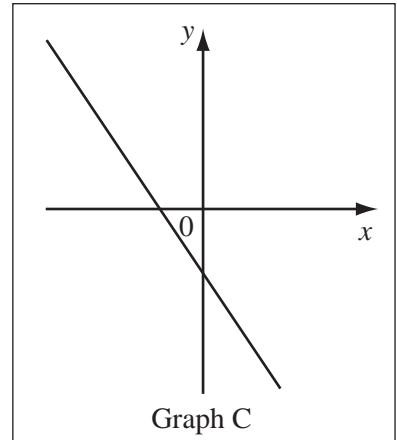
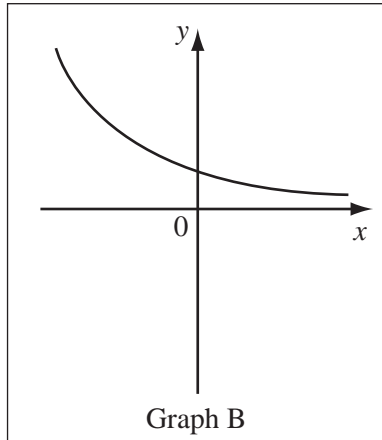
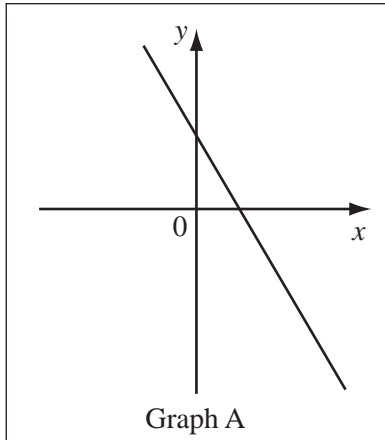
Write your answer as a single fraction.

*Answer(b)*  $fg(x) =$  ..... [2]

(c) Find  $h^{-1}(x)$ , the inverse of  $h(x)$ .

*Answer(c)*  $h^{-1}(x) =$  ..... [2]

(d) Write down which of these sketches shows the graph of each of  $y = f(x)$ ,  $y = g(x)$  and  $y = h(x)$ .



Answer(d)  $y = f(x)$  Graph .....

$y = g(x)$  Graph .....

$y = h(x)$  Graph ..... [3]

(e)  $k(x) = x^5 - 3$

Solve the equation  $k^{-1}(x) = 2$ .

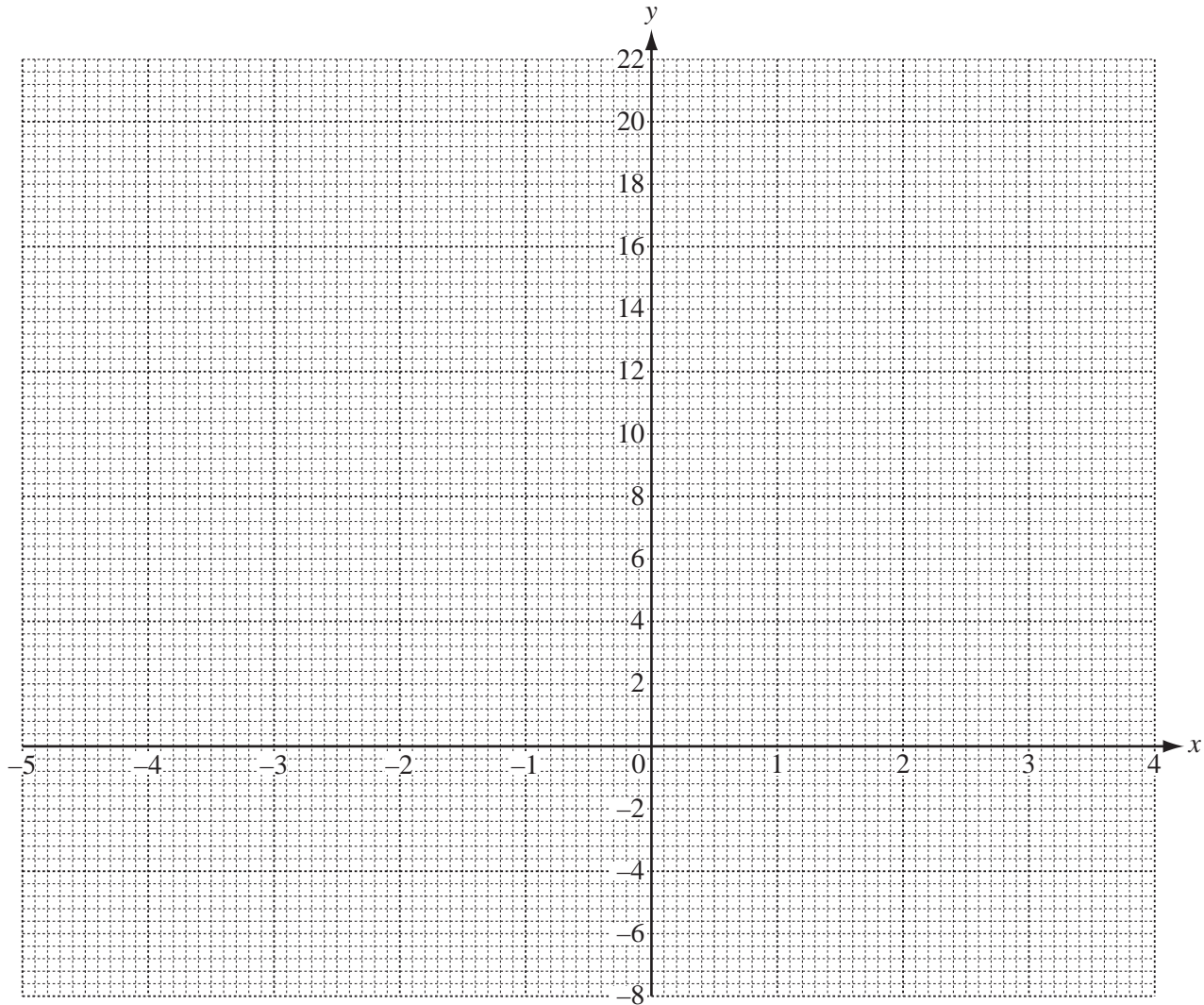
Answer(e)  $x =$  ..... [2]

2 (a) (i) Complete the table of values for  $y = \frac{1}{2}x^3 + x^2 - 7x$ .

$x$	-5	-4	-3	-2	-1	0	1	2	3	4
$y$	-2.5	12	16.5		7.5	0		-6	1.5	

[3]

(ii) On the grid, draw the graph of  $y = \frac{1}{2}x^3 + x^2 - 7x$  for  $-5 \leq x \leq 4$ .



[4]

(b) Use your graph to solve the equation  $\frac{1}{2}x^3 + x^2 - 7x = 2$ .

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or  $x =$

or  $x =$

214 [3]

(c) By drawing a suitable tangent, calculate an estimate of the gradient of the graph where  $x = -4$ .

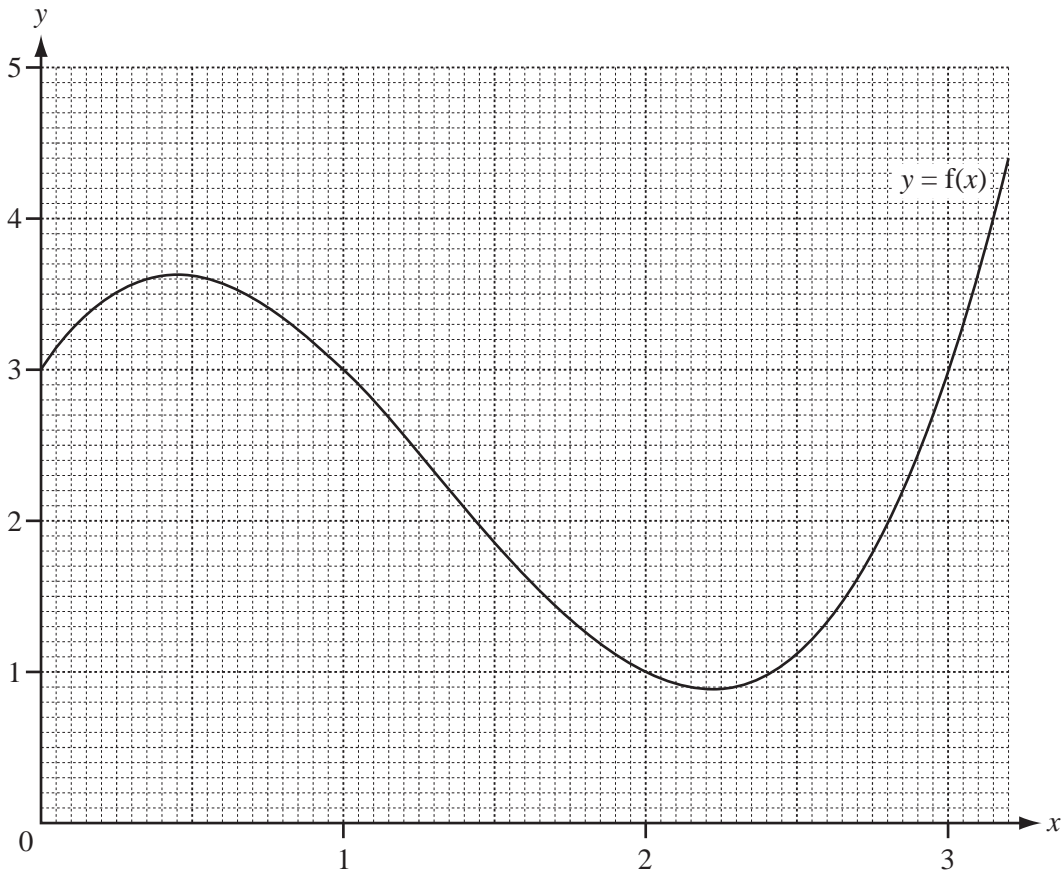
*Answer(c)* ..... [3]

(d) (i) On the grid draw the line  $y = 10 - 5x$  for  $-2 \leq x \leq 3$ . [3]

(ii) Use your graphs to solve the equation  $\frac{1}{2}x^3 + x^2 - 7x = 10 - 5x$ .

*Answer(d)(ii)*  $x =$  ..... [1]

8 The graph of  $y = f(x)$  is drawn on the grid for  $0 \leq x \leq 3.2$ .



- (a) (i) Draw the tangent to the curve  $y = f(x)$  at  $x = 2.5$ . [1]  
 (ii) Use your tangent to estimate the gradient of the curve at  $x = 2.5$ .

Answer(a)(ii) ..... [2]

- (b) Use the graph to solve  $f(x) = 2$ , for  $0 \leq x \leq 3.2$ .

Answer(b)  $x =$  ..... or  $x =$  ..... [2]



(c) 
$$g(x) = \frac{x}{2} + \frac{2}{x^2} \quad x \neq 0$$

(i) Complete the table for values of  $g(x)$ , correct to 1 decimal place.

$x$	0.7	1	1.5	2	2.5	3
$g(x)$			1.6		1.6	1.7

[2]

(ii) On the grid opposite, draw the graph of  $y = g(x)$  for  $0.7 \leq x \leq 3$ .

[3]

(iii) Solve  $f(x) = g(x)$  for  $0.7 \leq x \leq 3$ .

Answer(c) (iii)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

4

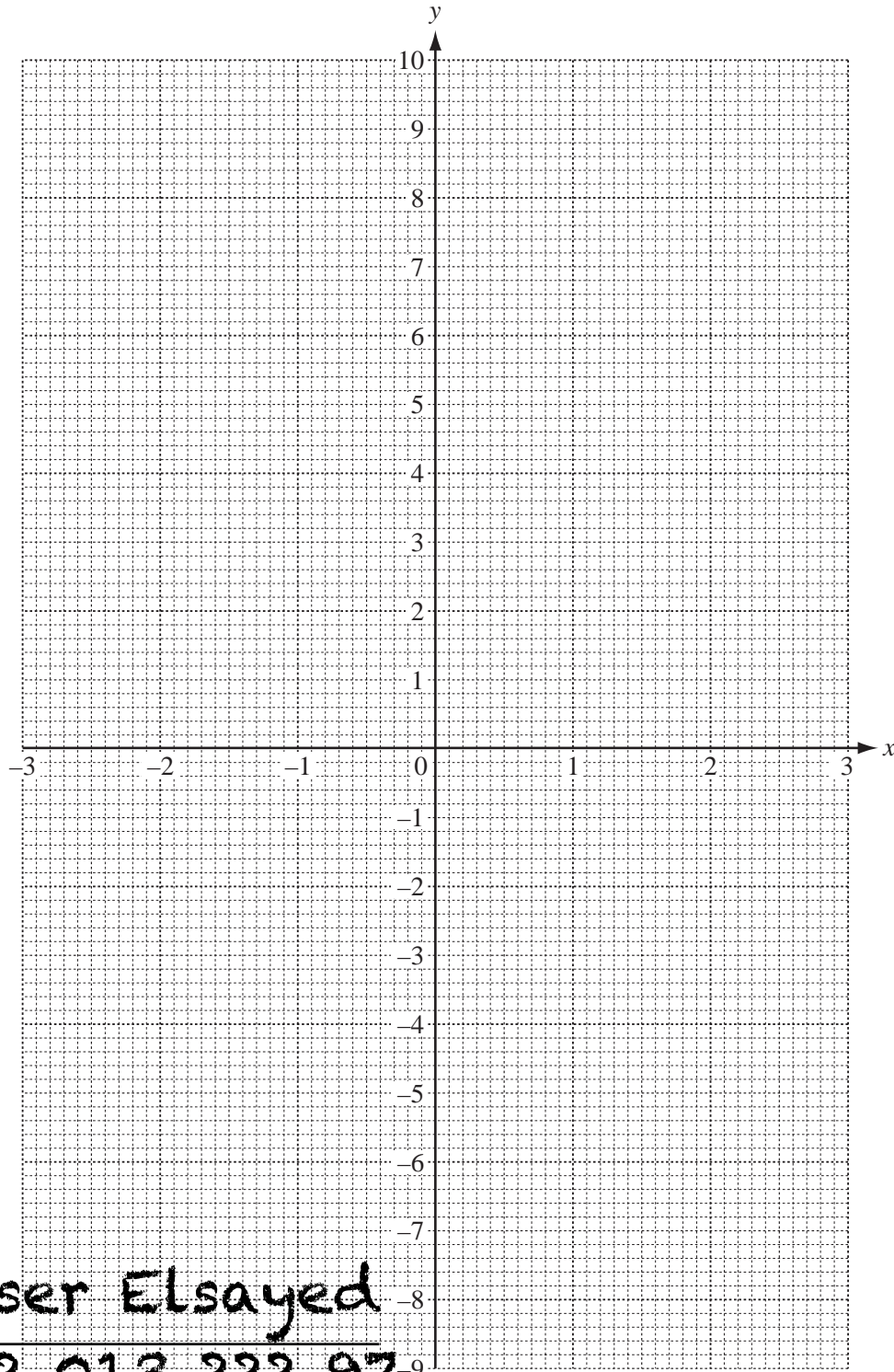
$$f(x) = \frac{2}{x^2} - 3x, \quad x \neq 0$$

(a) Complete the table.

$x$	-3	-2.5	-2	-1.5	-1	-0.5	0.5	1	1.5	2	2.5	3
$f(x)$	9.2	7.8	6.5	5.4		9.5	6.5		-3.6	-5.5	-7.2	-8.8

[2]

(b) On the grid, draw the graph of  $y = f(x)$ , for  $-3 \leq x \leq -0.5$  and  $0.5 \leq x \leq 3$ .



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(c) Use your graph to solve the equations.

(i)  $f(x) = 4$

Answer(c)(i)  $x =$  ..... [1]

(ii)  $f(x) = 3x$

Answer(c)(ii)  $x =$  ..... [2]

(d) The equation  $f(x) = 3x$  can be written as  $x^3 = k$ .

Find the value of  $k$ .

Answer(d)  $k =$  ..... [2]

(e) (i) Draw the straight line through the points  $(-1, 5)$  and  $(3, -9)$ .

[1]

(ii) Find the equation of this line.

Answer(e)(ii) ..... [3]

(iii) Complete the statement.

The straight line in part (e)(ii) is a ..... to the graph of  $y = f(x)$ . [1]

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2

$$f(x) = 3 - x - x^2 \quad g(x) = 3^x$$

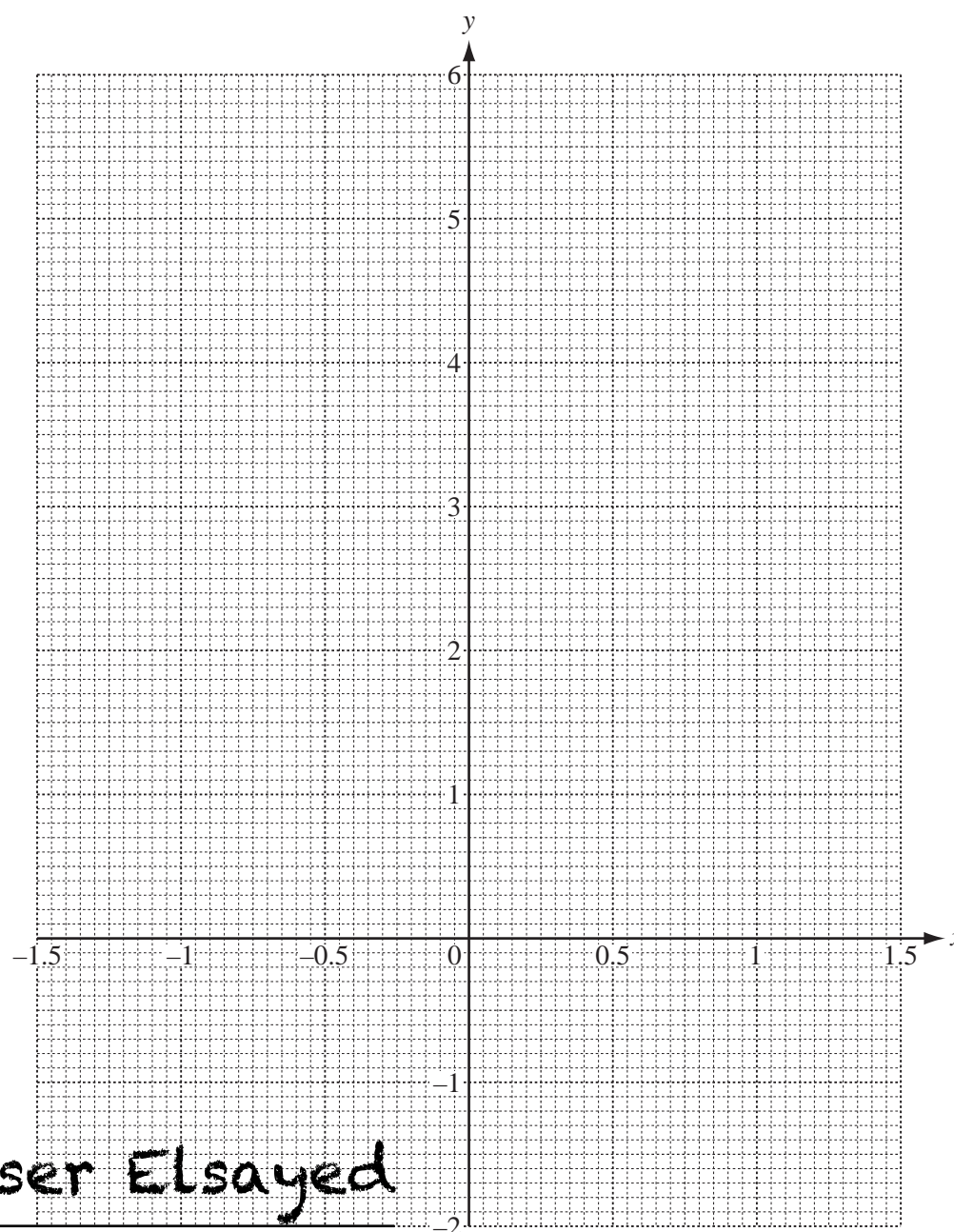
(a) Complete the tables of values for  $f(x)$  and  $g(x)$ .

$x$	-1.5	-1	-0.5	0	0.5	1	1.5
$f(x)$	2.25	3	3.25		2.25	1	-0.75

$x$	-1.5	-1	-0.5	0	0.5	1	1.5
$g(x)$	0.19		0.58		1.73	3	5.20

[3]

(b) On the grid, draw the graphs of  $y = f(x)$  and  $y = g(x)$  for  $-1.5 \leq x \leq 1.5$ .



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(c) For  $-1.5 \leq x \leq 1.5$ , use your graphs to solve

(i)  $f(x) = 0$ ,

*Answer(c)(i)*  $x = \dots\dots\dots$  [1]

(ii)  $g(x) = 4$ ,

*Answer(c)(ii)*  $x = \dots\dots\dots$  [1]

(iii)  $f(x) = g(x)$ .

*Answer(c)(iii)*  $x = \dots\dots\dots$  [1]

(d) By drawing a suitable tangent, find an estimate of the gradient of the graph of  $y = f(x)$  when  $x = 0.5$ .

*Answer(d)*  $\dots\dots\dots$  [3]

$$f(x) = x^2 + x - 3$$

$$g(x) = 2x + 7$$

$$h(x) = 2^x$$

- (a) Solve the equation  $f(x) = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

Answer(a)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(b)  $fg(x) = px^2 + qx + r$

Find the values of  $p$ ,  $q$  and  $r$ .

Answer(b)  $p = \dots\dots\dots$

$q = \dots\dots\dots$

$r = \dots\dots\dots$  222

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(c) Find  $g^{-1}(x)$ .

*Answer(c)*  $g^{-1}(x) = \dots\dots\dots$  [2]

(d) Find  $x$  when  $h(x) = 0.25$ .

*Answer(d)*  $x = \dots\dots\dots$  [1]

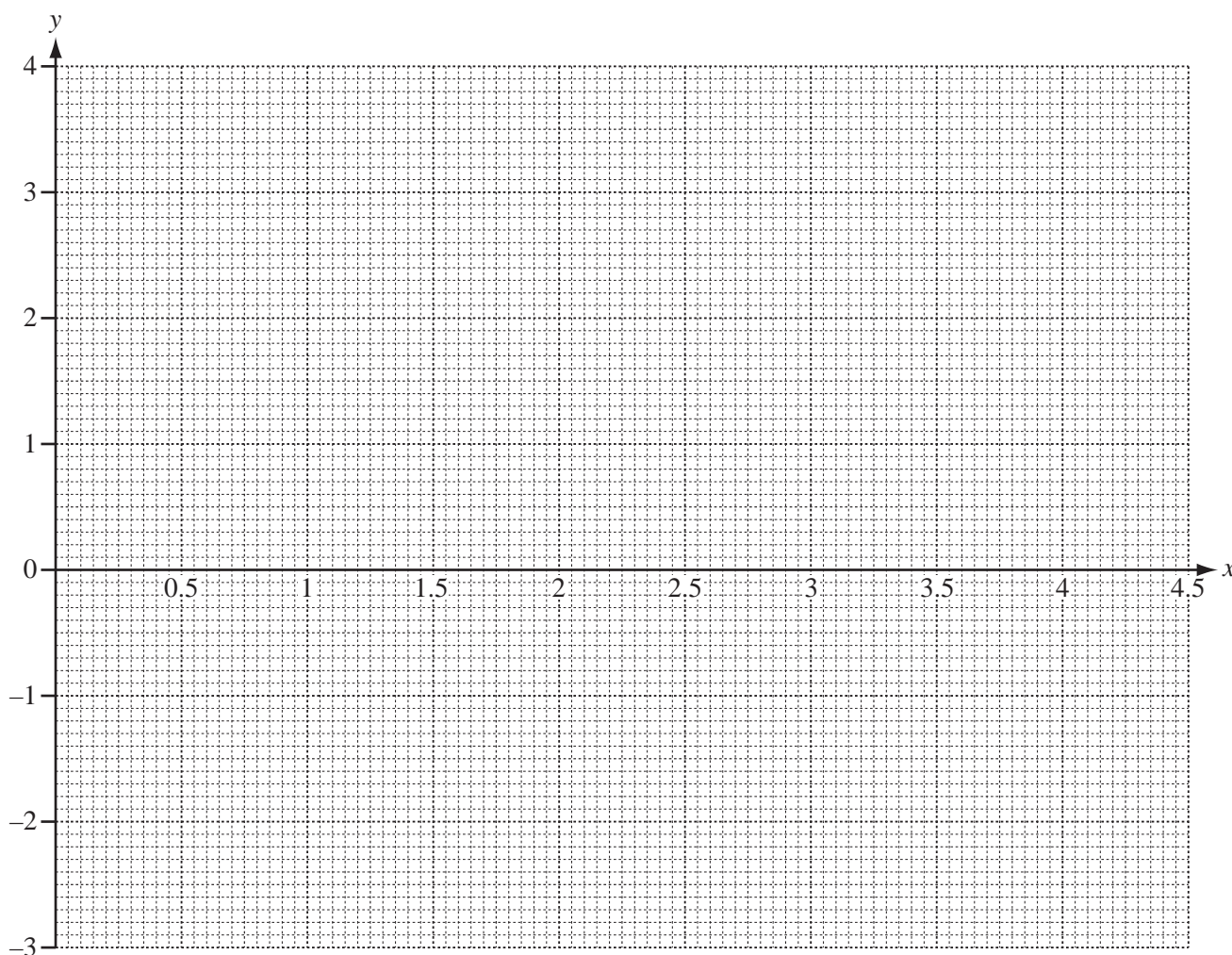
(e) Find  $hhh(3)$ .  
Give your answer in standard form, correct to 4 significant figures.

*Answer(e)*  $\dots\dots\dots$  [4]

- 3 The table shows some values for the function  $y = 11x - 2x^2 - 12$  for  $1 \leq x \leq 4.5$ .

$x$	1	1.5	2	2.5	3	3.5	4	4.5
$y$	-3		2	3	3			

- (a) Complete the table of values. [3]
- (b) On the grid below, draw the graph of  $y = 11x - 2x^2 - 12$  for  $1 \leq x \leq 4.5$ .



[4]



(c) By drawing a suitable line, use your graph to solve the equation  $11x - 2x^2 = 11$ .

*Answer(c)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(d) The line  $y = mx + 2$  is a tangent to the curve  $y = 11x - 2x^2 - 12$  at the point  $P$ .

By drawing this tangent,

(i) find the co-ordinates of the point  $P$ ,

*Answer(d)(i)* ( $\dots\dots\dots$ ,  $\dots\dots\dots$ ) [2]

(ii) work out the value of  $m$ .

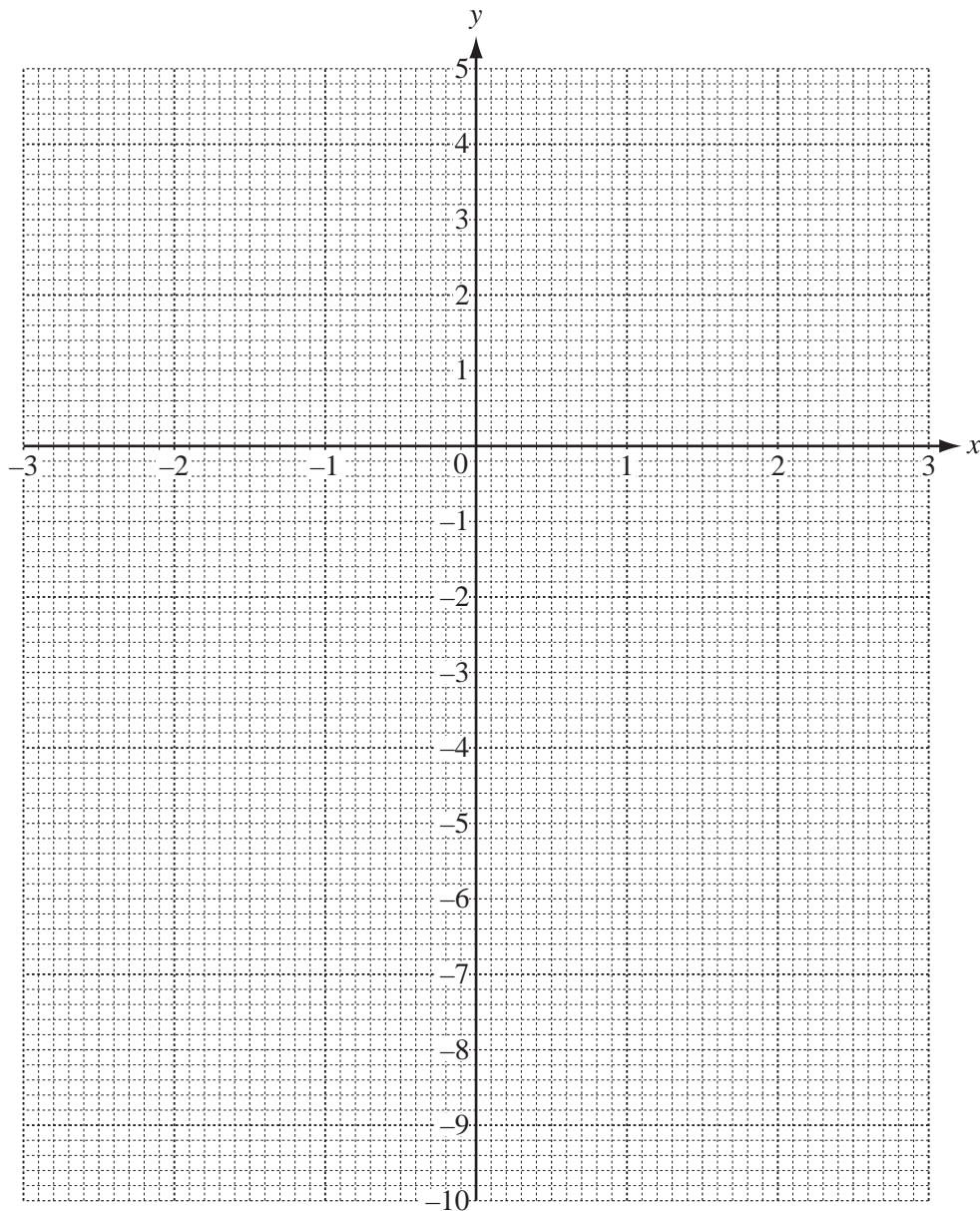
*Answer(d)(ii)*  $m = \dots\dots\dots$  [2]

5 (a) Complete this table of values for the function  $f(x) = \frac{1}{x} - x^2$ ,  $x \neq 0$ .

$x$	-3	-2	-1	-0.5	-0.2		0.2	0.5	1	2	3
$f(x)$	-9.33	-4.5	-2	-2.25			4.96			-3.5	-8.67

[3]

(b) Draw the graph of  $f(x) = \frac{1}{x} - x^2$  for  $-3 \leq x \leq -0.2$  and  $0.2 \leq x \leq 3$ .



[5]

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(c) Use your graph to solve  $f(x) = -3$ .

*Answer(c)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) By drawing a suitable line on your graph, solve the equation  $f(x) = 2x - 2$ .

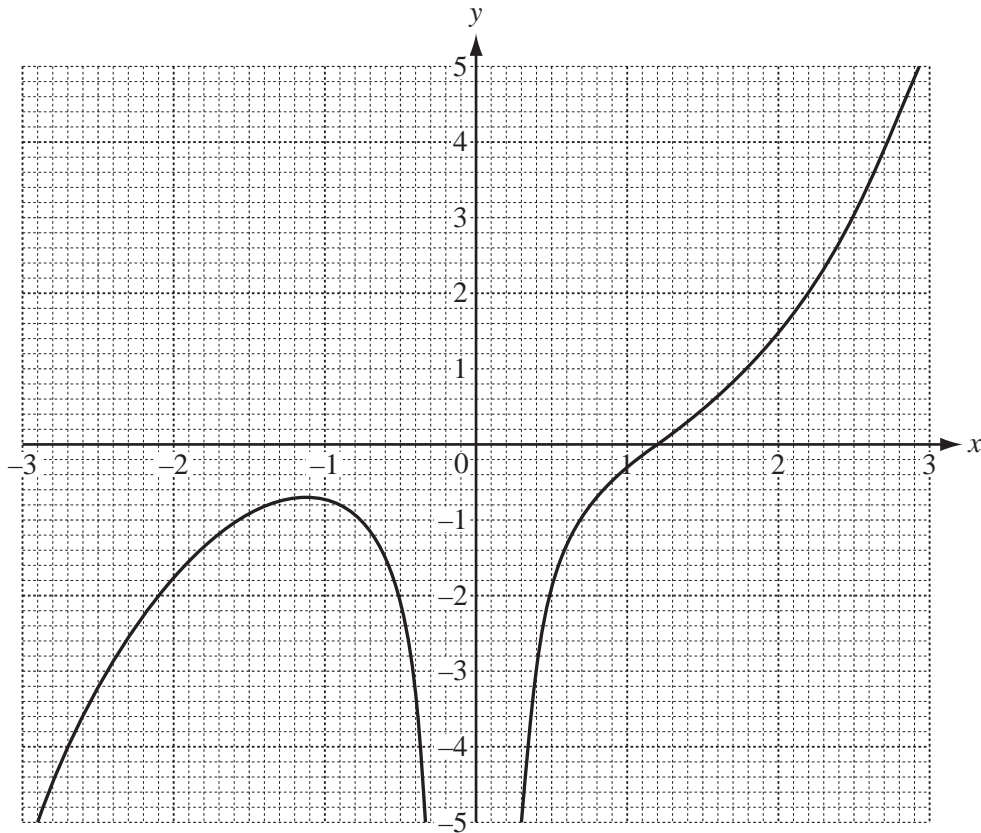
*Answer(d)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(e) By drawing a suitable tangent, work out an estimate of the gradient of the curve at the point where  $x = -2$ .

You must show your working.

*Answer(e)*  $\dots\dots\dots$  [3]

6 (a)



The diagram shows the graph of  $y = f(x)$  for  $-3 \leq x \leq 3$ .

(i) Find  $f(2)$ .

Answer(a)(i) ..... [1]

(ii) Solve the equation  $f(x) = 0$ .

Answer(a)(ii)  $x =$  ..... [1]

(iii) Write down the value of the largest **integer**,  $k$ , for which the equation  $f(x) = k$  has 3 solutions.

Answer(a)(iii)  $k =$  ..... [1]

(iv) By drawing a suitable straight line, solve the equation  $f(x) = x$ .

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..... or  $x =$  ..... or  $x =$  ..... [3]

(b)  $g(x) = 1 - 2x$      $h(x) = x^2 - 1$

(i) Find  $gh(3)$ .

*Answer(b)(i)* ..... [2]

(ii) Find  $g^{-1}(x)$ .

*Answer(b)(ii)*  $g^{-1}(x) =$  ..... [2]

(iii) Solve the equation  $h(x) = 3$ .

*Answer(b)(iii)*  $x =$  ..... or  $x =$  ..... [3]

(iv) Solve the equation  $g(3x) = 2x$ .

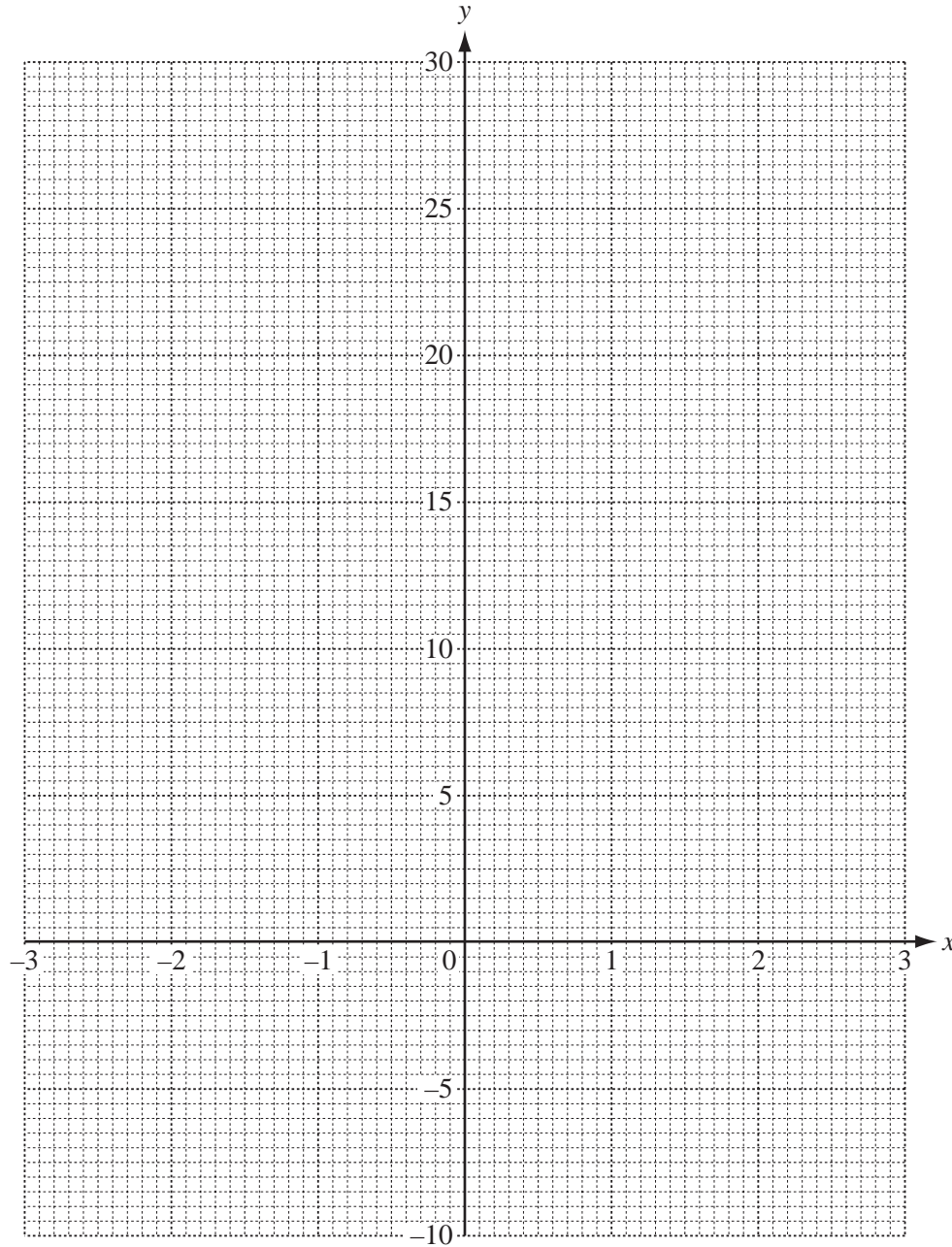
*Answer(b)(iv)*  $x =$  ..... [3]

5 (a) Complete the table of values for  $y = \frac{2}{x^2} - \frac{1}{x} - 3x$ .

x	-3	-2	-1	-0.5	-0.3		0.3	0.5	1	2	3
y	9.6		6		26.5		18.0		-2	-6	-9.1

[3]

(b) Draw the graph of  $y = \frac{2}{x^2} - \frac{1}{x} - 3x$  for  $-3 \leq x \leq -0.3$  and  $0.3 \leq x \leq 3$ .



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[5]

(c) Use your graph to solve these equations.

(i)  $\frac{2}{x^2} - \frac{1}{x} - 3x = 0$

Answer(c)(i)  $x = \dots\dots\dots$  [1]

(ii)  $\frac{2}{x^2} - \frac{1}{x} - 3x - 7.5 = 0$

Answer(c)(ii)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) (i) By drawing a suitable straight line on the graph, solve the equation  $\frac{2}{x^2} - \frac{1}{x} - 3x = 10 - 3x$ .

Answer(d)(i)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(ii) The equation  $\frac{2}{x^2} - \frac{1}{x} - 3x = 10 - 3x$  can be written in the form  $ax^2 + bx + c = 0$  where  $a, b$  and  $c$  are integers.

Find the values of  $a, b$  and  $c$ .

Answer(d)(ii)  $a = \dots\dots\dots$ ,  $b = \dots\dots\dots$ ,  $c = \dots\dots\dots$  [3]

8  $f(x) = 4x + 3$        $g(x) = \frac{7}{x+1}$  ( $x \neq -1$ )       $h(x) = x^2 + 5x$

(a) Work out

(i)  $h(-3)$ ,

*Answer(a)(i)* ..... [1]

(ii)  $hg(13)$ .

*Answer(a)(ii)* ..... [2]

(b) Find  $f^{-1}(x)$ .

*Answer(b)*  $f^{-1}(x) =$  ..... [2]



(c) (i) Solve the equation  $f(x) = 23$ .

*Answer(c)(i)*  $x = \dots\dots\dots$  [2]

(ii) Solve the equation  $h(x) = 7$ .

Show all your working and give your answers correct to 2 decimal places.

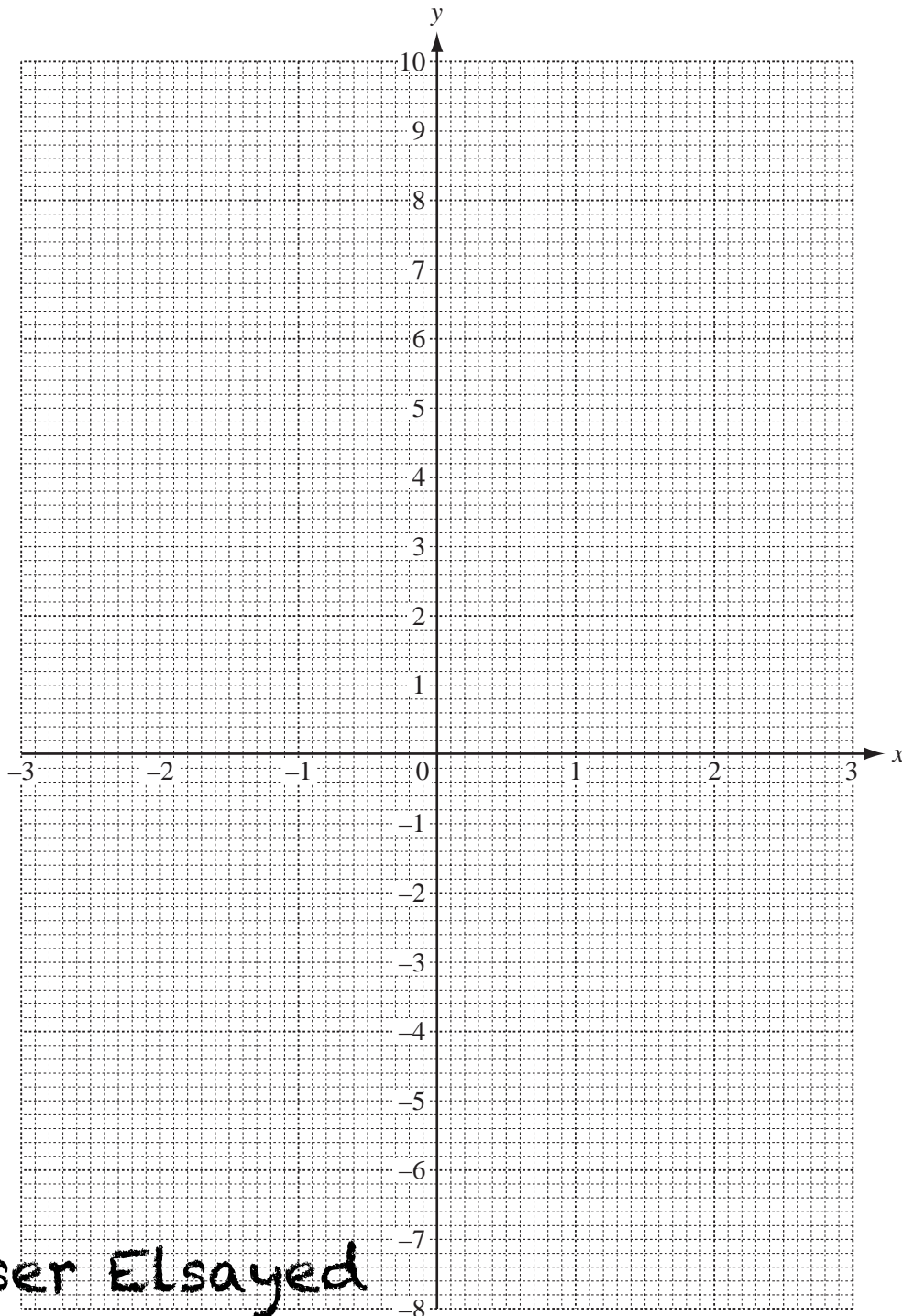
*Answer(c)(ii)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [5]

8 (a) Complete the table of values for  $y = x^3 - 3x + 1$ .

x	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5
y	-7.125	-1		3		1	-0.375	-1	-0.125	3	9.125

[2]

(b) Draw the graph of  $y = x^3 - 3x + 1$  for  $-2.5 \leq x \leq 2.5$ .



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(c) By drawing a suitable tangent, estimate the gradient of the curve at the point where  $x = 2$ .

*Answer(c)* ..... [3]

(d) Use your graph to solve the equation  $x^3 - 3x + 1 = 1$ .

*Answer(d)*  $x =$  ..... or  $x =$  ..... or  $x =$  ..... [2]

(e) Use your graph to complete the inequality in  $k$  for which the equation

$x^3 - 3x + 1 = k$  has three different solutions.

*Answer(e)* .....  $< k <$  ..... [2]

10 (a)  $f(x) = 2x - 3$        $g(x) = \frac{1}{x+1} + 2$        $h(x) = 3^x$

(i) Work out  $f(4)$ .

Answer(a)(i) ..... [1]

(ii) Work out  $fh(-1)$ .

Answer(a)(ii) ..... [2]

(iii) Find  $f^{-1}(x)$ , the inverse of  $f(x)$ .

Answer(a)(iii)  $f^{-1}(x) =$  ..... [2]

(iv) Find  $ff(x)$  in its simplest form.

Answer(a)(iv)  $ff(x) =$  ..... [2]

(v) Show that the equation  $f(x) = g(x)$  simplifies to  $2x^2 - 3x - 6 = 0$ .

*Answer(a)(v)*

[3]

(vi) Solve the equation  $2x^2 - 3x - 6 = 0$ .

Give your answers correct to 2 decimal places.  
Show all your working.

*Answer(a)(vi)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(b) Simplify  $\frac{x^2 - 3x + 2}{x^2 + 3x - 10}$ .

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*Answer(b)*  $\dots\dots\dots$  237 [4]

10  $f(x) = \frac{1}{x}, x \neq 0$        $g(x) = 1 - x$        $h(x) = x^2 + 1$

(a) Find  $fg\left(\frac{1}{2}\right)$ .

Answer(a) ..... [2]

(b) Find  $g^{-1}(x)$ , the inverse of  $g(x)$ .

Answer(b)  $g^{-1}(x) =$  ..... [1]

(c) Find  $hg(x)$ , giving your answer in its simplest form.

Answer(c)  $hg(x) =$  ..... [3]

(d) Find the value of  $x$  when  $g(x) = 7$ .

Answer(d)  $x =$  ..... [1]

(e) Solve the equation  $h(x) = 3x$ .  
Show your working and give your answers correct to 2 decimal places.

Answer(e)  $x =$  ..... or  $x =$  ..... [4]

(f) A function  $k(x)$  is its own inverse when  $k^{-1}(x) = k(x)$ .

For which of the functions  $f(x)$ ,  $g(x)$  and  $h(x)$  is this true?

Answer(f) ..... [1]

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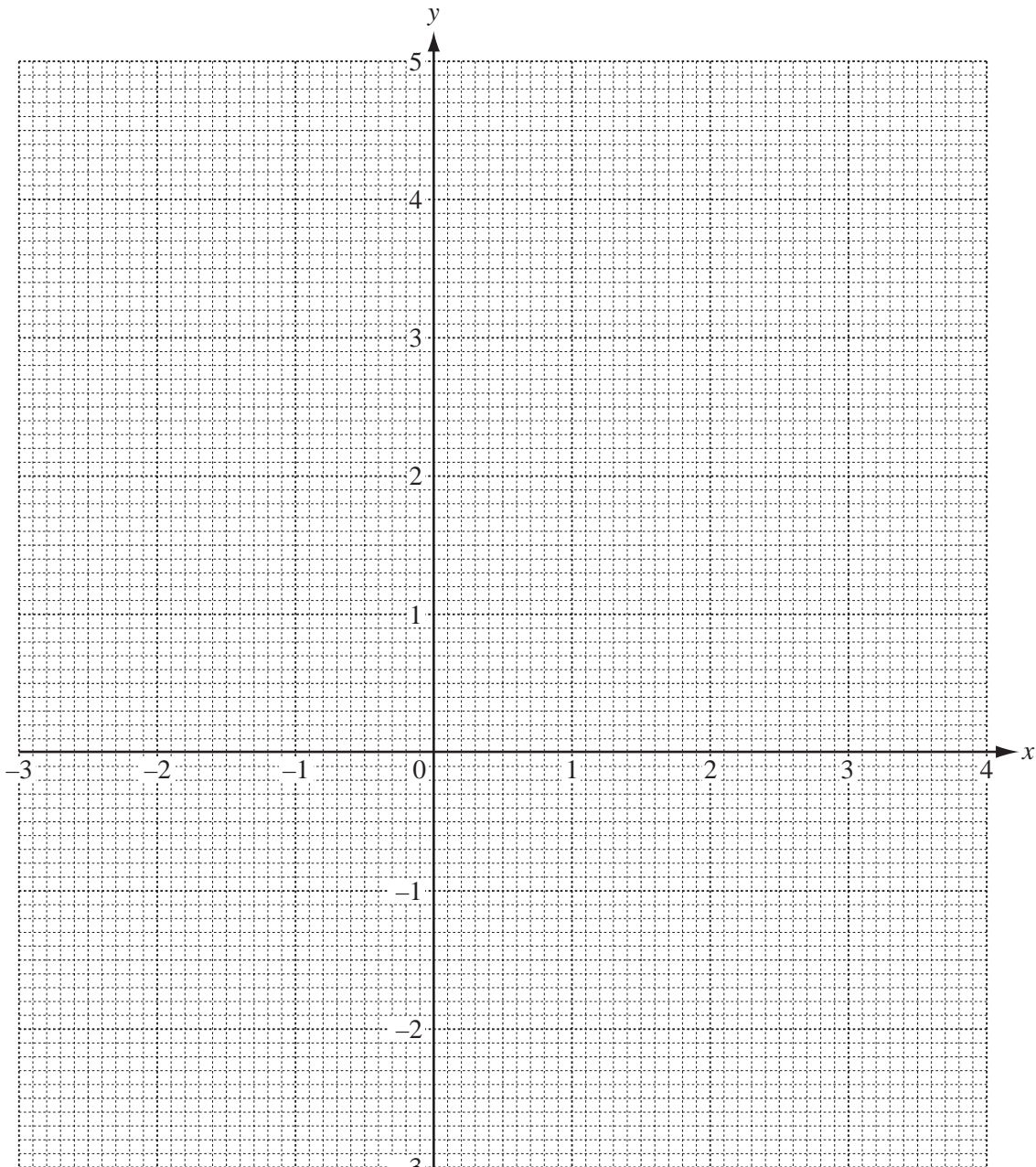
4 The table shows some values for the function  $y = \frac{1}{x^2} + x$ ,  $x \neq 0$ .

$x$	-3	-2	-1	-0.5	0.5	1	2	3	4
$y$	-2.89	-1.75		3.5		2	2.25		4.06

(a) Complete the table of values.

[3]

(b) On the grid, draw the graph of  $y = \frac{1}{x^2} + x$  for  $-3 \leq x \leq -0.5$  and  $0.5 \leq x \leq 4$ .



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[5]

(c) Use your graph to solve the equation  $\frac{1}{x^2} + x - 3 = 0$ .

*Answer(c)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) Use your graph to solve the equation  $\frac{1}{x^2} + x = 1 - x$ .

*Answer(d)*  $x = \dots\dots\dots$  [3]

(e) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where  $x = 2$ .

*Answer(e)*  $\dots\dots\dots$  [3]

(f) Using algebra, show that you can use the graph at  $y = 0$  to find  $\sqrt[3]{-1}$ .

*Answer(f)*

[3]



9       $f(x) = 4 - 3x$        $g(x) = 3^{-x}$

(a) Find  $f(2x)$  in terms of  $x$ .

*Answer(a)*  $f(2x) = \dots\dots\dots$  [1]

(b) Find  $ff(x)$  in its simplest form.

*Answer(b)*  $ff(x) = \dots\dots\dots$  [2]

(c) Work out  $gg(-1)$ .  
Give your answer as a fraction.

*Answer(c)*  $\dots\dots\dots$  [3]

(d) Find  $f^{-1}(x)$ , the inverse of  $f(x)$ .

*Answer(d)*  $f^{-1}(x) = \dots\dots\dots$  [2]

(e) Solve the equation  $gf(x) = 1$ .

*Answer(e)*  $x = \dots\dots\dots$  [3]

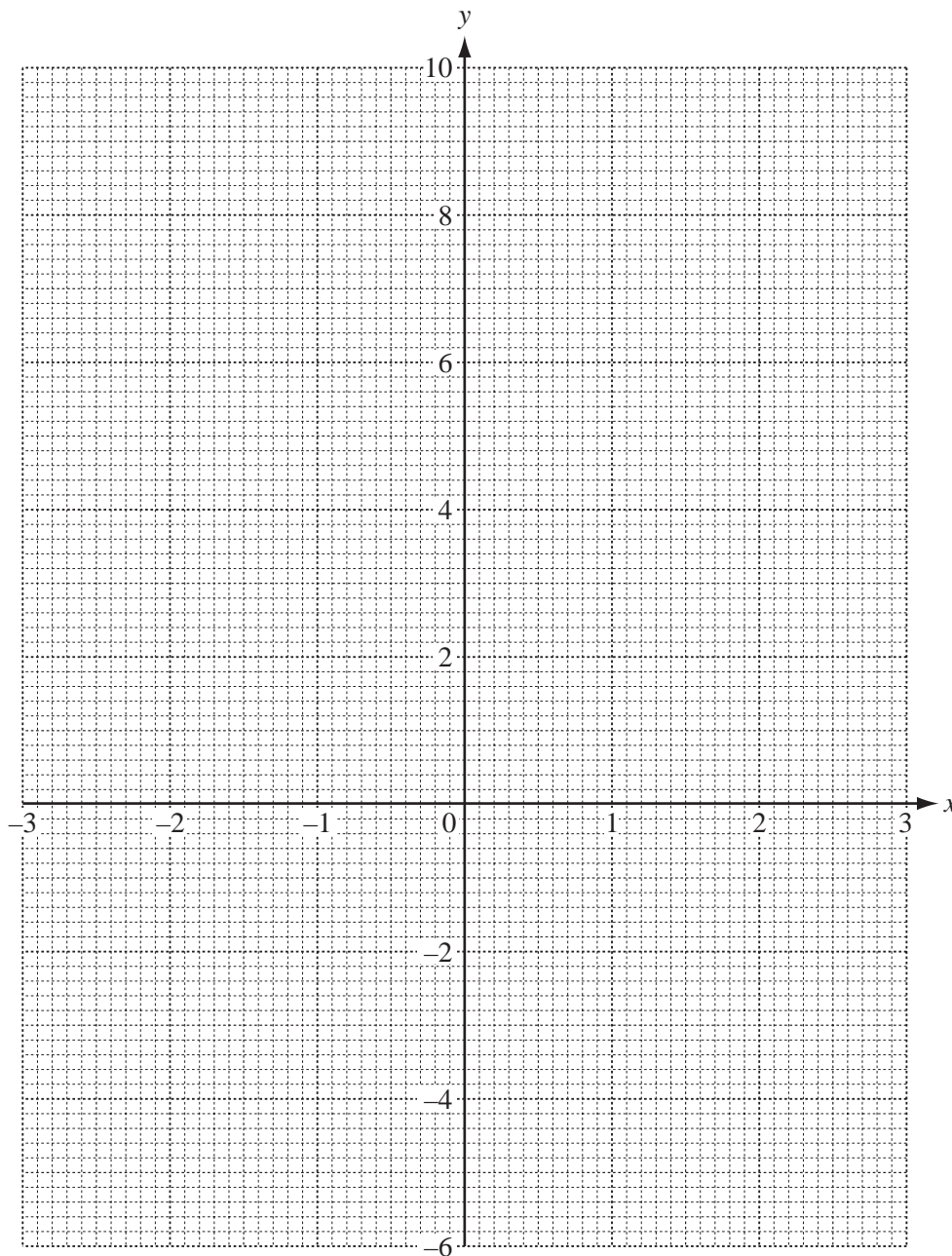
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5 (a) Complete the table of values for  $y = x^2 + \frac{3}{x}$ ,  $x \neq 0$ .

x	-3	-2	-1	-0.5		0.4	0.6	1	1.5	2	3
y	8	2.5		-5.8		7.7	5.4	4	4.3		10

[2]

(b) Draw the graph of  $y = x^2 + \frac{3}{x}$  for  $-3 \leq x \leq -0.5$  and  $0.4 \leq x \leq 3$ .



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[5]

(c) Use your graph to solve the equation  $x^2 + \frac{3}{x} = 5$ .

*Answer(c)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) By drawing a suitable straight line, solve the equation  $x^2 + \frac{3}{x} = x + 5$ .

*Answer(d)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

5  $f(x) = 5x - 2$

$$g(x) = \frac{7}{x-3}, x \neq 3$$

$$h(x) = 2x^2 + 7x$$

(a) Work out

(i)  $f(2)$ ,

Answer(a)(i) ..... [1]

(ii)  $hg(17)$ .

Answer(a)(ii) ..... [2]

(b) Solve  $g(x) = x + 3$ .

Answer(b)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(c) Solve  $h(x) = 11$ , showing all your working and giving your answers correct to 2 decimal places.

*Answer(c)*  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [5]

(d) Find  $f^{-1}(x)$ .

*Answer(d)*  $f^{-1}(x) = \dots\dots\dots$  [2]

(e) Solve  $g^{-1}(x) = -0.5$ .

*Answer(e)*  $x = \dots\dots\dots$  [1]

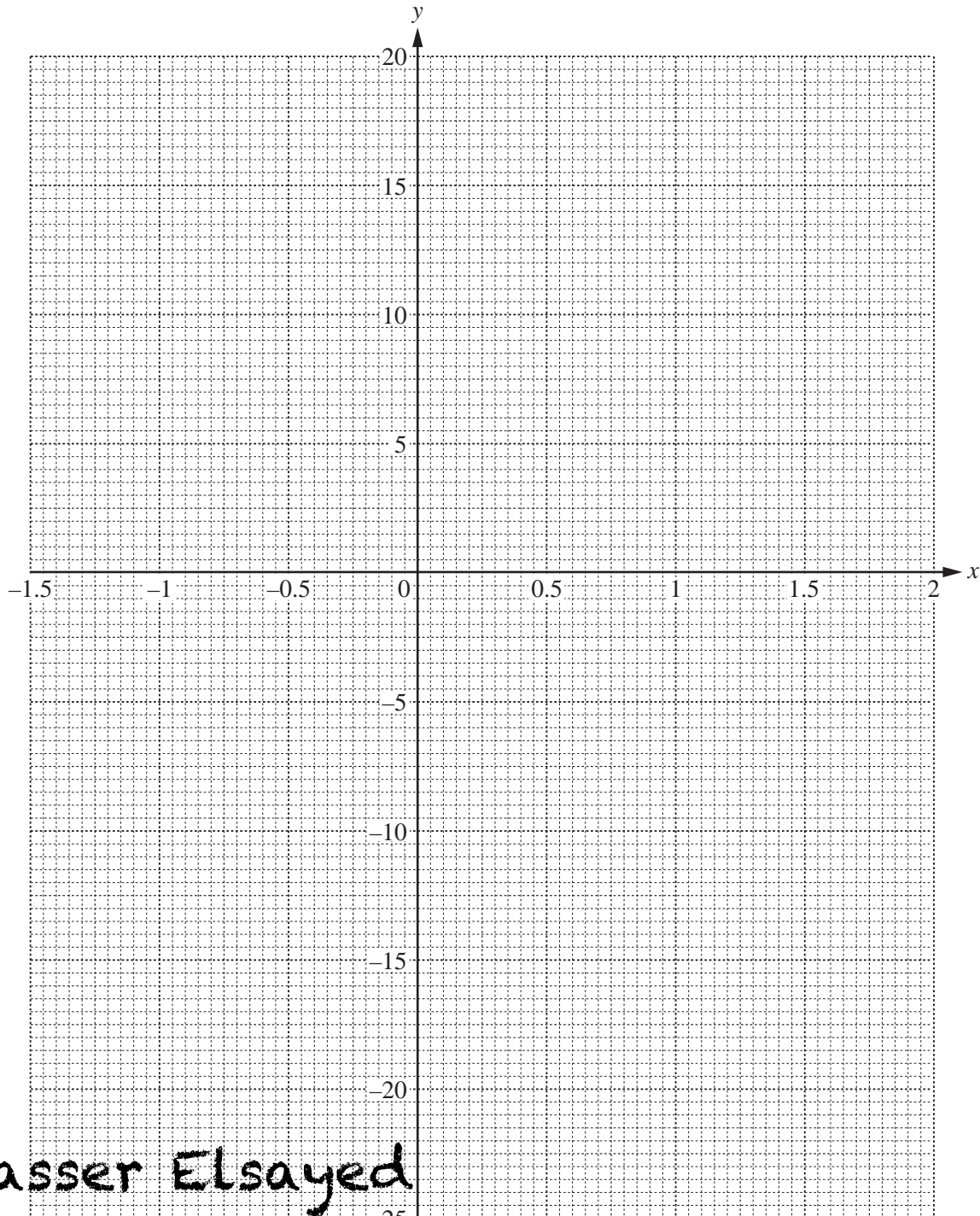
$$f(x) = 5x^3 - 8x^2 + 10$$

(a) Complete the table of values.

$x$	-1.5	-1	-0.5	0	0.5	0.75	1	1.5	2
$f(x)$	-24.9			10	8.6	7.6	7		18

[3]

(b) Draw the graph of  $y = f(x)$  for  $-1.5 \leq x \leq 2$ .



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246 [4]

(c) Use your graph to find an **integer** value of  $k$  so that  $f(x) = k$  has

(i) exactly one solution,

Answer(c)(i)  $k = \dots\dots\dots$  [1]

(ii) three solutions.

Answer(c)(ii)  $k = \dots\dots\dots$  [1]

(d) By drawing a suitable straight line on the graph, solve the equation  $f(x) = 15x + 2$  for  $-1.5 \leq x \leq 2$ .

Answer(d)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(e) Draw a tangent to the graph of  $y = f(x)$  at the point where  $x = 1.5$ .

Use your tangent to estimate the gradient of  $y = f(x)$  when  $x = 1.5$ .

Answer(e)  $\dots\dots\dots$  [3]

8 (a) A straight line joins the points  $(-1, -4)$  and  $(3, 8)$ .

(i) Find the midpoint of this line.

Answer(a)(i) (....., .....) [2]

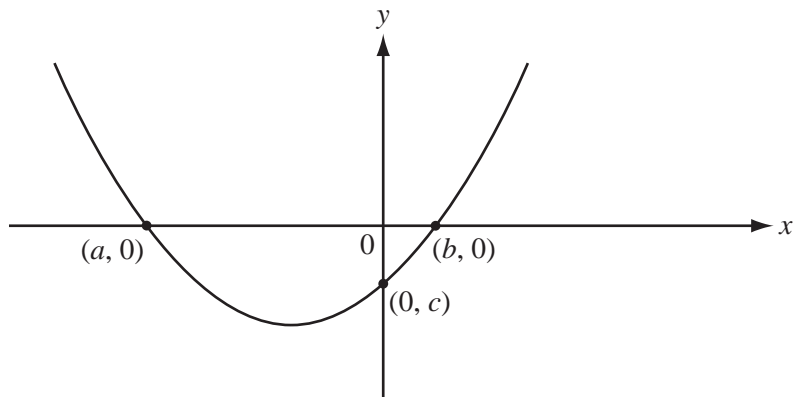
(ii) Find the equation of this line.  
Give your answer in the form  $y = mx + c$ .

Answer(a)(ii)  $y =$  ..... [3]

(b) (i) Factorise  $x^2 + 3x - 10$ .

Answer(b)(i) ..... [2]

(ii) The graph of  $y = x^2 + 3x - 10$  is sketched below.



Write down the values of  $a$ ,  $b$  and  $c$ .

Answer(b)(ii)  $a =$  .....

$b =$  .....

$c =$  ..... [3]

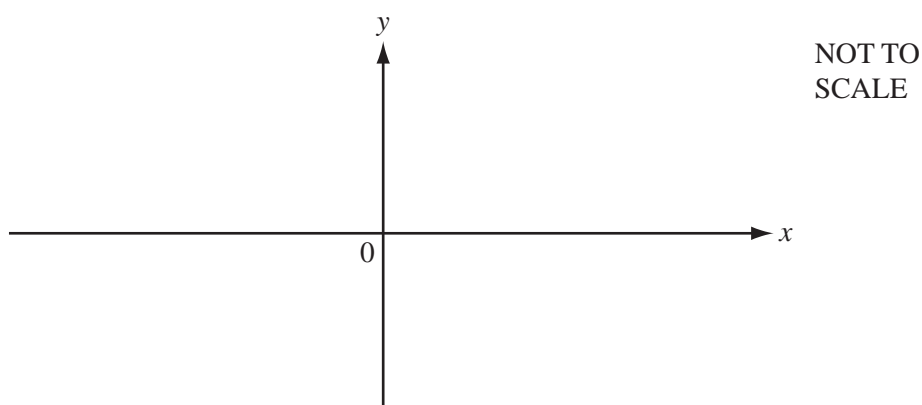
(iii) Write down the equation of the line of symmetry of the graph of  $y = x^2 + 3x - 10$ .

Answer(b)(iii) ..... [1]

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- (c) Sketch the graph of  $y = 18 + 7x - x^2$  on the axes below.  
Indicate clearly the values where the graph crosses the  $x$  and  $y$  axes.



[4]

(d) (i)  $x^2 + 12x - 7 = (x + p)^2 - q$

Find the value of  $p$  and the value of  $q$ .

Answer(d)(i)  $p = \dots\dots\dots$

$q = \dots\dots\dots$  [3]

- (ii) Write down the minimum value of  $y$  for the graph of  $y = x^2 + 12x - 7$ .

Answer(d)(ii)  $\dots\dots\dots$  [1]

39) June 2015 V1

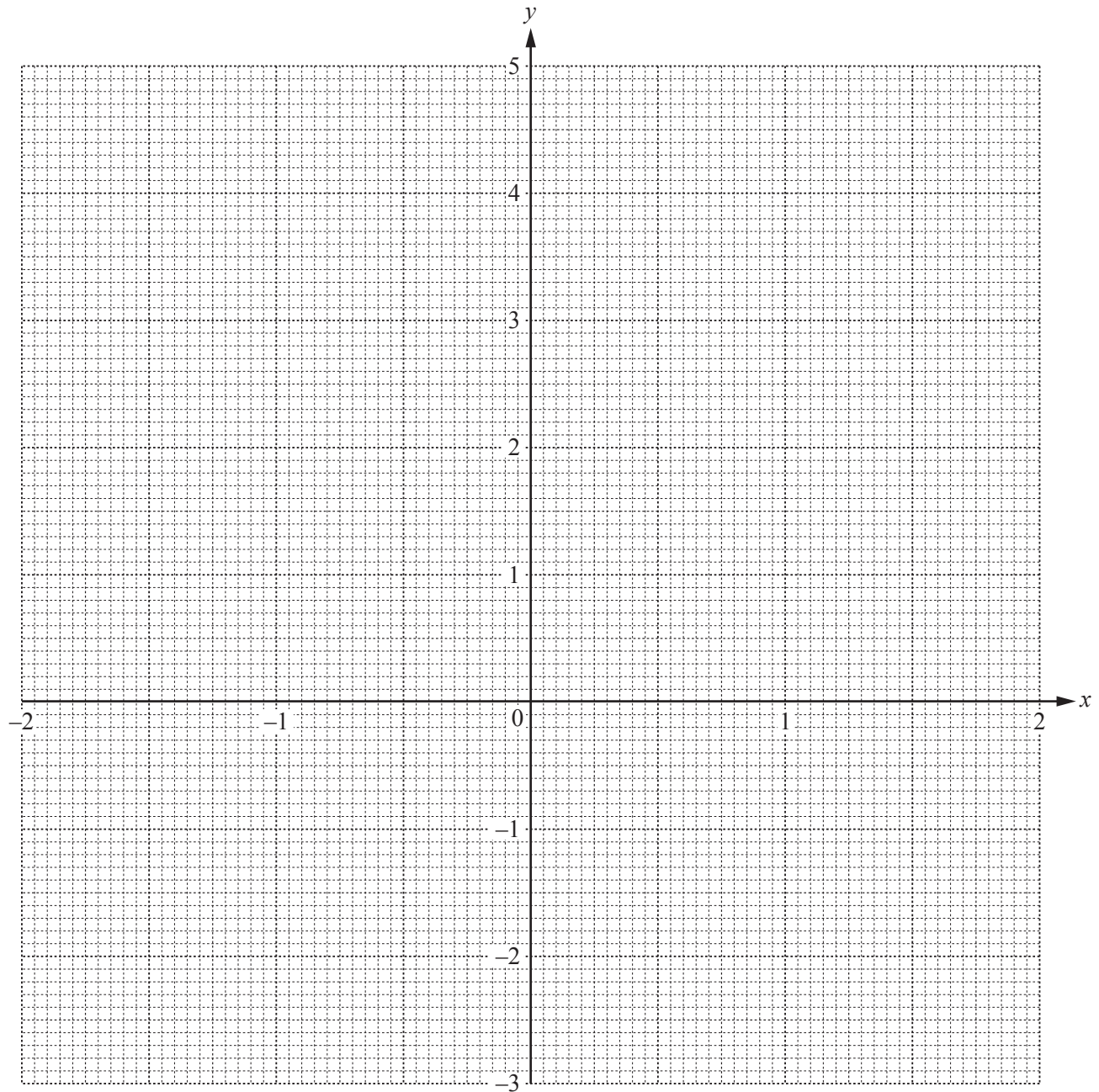
2 The table shows some values for  $y = x^2 - \frac{1}{2x}$ ,  $x \neq 0$ .

x	-2	-1.5	-1	-0.5	-0.25	-0.2	0.2	0.25	0.5	1	1.5	2
y	4.25	2.58			2.06	2.54	-2.46	-1.94			1.92	3.75

(a) Complete the table of values.

[4]

(b) On the grid, draw the graph of  $y = x^2 - \frac{1}{2x}$  for  $-2 \leq x \leq -0.2$  and  $0.2 \leq x \leq 2$ .



[5]

(c) By drawing a suitable line, use your graph to solve the equation  $x^2 - \frac{1}{2x} = 2$ .

Answer(c)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) The equation  $x^2 - \frac{1}{2x} = k$  has only one solution.

Write down the range of values of  $k$  for which this is possible.

*Answer(d)* ..... [2]

(e) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where  $x = -1$ .

*Answer(e)* ..... [3]

40) June 2015 V2

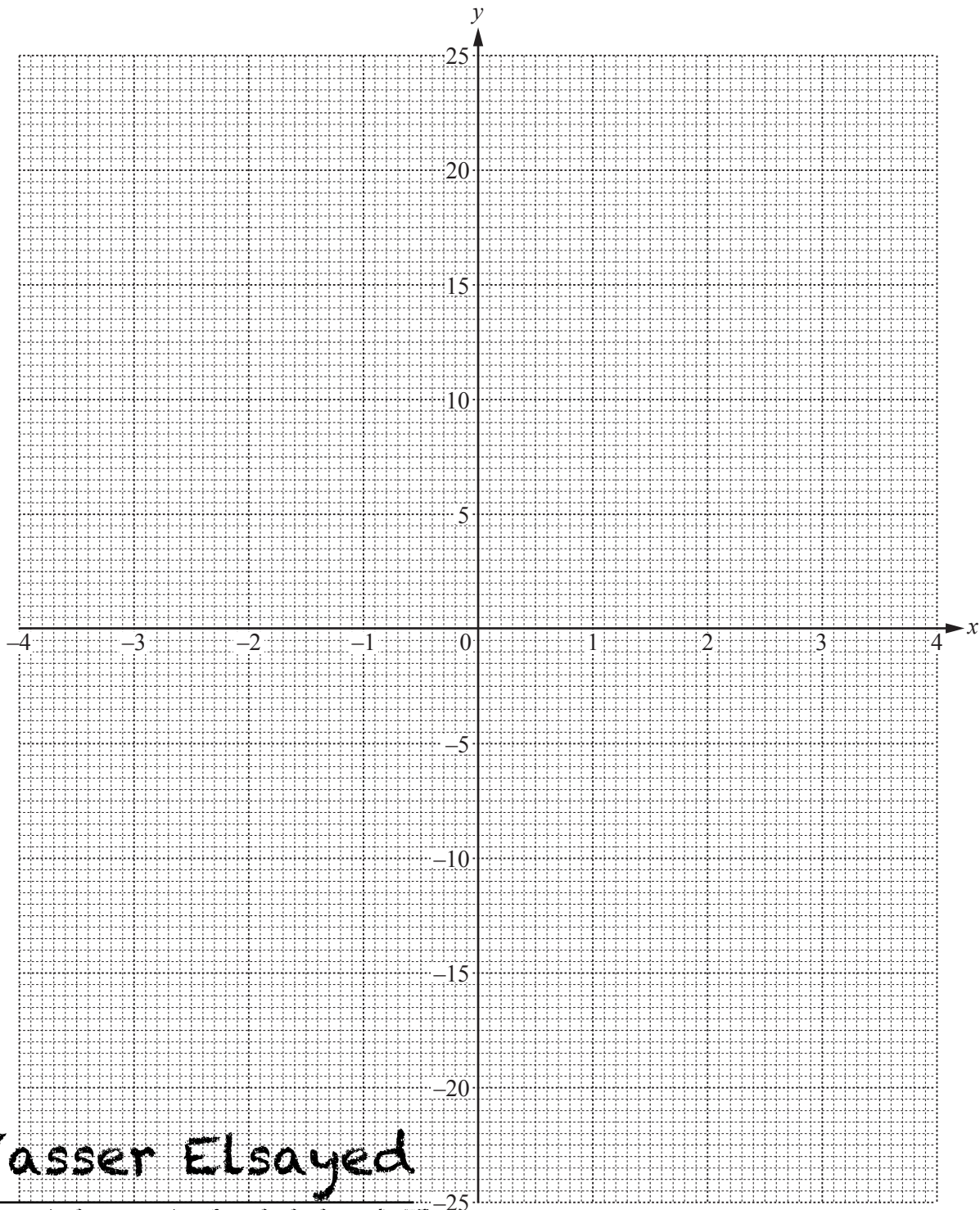
5  $y = x^2 - 2x + \frac{12}{x}, x \neq 0$

(a) Complete the table of values.

x	-4	-3	-2	-1	-0.5	0.5	1	2	3	4
y	21	11		-9	-22.75	23.25	11	6		11

[2]

(b) On the grid, draw the graph of  $y = x^2 - 2x + \frac{12}{x}$  for  $-4 \leq x \leq -0.5$  and  $0.5 \leq x \leq 4$ .



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252 [5]

(c) By drawing a suitable tangent, find an estimate of the gradient of the graph at the point (1, 11).

Answer(c) ..... [3]

(d) The equation  $x^2 - 2x + \frac{12}{x} = k$  has exactly two distinct solutions.

Use the graph to find

(i) the value of  $k$ ,

Answer(d)(i)  $k =$  ..... [1]

(ii) the solutions of  $x^2 - 2x + \frac{12}{x} = k$ .

Answer(d)(ii)  $x =$  ..... or  $x =$  ..... [2]

(e) The equation  $x^3 + ax^2 + bx + c = 0$  can be solved by drawing the line  $y = 3x + 1$  on the grid.

Find the value of  $a$ , the value of  $b$  and the value of  $c$ .

Answer(e)  $a =$  .....

$b =$  .....

$c =$  ..... [3]

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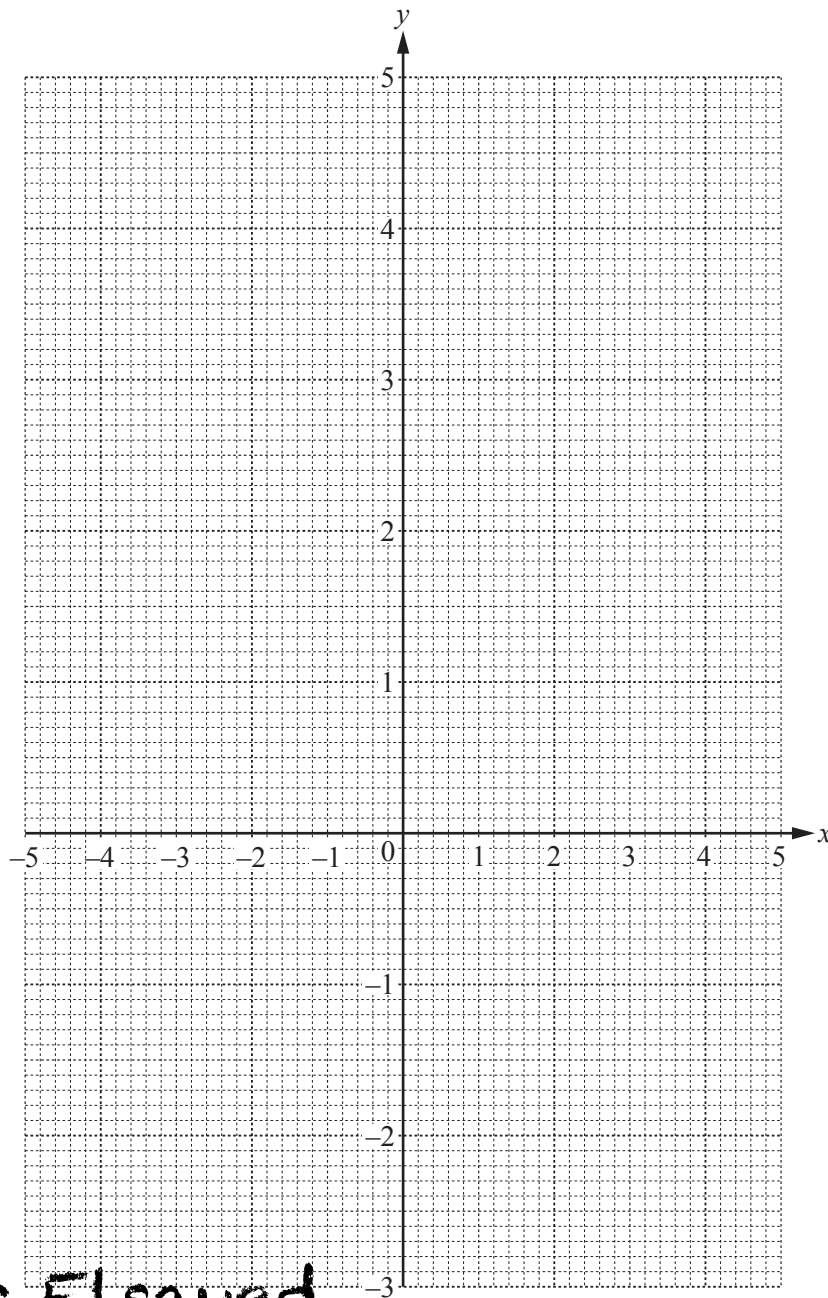
3  $f(x) = \frac{8}{x^2} + \frac{x}{2}, x \neq 0.$

(a) Complete the table of values for f(x).

x	-5	-4	-3	-2	-1.5		1.5	2	2.5	3	3.5	4	5
f(x)	-2.2	-1.5	-0.6		2.8		4.3		2.5	2.4	2.4		2.8

[3]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-5 \leq x \leq -1.5$  and  $1.5 \leq x \leq 5$ .



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[5]

(c) Solve  $f(x) = 0$ .

*Answer(c)*  $x = \dots\dots\dots$  [1]

(d) By drawing a suitable line on the grid, solve the equation  $f(x) = 1 - x$ .

*Answer(d)*  $x = \dots\dots\dots$  [3]

(e) By drawing a tangent at the point  $(-3, -0.6)$ , estimate the gradient of the graph of  $y = f(x)$  when  $x = -3$ .

*Answer(e)*  $\dots\dots\dots$  [3]

10  $f(x) = 2x - 1$

$g(x) = x^2 + x$

$h(x) = \frac{2}{x}, x \neq 0$

(a) Find  $ff(3)$ .

*Answer(a)* ..... [2]

(b) Find  $gf(x)$ , giving your answer in its simplest form.

*Answer(b)* ..... [3]

(c) Find  $f^{-1}(x)$ .

*Answer(c)*  $f^{-1}(x) =$  ..... [2]

(d) Find  $h(x) + h(x + 2)$ , giving your answer as a single fraction.

*Answer(d)* ..... [4]



2 (a) Calculate  $2^{0.7}$ .

Answer(a) ..... [1]

(b) Find the value of  $x$  in each of the following.

(i)  $2^x = 128$

Answer(b)(i)  $x =$  ..... [1]

(ii)  $2^x \times 2^9 = 2^{13}$

Answer(b)(ii)  $x =$  ..... [1]

(iii)  $2^9 \div 2^x = 4$

Answer(b)(iii)  $x =$  ..... [1]

(iv)  $2^x = \sqrt[3]{2}$

Answer(b)(iv)  $x =$  ..... [1]

(c) (i) Complete this table of values for  $y = 2^x$ .

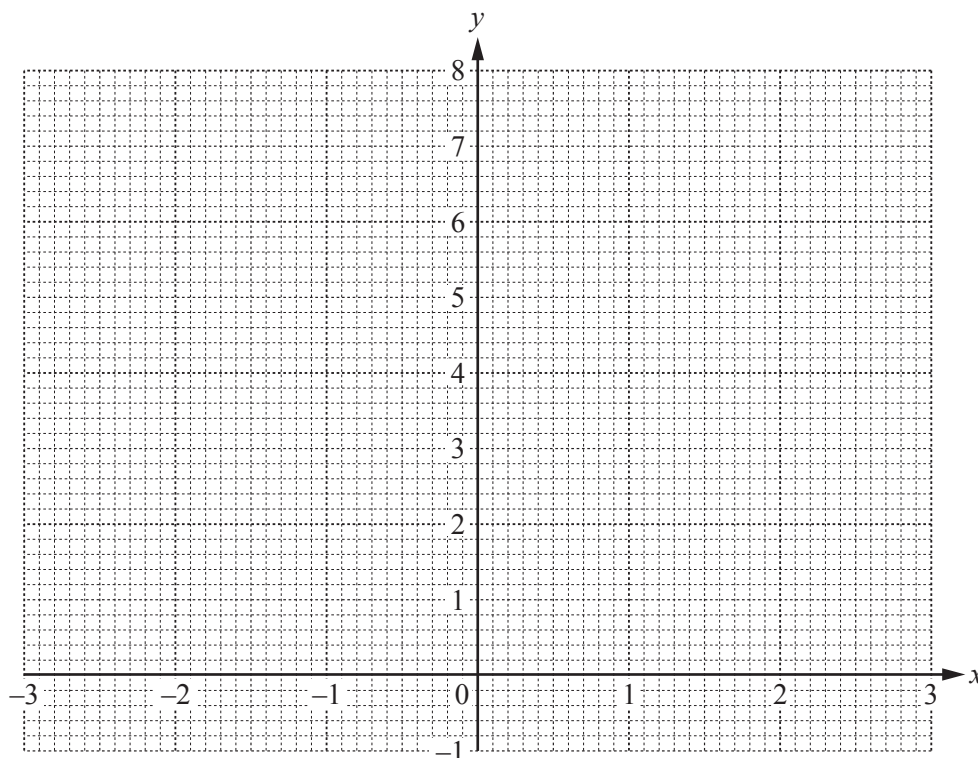
$x$	-3	-2	-1	0	1	2	3
$y$	0.125		0.5		2	4	8

[2]

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(ii) On the grid, draw the graph of  $y = 2^x$  for  $-3 \leq x \leq 3$ .



[4]

(iii) Use your graph to solve  $2^x = 5$ .

Answer(c)(iii)  $x = \dots\dots\dots$  [1]

(iv) Find the equation of the line joining the points (1, 2) and (3, 8).

Answer(c)(iv)  $\dots\dots\dots$  [3]

(v) By drawing a suitable line on your graph, solve  $2^x - 2 - x = 0$ .

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002 012 013 222 97 Answer(c)(v)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  **258** [2]

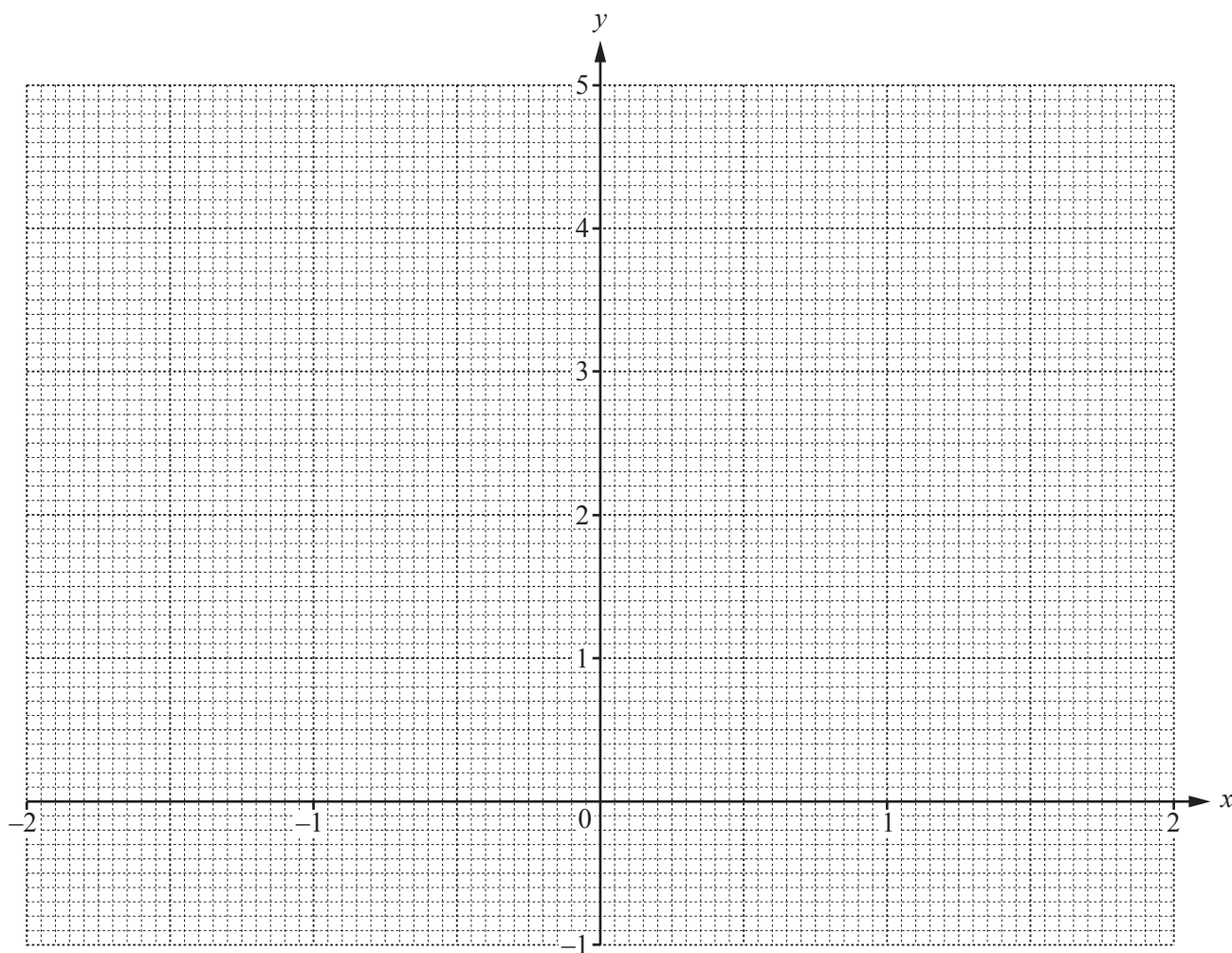
2 The table shows some values for  $y = x^3 - 3x + 2$ .

$x$	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
$y$		3.125		3.375	2		0		4

(a) Complete the table of values.

[4]

(b) On the grid, draw the graph of  $y = x^3 - 3x + 2$  for  $-2 \leq x \leq 2$ .



[4]

(c) By drawing a suitable line, solve the equation  $x^3 - 3x + 2 = x + 1$  for  $-2 \leq x \leq 2$ .

Answer(c)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(d) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where  $x = -1.5$ .

Answer(d)  $\dots\dots\dots$  [3]

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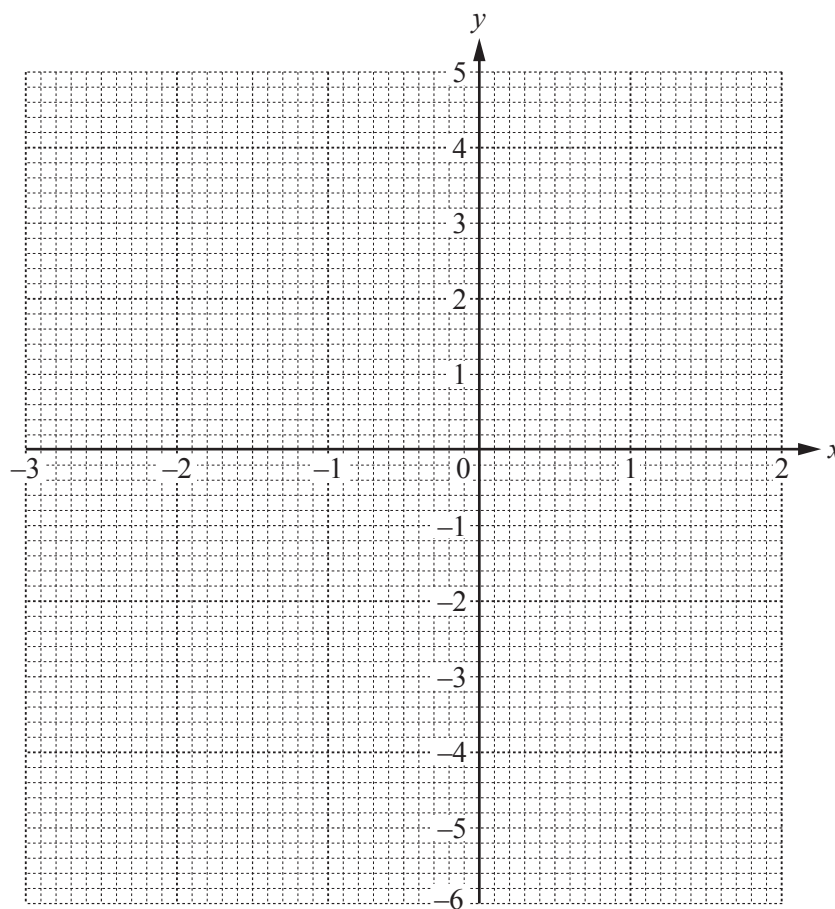
4  $f(x) = x - \frac{1}{2x^2}, x \neq 0$

(a) Complete the table of values.

x	-3	-2	-1.5	-1	-0.5	-0.3		0.3	0.5	1	1.5	2
f(x)	-3.1	-2.1	-1.7		-2.5	-5.9		-5.3	-1.5		1.3	1.9

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-3 \leq x \leq -0.3$  and  $0.3 \leq x \leq 2$ .



[5]

(c) Use your graph to solve the equation  $f(x) = 1$ .

Answer(c)  $x = \dots\dots\dots$  [1]

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(d) There is only one negative integer value,  $k$ , for which  $f(x) = k$  has only one solution for all real  $x$ .

Write down this value of  $k$ .

*Answer(d)*  $k = \dots\dots\dots$  [1]

(e) The equation  $2x - \frac{1}{2x^2} - 2 = 0$  can be solved using the graph of  $y = f(x)$  and a straight line graph.

(i) Find the equation of this straight line.

*Answer(e)(i)*  $y = \dots\dots\dots$  [1]

(ii) On the grid, draw this straight line and solve the equation  $2x - \frac{1}{2x^2} - 2 = 0$ .

*Answer(e)(ii)*  $x = \dots\dots\dots$  [3]

9             $f(x) = 2x - 1$              $g(x) = \frac{1}{x}, x \neq 0$              $h(x) = 2^x$

(a) Find  $h(3)$ .

*Answer(a)* ..... [1]

(b) Find  $fg(0.5)$ .

*Answer(b)* ..... [2]

(c) Find  $f^{-1}(x)$ .

*Answer(c)*  $f^{-1}(x) =$  ..... [2]

(d) Find  $ff(x)$ , giving your answer in its simplest form.

*Answer(d)* ..... [2]

(e) Find  $(f(x))^2 + 6$ , giving your answer in its simplest form.

*Answer(e)* ..... [2]

(f) Simplify  $hh^{-1}(x)$ .

*Answer(f)* ..... [1]

(g) Which of the following statements is true?

$$f^{-1}(x) = f(x)$$

$$g^{-1}(x) = g(x)$$

$$h^{-1}(x) = h(x)$$

*Answer(g)* ..... [1]

(h) Use two of the functions  $f(x)$ ,  $g(x)$  and  $h(x)$  to find the composite function which is equal to  $2^{x+1} - 1$ .

*Answer(h)* ..... [1]

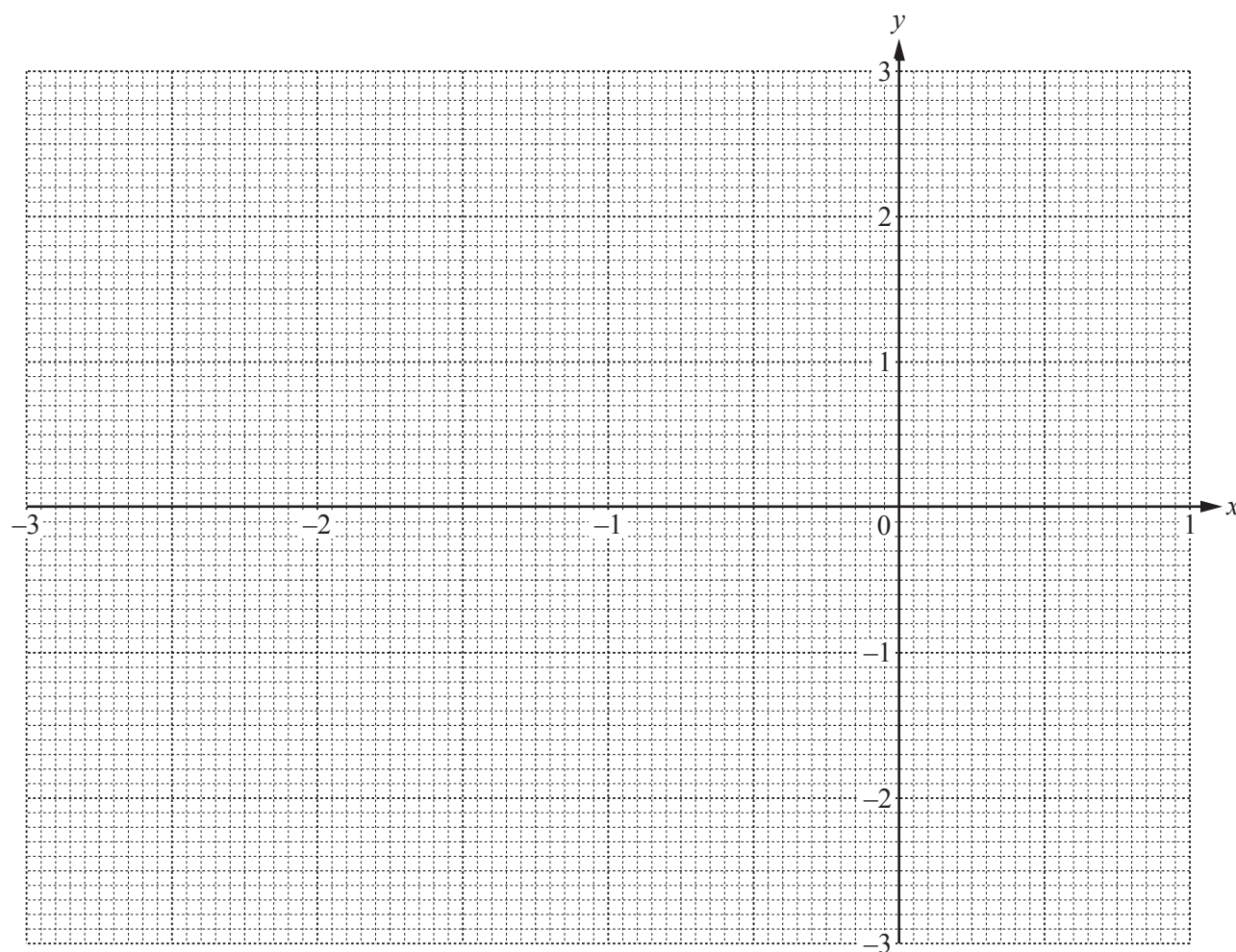
3 The table shows some values of  $y = x^3 + 3x^2 - 2$ .

$x$	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1
$y$	-2	1.13		1.38		-1.38		-1.13	

(a) Complete the table of values.

[3]

(b) On the grid, draw the graph of  $y = x^3 + 3x^2 - 2$  for  $-3 \leq x \leq 1$ .



[4]

(c) By drawing a suitable line, solve the equation  $x^3 + 3x^2 - 2 = \frac{1}{2}(x + 1)$ .

Answer(c)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(d) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where  $x = -1.75$ .

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Answer(d)  $\dots\dots\dots$  264 [3]



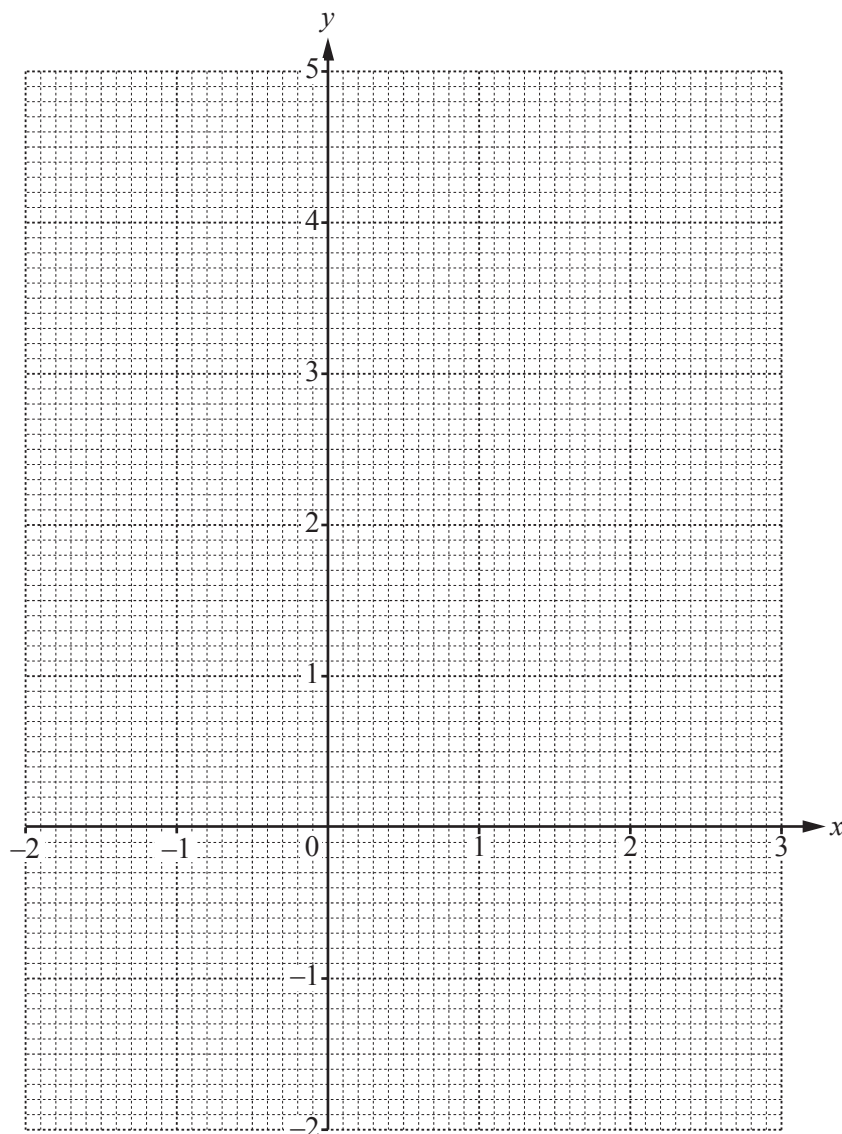
7 The table shows some values of  $y = x + \frac{1}{x^2}$ ,  $x \neq 0$ .

$x$	-2	-1.5	-1	-0.75	-0.5		0.5	0.75	1	1.5	2	3
$y$	-1.75	-1.06	0	1.03			4.50	2.53	2		2.25	

(a) Complete the table of values.

[3]

(b) On the grid, draw the graph of  $y = x + \frac{1}{x^2}$  for  $-2 \leq x \leq -0.5$  and  $0.5 \leq x \leq 3$ .



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[5]

(c) Use your graph to solve the equation  $x + \frac{1}{x^2} = 1.5$ .

$x = \dots\dots\dots$  [1]

(d) The line  $y = ax + b$  can be drawn on the grid to solve the equation  $\frac{1}{x^2} = 2.5 - 2x$ .

(i) Find the value of  $a$  and the value of  $b$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$  [2]

(ii) Draw the line  $y = ax + b$  to solve the equation  $\frac{1}{x^2} = 2.5 - 2x$ .

$x = \dots\dots\dots$  [3]

(e) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where  $x = 2$ .

$\dots\dots\dots$  [3]

11             $f(x) = 2 - 3x$              $g(x) = 7x + 3$

(a) Find

(i)  $f(-3)$ ,

..... [1]

(ii)  $g(2x)$ .

..... [1]

(b) Find  $gf(x)$  in its simplest form.

..... [2]

(c) Find  $x$  when  $3f(x) = 7$ .

$x =$  ..... [3]

(d) Solve the equation.

$$f(x + 4) - g(x) = 0$$

$x =$  ..... [3]

50) June 2016 V1

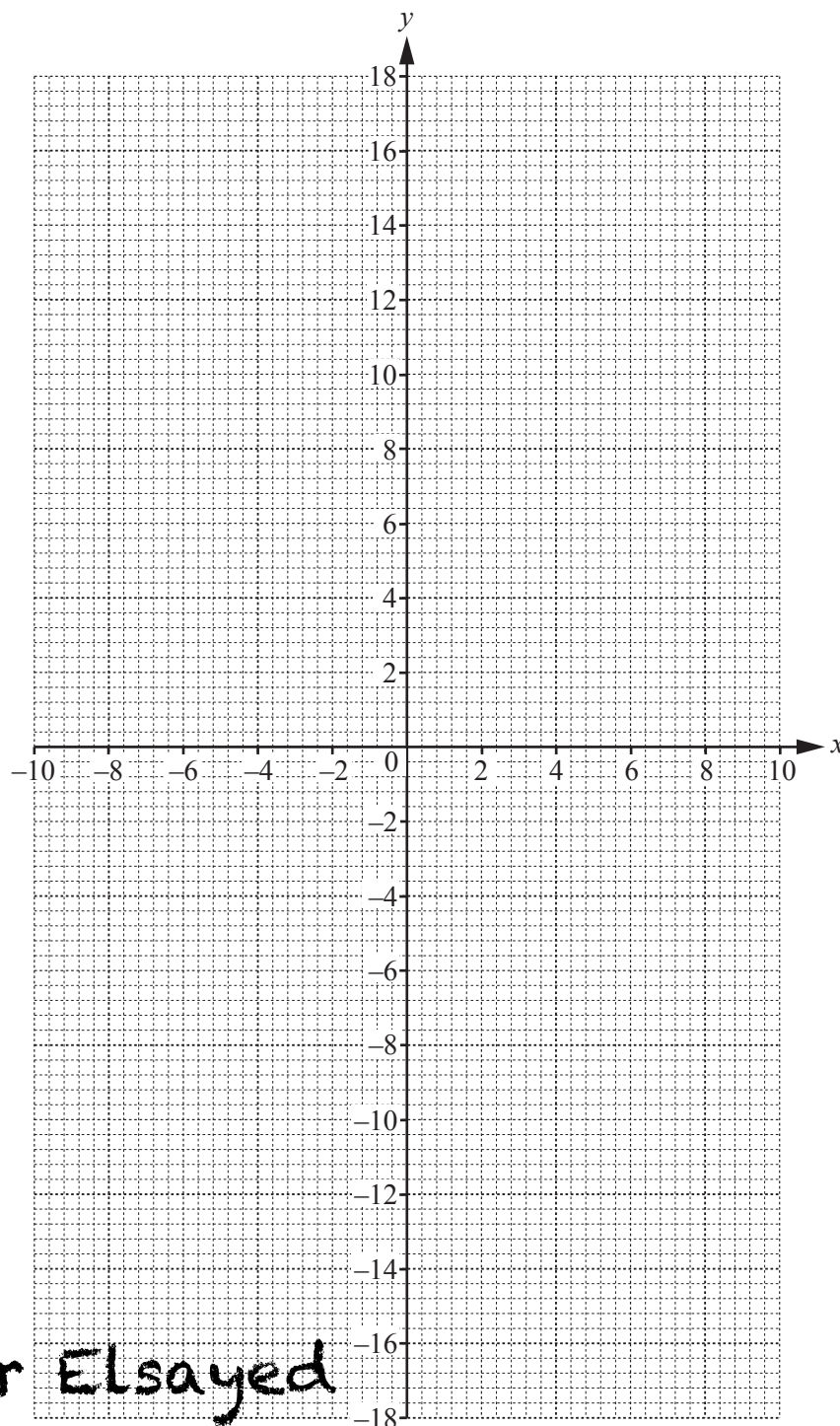
5  $f(x) = \frac{20}{x} + x, \quad x \neq 0$

(a) Complete the table.

$x$	-10	-8	-5	-2	-1.6	1.6	2	5	8	10
$f(x)$	-12	-10.5	-9	-12	-14.1	14.1	12			12

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-10 \leq x \leq -1.6$  and  $1.6 \leq x \leq 10$ .



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(c) Using your graph, solve the equation  $f(x) = 11$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(d)  $k$  is a prime number and  $f(x) = k$  has no solutions.

Find the possible values of  $k$ .

$\dots\dots\dots$  [2]

(e) The gradient of the graph of  $y = f(x)$  at the point  $(2, 12)$  is  $-4$ .

Write down the co-ordinates of the other point on the graph of  $y = f(x)$  where the gradient is  $-4$ .

$(\dots\dots\dots, \dots\dots\dots)$  [1]

(f) (i) The equation  $f(x) = x^2$  can be written as  $x^3 + px^2 + q = 0$ .

Show that  $p = -1$  and  $q = -20$ .

[2]

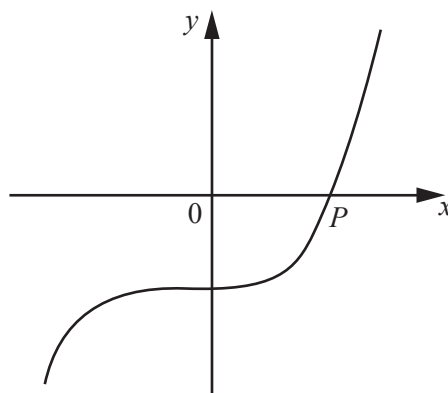
(ii) On the grid opposite, draw the graph of  $y = x^2$  for  $-4 \leq x \leq 4$ .

[2]

(iii) Using your graphs, solve the equation  $x^3 - x^2 - 20 = 0$ .

$x = \dots\dots\dots$  [1]

(iv)



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The diagram shows a sketch of the graph of  $y = x^3 - x^2 - 20$ .

$P$  is the point  $(n, 0)$ .

Write down the value of  $n$ .

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$n = \dots\dots\dots 269$  [1]

8

$$f(x) = 2x + 1$$

$$g(x) = x^2 + 4$$

$$h(x) = 2^x$$

(a) Solve the equation  $f(x) = g(1)$ .

$$x = \dots\dots\dots [2]$$

(b) Find the value of  $fh(3)$ .

$$\dots\dots\dots [2]$$

(c) Find  $f^{-1}(x)$ .

$$f^{-1}(x) = \dots\dots\dots [2]$$

(d) Find  $gf(x)$  in its simplest form.

$$\dots\dots\dots [3]$$

(e) Solve the equation  $h^{-1}(x) = 0.5$ .

$x = \dots\dots\dots [1]$

(f)  $\frac{1}{h(x)} = 2^{kx}$

Write down the value of  $k$ .

$k = \dots\dots\dots [1]$

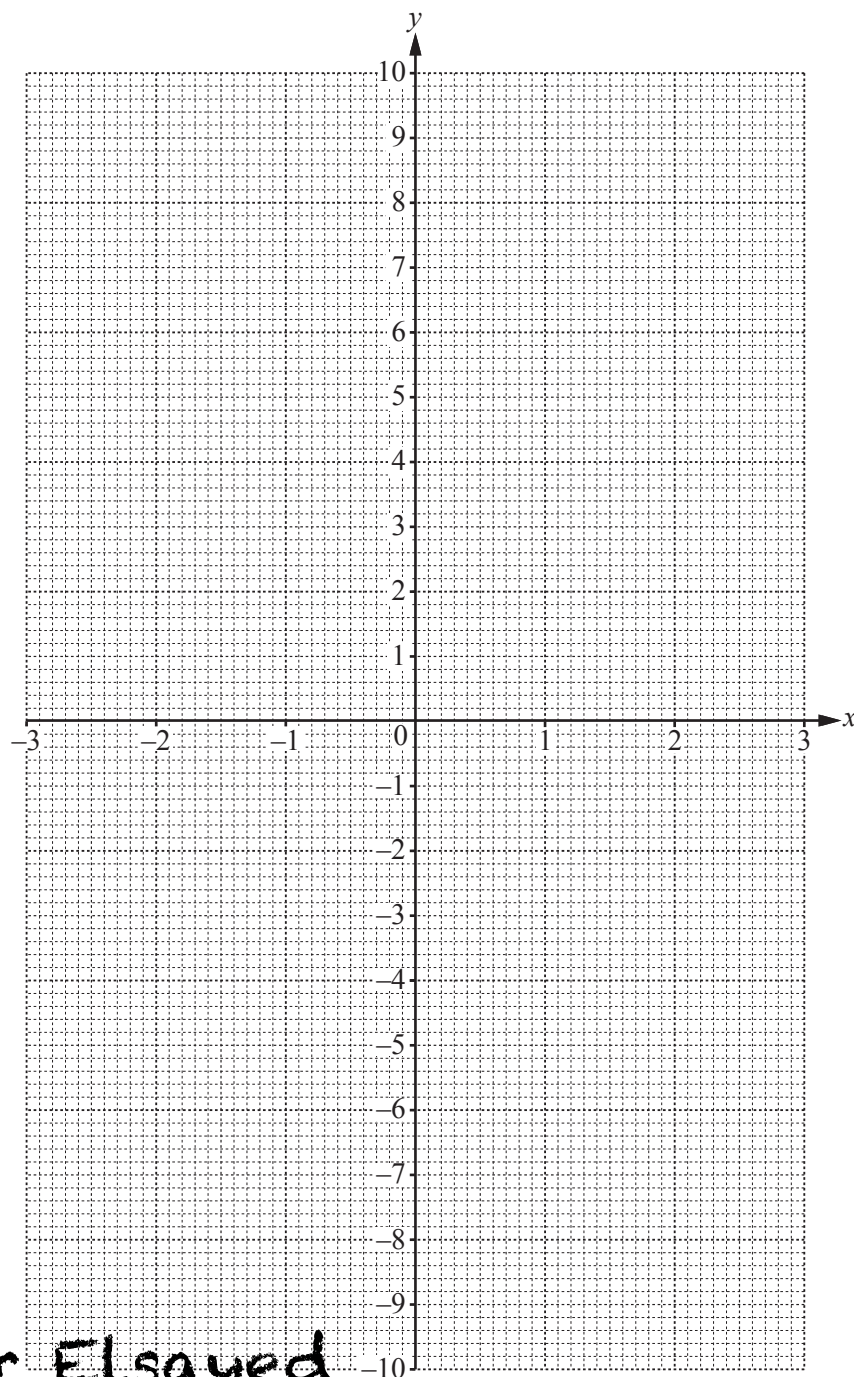
4

$$f(x) = x^2 - \frac{1}{x} - 4, \quad x \neq 0$$

(a) (i) Complete the table.

$x$	-3	-2	-1	-0.5	-0.1	0.2	0.5	1	2	3
$f(x)$	5.3	0.5		-1.8	6.0	-9.0	-5.8	-4		4.7

[2]

(ii) On the grid, draw the graph of  $y = f(x)$  for  $-3 \leq x \leq -0.1$  and  $0.2 \leq x \leq 3$ .

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[5]



(b) Use your graph to solve the equation  $f(x) = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(c) Find an integer  $k$ , for which  $f(x) = k$  has one solution.

$k = \dots\dots\dots$  [1]

(d) (i) By drawing a suitable straight line, solve the equation  $f(x) + 2 = -5x$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(ii)  $f(x) + 2 = -5x$  can be written as  $x^3 + ax^2 + bx - 1 = 0$ .

Find the value of  $a$  and the value of  $b$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$  [2]

8             $f(x) = 5x + 7$              $g(x) = \frac{4}{x-3}, x \neq 3$

(a) Find

(i)  $fg(1)$ ,

..... [2]

(ii)  $gf(x)$ ,

..... [2]

(iii)  $g^{-1}(x)$ ,

$g^{-1}(x) =$  ..... [3]

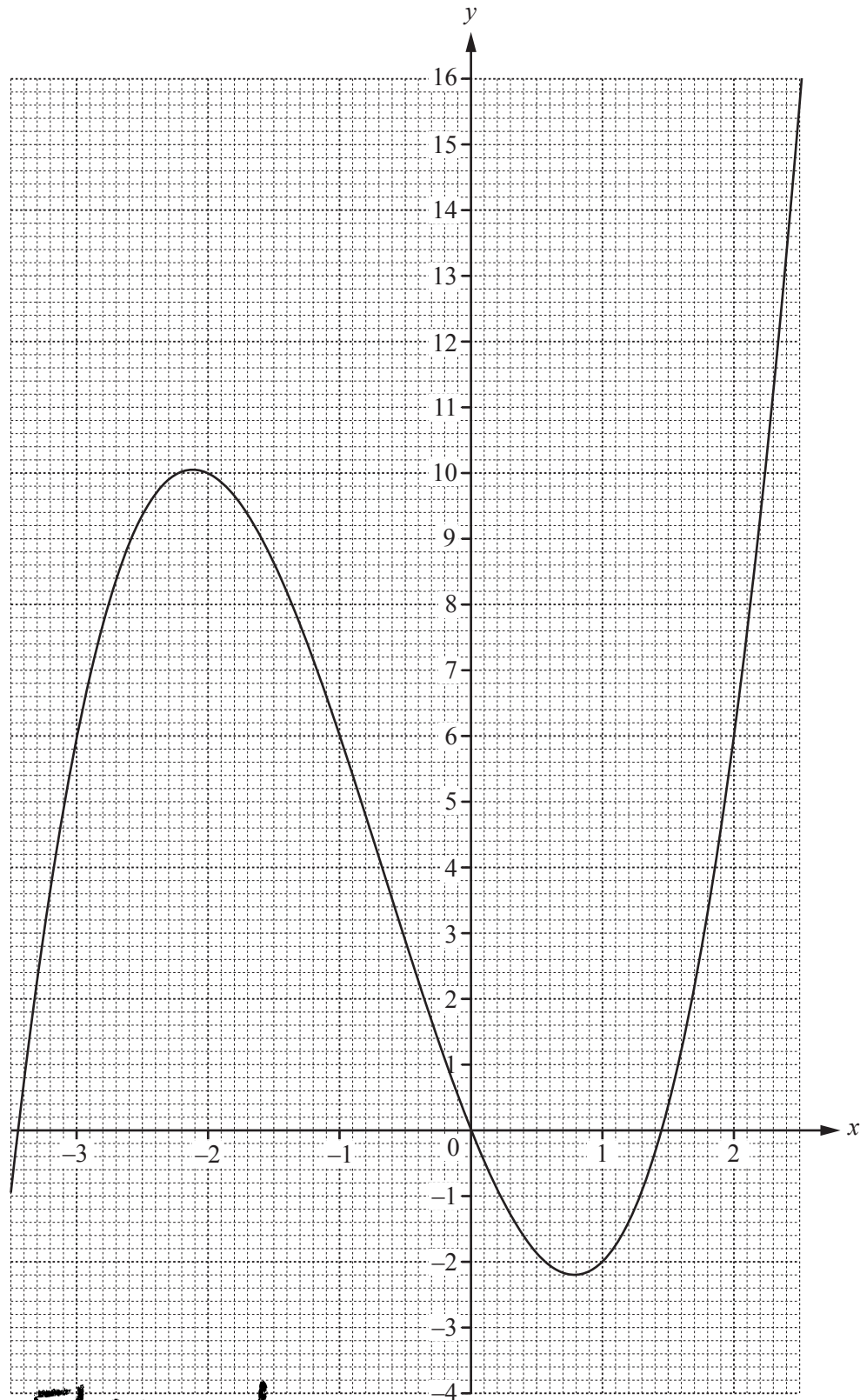
(iv)  $f^{-1}f(2)$ .

..... [1]

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3 The diagram shows the graph of  $y = f(x)$  for  $-3.5 \leq x \leq 2.5$ .



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(a) (i) Find  $f(-2)$ .

..... [1]

(ii) Solve the equation  $f(x) = 2$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(iii) Two tangents, each with gradient 0, can be drawn to the graph of  $y = f(x)$ .

Write down the equation of each tangent.

.....  
..... [2]

(b) (i) Complete the table for  $g(x) = \frac{2}{x} + 3$  for  $-3.5 \leq x \leq -0.5$  and  $0.5 \leq x \leq 2.5$ .

$x$	-3.5	-3	-2	-1	-0.5		0.5	1	2	2.5
$g(x)$	2.4	2.3		1			7	5		3.8

[3]

(ii) On the grid opposite, draw the graph of  $y = g(x)$ .

[4]

(iii) Use your graph to solve the equation  $f(x) = g(x)$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(c) Find  $gf(-2)$ .

..... [2]

(d) Find  $g^{-1}(5)$ .

..... [1]

(b)  $f(x) = g(x)$

(i) Show that  $5x^2 - 8x - 25 = 0$ .

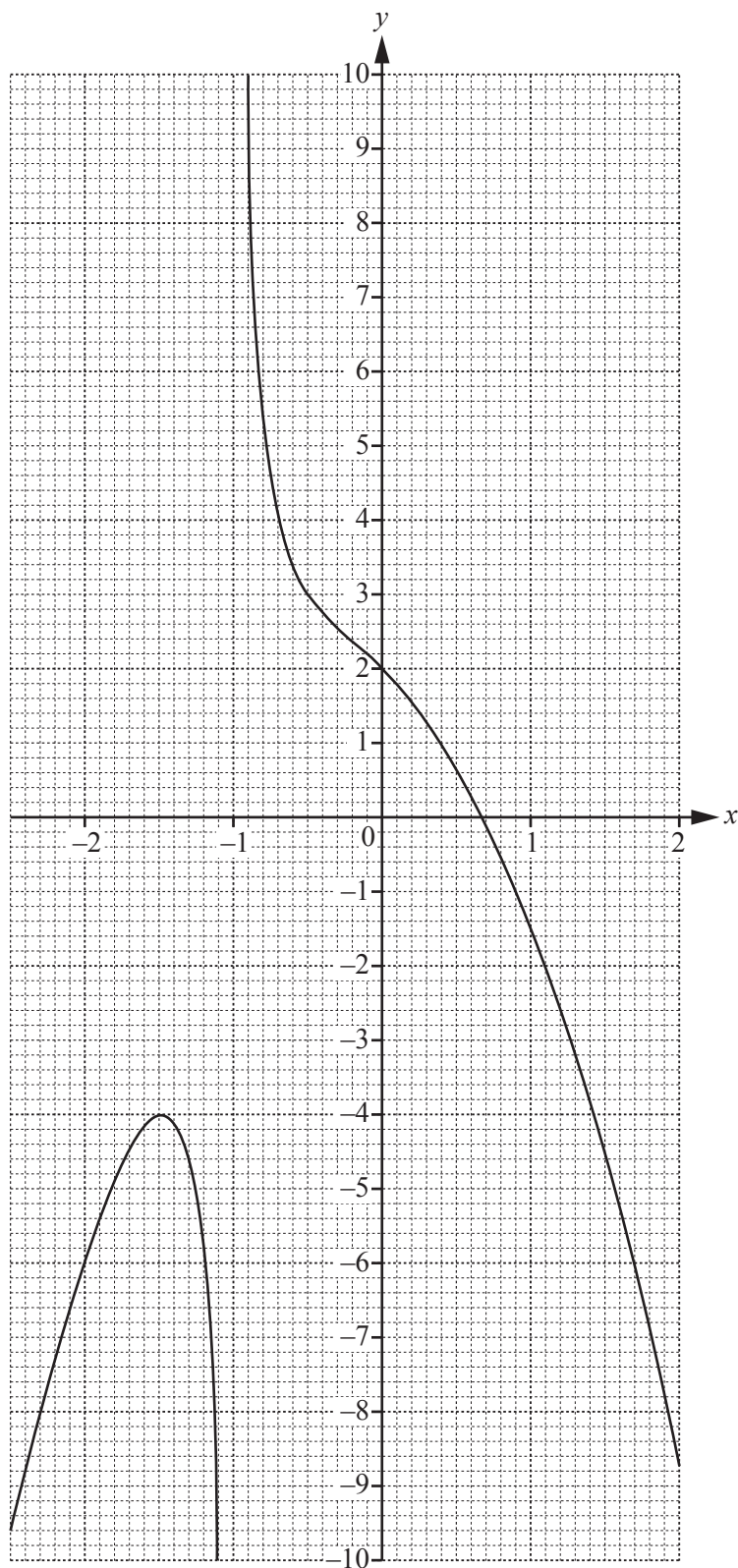
[3]

(ii) Solve  $5x^2 - 8x - 25 = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

55) June 2017 V1 \_\_\_\_\_

4 The diagram shows the graph of  $y = f(x)$  for  $-2.5 \leq x \leq 2$ .



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(a) Find  $f(1)$ .

..... [1]

(b) Solve  $f(x) = 3$ .

$x =$  ..... [1]

(c) The equation  $f(x) = k$  has only one solution for  $-2.5 \leq x \leq 2$ .

Write down the range of values of  $k$  for which this is possible.

..... [2]

(d) By drawing a suitable straight line, solve the equation  $f(x) = x - 5$ .

$x =$  ..... or  $x =$  ..... or  $x =$  ..... [3]

(e) Draw a tangent to the graph of  $y = f(x)$  at the point where  $x = 1$ .

Use your tangent to estimate the gradient of  $y = f(x)$  when  $x = 1$ .

..... [3]

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4

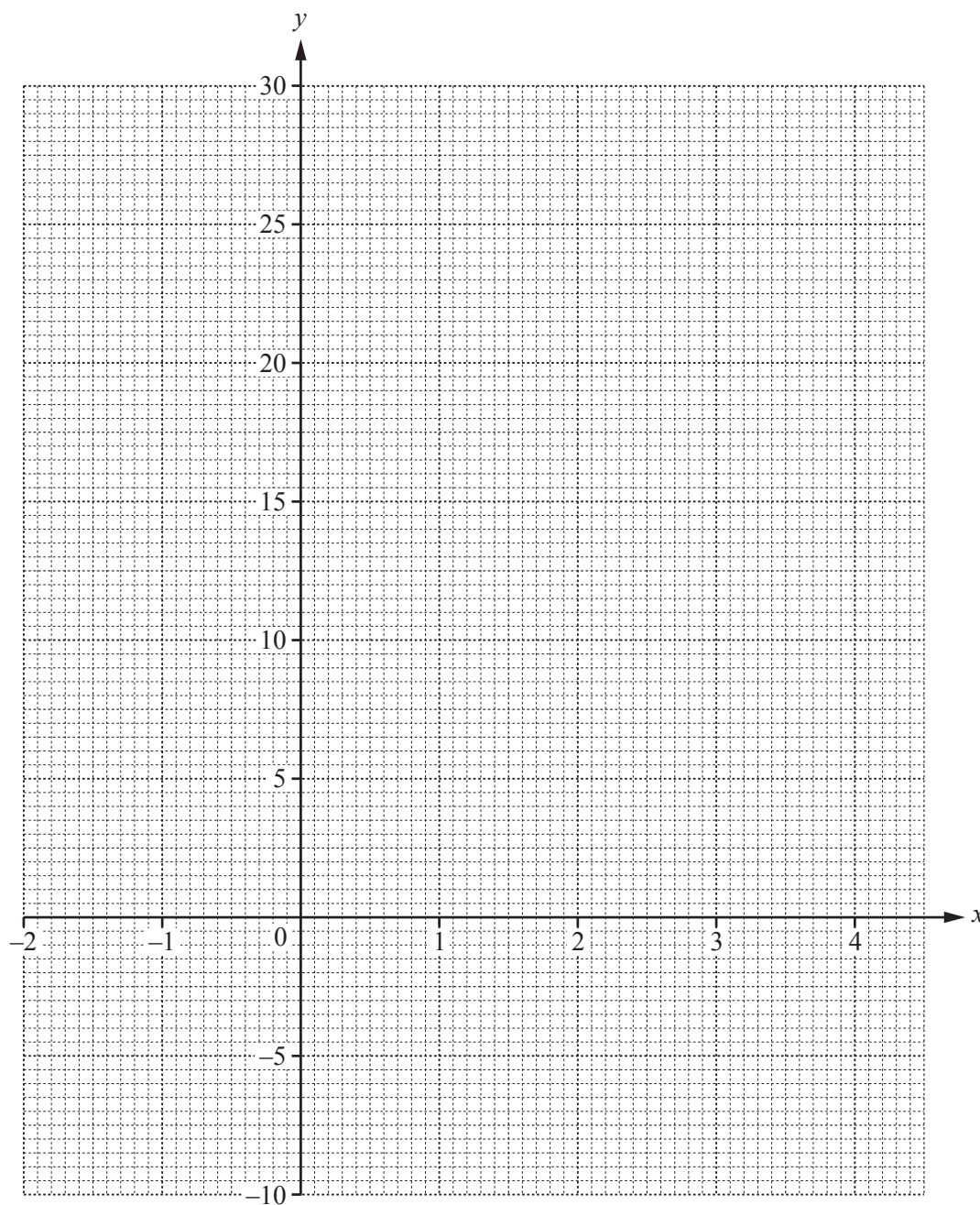
$$f(x) = x^3 - 4x^2 + 15$$

(a) Complete the table of values for  $y = f(x)$ .

$x$	-2	-1	-0.5	0	1	2	2.5	3	3.5	4	4.5
$y$	-9		13.9	15	12		5.6	6	8.9	15	25.1

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-2 \leq x \leq 4.5$ .



[4]

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(c) Use your graph to solve the equation  $f(x) = 0$ .

$x = \dots\dots\dots$  [1]

(d) By drawing a suitable tangent, estimate the gradient of the graph of  $y = f(x)$  when  $x = 3.5$ .

$\dots\dots\dots$  [3]

(e) By drawing a suitable straight line on the grid, solve the equation  $x^3 - 4x^2 - 2x + 5 = 0$ .

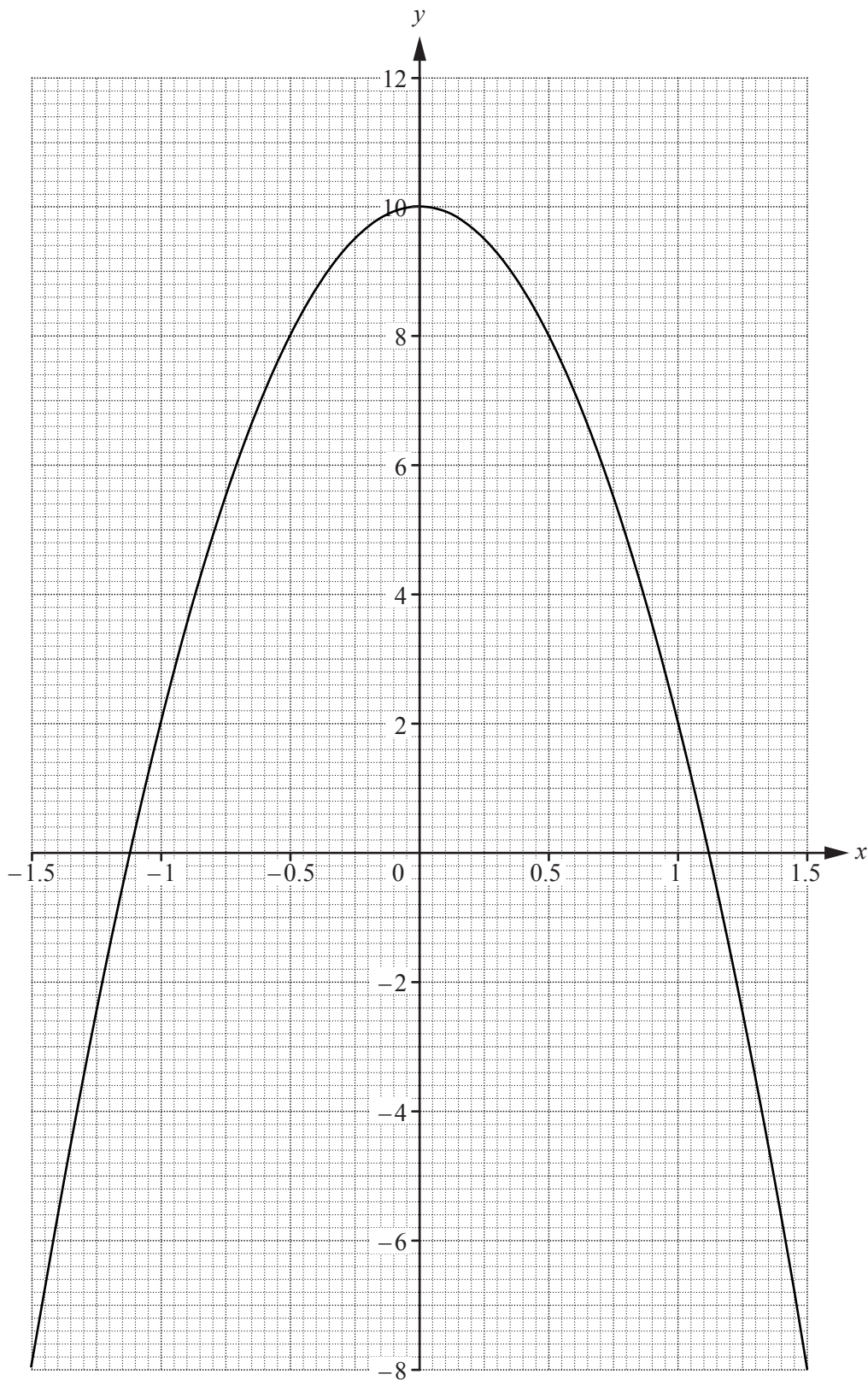
$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

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57) June 2018 V1

7 The graph of  $y = 10 - 8x^2$  for  $-1.5 \leq x \leq 1.5$  is drawn on the grid.



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- (a) Write down the equation of the line of symmetry of the graph.

..... [1]

- (b) On the grid opposite, draw the tangent to the curve at the point where  $x = 0.5$ .  
Find the gradient of this tangent.

..... [3]

- (c) The table shows some values for  $y = x^3 + 3x + 4$ .

$x$	-1.5	-1	-0.5	0	0.5	1	1.5
$y$	-3.9				5.6	8	11.9

- (i) Complete the table. [3]

- (ii) On the grid opposite, draw the graph of  $y = x^3 + 3x + 4$  for  $-1.5 \leq x \leq 1.5$ . [4]

- (d) Show that the values of  $x$  where the two curves intersect are the solutions to the equation  $x^3 + 8x^2 + 3x - 6 = 0$ .

[1]

- (e) By drawing a suitable straight line, solve the equation  $x^3 + 5x + 2 = 0$  for  $-1.5 \leq x \leq 1.5$ .

$x =$  ..... [3]

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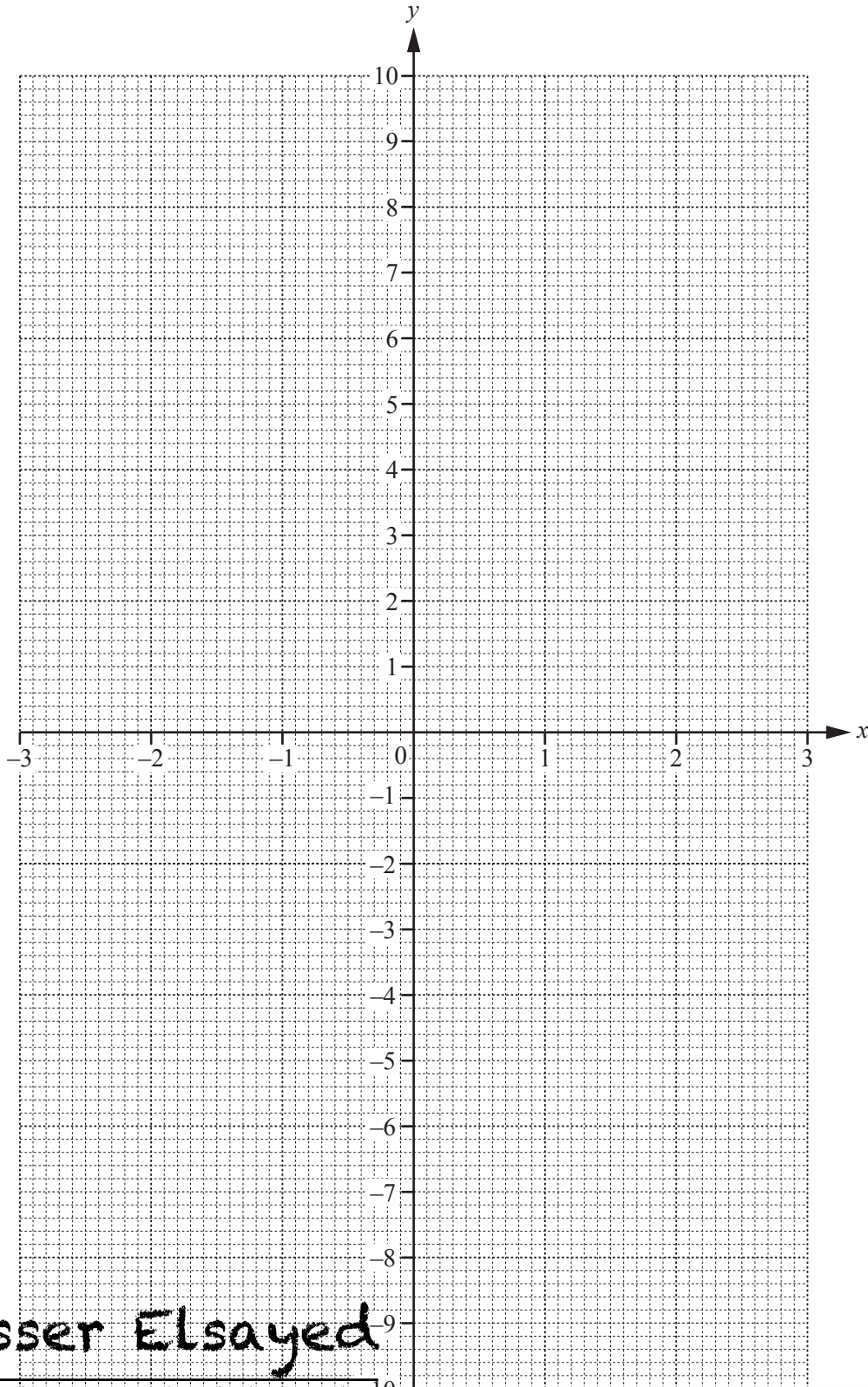
58) June 2018 V2

- 6 (a) Complete the table of values for  $y = \frac{x^3}{3} - \frac{1}{2x^2}$ ,  $x \neq 0$ .

x	-3	-2	-1	-0.5	-0.3		0.3	0.5	1	2	3
y	-9.1	-2.8	-0.8		-5.6		-5.5	-2.0			8.9

[3]

- (b) On the grid, draw the graph of  $y = \frac{x^3}{3} - \frac{1}{2x^2}$  for  $-3 \leq x \leq -0.3$  and  $0.3 \leq x \leq 3$ .



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284 [5]

- (c) (i) By drawing a suitable tangent, find an estimate of the gradient of the curve at  $x = -2$ .

..... [3]

- (ii) Write down the equation of the tangent to the curve at  $x = -2$ .  
Give your answer in the form  $y = mx + c$ .

$y =$  ..... [2]

- (d) Use your graph to solve the equations.

(i)  $\frac{x^3}{3} - \frac{1}{2x^2} = 0$

$x =$  ..... [1]

(ii)  $\frac{x^3}{3} - \frac{1}{2x^2} + 4 = 0$

$x =$  ..... or  $x =$  ..... or  $x =$  ..... [3]

- (e) The equation  $\frac{x^3}{3} - \frac{1}{2x^2} + 4 = 0$  can be written in the form  $ax^n + bx^{n-3} - 3 = 0$ .

Find the value of  $a$ , the value of  $b$  and the value of  $n$ .

$a =$  .....

$b =$  .....

$n =$  ..... [3]

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5 The table shows some values of  $y = \frac{1}{2x} - \frac{x}{4}$  for  $0.15 \leq x \leq 3.5$ .

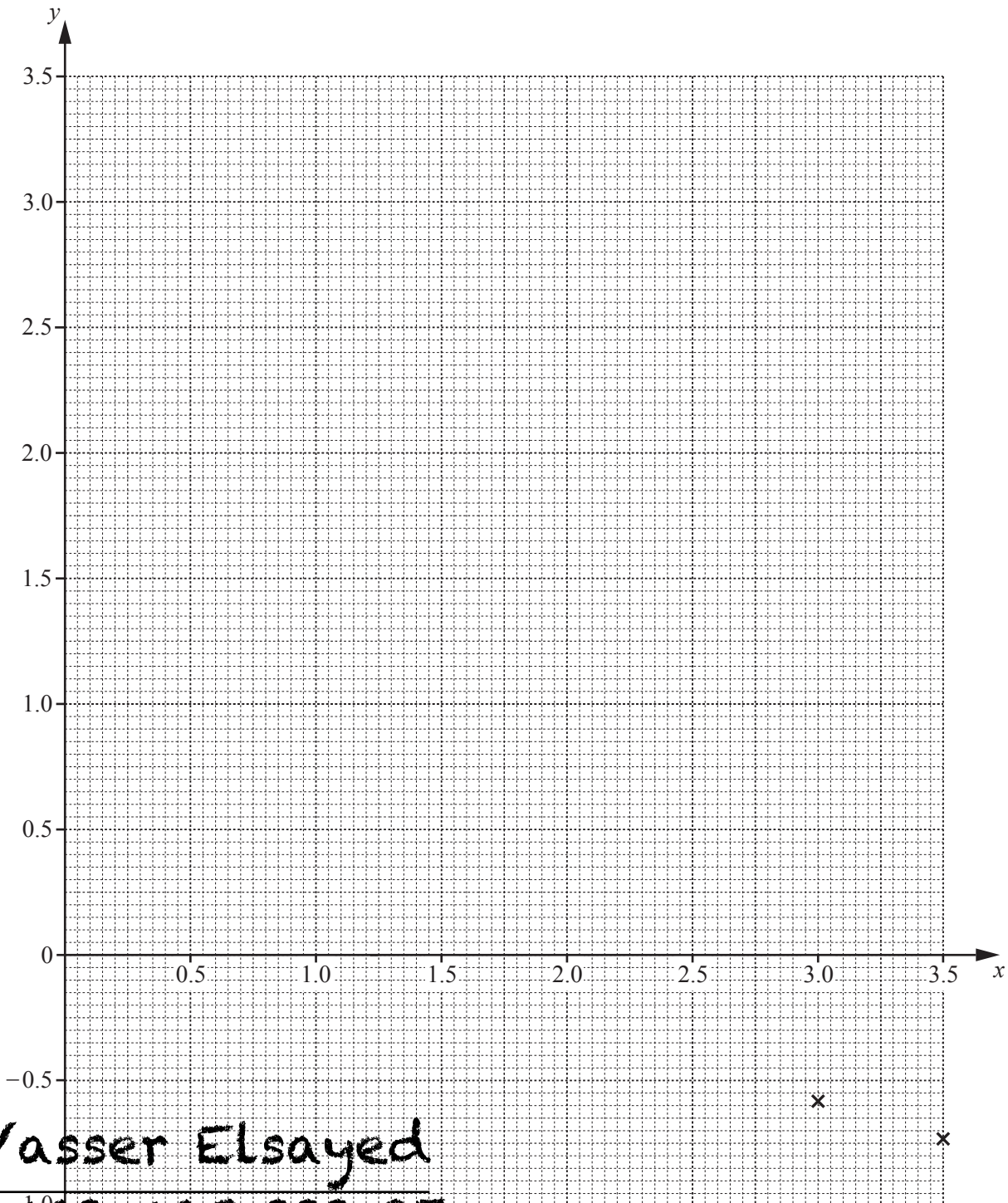
$x$	0.15	0.2	0.5	1	1.5	2	2.5	3	3.5
$y$	3.30		0.88		-0.04		-0.43	-0.58	-0.73

(a) Complete the table.

[3]

(b) On the grid, draw the graph of  $y = \frac{1}{2x} - \frac{x}{4}$  for  $0.15 \leq x \leq 3.5$ .

The last two points have been plotted for you.



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286 [4]

(c) Use your graph to solve the equation  $\frac{1}{2x} - \frac{x}{4} = \frac{1}{2}$  for  $0.15 \leq x \leq 3.5$ .

$x = \dots\dots\dots$  [1]

(d) (i) On the grid, draw the line  $y = 2 - x$ . [2]

(ii) Write down the  $x$  co-ordinates of the points where the line  $y = 2 - x$  crosses the graph of  $y = \frac{1}{2x} - \frac{x}{4}$  for  $0.15 \leq x \leq 3.5$ .

$x = \dots\dots\dots$  and  $x = \dots\dots\dots$  [2]

(e) Show that the graph of  $y = \frac{1}{2x} - \frac{x}{4}$  can be used to find the value of  $\sqrt{2}$  for  $0.15 \leq x \leq 3.5$ .

[2]

6  $f(x) = 3x + 2$

$g(x) = x^2 + 1$

$h(x) = 4^x$

(a) Find  $h(4)$ .

..... [1]

(b) Find  $fg(1)$ .

..... [2]

(c) Find  $gf(x)$  in the form  $ax^2 + bx + c$ .

..... [3]

(d) Find  $x$  when  $f(x) = g(7)$ .

$x =$  ..... [2]

(e) Find  $f^{-1}(x)$ .

$f^{-1}(x) =$  ..... [2]

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(f) Find  $\frac{g(x)}{f(x)} + x$ .

Give your answer as a single fraction, in terms of  $x$ , in its simplest form.

..... [3]

(g) Find  $x$  when  $h^{-1}(x) = 2$ .

$x =$  ..... [1]

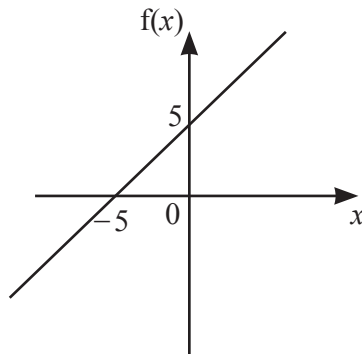
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10 (a) The diagrams show the graphs of two functions.

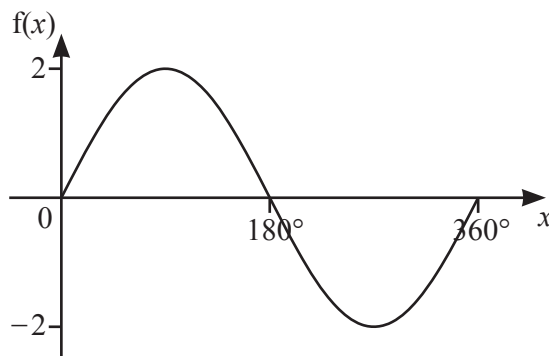
Write down each function.

(i)



$f(x) = \dots\dots\dots$  [2]

(ii)

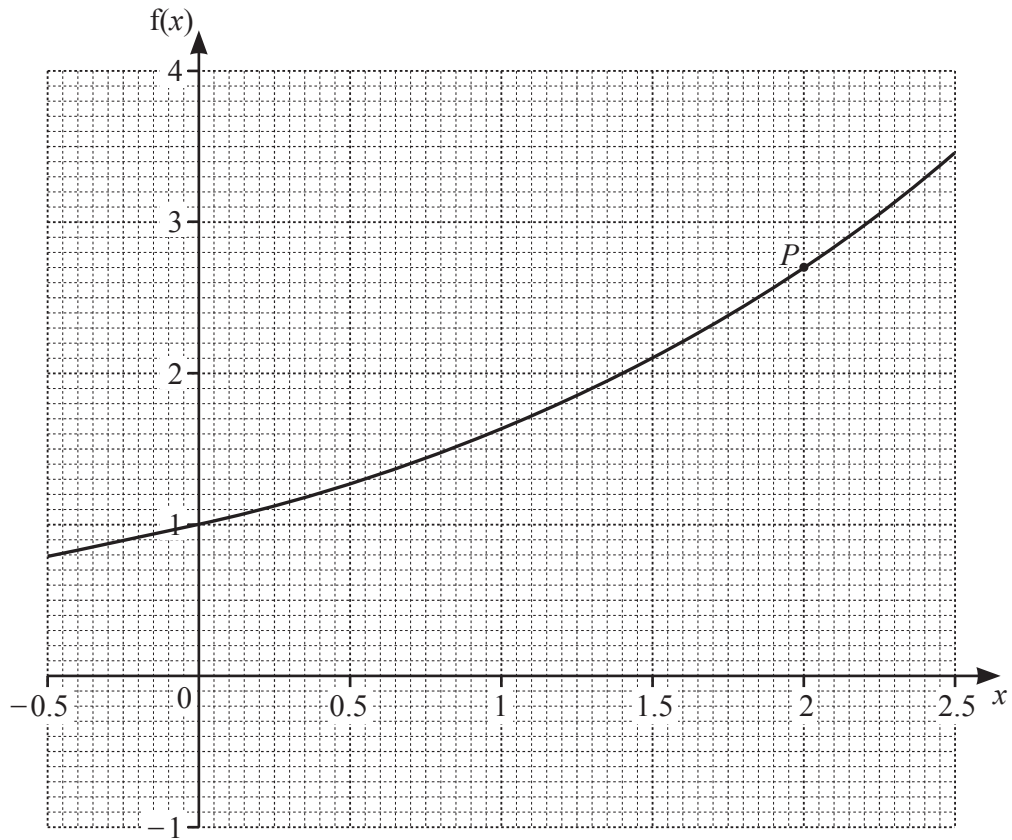


$f(x) = \dots\dots\dots$  [2]

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(b)



The diagram shows the graph of another function.

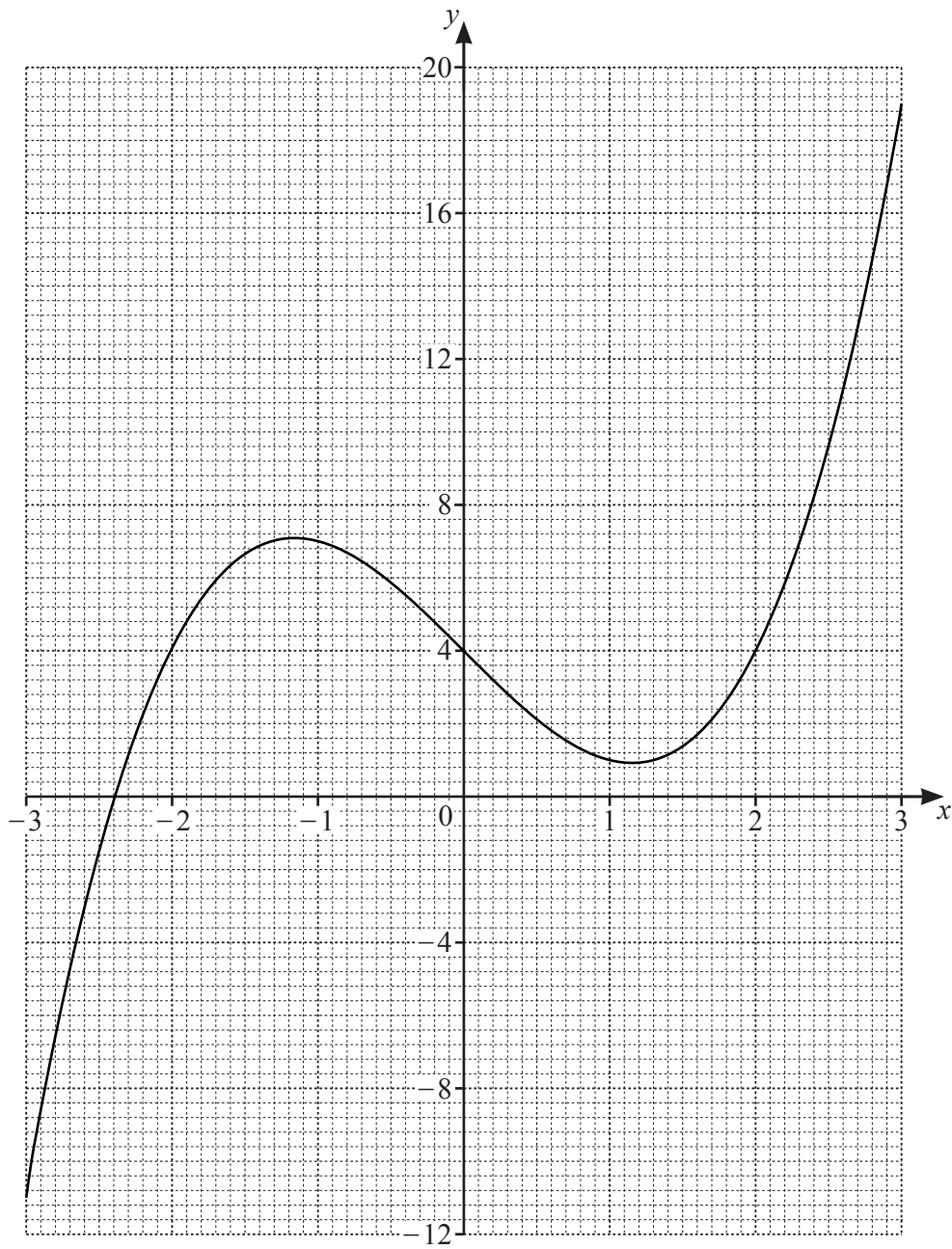
By drawing a suitable tangent, find an estimate for the gradient of the function at the point  $P$ .

..... [3]

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5 (a) The diagram shows the graph of  $y = f(x)$  for  $-3 \leq x \leq 3$ .



(i) Solve  $f(x) = 14$ .

$x = \dots\dots\dots$  [1]

(ii) By drawing a suitable tangent, find an estimate of the gradient of the graph at the point  $(-2, 4)$ .

$\dots\dots\dots$  [3]

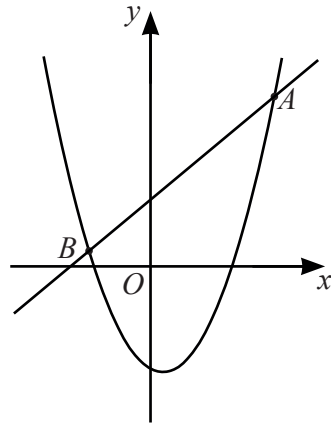
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(iii) By drawing a suitable straight line on the grid, solve  $f(x) = 2x - 2$  for  $-3 \leq x \leq 3$ .

$x = \dots\dots\dots$  [3]

(b)



NOT TO  
SCALE

The diagram shows a curve with equation  $y = 2x^2 - 2x - 7$ .

The straight line with equation  $y = 3x + 5$  intersects the curve at the points  $A$  and  $B$ .

Find the coordinates of the points  $A$  and  $B$ .

$A$  (....., .....) )

$B$  (....., .....) [5]

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10       $f(x) = x^2 + 1$        $g(x) = 1 - 2x$        $h(x) = \frac{1}{x}, x \neq 0$        $j(x) = 5^x$

(a) Find the value of

(i)  $f(3)$ ,

..... [1]

(ii)  $gf(3)$ .

..... [1]

(b) Find  $g^{-1}(x)$ .

$g^{-1}(x) =$  ..... [2]

(c) Find  $x$  when  $h(x) = 2$ .

$x =$  ..... [1]

(d) Find  $g(x)g(x) - gg(x)$ , giving your answer in the form  $ax^2 + bx + c$ .

..... [4]

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(e) Find  $hh(x)$ , giving your answer in its simplest form.

..... [1]

(f) Find  $j(5)$ .

..... [1]

(g) Find  $x$  when  $j^{-1}(x) = 2$ .

$x =$  ..... [1]

(h)  $j(x) = hg(-12)$

Find the value of  $x$ .

$x =$  ..... [2]

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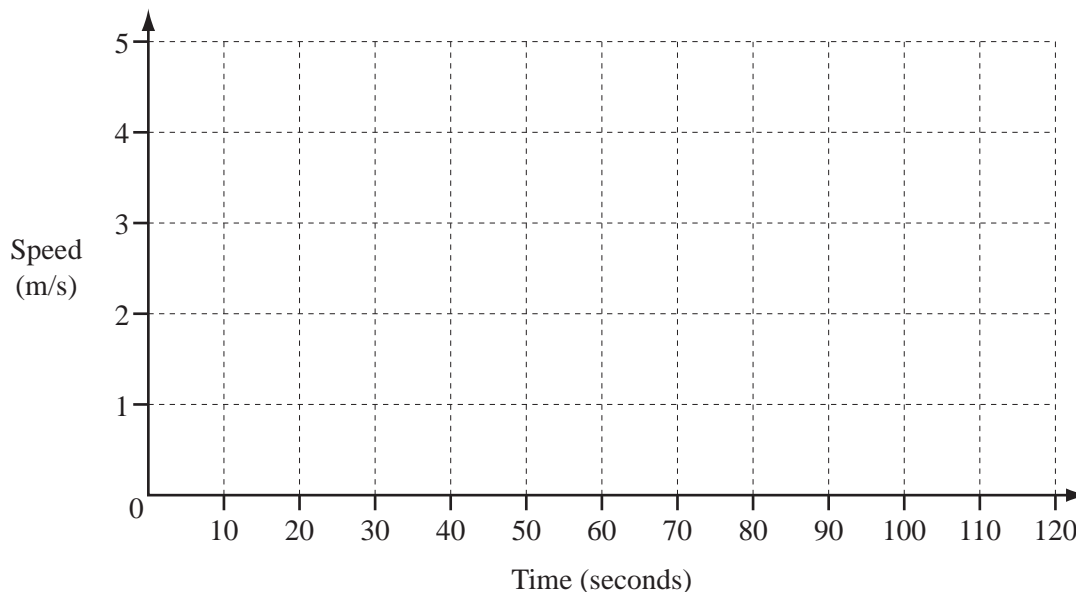
# Speed, Distance and Time

Mr. Yasser Elsayed  
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- 2 Emily cycles along a path for 2 minutes.  
She starts from rest and accelerates at a constant rate until she reaches a speed of 5 m/s after 40 seconds.  
She continues cycling at 5 m/s for 60 seconds.  
She then decelerates at a constant rate until she stops after a further 20 seconds.

(a) On the grid, draw a speed-time graph to show Emily's journey.



[2]

(b) Find Emily's acceleration.

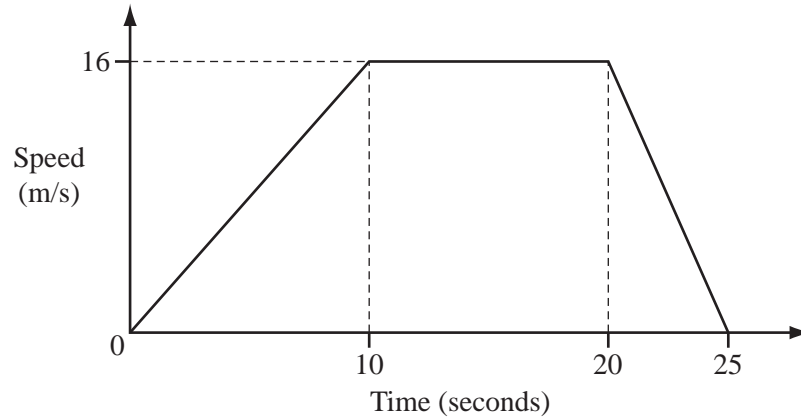
Answer(b) ..... m/s<sup>2</sup> [1]

(c) Calculate Emily's average speed for the journey.

Answer(c) ..... m/s [4]

8

(c) The diagram shows the speed-time graph for a car travelling between two sets of traffic lights.



(i) Calculate the deceleration of the car for the last 5 seconds of the journey.

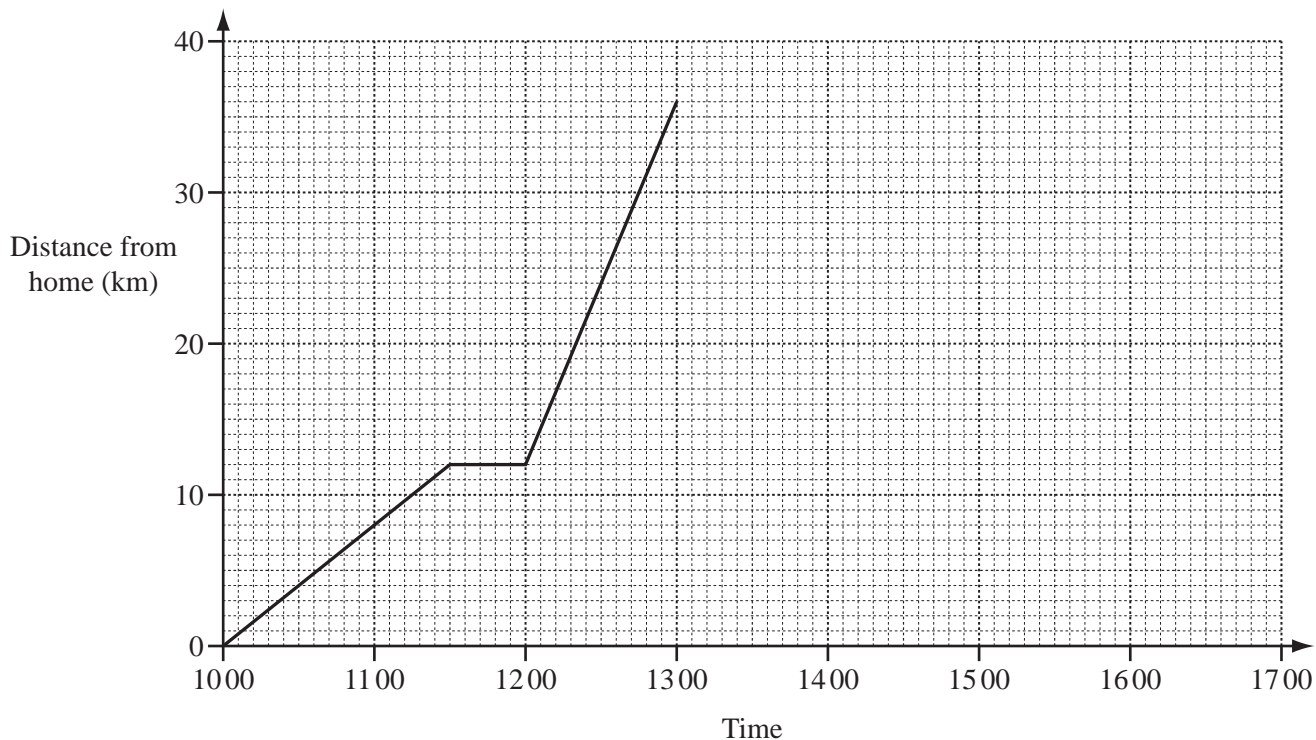
Answer(c)(i) ..... m/s<sup>2</sup> [1]

(ii) Calculate the average speed of the car between the two sets of traffic lights.

Answer(c)(ii) ..... m/s [4]

3) June 2014 V1

- 2 Ali leaves home at 1000 to cycle to his grandmother's house. He arrives at 1300. The distance-time graph represents his journey.



- (a) Calculate Ali's speed between 1000 and 1130. Give your answer in kilometres per hour.

Answer(a) ..... km/h [2]

- (b) Show that Ali's average speed for the whole journey to his grandmother's house is 12 km/h.

Answer(b)

[2]

- (c) Change 12 kilometres per hour into metres per minute.

Answer(c) ..... m/min [2]

- (d) Ali stays for 45 minutes at his grandmother's house and then returns home.

He arrives home at 1642.

Complete the distance-time

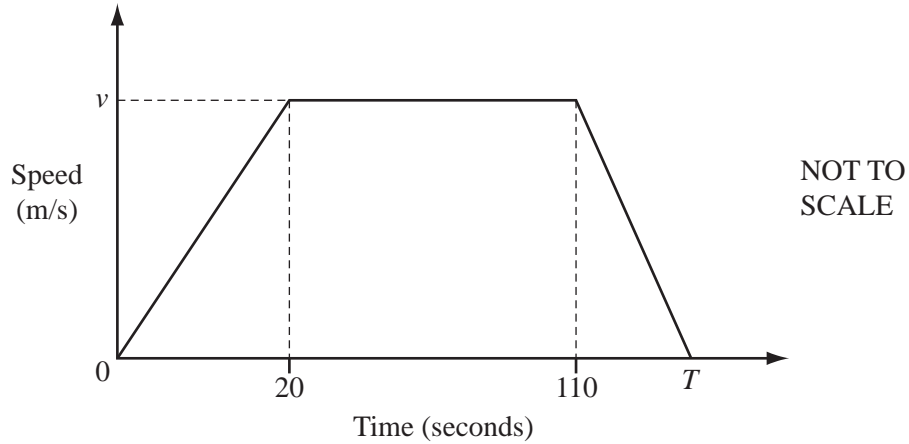
[2]

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2 (c) The diagram shows the speed-time graph for a car travelling along a road for  $T$  seconds.



To begin with the car accelerated at  $0.75 \text{ m/s}^2$  for 20 seconds to reach a speed of  $v \text{ m/s}$ .

(i) Show that the speed,  $v$ , of the car is  $15 \text{ m/s}$ .

*Answer(c)(i)*

[1]

(ii) The total distance travelled is **1.8 kilometres**.

Calculate the total time,  $T$ , of the journey.

*Answer(c)(ii)* ..... seconds [4]

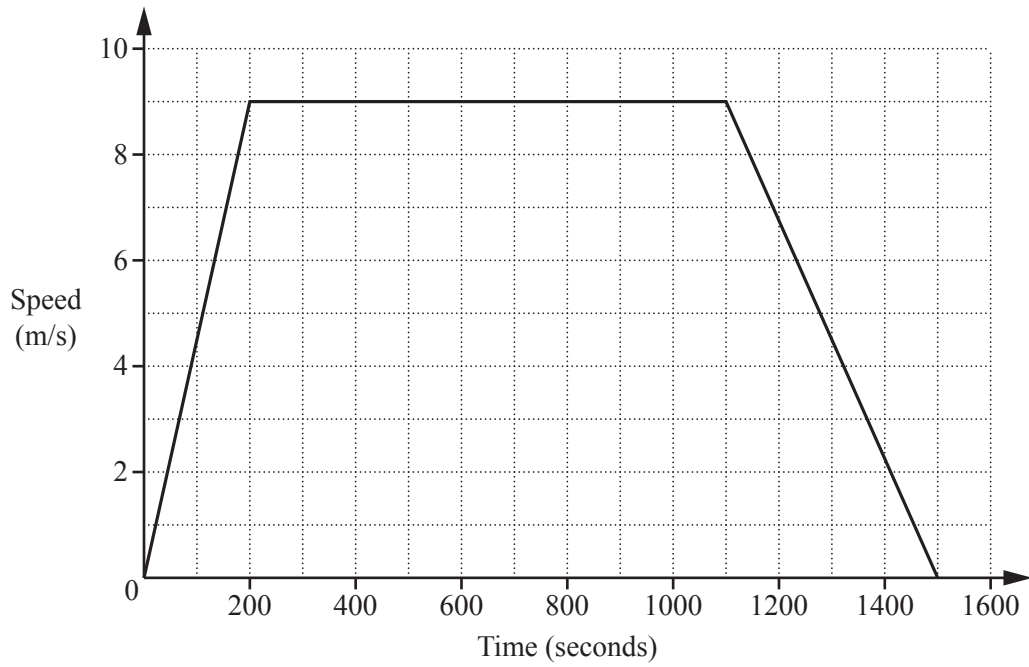
(d) Asma runs 22 kilometres, correct to the nearest kilometre.  
She takes  $2\frac{1}{2}$  hours, correct to the nearest half hour.

Calculate the upper bound of Asma's speed.

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*Answer(d)* ..... km/h [3]  
**300**

3 (b) Davinder draws a speed-time graph for his bus journey to the market.



Find

(i) the acceleration of the bus during the first 200 seconds,

..... m/s<sup>2</sup> [1]

(ii) the total distance travelled by the bus,

..... m [3]

(iii) the average speed of the bus for the whole journey.

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..... 301 [1]

11 Brad travelled from his home in New York to Chamonix.

- He left his home at 16 30 and travelled by taxi to the airport in New York.  
This journey took 55 minutes and had an average speed of 18 km/h.
- He then travelled by plane to Geneva, departing from New York at 22 15.  
The flight path can be taken as an arc of a circle of radius 6400 km with a sector angle of  $55.5^\circ$ .  
The local time in Geneva is 6 hours ahead of the local time in New York.  
Brad arrived in Geneva at 11 25 the next day.
- To complete his journey, Brad travelled by bus from Geneva to Chamonix.  
This journey started at 13 00 and took 1 hour 36 minutes.  
The average speed was 65 km/h.  
The local time in Chamonix is the same as the local time in Geneva.

Find the overall average speed of Brad's journey from his home in New York to Chamonix.  
Show all your working and give your answer in km/h.

..... km/h [11]

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# Linear Programming

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10 A company has a vehicle parking area of  $1200 \text{ m}^2$  with space for  $x$  cars and  $y$  trucks.

Each car requires  $20 \text{ m}^2$  of space and each truck requires  $100 \text{ m}^2$  of space.

(a) Show that  $x + 5y \leq 60$ .

Answer(a)

[1]

(b) There must also be space for

(i) at least 40 vehicles,

(ii) at least 2 trucks.

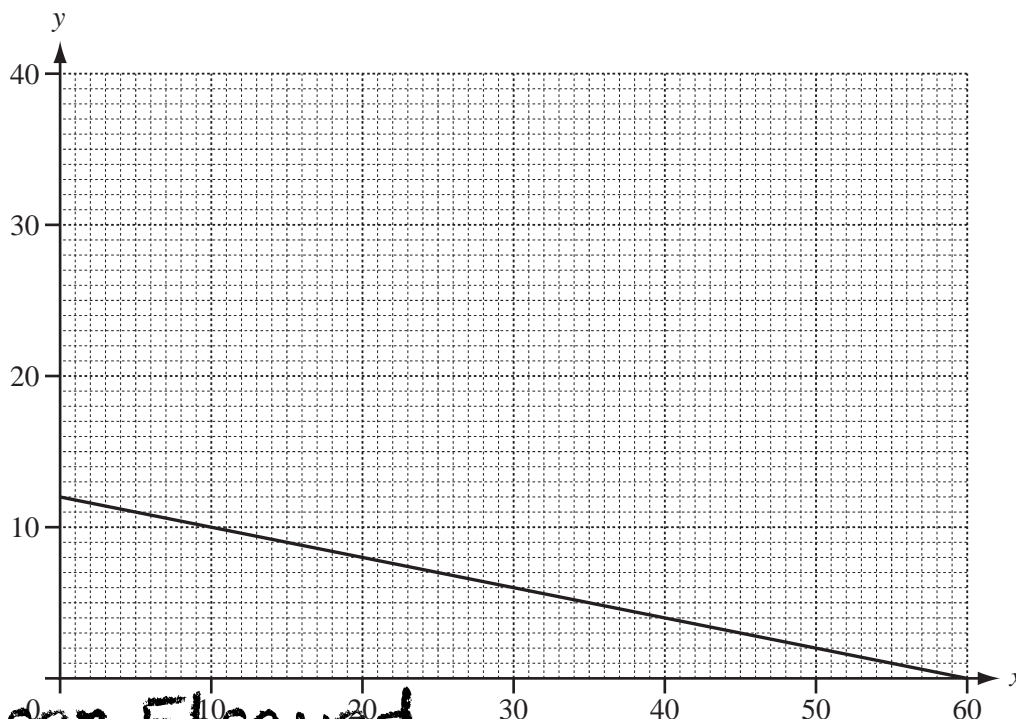
Write down two more inequalities to show this information.

Answer(b)(i) ..... [1]

Answer(b)(ii) ..... [1]

(c) One line has been drawn for you.

On the grid, show the three inequalities by drawing the other two lines and shading the **unwanted** regions.



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[4]

304



(d) Use your graph to find the largest possible number of trucks.

*Answer(d)* ..... [1]

(e) The company charges \$5 for parking each car and \$10 for parking each truck.  
Find the number of cars and the number of trucks which give the company the greatest possible income.

Calculate this income.

*Answer(e)* Number of cars = .....

Number of trucks = .....

Greatest possible income = \$ ..... [3]

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9 Peter wants to plant  $x$  plum trees and  $y$  apple trees.

He wants at least 3 plum trees and at least 2 apple trees.

(a) Write down one inequality in  $x$  and one inequality in  $y$  to represent these conditions.

*Answer(a)* ..... , ..... [2]

(b) There is space on his land for no more than 9 trees.

Write down an inequality in  $x$  and  $y$  to represent this condition.

*Answer(b)* ..... [1]

(c) Plum trees cost \$6 and apple trees cost \$14.

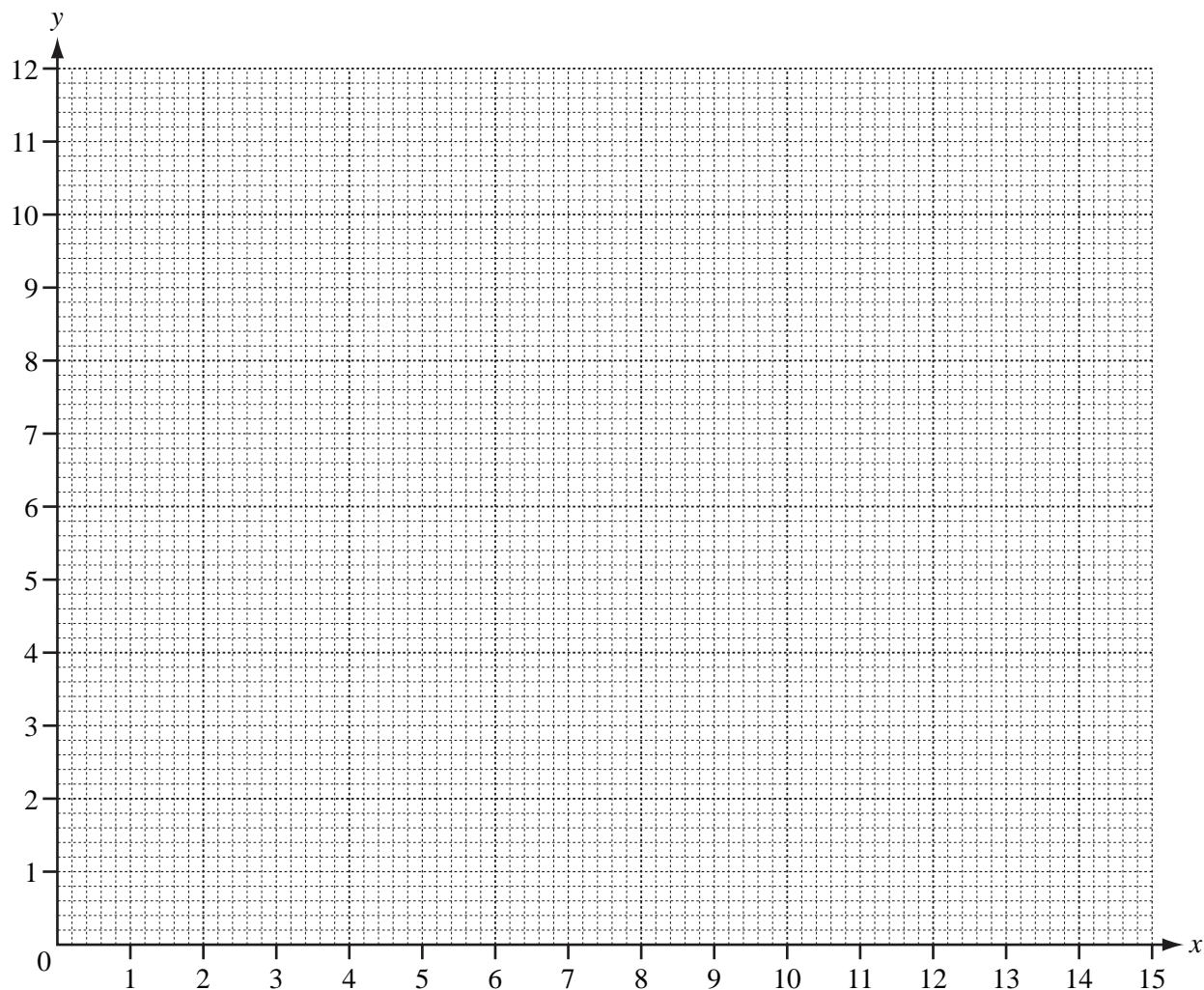
Peter wants to spend no more than \$84.

Write down an inequality in  $x$  and  $y$ , and show that it simplifies to  $3x + 7y \leq 42$ .

*Answer(c)*

[1]

(d) On the grid, draw four lines to show the four inequalities and shade the **unwanted** regions.



[7]

(e) Calculate the smallest cost when Peter buys a total of 9 trees.

Answer(e) \$ ..... [2]

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- 8 Mr Chang hires  $x$  large coaches and  $y$  small coaches to take 300 students on a school trip. Large coaches can carry 50 students and small coaches 30 students. There is a maximum of 5 large coaches.

(a) Explain clearly how the following two inequalities satisfy these conditions.

(i)  $x \leq 5$

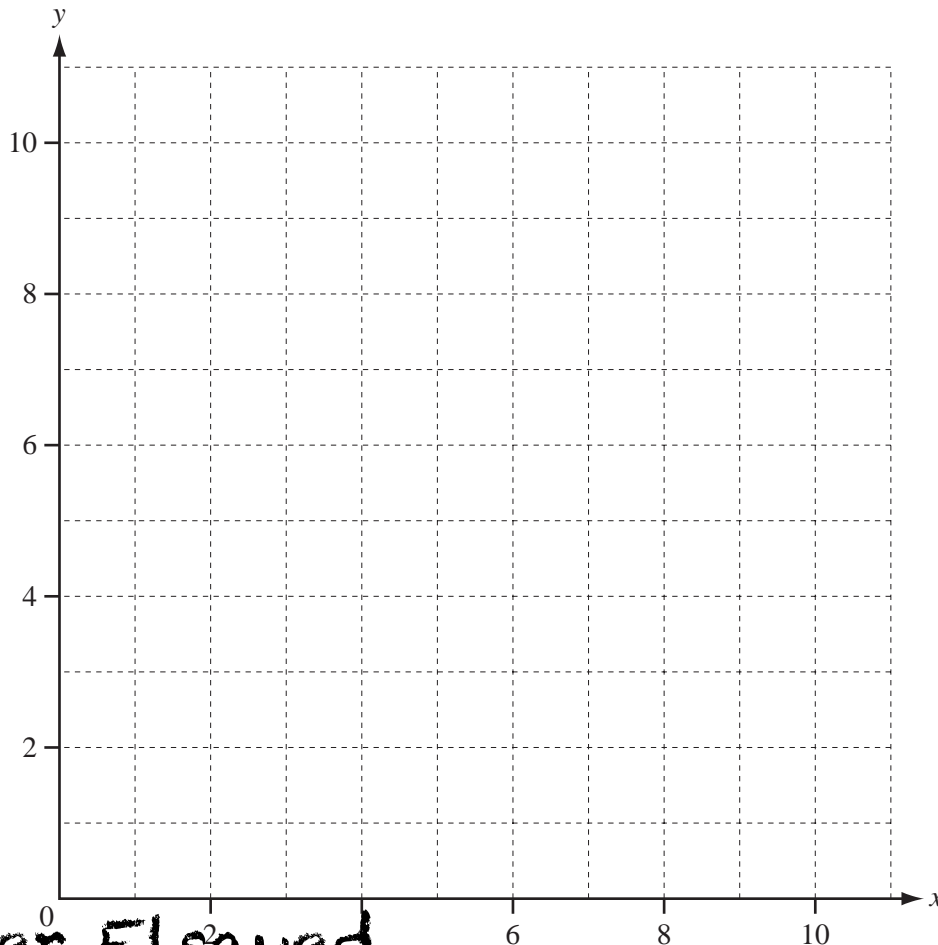
Answer(a)(i) ..... [1]

(ii)  $5x + 3y \geq 30$

Answer(a)(ii) ..... [2]  
.....

Mr Chang also knows that  $x + y \leq 10$ .

(b) On the grid, show the information above by drawing three straight lines and shading the **unwanted** regions.



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[5]

(c) A large coach costs \$450 to hire and a small coach costs \$350.

(i) Find the number of large coaches and the number of small coaches that would give the minimum hire cost for this school trip.

*Answer(c)(i)* Large coaches .....

Small coaches ..... [2]

(ii) Calculate this minimum cost.

*Answer(c)(ii)* \$ ..... [1]

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4) November 2011 V3

10 Hassan stores books in large boxes and small boxes.  
Each large box holds 20 books and each small box holds 10 books.  
He has  $x$  large boxes and  $y$  small boxes.

(a) Hassan must store at least 200 books.

Show that  $2x + y \geq 20$ .

Answer(a)

[1]

(b) Hassan must not use more than 15 boxes.

He must use at least 3 small boxes.

The number of small boxes must be less than or equal to the number of large boxes.

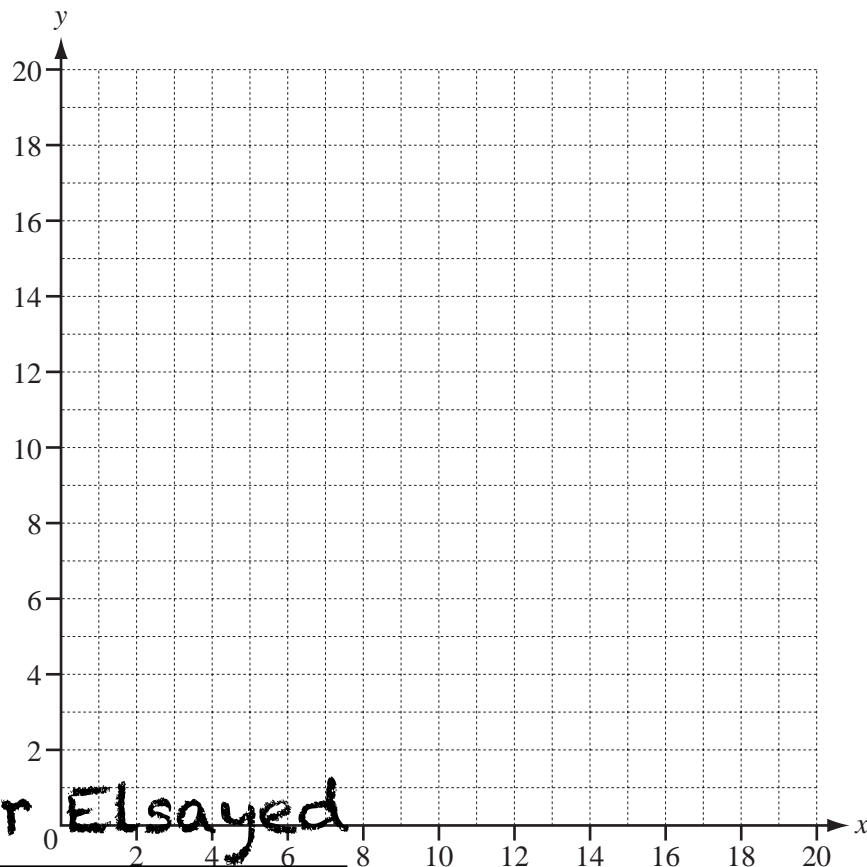
Write down three inequalities to show this information.

Answer(b) .....

.....

..... [3]

(c) On the grid, show the information in **part (a)** and **part (b)** by drawing four straight lines and shading the **unwanted** regions.



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(d) A large box costs \$5 and a small box costs \$2.

(i) Find the least possible total cost of the boxes.

*Answer(d)(i)* \$ ..... [1]

(ii) Find the number of large boxes and the number of small boxes which give this least possible cost.

*Answer(d)(ii)* Number of large boxes = .....

Number of small boxes = ..... [2]

3 Pablo plants  $x$  lemon trees and  $y$  orange trees.

(a) (i) He plants at least 4 lemon trees.

Write down an inequality in  $x$  to show this information.

*Answer(a)(i)* ..... [1]

(ii) Pablo plants at least 9 orange trees.

Write down an inequality in  $y$  to show this information.

*Answer(a)(ii)* ..... [1]

(iii) The greatest possible number of trees he can plant is 20.

Write down an inequality in  $x$  and  $y$  to show this information.

*Answer(a)(iii)* ..... [1]

(b) Lemon trees cost \$5 each and orange trees cost \$10 each.

The maximum Pablo can spend is \$170.

Write down an inequality in  $x$  and  $y$  and show that it simplifies to  $x + 2y \leq 34$ .

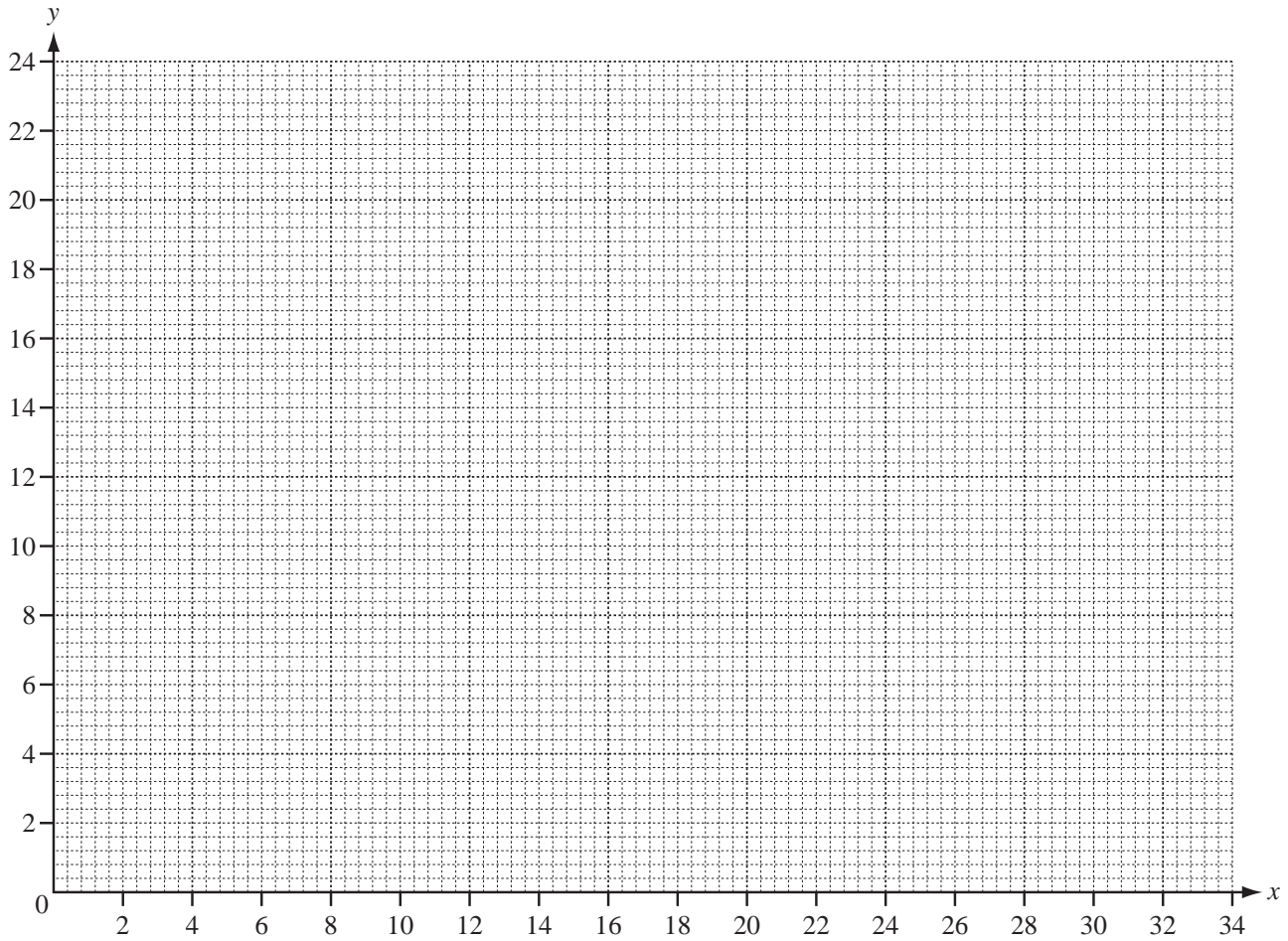
*Answer (b)*

[1]

(c) (i) On the grid opposite, draw four lines to show the four inequalities and shade the **unwanted** region.

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[7]

(ii) Calculate the smallest cost when Pablo buys a total of 20 trees.

Answer(c)(ii) \$ ..... [2]

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6) November 2012 V2

- 7 Jay makes wooden boxes in two sizes. He makes  $x$  small boxes and  $y$  large boxes.  
He makes at least 5 **small** boxes.  
The greatest number of **large** boxes he can make is 8.  
The greatest total number of boxes is 14.  
The number of **large** boxes is at least half the number of **small** boxes.

(a) (i) Write down four inequalities in  $x$  and  $y$  to show this information.

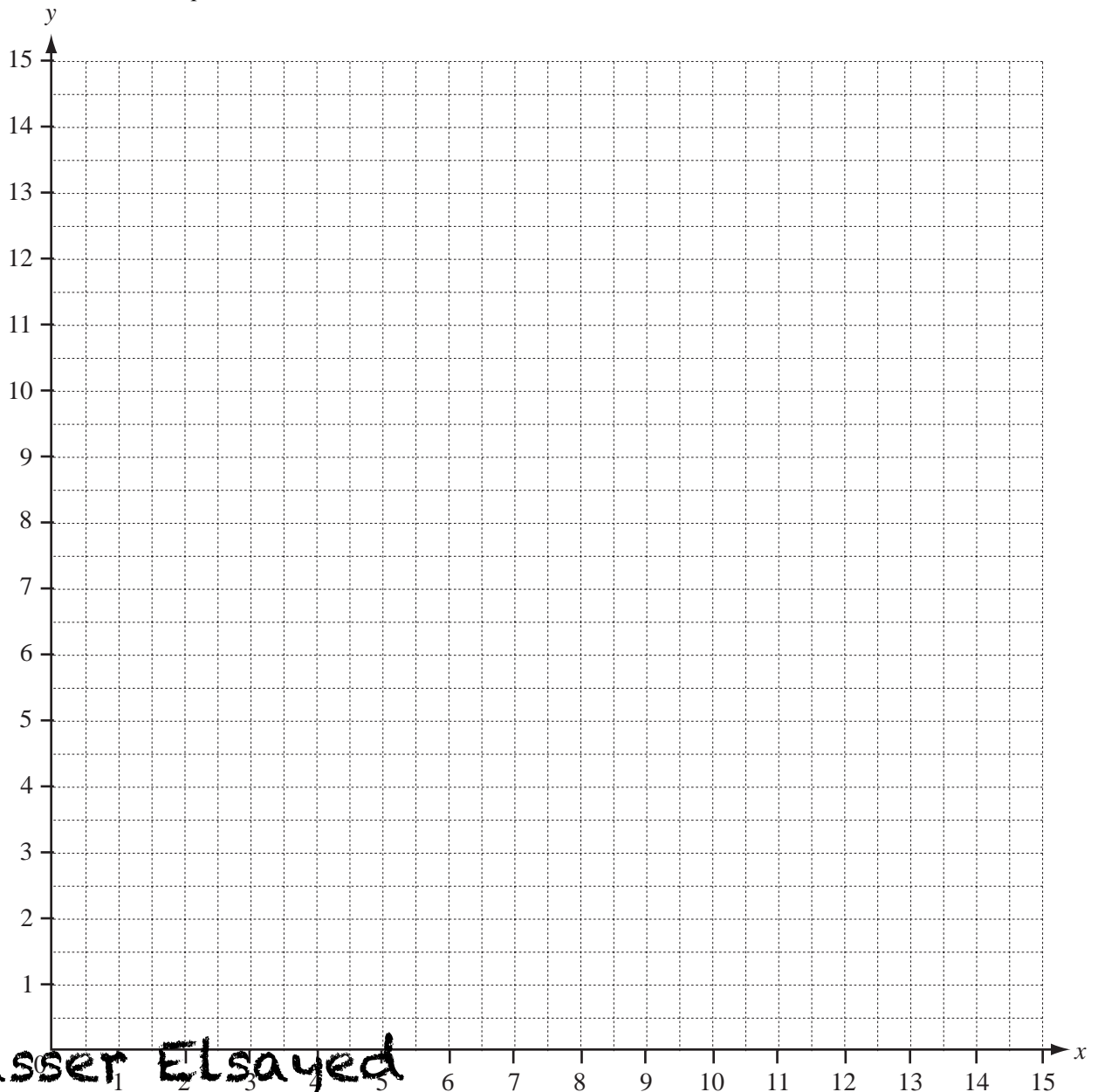
Answer(a)(i) .....

.....

.....

..... [4]

(ii) Draw four lines on the grid and write the letter R in the region which represents these inequalities.



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(b) The price of the small box is \$20 and the price of the large box is \$45.

(i) What is the greatest amount of money he receives when he sells all the boxes he has made?

*Answer(b)(i)* \$ ..... [2]

(ii) For this amount of money, how many boxes of each size did he make?

*Answer(b)(ii)* ..... small boxes and ..... large boxes [1]

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3 (a) Luk wants to buy  $x$  goats and  $y$  sheep.

(i) He wants to buy at least 5 goats.

Write down an inequality in  $x$  to represent this condition.

*Answer(a)(i)* ..... [1]

(ii) He wants to buy at least 11 sheep.

Write down an inequality in  $y$  to represent this condition.

*Answer(a)(ii)* ..... [1]

(iii) He wants to buy at least 20 animals.

Write down an inequality in  $x$  and  $y$  to represent this condition.

*Answer(a)(iii)* ..... [1]

(b) Goats cost \$4 and sheep cost \$8.  
The maximum Luk can spend is \$160.

Write down an inequality in  $x$  and  $y$  and show that it simplifies to  $x + 2y \leq 40$ .

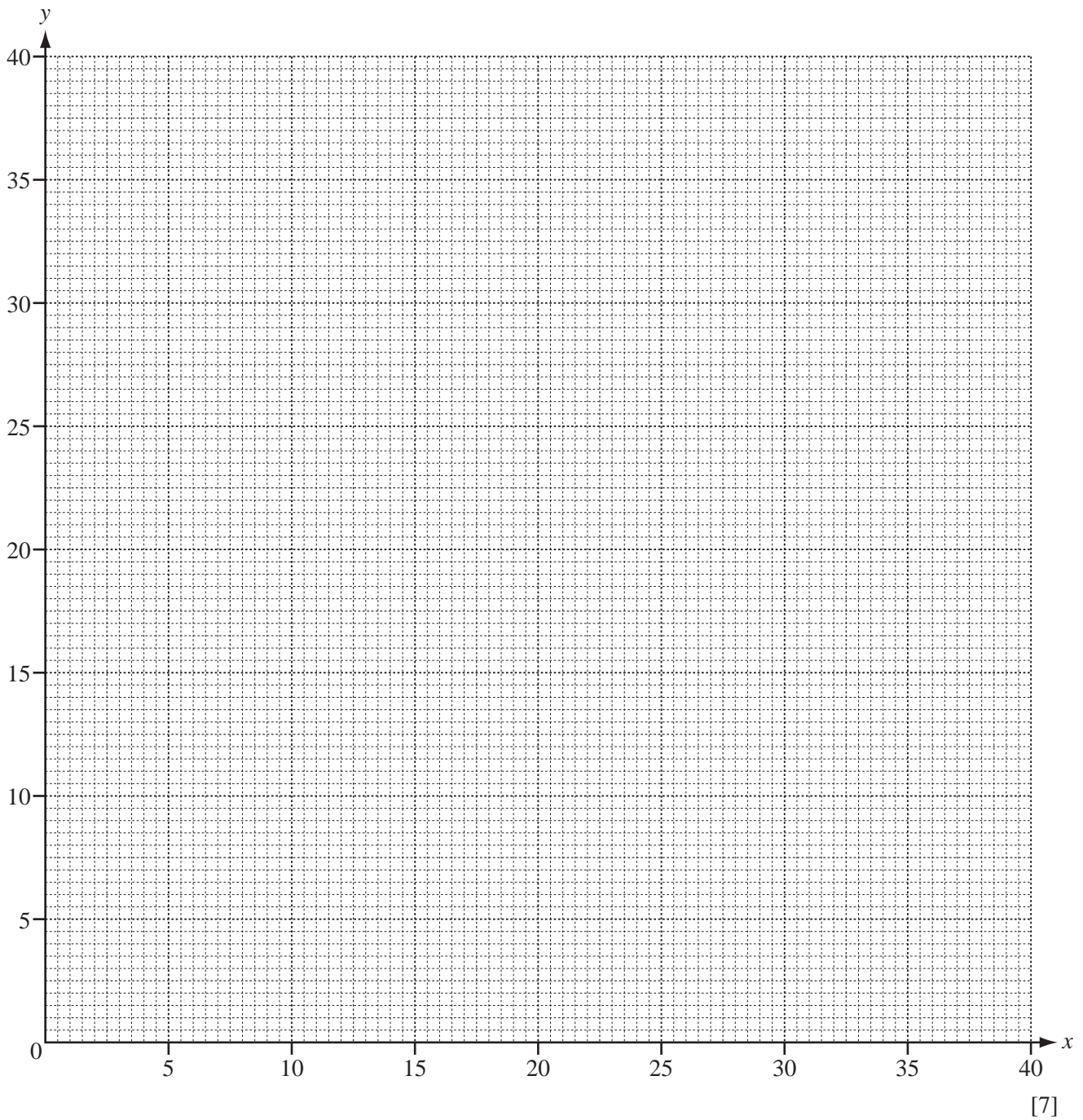
*Answer(b)*

[1]

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- (c) (i) On the grid below, draw four lines to show the four inequalities and shade the **unwanted** regions.

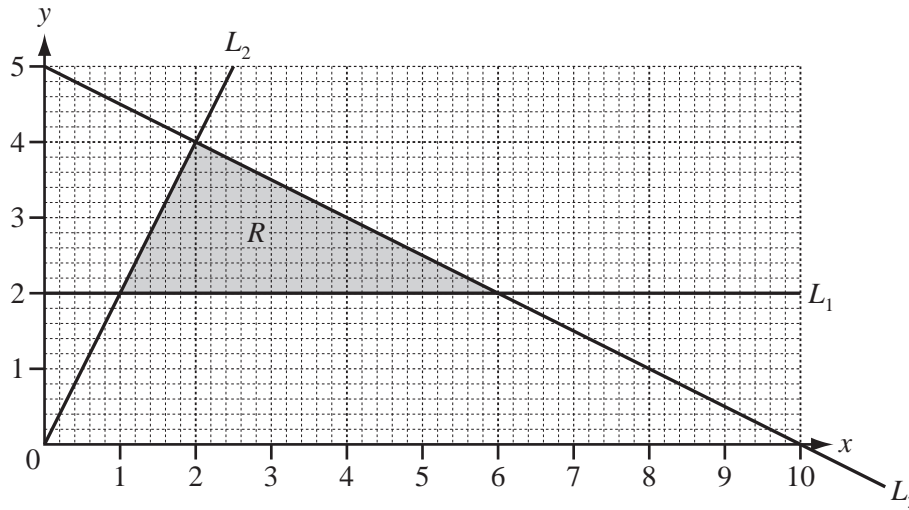


- (ii) Work out the maximum number of animals that Luk can buy.

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Answer(c)(ii) ..... [2]  
317

9



(a) Find the equations of the lines  $L_1$ ,  $L_2$  and  $L_3$ .

Answer(a)  $L_1$  .....

$L_2$  .....

$L_3$  ..... [5]

(b) Write down the three inequalities that define the shaded region,  $R$ .

Answer(b) .....

.....

..... [3]

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- (c) A gardener buys  $x$  bushes and  $y$  trees.  
 The cost of a bush is \$30 and the cost of a tree is \$200.  
 The shaded region  $R$  shows the only possible numbers of bushes and trees the gardener can buy.

- (i) Find the number of bushes and the number of trees when the total cost is \$720.

*Answer(c)(i)* ..... bushes  
 ..... trees [2]

- (ii) Find the number of bushes and the number of trees which give the greatest possible total cost.  
 Write down this greatest possible total cost.

*Answer(c)(ii)* ..... bushes  
 ..... trees

Greatest possible total cost = \$ ..... [3]

3

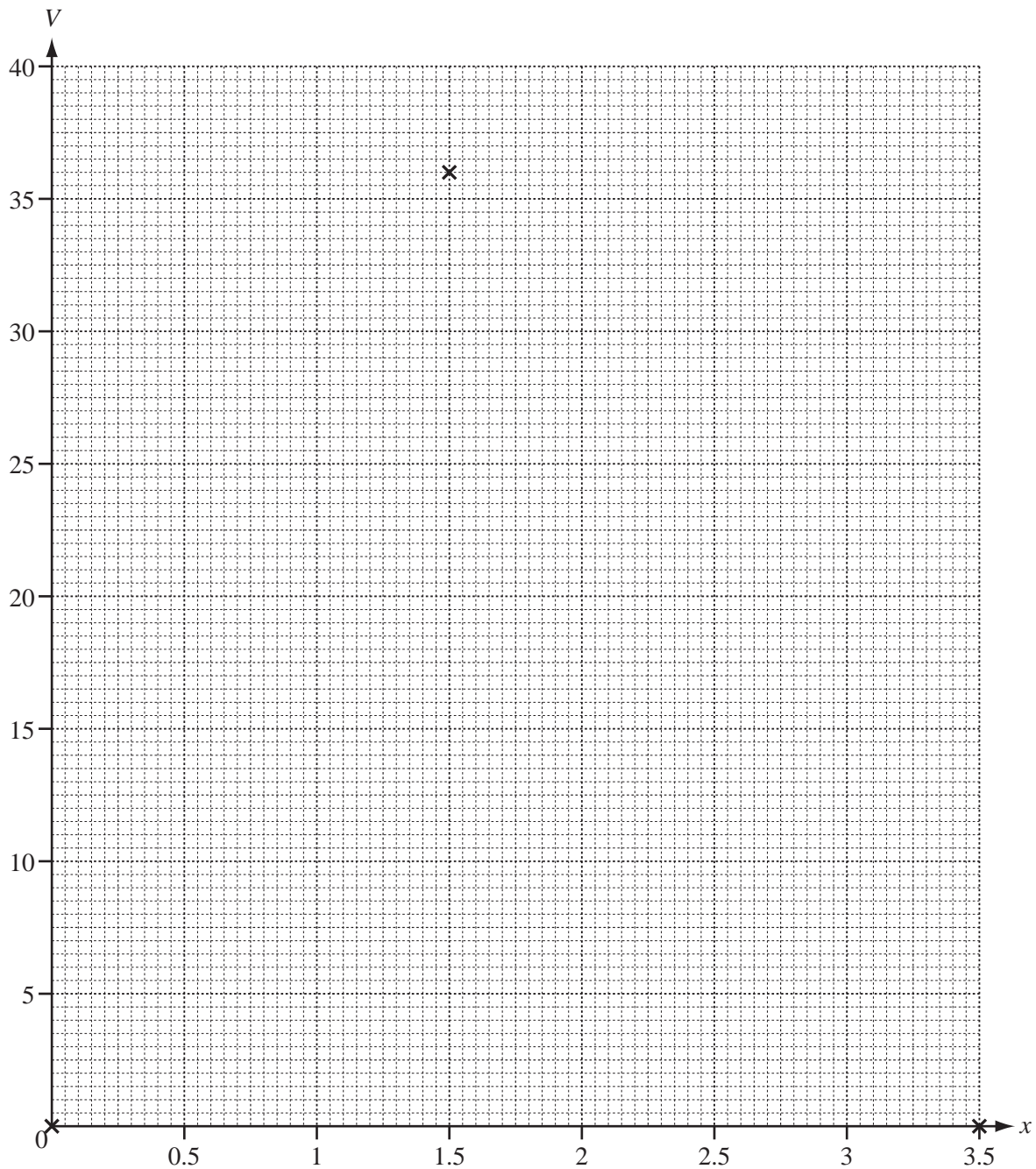
(c) Complete this table of values for  $V = 4x^3 - 32x^2 + 63x$ .

$x$	0	0.5	1	1.5	2	2.5	3	3.5
$V$	0		35	36	30		9	0

[2]

(d) On the grid opposite, draw the graph of  $V = 4x^3 - 32x^2 + 63x$  for  $0 \leq x \leq 3.5$ .  
Three of the points have been plotted for you.





[3]

- (e) The volume of the box is at least  $30 \text{ cm}^3$ .  
Write down, as an inequality, the possible values of  $x$ .

Answer(e) ..... [2]

- (f) (i) Write down the maximum volume of the box.

Answer(f)(i) .....  $\text{cm}^3$  [1]

Write down the value of  $x$  which gives the maximum volume.

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Answer(f)(ii) ..... [1]

8 Sima sells  $x$  biscuits and  $y$  cakes.

(a) (i) She sells at least 100 biscuits.

Write down an inequality in  $x$ .

*Answer(a)(i)* ..... [1]

(ii) She sells at least 120 cakes.

Write down an inequality in  $y$ .

*Answer(a)(ii)* ..... [1]

(iii) She sells a maximum of 300 biscuits and cakes altogether.

Write down an inequality in  $x$  and  $y$

*Answer(a)(iii)* ..... [1]

(iv) Sima makes a profit of 40 cents on each biscuit and 80 cents on each cake.

Her total profit is at least \$160.

Show that  $x + 2y \geq 400$ .

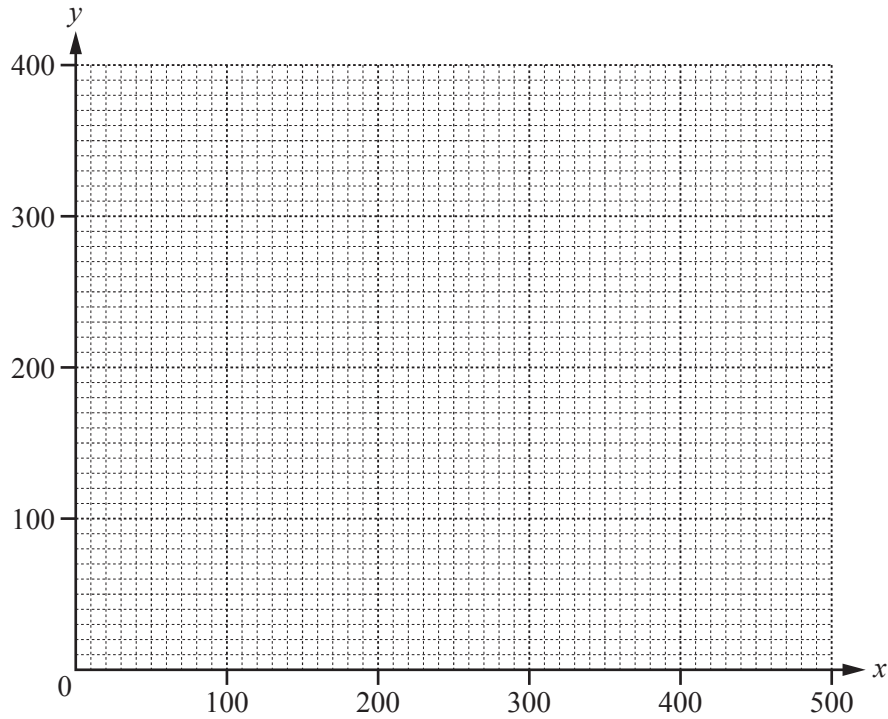
*Answer(a)(iv)*

[1]

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(b) On the grid, draw four lines to show the four inequalities and shade the unwanted regions.



[6]

(c) Calculate Sima's maximum profit.  
Give your answer in dollars.

Answer(c) \$ ..... [2]

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4 Ali buys  $x$  rose bushes and  $y$  lavender bushes.

He buys:

- at least 5 rose bushes
- at most 8 lavender bushes
- at most 15 bushes in total
- more lavender bushes than rose bushes.

(a) (i) Write down four inequalities, in terms of  $x$  and/or  $y$ , to show this information.

*Answer(a)(i)* .....

.....

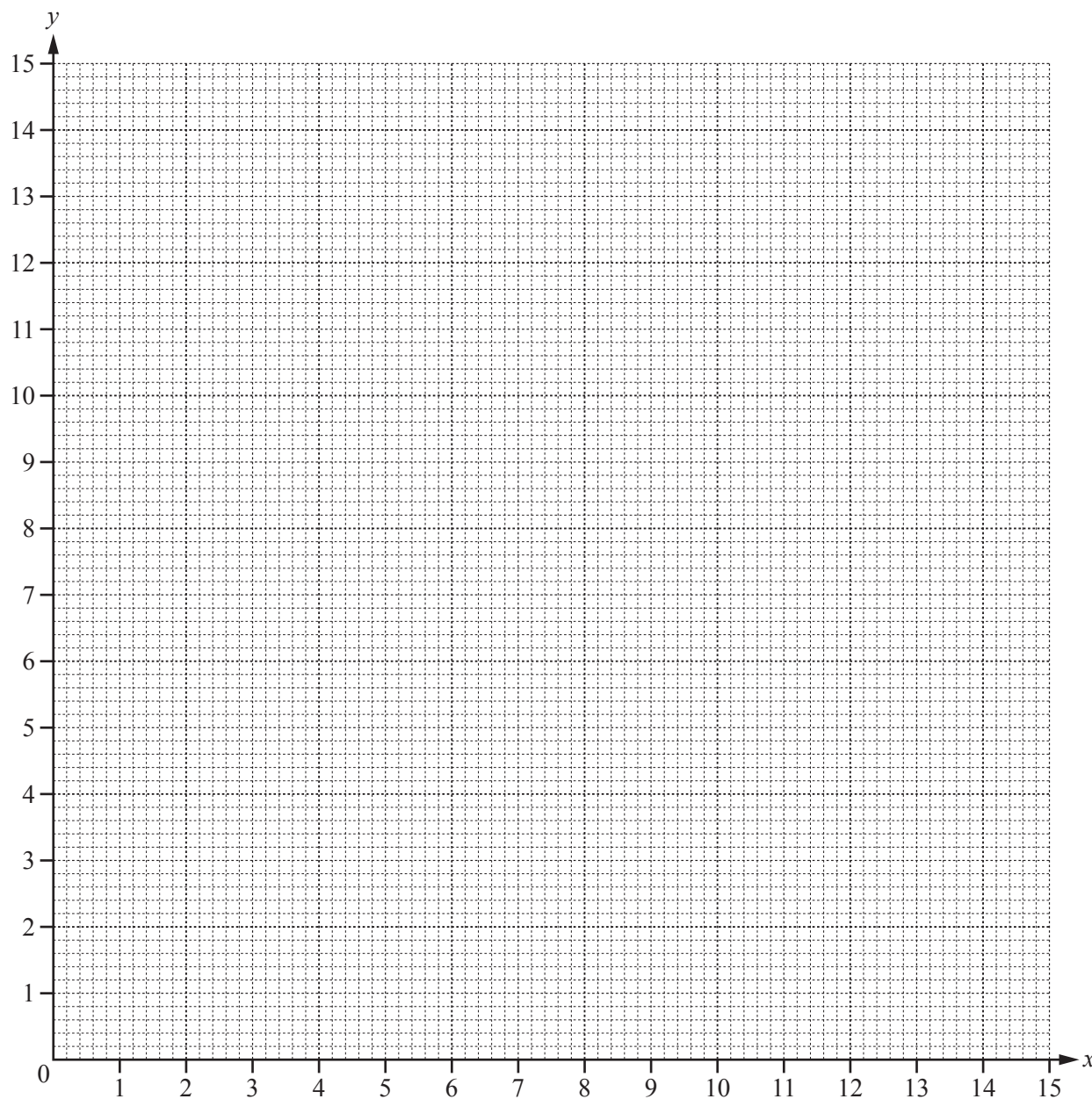
.....

..... [4]

(ii) On the grid, show the information in **part (a)(i)** by drawing four straight lines.  
Label the region R where all four inequalities are true.

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(b) Rose bushes cost \$6 each and lavender bushes cost \$4.50 each. [5]

What is the greatest amount of money Ali could spend?

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Answer(b) \$ ..... [2]

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- 10 The school cook buys potatoes in small sacks, each of mass 4 kg, and large sacks, each of mass 10 kg. He buys  $x$  small sacks and  $y$  large sacks. Today, he buys less than 80 kg of potatoes.

(a) Show that  $2x + 5y < 40$ .

*Answer(a)*

[1]

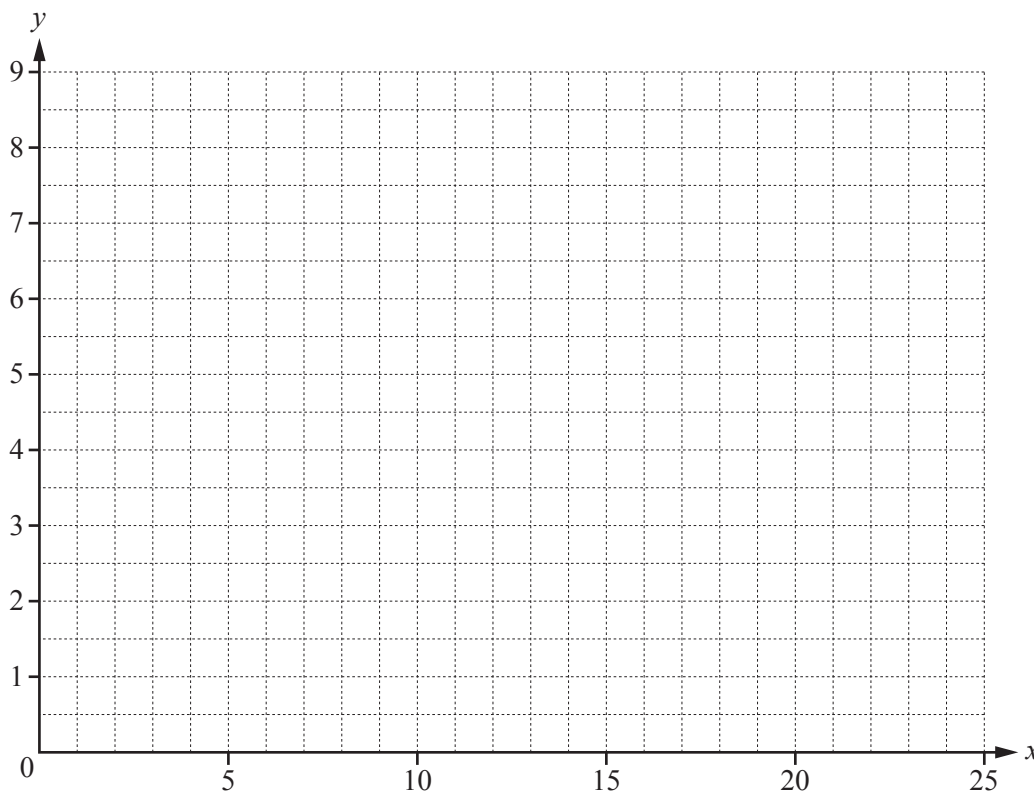
- (b) He buys more large sacks than small sacks.  
He buys no more than 6 large sacks.

Write down two inequalities to show this information.

*Answer(b)* .....

..... [2]

- (c) On the grid, show the information in **part (a)** and **part (b)** by drawing three straight lines and shading the unwanted regions.



[5]

- (d) Find the greatest mass of potatoes the cook can buy today.

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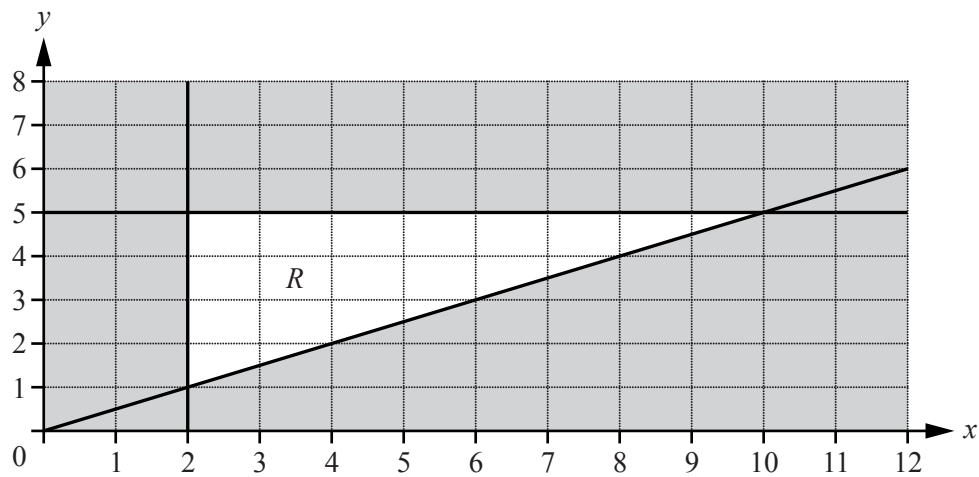
*Answer(d)* ..... kg [2]

13) June 2018 V3

- 9 (a) Find the equation of the straight line that is perpendicular to the line  $y = \frac{1}{2}x + 1$  and passes through the point (1, 3).

..... [3]

(b)



- (i) Find the three inequalities that define the region R.

.....  
 .....  
 ..... [4]

- (ii) Find the point (x, y), with integer co-ordinates, inside the region R such that  $3x + 5y = 35$ .

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( ..... , ..... ) [2]

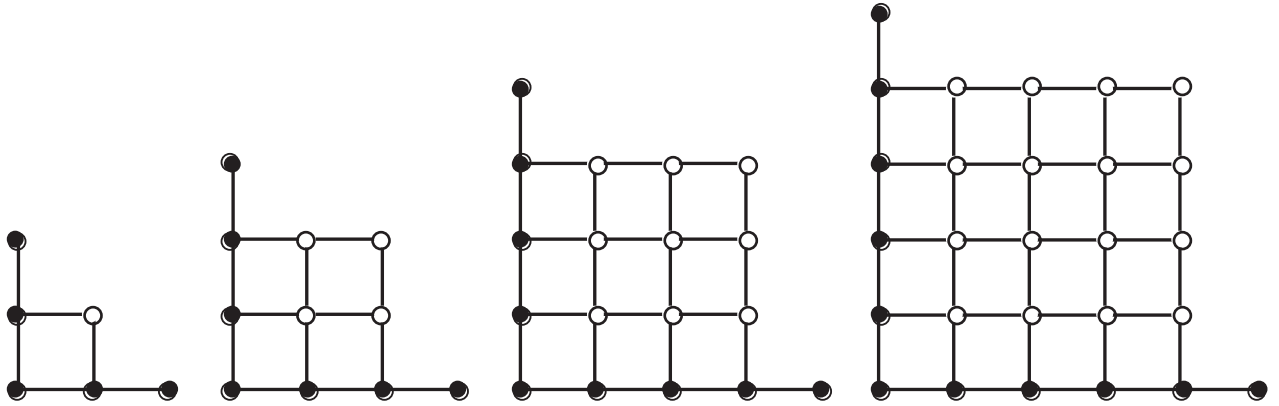
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# Sequences

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**Diagram 1**

1 white dot  
5 black dots  
6 lines

**Diagram 2**

4 white dots  
7 black dots  
14 lines

**Diagram 3**

9 white dots  
9 black dots  
26 lines

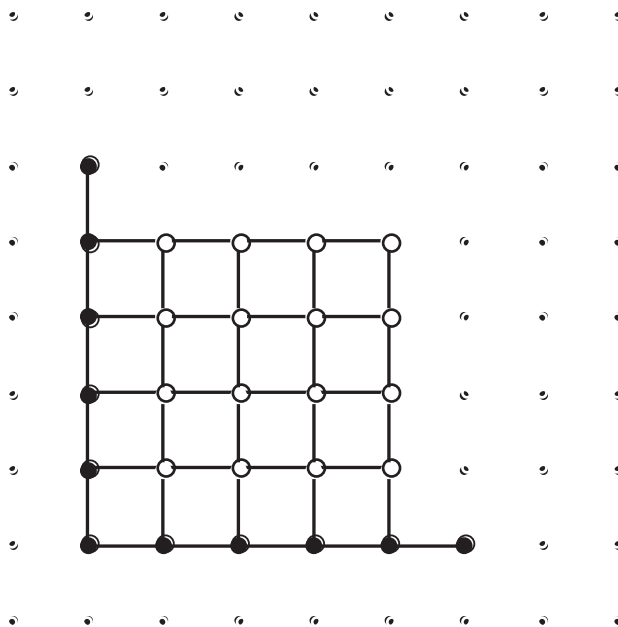
**Diagram 4**

16 white dots  
11 black dots  
42 lines

The four diagrams above are the first four of a pattern.

(a) Diagram 5 has been started below.

Complete this diagram and write down the information about the numbers of dots and lines.



**Diagram 5**

..... white dots

..... black dots

..... lines

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(b) Complete the information about the number of dots and lines in Diagram 8.

*Answer(b)* ..... white dots  
..... black dots  
..... lines [3]

(c) Complete the information about the number of dots in Diagram  $n$ .  
Give your answers in terms of  $n$ .

*Answer(c)* ..... white dots  
..... black dots [2]

(d) The number of lines in diagram  $n$  is  $k(n^2 + n + 1)$ .

Find

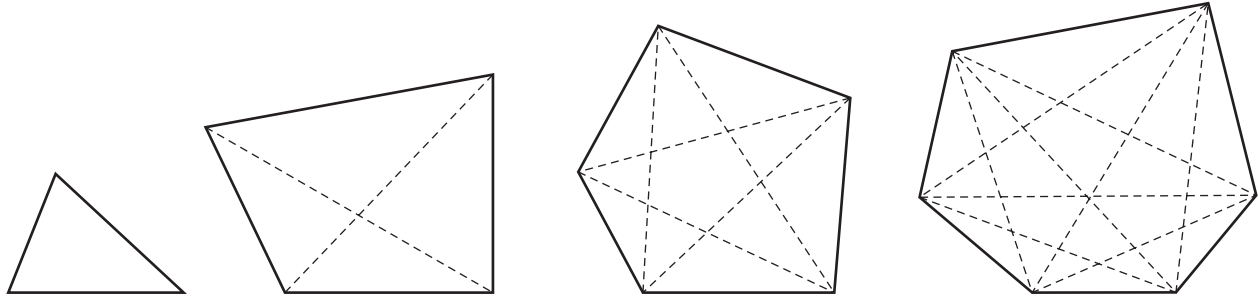
(i) the value of  $k$ ,

*Answer(d)(i)*  $k =$  ..... [1]

(ii) the number of lines in Diagram 100.

*Answer(d)(ii)* ..... [1]

10



The diagrams show some polygons and their diagonals.

(a) Complete the table.

Number of sides	Name of polygon	Total number of diagonals
3	triangle	0
4	quadrilateral	2
5		5
6	hexagon	9
7	heptagon	14
8		

[3]

(b) Write down the total number of diagonals in

(i) a decagon (a 10-sided polygon),

Answer(b)(i) ..... [1]

(ii) a 12-sided polygon.

Answer(b)(ii) ..... [1]

(c) A polygon with  $n$  sides has a total of  $\frac{1}{p}n(n - q)$  diagonals, where  $p$  and  $q$  are integers.

(i) Find the values of  $p$  and  $q$ .

*Answer(c)(i)*  $p =$  .....

$q =$  ..... [3]

(ii) Find the total number of diagonals in a polygon with 100 sides.

*Answer(c)(ii)* ..... [1]

(iii) Find the number of sides of a polygon which has a total of 170 diagonals.

*Answer(c)(iii)* ..... [2]

(d) A polygon with  $n + 1$  sides has 30 more diagonals than a polygon with  $n$  sides.

Find  $n$ .

*Answer(d)*  $n =$  ..... [1]

10

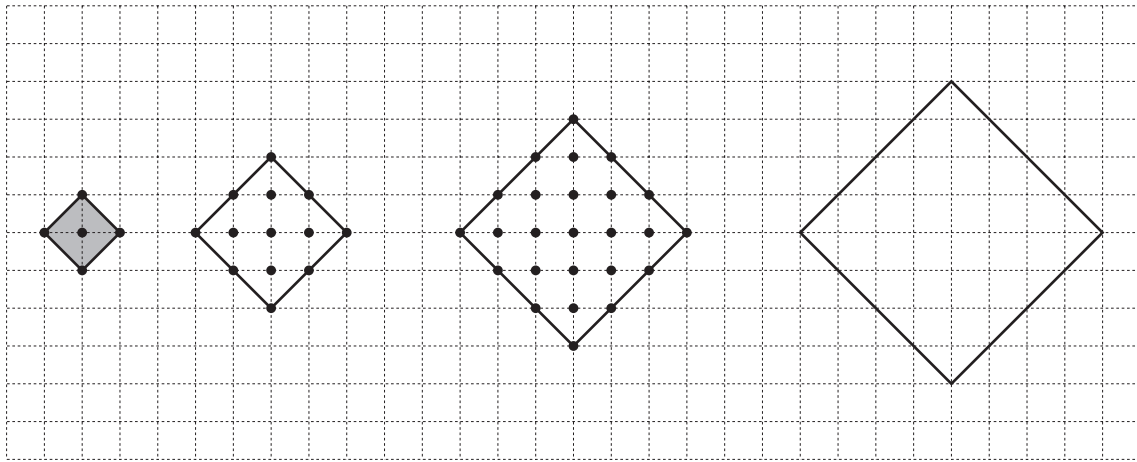


Diagram 1

Diagram 2

Diagram 3

Diagram 4

The diagrams show squares and dots on a grid.

Some dots are on the sides of each square and other dots are inside each square.

The area of the square (shaded) in Diagram 1 is 1 unit<sup>2</sup>.

(a) Complete Diagram 4 by marking all the dots. [1]

(b) Complete the columns in the table below for Diagrams 4, 5 and  $n$ .

Diagram	1	2	3	4	5	-----	$n$
Number of units of area	1	4	9			-----	
Number of dots inside the square	1	5	13			-----	$(n - 1)^2 + n^2$
Number of dots on the sides of the square	4	8	12			-----	
Total number of dots	5	13	25			-----	

[7]

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(c) For Diagram 200, find the number of dots

(i) inside the square,

*Answer(c)(i)* ..... [1]

(ii) on the sides of the square.

*Answer(c)(ii)* ..... [1]

(d) Which diagram has 265 dots inside the square?

*Answer(d)* ..... [1]

4) November 2010 V1

9 (a) The first five terms  $P_1, P_2, P_3, P_4$  and  $P_5$  of a sequence are given below.

$$1 = 1 = P_1$$

$$1 + 2 = 3 = P_2$$

$$1 + 2 + 3 = 6 = P_3$$

$$1 + 2 + 3 + 4 = 10 = P_4$$

$$1 + 2 + 3 + 4 + 5 = 15 = P_5$$

(i) Write down the next term,  $P_6$ , in the sequence 1, 3, 6, 10, 15...

Answer(a)(i) ..... [1]

(ii) The formula for the  $n$ th term of this sequence is

$$P_n = \frac{1}{2}n(n + 1).$$

Show this formula is true when  $n = 6$ .

Answer (a)(ii)

[1]

(iii) Use the formula to find  $P_{50}$ , the 50th term of this sequence.

Answer(a)(iii) ..... [1]

(iv) Use your answer to **part (iii)** to find  $3 + 6 + 9 + 12 + 15 + \dots + 150$ .

Answer(a)(iv) ..... [1]

(v) Find  $1 + 2 + 3 + 4 + 5 + \dots + 150$ .

Answer(a)(v) ..... [1]

(vi) Use your answers to **parts (iv)** and **(v)** to find the sum of the numbers less than 150 which are **not** multiples of 3.

Answer(a)(vi) ..... [1]

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This question continues on the next page.

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(b) The first five terms,  $S_1, S_2, S_3, S_4$  and  $S_5$  of a different sequence are given below.

$$\begin{aligned} (1 \times 1) &= 1 = S_1 \\ (1 \times 2) + (2 \times 1) &= 4 = S_2 \\ (1 \times 3) + (2 \times 2) + (3 \times 1) &= 10 = S_3 \\ (1 \times 4) + (2 \times 3) + (3 \times 2) + (4 \times 1) &= 20 = S_4 \\ (1 \times 5) + (2 \times 4) + (3 \times 3) + (4 \times 2) + (5 \times 1) &= 35 = S_5 \end{aligned}$$

(i) Work out the next term,  $S_6$ , in the sequence 1, 4, 10, 20, 35...

*Answer(b)(i)* ..... [2]

(ii) The formula for the  $n$ th term of this sequence is

$$S_n = \frac{1}{6}n(n+1)(n+2).$$

Show this formula is true for  $n = 6$ .

*Answer(b)(ii)*

[1]

(iii) Find  $(1 \times 20) + (2 \times 19) + (3 \times 18) \dots + (20 \times 1)$ .

*Answer(b)(iii)* ..... [1]

(c) Show that  $S_6 - S_5 = P_6$ , where  $P_6$  is your answer to **part (a)(i)**.

*Answer(c)*

[1]

(d) Show by algebra that  $S_n - S_{n-1} = P_n$ .  $[P_n = \frac{1}{2}n(n+1)]$

*Answer(d)*



10 In all the following sequences, after the first two terms, the rule is to add the previous two terms to find the next term.

(a) Write down the next two terms in this sequence.

1      1      2      3      5      8      13      .....      .....      [1]

(b) Write down the first two terms of this sequence.

.....      .....      3      11      14      [2]

(c) (i) Find the value of  $d$  and the value of  $e$ .

2       $d$        $e$       10

Answer(c)(i)  $d =$  .....

$e =$  ..... [3]

(ii) Find the value of  $x$ , the value of  $y$  and the value of  $z$ .

-33       $x$        $y$        $z$       18

Answer(c)(ii)  $x =$  .....

$y =$  .....

$z =$  ..... [5]

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11

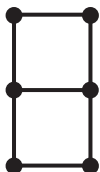


Diagram 1

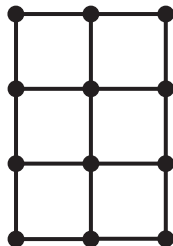


Diagram 2

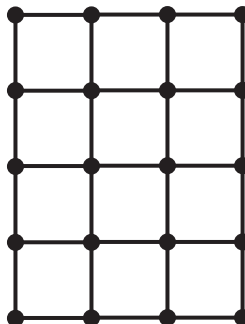


Diagram 3

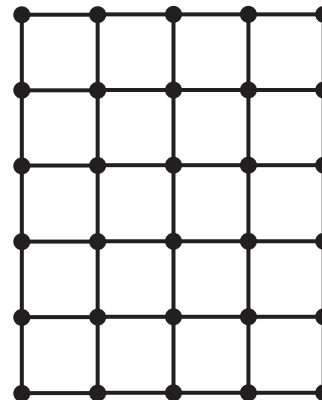


Diagram 4

The first four Diagrams in a sequence are shown above.  
 Each Diagram is made from dots and one centimetre lines.  
 The area of each small square is  $1 \text{ cm}^2$ .

(a) Complete the table for Diagrams 5 and 6.

Diagram	1	2	3	4	5	6
Area ( $\text{cm}^2$ )	2	6	12	20		
Number of dots	6	12	20	30		
Number of one centimetre lines	7	17	31	49		

[4]

(b) The **area** of Diagram  $n$  is  $n(n+1) \text{ cm}^2$ .

(i) Find the **area** of Diagram 50.

Answer(b)(i) .....  $\text{cm}^2$  [1]

(ii) Which Diagram has an **area** of  $930 \text{ cm}^2$ ?

Answer(b)(ii) ..... [1]

(c) Find, in terms of  $n$ , the number of **dots** in Diagram  $n$ .

Answer(c) ..... [1]

(d) The number of one centimetre lines in Diagram  $n$  is  $2n^2 + pn + 1$ .

(i) Show that  $p = 4$ .

*Answer(d)(i)*

[2]

(ii) Find the number of one centimetre lines in Diagram 10.

*Answer(d)(ii)* ..... [1]

(iii) Which Diagram has 337 one centimetre lines?

*Answer(d)(iii)* ..... [3]

(e) For **each** Diagram, the number of squares of area  $1 \text{ cm}^2$  is  $A$ , the number of dots is  $D$  and the number of one centimetre lines is  $L$ .

Find a connection between  $A$ ,  $D$  and  $L$  that is true for each Diagram.

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*Answer(e)* ..... [1]  
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10 The first and the  $n$ th terms of sequences  $A$ ,  $B$  and  $C$  are shown in the table below.

(a) Complete the table for each sequence.

	1st term	2nd term	3rd term	4th term	5th term	$n$ th term
Sequence $A$	1					$n^3$
Sequence $B$	4					$4n$
Sequence $C$	4					$(n + 1)^2$

[5]

(b) Find

(i) the 8th term of sequence  $A$ ,

Answer(b)(i) ..... [1]

(ii) the 12th term of sequence  $C$ .

Answer(b)(ii) ..... [1]

(c) (i) Which term in sequence  $A$  is equal to 15 625?

Answer(c)(i) ..... [1]

(ii) Which term in sequence  $C$  is equal to 10 000?

Answer(c)(ii) ..... [1]

(d) The first four terms of sequences  $D$  and  $E$  are shown in the table below.

Use the results from **part (a)** to find the 5th and the  $n$ th terms of the sequences  $D$  and  $E$ .

	1st term	2nd term	3rd term	4th term	5th term	$n$ th term
Sequence $D$	5	16	39	80		
Sequence $E$	0	1	4	9		

[4]

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9 (a) (i) Work out the first 3 terms of the sequence whose  $n$ th term is  $n(n + 2)$ .

Answer(a)(i) ..... , ..... , ..... [2]

(ii) Which term in this sequence is equal to 168?

Answer(a)(ii) ..... [3]

(b) Find a formula for the  $n$ th term of the following sequences.

(i) 5      8      11      14      17 .....

Answer(b)(i) ..... [2]

(ii) 1      2      4      8      16 .....

Answer(b)(ii) ..... [2]

(c)



Diagram 1

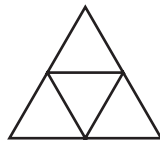


Diagram 2

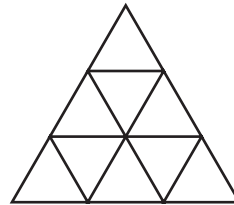


Diagram 3

A sequence of diagrams is formed by drawing equilateral triangles each of side one centimetre.  
 Diagram 1 has 3 one centimetre lines.  
 Diagram 2 has 9 one centimetre lines.

The formula for the **total** number of one centimetre lines needed to draw **all of the first  $n$  diagrams** is

$$an^3 + bn^2 + n.$$

Find the values of  $a$  and  $b$ .

Answer(c)  $a =$  .....

$b =$  ..... [6]

11 (a) (i) The first three positive integers 1, 2 and 3 have a sum of 6.

Write down the sum of the first 4 positive integers.

Answer(a)(i) ..... [1]

(ii) The formula for the sum of the first  $n$  integers is  $\frac{n(n+1)}{2}$ .

Show the formula is correct when  $n = 3$ .

Answer(a)(ii)

[1]

(iii) Find the sum of the first 120 positive integers.

Answer(a)(iii) ..... [1]

(iv) Find the sum of the integers

121 + 122 + 123 + 124 + ..... + 199 + 200.

Answer(a)(iv) ..... [2]

(v) Find the sum of the even numbers

2 + 4 + 6 + ..... + 800.

Answer(a)(v) ..... [2]

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(b) (i) Complete the following statements about the sums of cubes and the sums of integers.

$$1^3 = 1$$

$$1 = 1$$

$$1^3 + 2^3 = 9$$

$$1 + 2 = 3$$

$$1^3 + 2^3 + 3^3 = \dots\dots\dots$$

$$1 + 2 + 3 = \dots\dots\dots$$

$$1^3 + 2^3 + 3^3 + 4^3 = \dots\dots\dots$$

$$1 + 2 + 3 + 4 = \dots\dots\dots \quad [2]$$

(ii) The sum of the first 14 integers is 105.

Find the sum of the first 14 cubes.

*Answer(b)(ii)* ..... [1]

(iii) Use the formula in **part(a)(ii)** to write down a formula for the sum of the first  $n$  cubes.

*Answer(b)(iii)* ..... [1]

(iv) Find the sum of the first 60 cubes.

*Answer(b)(iv)* ..... [1]

(v) Find  $n$  when the sum of the first  $n$  cubes is 278 784.

*Answer(b)(v) n =* ..... [2]

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12 (a) The  $n$ th term of a sequence is  $n(n+1)$ .

(i) Write the two missing terms in the spaces. 2, 6, ....., 20, ..... [2]

(ii) Write down an expression in terms of  $n$  for the  $(n + 1)$ th term.

Answer(a)(ii) ..... [1]

(iii) The difference between the  $n$ th term and the  $(n + 1)$ th term is  $pn + q$ .

Find the values of  $p$  and  $q$ .

Answer(a)(iii)  $p =$  .....

$q =$  ..... [2]

(iv) Find the positions of the two consecutive terms which have a difference of 140.

Answer(a)(iv) ..... and ..... [2]

(b) A sequence  $u_1, u_2, u_3, u_4, \dots$  is given by the following rules.

$$u_1 = 2, \quad u_2 = 3 \quad \text{and} \quad u_n = 2u_{n-2} + u_{n-1} \quad \text{for } n \geq 3.$$

For example, the third term is  $u_3$  and  $u_3 = 2u_1 + u_2 = 2 \times 2 + 3 = 7$ .

So, the sequence is 2, 3, 7,  $u_4$ ,  $u_5$ , .....

(i) Show that  $u_4 = 13$ .

Answer(b)(i) ..... [1]

(ii) Find the value of  $u_5$ .

Answer(b)(ii)  $u_5 =$  ..... [1]

(iii) Two consecutive terms of the sequence are 3413 and 6827.

Find the term before and the term after these two given terms.

Answer(b)(iii) ....., 3413, 6827, ..... [2]

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(b) (i) Write the four missing terms in the table for sequences A, B, C and D.

Term	1	2	3	4	5		$n$
Sequence A	-4		2	5	8		$3n - 7$
Sequence B	1	4	9	16	25		
Sequence C	5	10	15	20	25		
Sequence D	6	14	24	36	50		

[4]

(ii) Which term in sequence D is equal to 500?

Answer(b)(ii) ..... [2]

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345

11

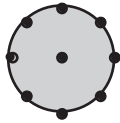


Diagram 1

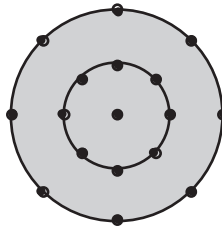


Diagram 2

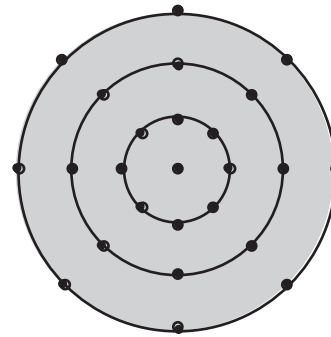


Diagram 3

The diagrams show a sequence of dots and circles.  
 Each diagram has one dot at the centre and 8 dots on each circle.  
 The radius of the first circle is 1 unit.  
 The radius of each new circle is 1 unit greater than the radius of the previous circle.

(a) Complete the table for diagrams 4 and 5.

Diagram	1	2	3	4	5
Number of dots	9	17	25		
Area of the largest circle	$\pi$	$4\pi$	$9\pi$		
Total length of the circumferences of the circles	$2\pi$	$6\pi$	$12\pi$		

(b) (i) Write down, in terms of  $n$ , the number of dots in diagram  $n$ . [4]

Answer(b)(i) ..... [2]

(ii) Find  $n$ , when the number of dots in diagram  $n$  is 1097.

Answer(b)(ii)  $n =$  ..... [2]

(c) Write down, in terms of  $n$  and  $\pi$ , the area of the largest circle in

(i) diagram  $n$ ,

Answer(c)(i) ..... [1]

(ii) diagram  $3n$ .

Answer(c)(ii) ..... [1]

(d) Find, in terms of  $n$  and  $\pi$ , the total length of the circumferences of the circles in diagram  $n$ .

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Answer(d) ..... [2]

10 (a) Complete the table for the 6th term and the  $n$ th term in each sequence.

	Sequence	6th term		$n$ th term
<i>A</i>	11, 9, 7, 5, 3			
<i>B</i>	1, 4, 9, 16, 25			
<i>C</i>	2, 6, 12, 20, 30			
<i>D</i>	3, 9, 27, 81, 243			
<i>E</i>	1, 3, 15, 61, 213			

[12]

(b) Find the value of the 100th term in

(i) Sequence *A*,

Answer(b)(i) ..... [1]

(ii) Sequence *C*.

Answer(b)(ii) ..... [1]

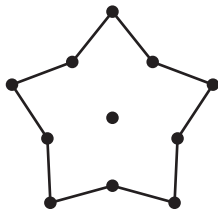
(c) Find the value of  $n$  in Sequence  $D$  when the  $n$ th term is equal to 6561.

*Answer(c)*  $n =$  ..... [1]

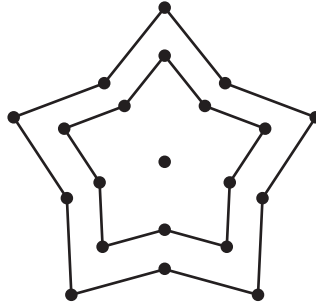
(d) Find the value of the 10th term in Sequence  $E$ .

*Answer(d)* ..... [1]

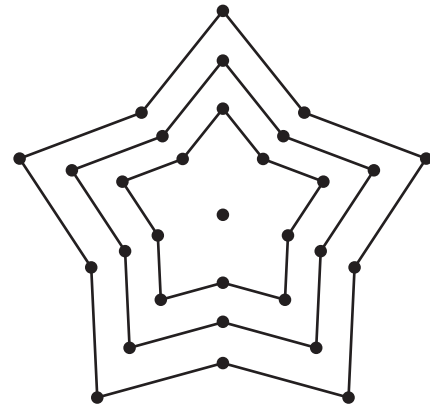
10



Star 1



Star 2



Star 3

The diagrams show a sequence of stars made of lines and dots.

(a) Complete the table for Star 5, Star 7 and Star  $n$ .

	Star 1	Star 2	Star 3	Star 4	Star 5		Star 7		Star $n$
Number of lines	10	20	30	40					
Number of dots	11	21	31	41					

[4]

(b) The sums of the number of dots in two consecutive stars are shown in the table.

Star 1 and Star 2	Star 2 and Star 3	Star 3 and Star 4
32	52	72

Find the sum of the number of dots in

(i) Star 10 and Star 11,

Answer(b)(i) ..... [1]

(ii) Star  $n$  and Star  $(n + 1)$ ,

Answer(b)(ii) ..... [1]

(iii) Star  $(n + 7)$  and Star  $(n + 8)$ .

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Answer(b)(iii) ..... 349

(c) The **total number of dots** in the first  $n$  stars is given by the expression  $5n^2 + 6n$ .

(i) Show that this expression is correct when  $n = 3$ .

*Answer(c)(i)*

[2]

(ii) Find the total number of dots in the first 10 stars.

*Answer(c)(ii)* ..... [1]

(d) The total number of dots in the first  $n$  stars is  $5n^2 + 6n$ .

The number of dots in the  $(n + 1)$ th star is  $10(n + 1) + 1$ .

Add these two expressions to show that the total number of dots in the first  $(n + 1)$  stars is

$$5(n + 1)^2 + 6(n + 1).$$

You must show each step of your working.

*Answer(d)*

10

(b)  $1^2 = 1$

$1^2 + 2^2 = 5$

$1^2 + 2^2 + 3^2 = 14$

$1^2 + 2^2 + 3^2 + 4^2 = 30$

$1^2 + 2^2 + 3^2 + 4^2 + \dots + n^2 = an^3 + bn^2 + \frac{n}{6}$

Work out the values of  $a$  and  $b$ .

Answer(b)  $a = \dots\dots\dots$

$b = \dots\dots\dots$  [6]

10 (a)	1	= 1
	1 + 2	= 3
	1 + 2 + 3	= 6
	1 + 2 + 3 + 4	= 10

(i) Write down the next line of this pattern.

Answer(a)(i) ..... [1]

(ii) The sum of the first  $n$  integers is  $\frac{n}{k}(n + 1)$ .

Show that  $k = 2$ .

Answer(a)(ii)

[2]

(iii) Find the sum of the first 60 integers.

Answer(a)(iii) ..... [1]

(iv) Find  $n$  when the sum of the first  $n$  integers is 465.

Answer(a)(iv)  $n =$  ..... [2]

(v)  $1 + 2 + 3 + 4 + \dots + x = \frac{(n - 8)(n - 7)}{2}$

Write  $x$  in terms of  $n$ .

Answer(a)(v)  $x =$  ..... [1]



(b)	$1^3$	$= 1$
	$1^3 + 2^3$	$= 9$
	$1^3 + 2^3 + 3^3$	$= 36$
	$1^3 + 2^3 + 3^3 + 4^3$	$= 100$

(i) Complete the statement.

$$1^3 + 2^3 + 3^3 + 4^3 + 5^3 = \dots\dots\dots = (\dots\dots\dots)^2 \quad [2]$$

(ii) The sum of the first  $n$  integers is  $\frac{n}{2}(n + 1)$ .

Find an expression, in terms of  $n$ , for the sum of the first  $n$  cubes.

*Answer(b)(ii)* ..... [1]

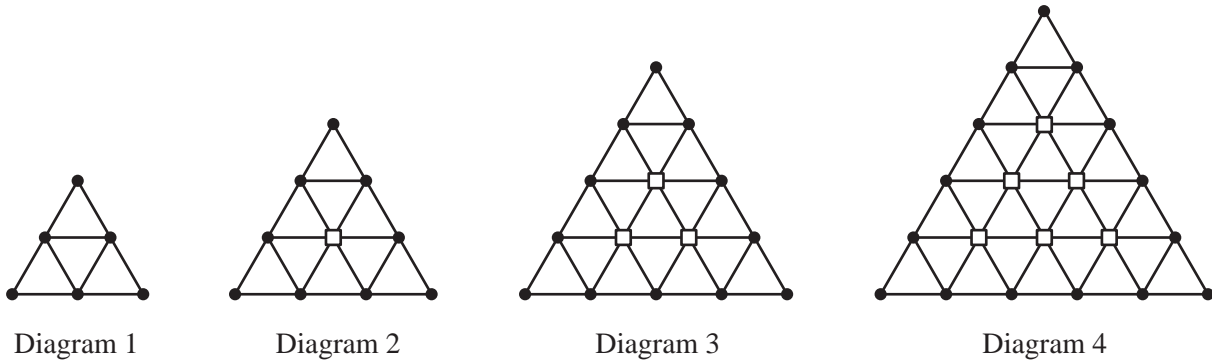
(iii) Find the sum of the first 19 cubes.

*Answer(b)(iii)* ..... [2]

- 10 Complete the table for the following sequences.  
The first row has been completed for you.

	Sequence				Next two terms		$n$ th term	
	1	5	9	13	17	21	$4n - 3$	
(a)	12	21	30	39				[3]
(b)	80	74	68	62				[3]
(c)	1	8	27	64				[2]
(d)	2	10	30	68				[2]

9 The first four diagrams in a sequence are shown below.



The diagrams are made from dots (●) and squares (□) joined by lines.

(a) Complete the table.

Diagram	1	2	3	4	5		n
Number of dots	6	9	12				
Number of squares	0	1	3				$\frac{1}{2}n(n-1)$
Number of triangles	4	9	16				
Number of lines	9	18	30	45	63		$\frac{3}{2}(n+1)(n+2)$

[9]

(b) Which diagram has 360 lines?

Answer(b) ..... [2]

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(c) The **total** number of lines in the first  $n$  diagrams is

$$\frac{1}{2}n^3 + pn^2 + qn.$$

(i) When  $n = 1$ , show that  $p + q = 8\frac{1}{2}$ .

*Answer(c)(i)*

[1]

(ii) By choosing another value of  $n$  and using the equation in **part (c)(i)**, find the values of  $p$  and  $q$ .

*Answer(c)(ii)*  $p = \dots\dots\dots$

$q = \dots\dots\dots$  [5]

11

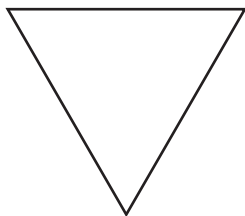


Diagram 1

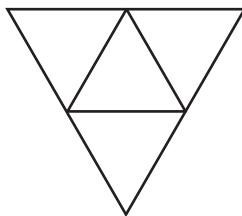


Diagram 2

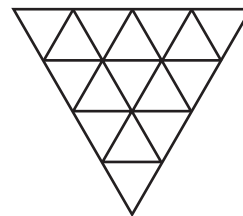


Diagram 3

The first three diagrams in a sequence are shown above.  
Diagram 1 shows an equilateral triangle with sides of length 1 unit.

In Diagram 2, there are 4 triangles with sides of length  $\frac{1}{2}$  unit.

In Diagram 3, there are 16 triangles with sides of length  $\frac{1}{4}$  unit.

(a) Complete this table for Diagrams 4, 5, 6 and  $n$ .

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6	Diagram $n$
Length of side	1	$\frac{1}{2}$	$\frac{1}{4}$				
Length of side as a power of 2	$2^0$	$2^{-1}$	$2^{-2}$				

[6]

(b) (i) Complete this table for the number of the smallest triangles in Diagrams 4, 5 and 6.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of smallest triangles	1	4	16			
Number of smallest triangles as a power of 2	$2^0$	$2^2$	$2^4$			

[2]

(ii) Find the number of the smallest triangles in Diagram  $n$ , giving your answer as a power of 2.

Answer(b)(ii) ..... [1]

(c) Calculate the number of the smallest triangles in the diagram where the smallest triangles have sides of length  $\frac{1}{128}$  unit.

Answer(c) ..... [2]

9

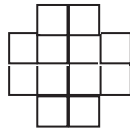


Diagram 1

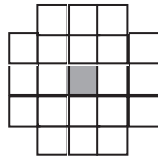


Diagram 2

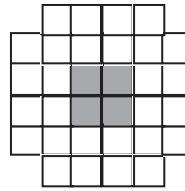


Diagram 3

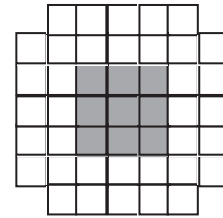


Diagram 4

The first four diagrams in a sequence are shown above.

The diagrams are drawn using white squares  $\square$  and grey squares  $\blacksquare$ .

(a) Complete the columns in the table for Diagram 4 and Diagram  $n$ .

Diagram	1	2	3	4		$n$
Number of white squares	12	20	28			
Number of grey squares	0	1	4			
Total number of squares	12	21	32			$(n + 1)(n + 5)$

[6]

(b) Work out the number of the diagram which has a total of 480 squares.

Answer(b) ..... [2]

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(c) The **total** number of squares in the **first  $n$  diagrams** is

$$\frac{1}{3}n^3 + pn^2 + qn.$$

(i) Use  $n = 1$  in this expression to show that  $p + q = 11\frac{2}{3}$ .

*Answer(c)(i)*

[1]

(ii) Use  $n = 2$  in the expression to show that  $4p + 2q = 30\frac{1}{3}$ .

*Answer(c)(ii)*

[2]

(iii) Find the values of  $p$  and  $q$ .

*Answer(c)(iii)*  $p = \dots\dots\dots$

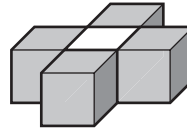
$q = \dots\dots\dots$  [3]

9

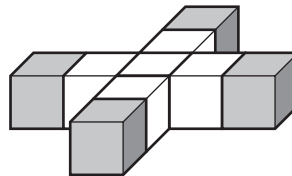
Layer 1



Layer 2



Layer 3



The diagrams show layers of white and grey cubes.  
Khadega places these layers on top of each other to make a tower.

(a) Complete the table for towers with 5 and 6 layers.

Number of layers	1	2	3	4	5	6
<b>Total</b> number of <b>white</b> cubes	0	1	6	15		
<b>Total</b> number of <b>grey</b> cubes	1	5	9	13		
<b>Total</b> number of cubes	1	6	15	28		

[4]

(b) (i) Find, in terms of  $n$ , the **total** number of **grey** cubes in a tower with  $n$  layers.

*Answer(b)(i)* ..... [2]

(ii) Find the total number of grey cubes in a tower with 60 layers.

*Answer(b)(ii)* ..... [1]

(iii) Khadega has plenty of white cubes but only 200 grey cubes.  
How many layers are there in the highest tower that she can build?

*Answer(b)(iii)* ..... [2]

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(c) The expression for the **total** number of **white** cubes in a tower with  $n$  layers is  $pn^2 + qn + 3$ .

Find the value of  $p$  and the value of  $q$ .  
Show all your working.

Answer(c)  $p = \dots\dots\dots$

$q = \dots\dots\dots$  [5]

(d) Find an expression, in terms of  $n$ , for the **total** number of cubes in a tower with  $n$  layers.  
Give your answer in its simplest form.

Answer(d)  $\dots\dots\dots$  [2]

11 The first four terms of sequences A, B, C and D are shown in the table.

Sequence	1st term	2nd term	3rd term	4th term	5th term	<i>n</i> th term
A	$\frac{1}{3}$	$\frac{2}{4}$	$\frac{3}{5}$	$\frac{4}{6}$		
B	3	4	5	6		
C	-1	0	1	2		
D	-3	0	5	12		

(a) Complete the table.

[8]

(b) Which term in sequence A is equal to  $\frac{36}{37}$ ?

Answer(b) ..... [2]

(c) Which term in sequence D is equal to 725?

Answer(c) ..... [2]

- 9 The first three diagrams in a sequence are shown below.  
The diagrams are made by drawing lines of length 1 cm.



Diagram 1

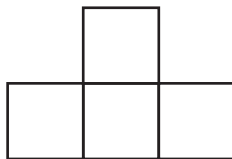


Diagram 2

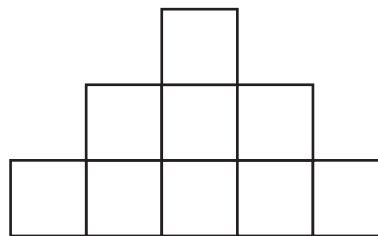


Diagram 3

- (a) The areas of each of the first three diagrams are shown in this table.

Diagram	1	2	3
Area (cm <sup>2</sup> )	1	4	9

- (i) Find the area of Diagram 4.

Answer(a)(i) ..... cm<sup>2</sup> [1]

- (ii) Find, in terms of  $n$ , the area of Diagram  $n$ .

Answer(a)(ii) ..... cm<sup>2</sup> [1]

- (b) The numbers of 1 cm lines needed to draw each of the first three diagrams are shown in this table.

Diagram	1	2	3
Number of 1 cm lines	4	13	26

- (i) Find the number of 1 cm lines needed to draw Diagram 4.

Answer(b)(i) ..... [1]

- (ii) In which diagram are 118 lines of length 1 cm needed?

Answer(b)(ii) ..... [1]

- (c) The **total** number of 1 cm lines needed to draw both Diagram 1 and Diagram 2 is 17.  
The **total** number of 1 cm lines needed to draw all of the first  $n$  diagrams is

$$\frac{2}{3}n^3 + an^2 + bn.$$

Find the value of  $a$  and the value of  $b$ .  
Show all your working.

*Answer(c)*  $a = \dots\dots\dots$

$b = \dots\dots\dots$  [6]

10 Complete the table for each sequence.

Sequence	1st term	2nd term	3rd term	4th term	5th term	6th term		$n$ th term
A	15	8	1	-6				
B	$\frac{5}{18}$	$\frac{6}{19}$	$\frac{7}{20}$	$\frac{8}{21}$				
C	2	5	10	17				
D	2	6	18	54				

[11]

11

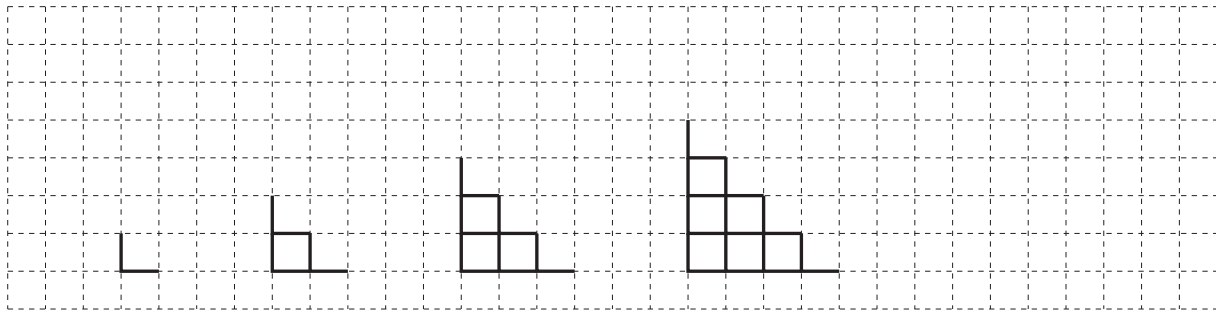


Diagram 1

Diagram 2

Diagram 3

Diagram 4

Diagram 5

Diagram 1 shows two lines of length 1 unit at right angles forming an .

Two s are added to Diagram 1 to make Diagram 2. This forms one small square.

Three s are added to Diagram 2 to make Diagram 3. This forms three small squares.  
The sequence of Diagrams continues.

(a) Draw Diagram 5.

[1]

(b) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5
Number of lines of length 1 unit	2	6	12	20	
Number of small squares	0	1	3	6	

[2]

(c) Find an expression, in terms of  $n$ , for the number of lines of length 1 unit in Diagram  $n$ .

Answer(c) ..... [2]

(d) Find an expression, in terms of  $n$ , for the number of small squares in Diagram  $n$ .

Answer(d) ..... [2]

10

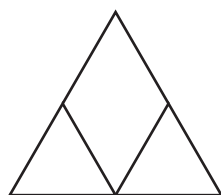


Diagram 1

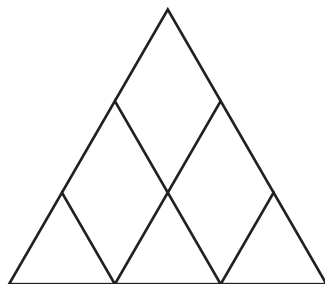


Diagram 2

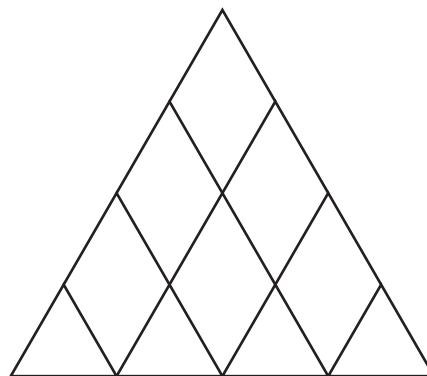


Diagram 3

Each diagram is made from tiles in the shape of equilateral triangles and rhombuses. The length of a side of each tile is 1 unit.

(a) Complete the table below for this sequence of diagrams.

Diagram	1	2	3	4	5
Number of equilateral triangle shaped tiles	2	3	4	5	6
Number of rhombus shaped tiles	1	3	6		
Total number of tiles	3	6	10		
Number of 1 unit lengths	8	15	24		

[6]

(b) (i) The number of 1 unit lengths in Diagram  $n$  is  $n^2 + 4n + p$ .

Find the value of  $p$ .

$p = \dots\dots\dots$  [2]

(ii) Calculate the number of 1 unit lengths in Diagram 10.

$\dots\dots\dots$  [1]

(c) The total number of tiles in Diagram  $n$  is  $an^2 + bn + 1$ .

Find the value of  $a$  and the value of  $b$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$  [5]

(d) Part of the Louvre museum in Paris is in the shape of a square-based pyramid made from glass tiles. Each of the triangular faces of the pyramid is represented by Diagram 17 in the sequence.

(i) Calculate the total number of glass tiles on one triangular face of this pyramid.

$\dots\dots\dots$  [2]

(ii) 11 tiles are removed from one of the triangular faces to create an entrance into the pyramid.

Calculate the total number of glass tiles used to construct this pyramid.

$\dots\dots\dots$  [1]



9 (a) The  $n$ th term of a sequence is  $8n - 3$ .

(i) Write down the first two terms of this sequence.

....., ..... [1]

(ii) Show that the number 203 is not in this sequence.

[2]

(b) Find the  $n$ th term of these sequences.

(i) 13, 19, 25, 31, ...

..... [2]

(ii) 4, 8, 14, 22, ...

..... [2]

(c) ... , 20, 50, ...

The second term of this sequence is 20 and the third term is 50.

The rule for finding the next term in this sequence is subtract  $y$  then multiply by 5.

Find the value of  $y$  and work out the first term of this sequence.

$y =$  .....

First term = ..... [4]

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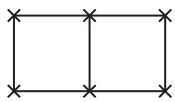


Diagram 1

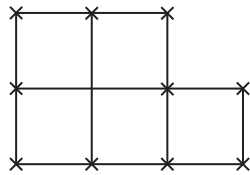


Diagram 2

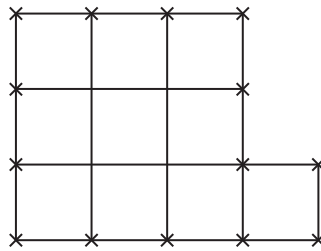


Diagram 3

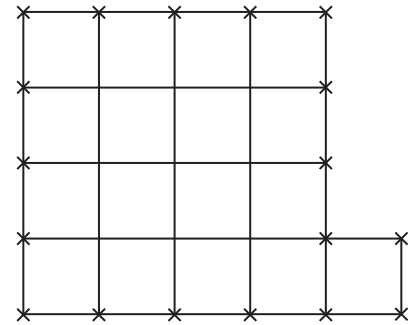


Diagram 4

These are the first four diagrams in a sequence.  
Each diagram is made from small squares and crosses.

(a) Complete the table.

Diagram	1	2	3	4	5		$n$
Number of crosses	6	10	14				
Number of small squares	2	5	10				

[6]

(b) Find the number of crosses in Diagram 60.

..... [1]

(c) Which diagram has 226 squares?

Diagram ..... [1]

(d) The side of each small square has length 1 cm.  
The number of lines of length 1 cm in Diagram  $n$  is  $2n^2 + 2n + q$ .

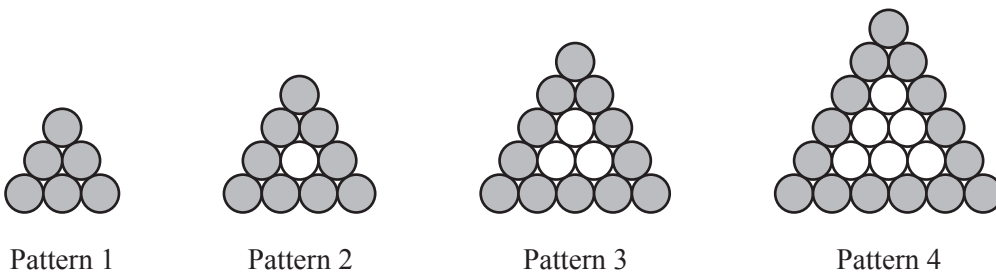
Find the value of  $q$ .

$q =$  ..... [2]

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12 Marco is making patterns with grey and white circular mats.



The patterns form a sequence.

Marco makes a table to show some information about the patterns.

Pattern number	1	2	3	4	5
Number of grey mats	6	9	12	15	
Total number of mats	6	10	15	21	

(a) Complete the table for Pattern 5. [2]

(b) Find an expression, in terms of  $n$ , for the number of grey mats in Pattern  $n$ .

..... [2]

(c) Marco makes a pattern with 24 grey mats.

Find the total number of mats in this pattern.

..... [2]

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- (d) Marco needs a total of 6 mats to make the first pattern.  
He needs a total of 16 mats to make the first two patterns.  
He needs a total of  $\frac{1}{6}n^3 + an^2 + bn$  mats to make the first  $n$  patterns.

Find the value of  $a$  and the value of  $b$ .

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots [6]$$

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11



Diagram 1



Diagram 2

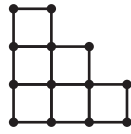


Diagram 3

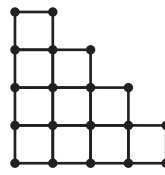


Diagram 4

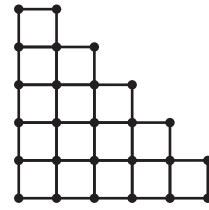


Diagram 5

The sequence of diagrams above is made up of small lines and dots.

(a) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of small lines	4	10	18	28		
Number of dots	4	8	13	19		

[4]

(b) For Diagram  $n$  find an expression, in terms of  $n$ , for the number of small lines.

..... [2]

(c) Diagram  $r$  has 10 300 small lines.

Find the value of  $r$ .

$r =$  ..... [2]

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(d) The number of dots in Diagram  $n$  is  $an^2 + bn + 1$ .

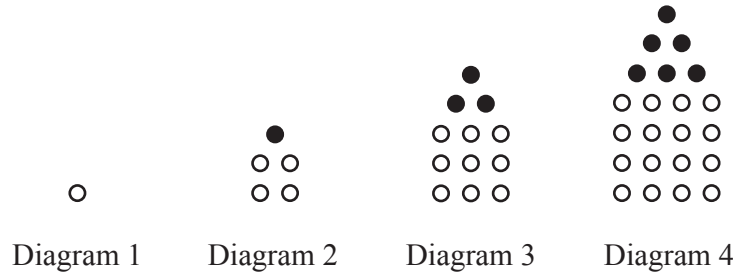
Find the value of  $a$  and the value of  $b$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$  [2]

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These are the first four diagrams of a sequence.  
The diagrams are made from white dots and black dots.

(a) Complete the table for Diagram 5 and Diagram 6.

Diagram	1	2	3	4	5	6
Number of white dots	1	4	9	16		
Number of black dots	0	1	3	6		
Total number of dots	1	5	12	22		

[2]

(b) Write an expression, in terms of  $n$ , for the number of white dots in Diagram  $n$ .

..... [1]

(c) The expression for the total number of dots in Diagram  $n$  is  $\frac{1}{2}(3n^2 - n)$ .

(i) Find the total number of dots in Diagram 8.

..... [1]

(ii) Find an expression for the number of black dots in Diagram  $n$ .  
Give your answer in its simplest form.

..... [2]

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(d)  $T$  is the total number of dots used to make **all** of the first  $n$  diagrams.

$$T = an^3 + bn^2$$

Find the value of  $a$  and the value of  $b$ .  
You must show all your working.

$a =$  .....

$b =$  ..... [5]

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11

Sequence	1st term	2nd term	3rd term	4th term	5th term		$n$ th term
A	13	9	5	1			
B	0	7	26	63			
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$			

(a) Complete the table for the three sequences.

[10]

(b) One term in Sequence C is  $\frac{p}{q}$ .

Write down the next term in Sequence C in terms of  $p$  and  $q$ .

..... [2]

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33) November 2020 V3

11 The table shows the first four terms in sequences  $A$ ,  $B$ , and  $C$ .

Sequence	1st term	2nd term	3rd term	4th term	5th term		$n$ th term
$A$	4	9	14	19			
$B$	3	10	29	66			
$C$	1	4	16	64			

Complete the table.

[9]

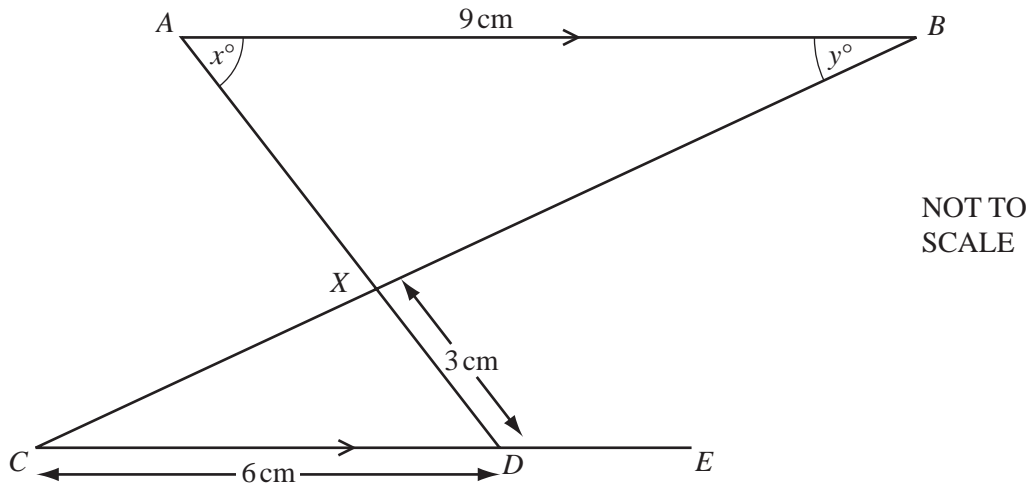
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# Plane Geometry

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9 (a)



The lines  $AB$  and  $CDE$  are parallel.  
 $AD$  and  $CB$  intersect at  $X$ .  
 $AB = 9$  cm,  $CD = 6$  cm and  $DX = 3$  cm.

(i) Complete the following statement.

Triangle  $ABX$  is ..... to triangle  $DCX$ . [1]

(ii) Calculate the length of  $AX$ .

Answer(a)(ii)  $AX =$  ..... cm [2]

(iii) The area of triangle  $DCX$  is  $6 \text{ cm}^2$ .

Calculate the area of triangle  $ABX$ .

Answer(a)(iii) .....  $\text{cm}^2$  [2]

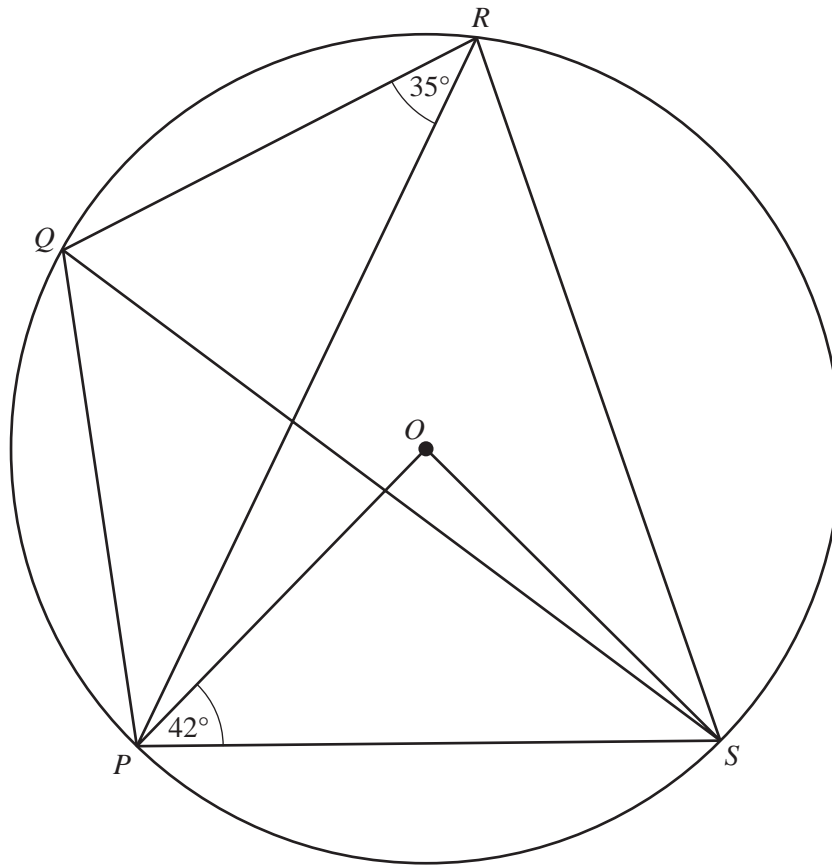
(iv) Angle  $BAX = x^\circ$  and angle  $ABX = y^\circ$ .

Find angle  $AXB$  and angle  $XDE$  in terms of  $x$  and/or  $y$ .

Answer(a)(iv) Angle  $AXB =$  .....

Angle  $XDE =$  ..... [2]

(b)



NOT TO SCALE

$P, Q, R$  and  $S$  lie on a circle, centre  $O$ .  
Angle  $OPS = 42^\circ$  and angle  $PRQ = 35^\circ$ .

Calculate

(i) angle  $POS$ ,

Answer(b)(i) Angle  $POS = \dots\dots\dots$  [1]

(ii) angle  $PRS$ ,

Answer(b)(ii) Angle  $PRS = \dots\dots\dots$  [1]

(iii) angle  $SPQ$ ,

Answer(b)(iii) Angle  $SPQ = \dots\dots\dots$  [1]

(iv) angle  $PSQ$ .

Answer(b)(iv) Angle  $PSQ = \dots\dots\dots$  [1]

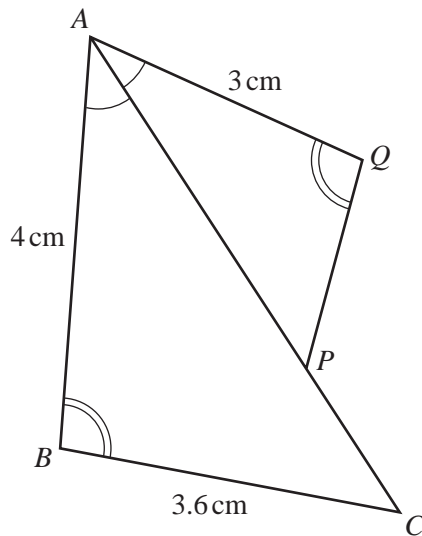
(c) The interior angle of a regular polygon is 8 times as large as the exterior angle.

Calculate the number of sides of the polygon.

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Answer(c)  $\dots\dots\dots$  [3]

5 (a)



NOT TO SCALE

The diagram shows two triangles  $ACB$  and  $APQ$ .

Angle  $PAQ =$  angle  $BAC$  and angle  $AQP =$  angle  $ABC$ .

$AB = 4$  cm,  $BC = 3.6$  cm and  $AQ = 3$  cm.

(i) Complete the following statement.

Triangle  $ACB$  is ..... to triangle  $APQ$ . [1]

(ii) Calculate the length of  $PQ$ .

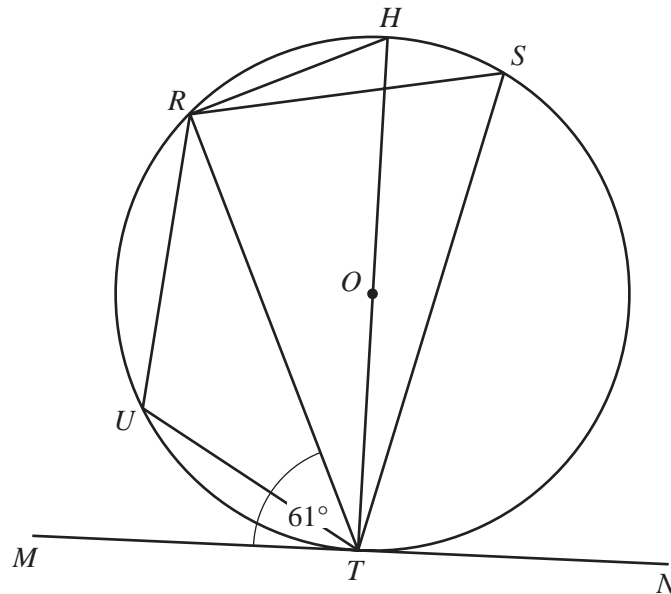
Answer(a)(ii)  $PQ =$  ..... cm [2]

(iii) The area of triangle  $ACB$  is  $5.6$  cm<sup>2</sup>.

Calculate the area of triangle  $APQ$ .

Answer(a)(iii) ..... cm<sup>2</sup> [2]  
382

(b)



NOT TO  
SCALE

$R, H, S, T$  and  $U$  lie on a circle, centre  $O$ .  
 $HT$  is a diameter and  $MN$  is a tangent to the circle at  $T$ .  
Angle  $RTM = 61^\circ$ .

Find

(i) angle  $RTH$ ,

Answer(b)(i) Angle  $RTH = \dots\dots\dots$  [1]

(ii) angle  $RHT$ ,

Answer(b)(ii) Angle  $RHT = \dots\dots\dots$  [1]

(iii) angle  $RST$ ,

Answer(b)(iii) Angle  $RST = \dots\dots\dots$  [1]

(iv) angle  $RUT$ .

Answer(b)(iv) Angle  $RUT = \dots\dots\dots$  [1]

(c)  $ABCDEF$  is a hexagon.

The interior angle  $B$  is  $4^\circ$  greater than interior angle  $A$ .

The interior angle  $C$  is  $4^\circ$  greater than interior angle  $B$ , and so on, with each of the next interior angles  $4^\circ$  greater than the previous one.

(i) By how many degrees is interior angle  $F$  greater than interior angle  $A$ ?

Answer(c)(i)  $\dots\dots\dots$  [1]

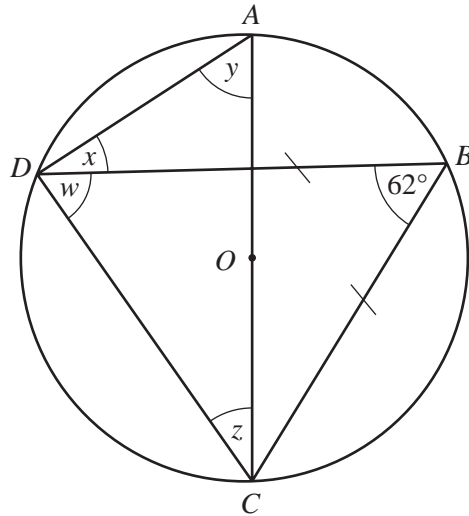
(ii) Calculate interior angle  $A$ .

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Answer(c)(ii)  $\dots\dots\dots$  38 [3]

7 (a)



NOT TO  
SCALE

$A, B, C$  and  $D$  are points on the circumference of a circle centre  $O$ .  
 $AC$  is a diameter.

$BD = BC$  and angle  $DBC = 62^\circ$ .

Work out the values of  $w, x, y$  and  $z$ .  
Give a reason for each of your answers.

$w =$  ..... because ..... [2]

$x =$  ..... because ..... [2]

$y =$  ..... because ..... [2]

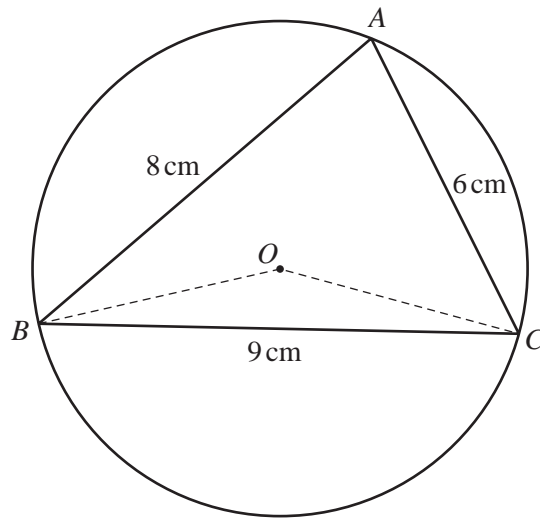
$z =$  ..... because ..... [2]

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4



NOT TO SCALE

The circle, centre  $O$ , passes through the points  $A$ ,  $B$  and  $C$ .

In the triangle  $ABC$ ,  $AB = 8$  cm,  $BC = 9$  cm and  $CA = 6$  cm.

(a) Calculate angle  $BAC$  and show that it rounds to  $78.6^\circ$ , correct to 1 decimal place.

*Answer(a)*

[4]

(b)  $M$  is the midpoint of  $BC$ .

(i) Find angle  $BOM$ .

*Answer(b)(i)* Angle  $BOM = \dots\dots\dots$  [1]

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- (ii) Calculate the radius of the circle and show that it rounds to 4.59 cm, correct to 3 significant figures.

*Answer(b)(ii)*

[3]

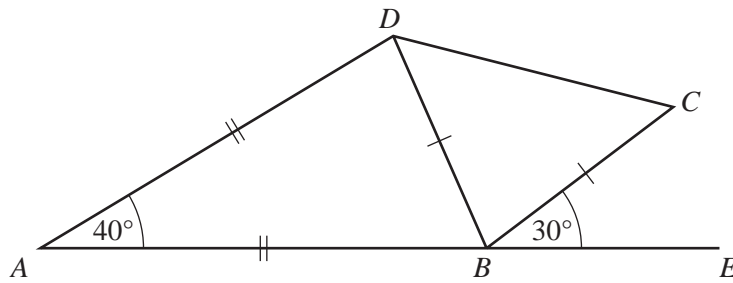
- (c) Calculate the area of the triangle  $ABC$  as a percentage of the area of the circle.

*Answer(c)* ..... % [4]

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3 (a)



NOT TO SCALE

$ABCD$  is a quadrilateral with angle  $BAD = 40^\circ$ .  
 $AB$  is extended to  $E$  and angle  $EBC = 30^\circ$ .  
 $AB = AD$  and  $BD = BC$ .

(i) Calculate angle  $BCD$ .

Answer(a)(i) Angle  $BCD =$  ..... [3]

(ii) Give a reason why  $DC$  is not parallel to  $AE$ .

Answer(a)(ii) ..... [1]

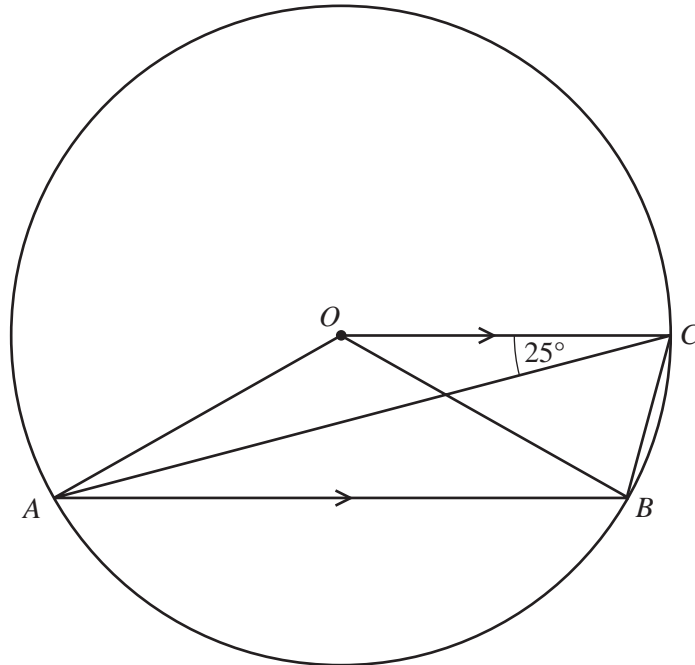
(b) A regular polygon has  $n$  sides.

Each exterior angle is  $\frac{5n}{2}$  degrees.

Find the value of  $n$ .

Answer(b)  $n =$  ..... [3]

(c)



NOT TO  
SCALE

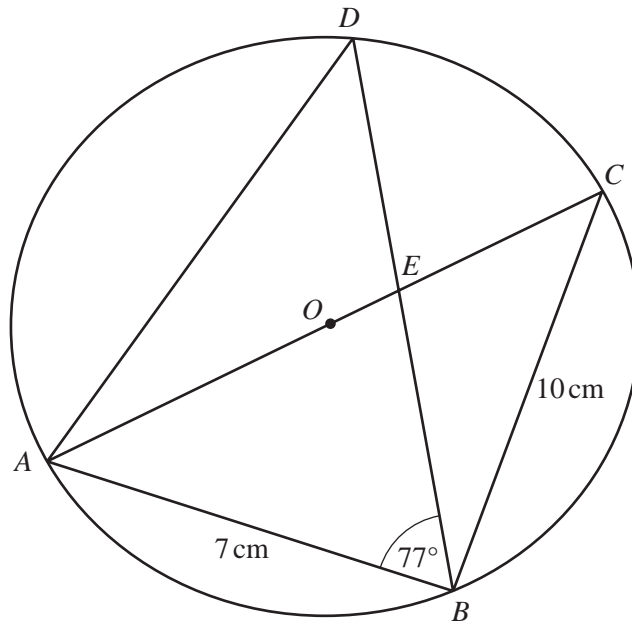
The diagram shows a circle centre  $O$ .  
 $A$ ,  $B$  and  $C$  are points on the circumference.  
 $OC$  is parallel to  $AB$ .  
Angle  $OCA = 25^\circ$ .

Calculate angle  $OBC$ .

Answer(c) Angle  $OBC =$  ..... [3]

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NOT TO SCALE

$A, B, C$  and  $D$  lie on a circle, centre  $O$ .  
 $AB = 7$  cm,  $BC = 10$  cm and angle  $ABD = 77^\circ$ .  
 $AOC$  is a diameter of the circle.

(a) Find angle  $ABC$ .

Answer(a) Angle  $ABC = \dots\dots\dots$  [1]

(b) Calculate angle  $ACB$  and show that it rounds to  $35^\circ$  correct to the nearest degree.

Answer(b)

[2]

(c) Explain why angle  $ADB =$  angle  $ACB$ .

Mr. Yasser Elsayed ..... [1]

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(d) (i) Calculate the length of  $AD$ .

*Answer(d)(i)*  $AD =$  ..... cm [3]

(ii) Calculate the area of triangle  $ABD$ .

*Answer(d)(ii)* .....  $\text{cm}^2$  [2]

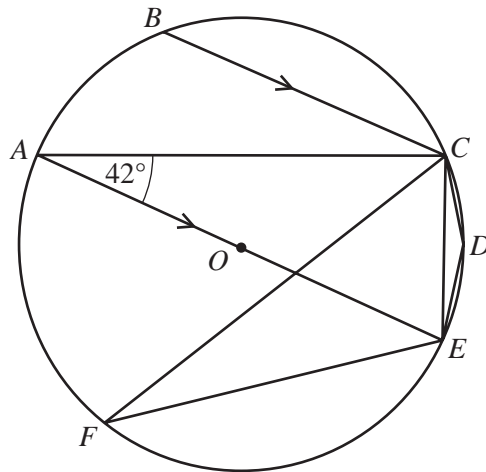
(e) The area of triangle  $AED = 12.3 \text{ cm}^2$ , correct to 3 significant figures.

Use similar triangles to calculate the area of triangle  $BEC$ .

*Answer(e)* .....  $\text{cm}^2$  [3]

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4 (a)



NOT TO SCALE

$A, B, C, D, E$  and  $F$  are points on the circumference of a circle centre  $O$ .  
 $AE$  is a diameter of the circle.  
 $BC$  is parallel to  $AE$  and angle  $CAE = 42^\circ$ .

Giving a reason for each answer, find

(i) angle  $BCA$ ,

Answer(a)(i) Angle  $BCA = \dots\dots\dots$

Reason ..... [2]

(ii) angle  $ACE$ ,

Answer(a)(ii) Angle  $ACE = \dots\dots\dots$

Reason ..... [2]

(iii) angle  $CFE$ ,

Answer(a)(iii) Angle  $CFE = \dots\dots\dots$

Reason ..... [2]

(iv) angle  $CDE$ .

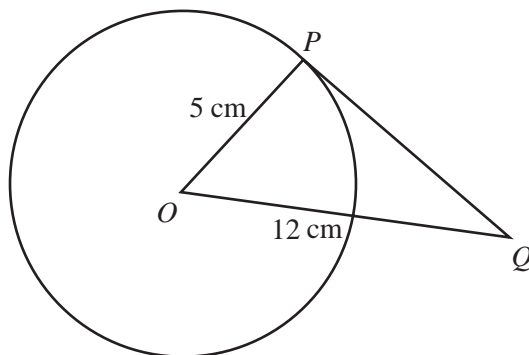
Answer(a)(iv) Angle  $CDE = \dots\dots\dots$

Reason ..... [2]

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(b)



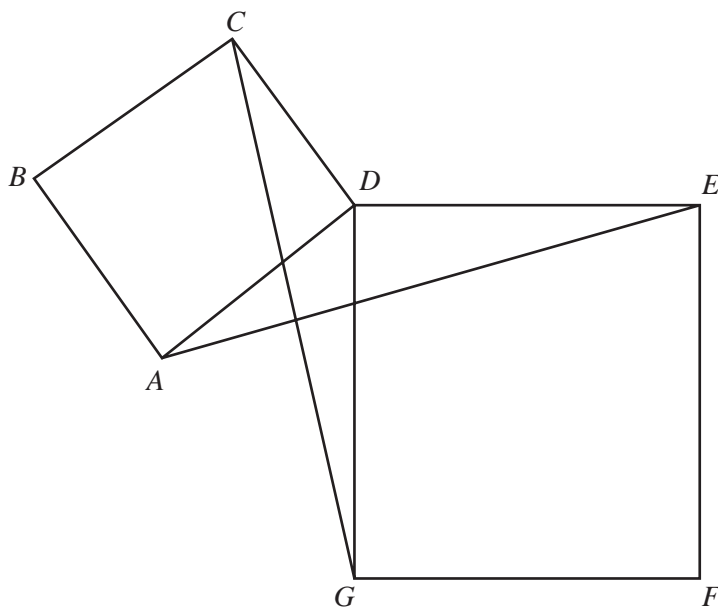
NOT TO SCALE

In the diagram,  $O$  is the centre of the circle and  $PQ$  is a tangent to the circle at  $P$ .  
 $OP = 5$  cm and  $OQ = 12$  cm.

Calculate  $PQ$ .

Answer(b)  $PQ =$  ..... cm [3]

(c)



NOT TO SCALE

In the diagram,  $ABCD$  and  $DEFG$  are squares.

(i) In the triangles  $CDG$  and  $ADE$ , explain with a reason which sides and/or angles are equal.

Answer (c)(i)

[3]

(ii) Complete the following statement.

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Triangle  $CDG$  is ..... to triangle  $ADE$ .

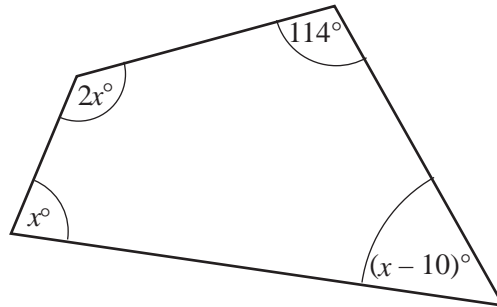
[1]

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6 (a)

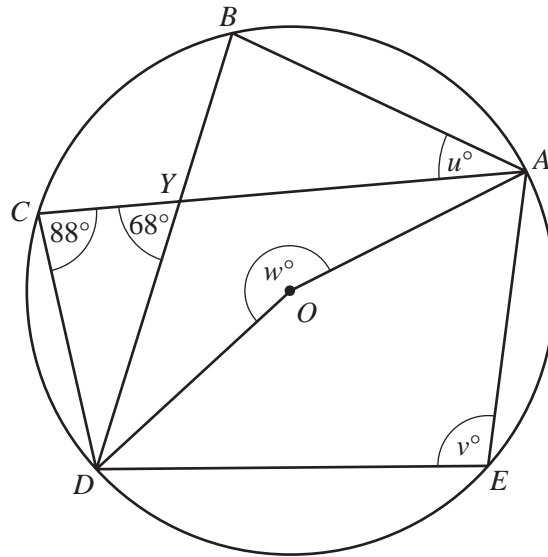


NOT TO  
SCALE

Find the value of  $x$ .

Answer(a)  $x =$  ..... [3]

8 (a)



NOT TO SCALE

$A, B, C, D$  and  $E$  lie on the circle, centre  $O$ .  
 $CA$  and  $BD$  intersect at  $Y$ .  
 Angle  $DCA = 88^\circ$  and angle  $CYD = 68^\circ$ .  
 Angle  $BAC = u^\circ$ , angle  $AED = v^\circ$  and reflex angle  $AOD = w^\circ$ .

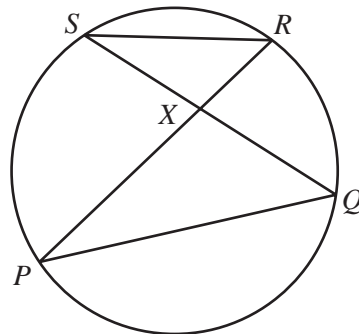
Calculate the values of  $u, v$  and  $w$ .

Answer(a)  $u = \dots\dots\dots$

$v = \dots\dots\dots$

$w = \dots\dots\dots$  [4]

(b)

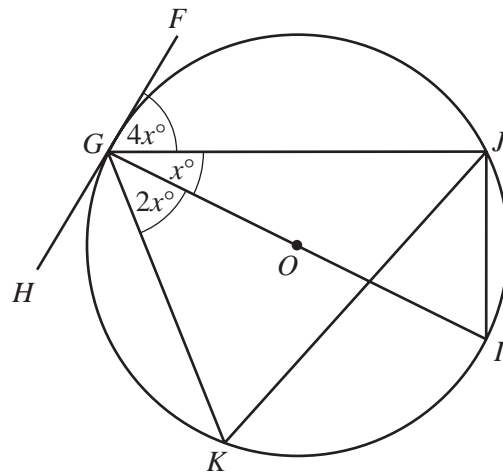


NOT TO SCALE

$P, Q, R$  and  $S$  lie on the circle.  $PR$  and  $QS$  intersect at  $X$ .  
 The area of triangle  $RSX = 1.2 \text{ cm}^2$  and  $PX = 3 SX$ .

Calculate the area of triangle  $PQX$ .

(c)



NOT TO  
SCALE

$GI$  is a diameter of the circle.  
 $FGH$  is a tangent to the circle at  $G$ .  
 $J$  and  $K$  also lie on the circle.  
Angle  $JGI = x^\circ$ , angle  $FGJ = 4x^\circ$  and angle  $KGI = 2x^\circ$ .

Find

(i) the value of  $x$ ,

Answer(c)(i)  $x =$  ..... [2]

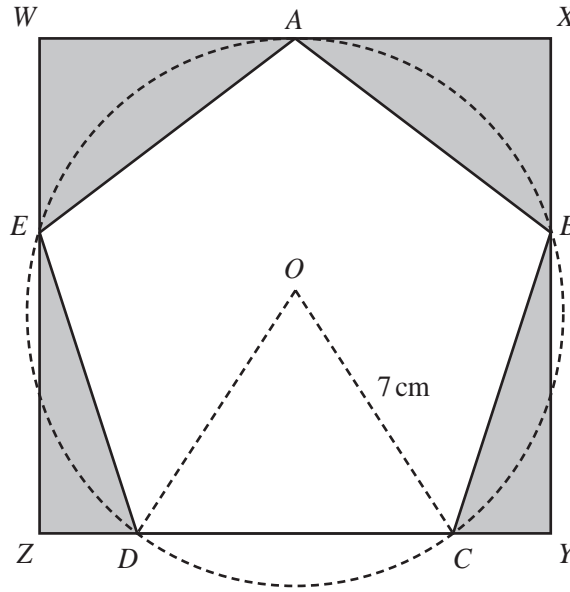
(ii) the size of angle  $JKG$ ,

Answer(c)(ii) Angle  $JKG =$  ..... [2]

(iii) the size of angle  $GJK$ .

Answer(c)(iii) Angle  $GJK =$  ..... [1]

7



NOT TO  
SCALE

The vertices  $A$ ,  $B$ ,  $C$ ,  $D$  and  $E$  of a regular pentagon lie on the circumference of a circle, centre  $O$ , radius  $7$  cm.

They also lie on the sides of a rectangle  $WXYZ$ .

(a) Show that

(i) angle  $DOC = 72^\circ$ ,

*Answer(a)(i)*

[1]

(ii) angle  $DCB = 108^\circ$ ,

*Answer(a)(ii)*

[2]

(iii) angle  $CBY = 18^\circ$ .

*Answer(a)(iii)*

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[1]

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(b) Show that the length  $CD$  of one side of the pentagon is 8.23 cm correct to three significant figures.

*Answer(b)*

(c) Calculate [3]

(i) the area of the triangle  $DOC$ ,

*Answer(c)(i)* .....  $\text{cm}^2$  [2]

(ii) the area of the pentagon  $ABCDE$ ,

*Answer(c)(ii)* .....  $\text{cm}^2$  [1]

(iii) the area of the sector  $ODC$ ,

*Answer(c)(iii)* .....  $\text{cm}^2$  [2]

(iv) the length  $XY$ .

*Answer(c)(iv)* .....  $\text{cm}$  [2]

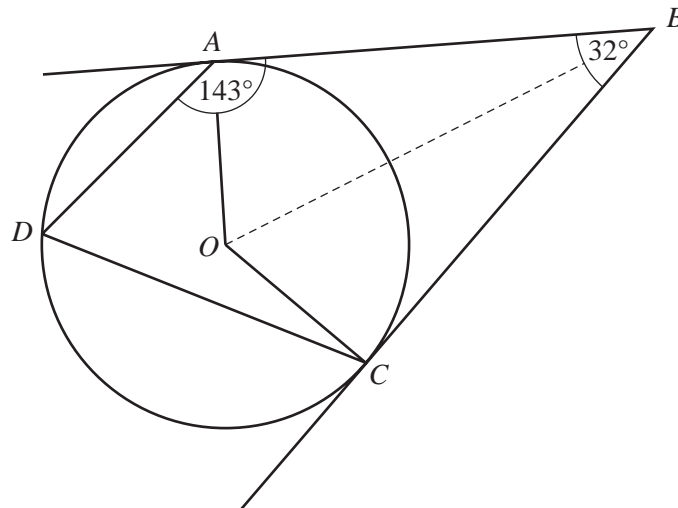
(d) Calculate the ratio  
area of the pentagon  $ABCDE$  : area of the rectangle  $WXYZ$ .

Give your answer in the form 1 :  $n$ .

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*Answer(d)* 1 : ..... [5]  
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4 (a)



NOT TO SCALE

Points  $A$ ,  $C$  and  $D$  lie on a circle centre  $O$ .  
 $BA$  and  $BC$  are tangents to the circle.  
 Angle  $ABC = 32^\circ$  and angle  $DAB = 143^\circ$ .

(i) Calculate angle  $AOC$  in quadrilateral  $AOCB$ .

Answer(a)(i) Angle  $AOC =$  ..... [2]

(ii) Calculate angle  $ADC$ .

Answer(a)(ii) Angle  $ADC =$  ..... [1]

(iii) Calculate angle  $OCD$ .

Answer(a)(iii) Angle  $OCD =$  ..... [2]

(iv)  $OA = 6$  cm.

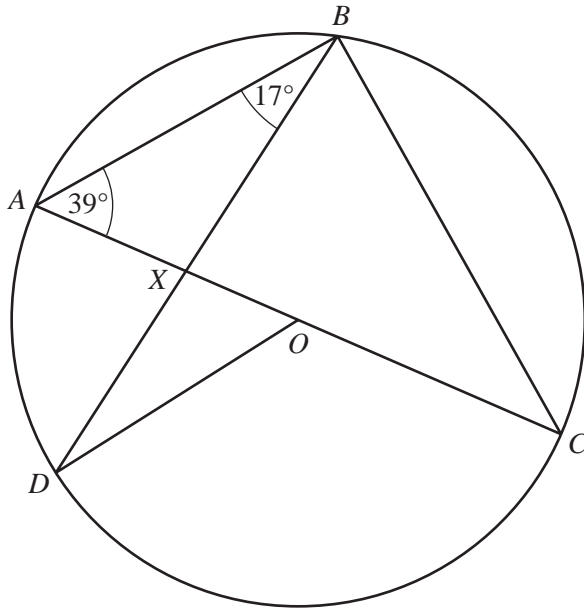
Calculate the length of  $AB$ .

Answer(a)(iv)  $AB =$  ..... cm [3]  
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(b)



NOT TO SCALE

$A, B, C$  and  $D$  are on the circumference of the circle centre  $O$ .  
 $AC$  is a diameter.  
Angle  $CAB = 39^\circ$  and angle  $ABD = 17^\circ$ .

(i) Calculate angle  $ACB$ .

Answer(b)(i) Angle  $ACB =$  ..... [2]

(ii) Calculate angle  $BXC$ .

Answer(b)(ii) Angle  $BXC =$  ..... [2]

(iii) Give the reason why angle  $DOA$  is  $34^\circ$ .

Answer(b)(iii) ..... [1]

(iv) Calculate angle  $BDO$ .

Answer(b)(iv) Angle  $BDO =$  ..... [1]

(v) The radius of the circle is 12 cm. Calculate the length of major arc  $ABCD$

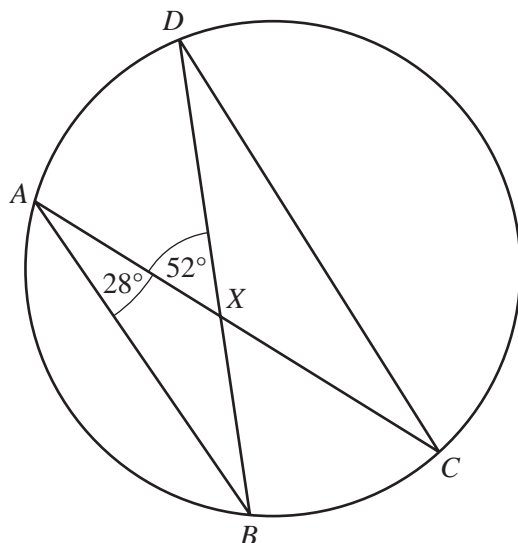
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Answer(b)(v) Arc  $ABCD =$  ..... cm [3]

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8 (a)

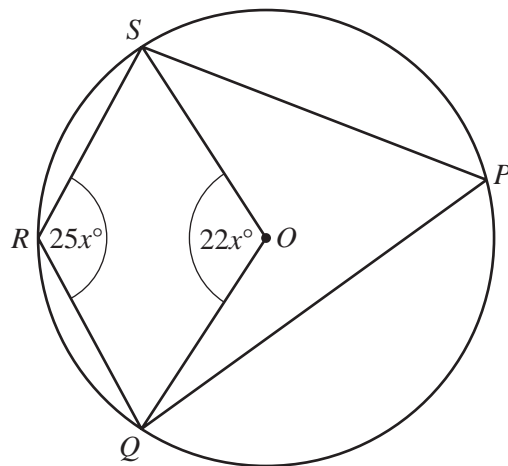


NOT TO SCALE

$A, B, C$  and  $D$  lie on a circle.  
 The chords  $AC$  and  $BD$  intersect at  $X$ .  
 Angle  $BAC = 28^\circ$  and angle  $AXD = 52^\circ$ .  
 Calculate angle  $XCD$ .

Answer(a) Angle  $XCD = \dots\dots\dots$  [3]

(b)



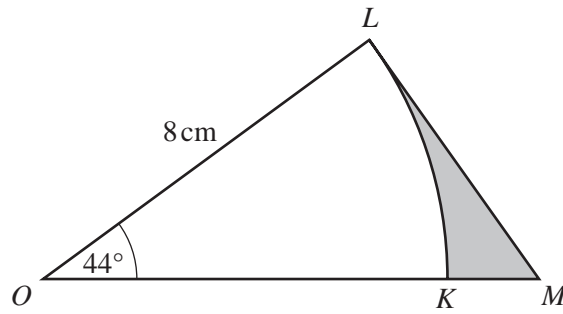
NOT TO SCALE

$PQRS$  is a cyclic quadrilateral in the circle, centre  $O$ .  
 Angle  $QOS = 22x^\circ$  and angle  $QRS = 25x^\circ$ .  
 Find the value of  $x$ .

Answer(b)  $x = \dots\dots\dots$  [3]



(c)



NOT TO  
SCALE

In the diagram  $OKL$  is a sector of a circle, centre  $O$  and radius 8 cm.  
 $OKM$  is a straight line and  $ML$  is a tangent to the circle at  $L$ .  
Angle  $LOK = 44^\circ$ .

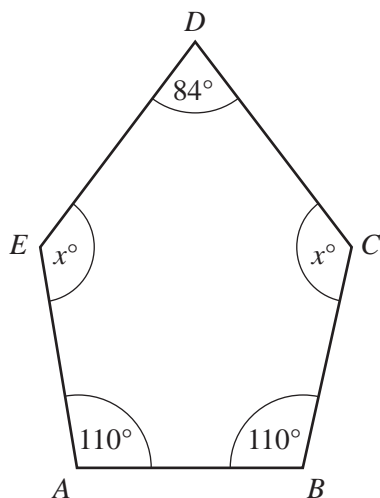
Calculate the area shaded in the diagram.

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Answer(c) ..... cm<sup>2</sup> [5]

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8 (a)



NOT TO SCALE

In the pentagon  $ABCDE$ , angle  $EAB = \text{angle } ABC = 110^\circ$  and angle  $CDE = 84^\circ$ .  
Angle  $BCD = \text{angle } DEA = x^\circ$ .

(i) Calculate the value of  $x$ .

Answer(a)(i)  $x = \dots\dots\dots$  [2]

(ii)  $BC = CD$ .  
Calculate angle  $CBD$ .

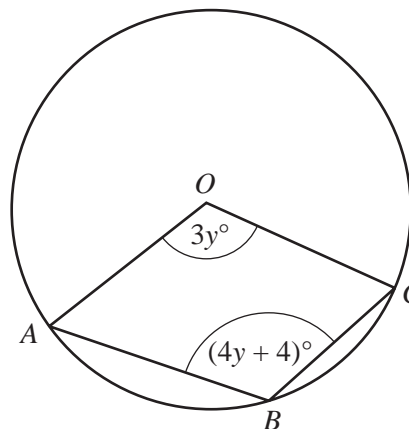
Answer(a)(ii) Angle  $CBD = \dots\dots\dots$  [1]

(iii) This pentagon also has one line of symmetry.  
Calculate angle  $ADB$ .

Answer(a)(iii) Angle  $ADB = \dots\dots\dots$  [1]

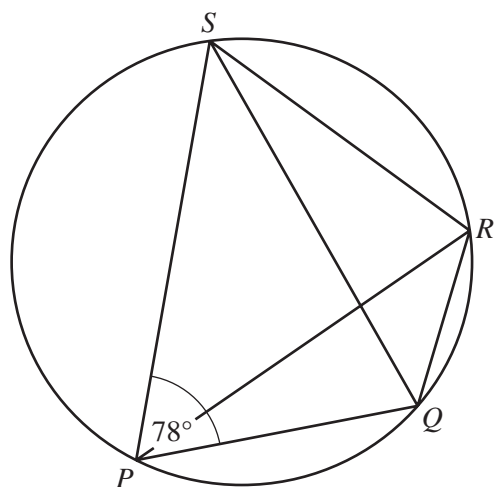
(b)  $A, B$  and  $C$  lie on a circle centre  $O$ .  
Angle  $AOC = 3y^\circ$  and angle  $ABC = (4y + 4)^\circ$ .

Find the value of  $y$ .



NOT TO SCALE

(c)



NOT TO SCALE

In the cyclic quadrilateral  $PQRS$ , angle  $SPQ = 78^\circ$ .

(i) Write down the geometrical reason why angle  $QRS = 102^\circ$ .

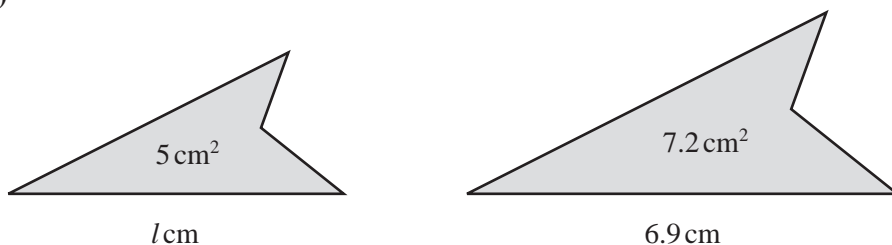
Answer(c)(i) ..... [1]

(ii) Angle  $PRQ$  : Angle  $PRS = 1 : 2$ .

Calculate angle  $PQS$ .

Answer(c)(ii) Angle  $PQS =$  ..... [3]

(d)



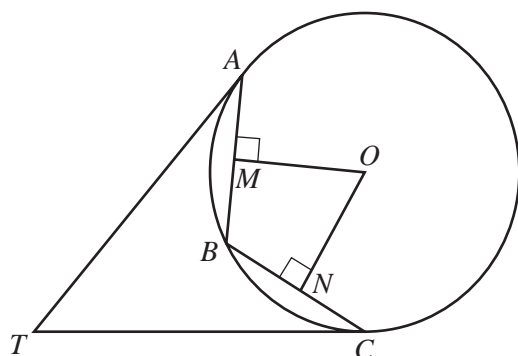
NOT TO SCALE

The diagram shows two similar figures.  
The areas of the figures are  $5\text{ cm}^2$  and  $7.2\text{ cm}^2$ .  
The lengths of the bases are  $l\text{ cm}$  and  $6.9\text{ cm}$ .

Calculate the value of  $l$ .

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Answer(d)  $l =$  ..... 403 [3]



NOT TO SCALE

$A, B$  and  $C$  lie on the circle centre  $O$ , radius  $8.5$  cm.  
 $AB = BC = 10.7$  cm.  
 $OM$  is perpendicular to  $AB$  and  $ON$  is perpendicular to  $BC$ .

(a) Calculate the area of the circle.

Answer(a) ..... cm<sup>2</sup> [2]

(b) Write down the length of  $MB$ .

Answer(b) ..... cm [1]

(c) Calculate angle  $MOB$  and show that it rounds to  $39^\circ$  correct to the nearest degree.

Answer(c)

[2]

(d) Using angle  $MOB = 39^\circ$ , calculate the length of the **major** arc  $AC$ .

Answer(d) ..... cm [3]

(e) The tangents to the circle at  $A$  and at  $C$  meet at  $T$ .

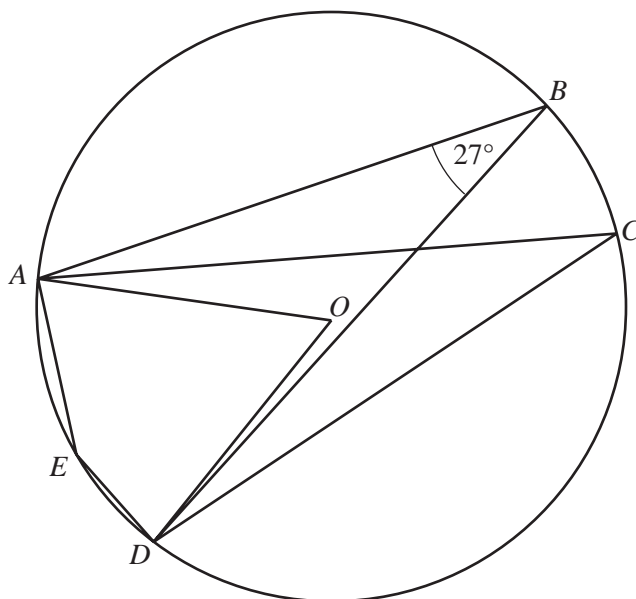
Explain clearly why triangle  $ATB$  is congruent to triangle  $CTB$ .

Answer(e)

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8 (a)



NOT TO SCALE

A, B, C, D and E are points on the circle centre O.  
 Angle  $ABD = 27^\circ$ .

Find

(i) angle  $ACD$ ,

Answer(a)(i) Angle  $ACD = \dots\dots\dots$  [1]

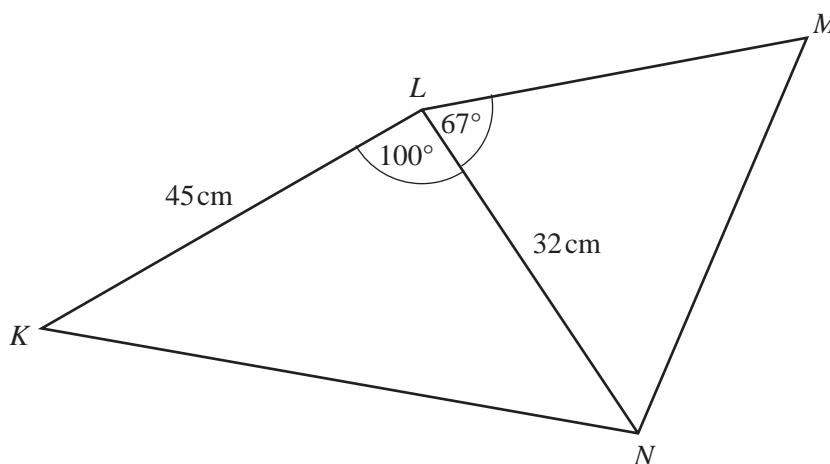
(ii) angle  $AOD$ ,

Answer(a)(ii) Angle  $AOD = \dots\dots\dots$  [1]

(iii) angle  $AED$ .

Answer(a)(iii) Angle  $AED = \dots\dots\dots$  [1]

(b)



NOT TO SCALE

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 The diagram shows a quadrilateral  $KLMN$   
 $KL = 45$  cm,  $LN = 32$  cm, angle  $KLN = 100^\circ$  and angle  $NLM = 67^\circ$ .

(i) Calculate the length  $KN$ .

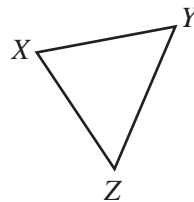
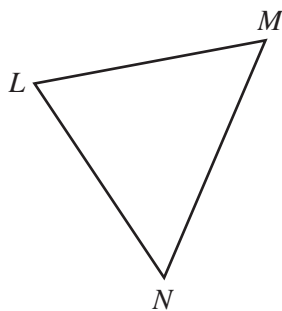
Answer(b)(i)  $KN = \dots\dots\dots$  cm [4]

(ii) The area of triangle  $LMN$  is  $324 \text{ cm}^2$ .

Calculate the length  $LM$ .

Answer(b)(ii)  $LM = \dots\dots\dots$  cm [3]

(iii) Another triangle  $XYZ$  is mathematically similar to triangle  $LMN$ .



NOT TO SCALE

$XZ = 16 \text{ cm}$  and the area of triangle  $LMN$  is  $324 \text{ cm}^2$ .

Calculate the area of triangle  $XYZ$ .

Answer(b)(iii)  $\dots\dots\dots$   $\text{cm}^2$  [2]

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- 4 (a) One angle of an isosceles triangle is  $48^\circ$ .

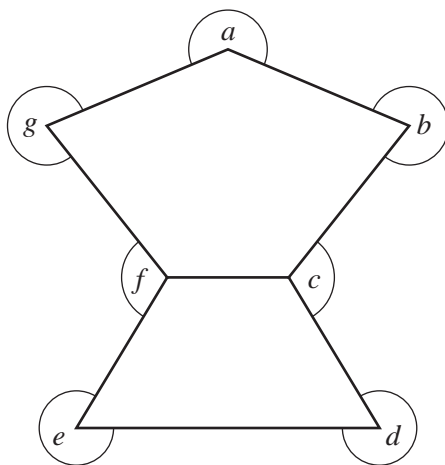
Write down the possible pairs of values for the remaining two angles.

Answer(a) ..... and .....  
..... and ..... [2]

- (b) Calculate the sum of the interior angles of a pentagon.

Answer(b) ..... [2]

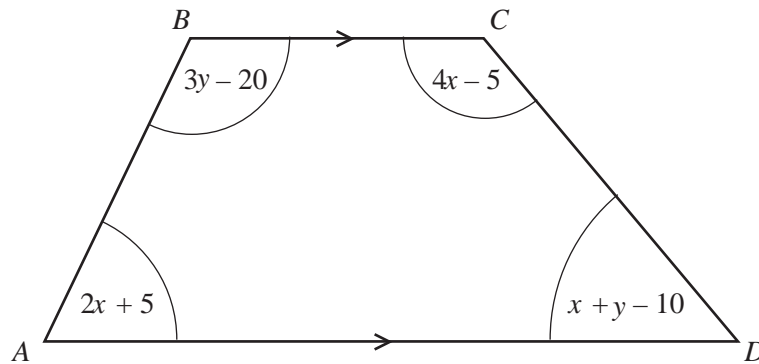
- (c) Calculate the sum of the angles  $a, b, c, d, e, f$  and  $g$  shown in this diagram.



NOT TO  
SCALE

Answer(c) ..... [2]

- (d) The trapezium,  $ABCD$ , has four angles as shown. All the angles are in degrees.



NOT TO SCALE

- (i) Show that  $7x + 4y = 390$ .

*Answer(d)(i)*

[1]

- (ii) Show that  $2x + 3y = 195$ .

*Answer(d)(ii)*

[1]

- (iii) Solve these simultaneous equations.

*Answer(d)(iii)*  $x = \dots\dots\dots$

$y = \dots\dots\dots$  [4]

- (iv) Use your answer to **part (d)(iii)** to find the sizes of all four angles of the trapezium.

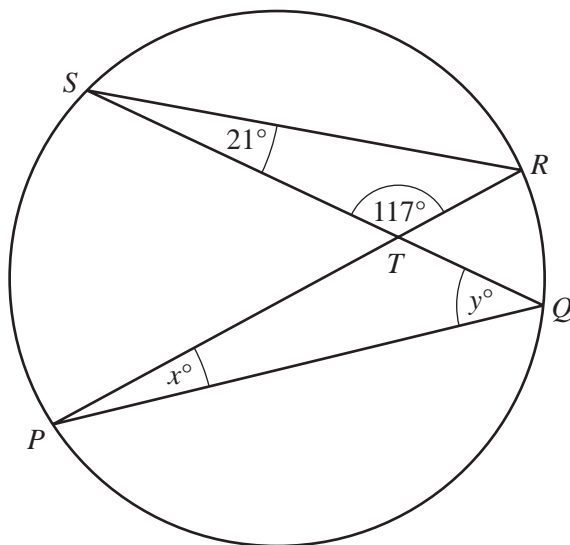
**Mr. Yasser Elsayed** ..... , ..... , ..... , ..... [1]

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NOT TO SCALE

(a) The chords  $PR$  and  $SQ$  of the circle intersect at  $T$ .  
Angle  $RST = 21^\circ$  and angle  $STR = 117^\circ$ .

(i) Find the values of  $x$  and  $y$ .

Answer(a)(i)  $x = \dots\dots\dots$

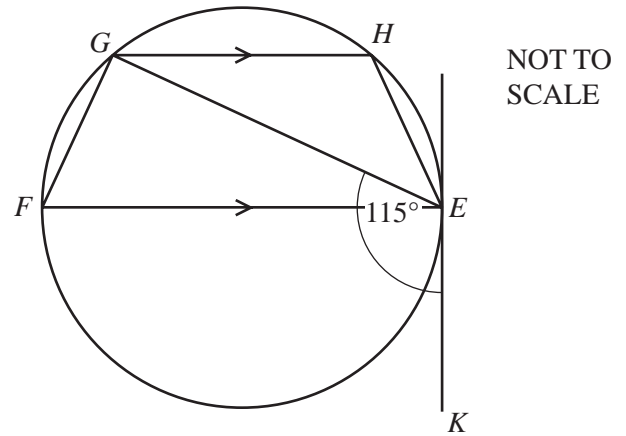
$y = \dots\dots\dots$  [2]

(ii)  $SR = 8.23$  cm,  $RT = 3.31$  cm and  $PQ = 9.43$  cm.

Calculate the length of  $TQ$ .

Answer(a)(ii)  $TQ = \dots\dots\dots$  cm [2]

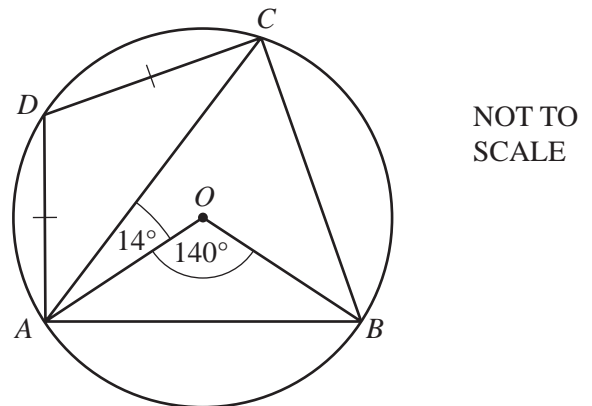
- (b)  $EFGH$  is a cyclic quadrilateral.  
 $EF$  is a diameter of the circle.  
 $KE$  is the tangent to the circle at  $E$ .  
 $GH$  is parallel to  $FE$  and angle  $KEG = 115^\circ$ .



Calculate angle  $GEH$ .

Answer(b) Angle  $GEH = \dots\dots\dots$  [4]

- (c)  $A, B, C$  and  $D$  are points on the circle centre  $O$ .  
 Angle  $AOB = 140^\circ$  and angle  $OAC = 14^\circ$ .  
 $AD = DC$ .

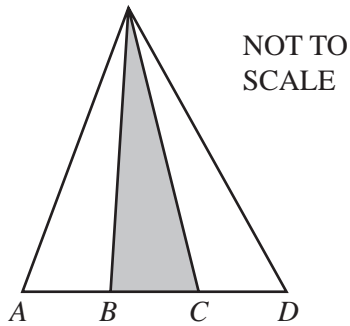


Calculate angle  $ACD$ .

Answer(c) Angle  $ACD = \dots\dots\dots$  [5]

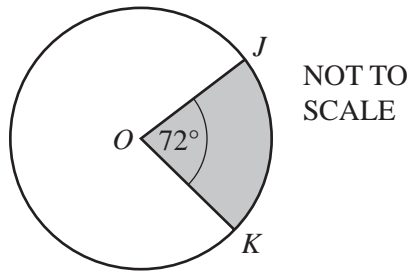
- 11 The total area of each of the following shapes is  $X$ .  
The area of the shaded part of each shape is  $kX$ .

For each shape, find the value of  $k$  and write your answer below each diagram.



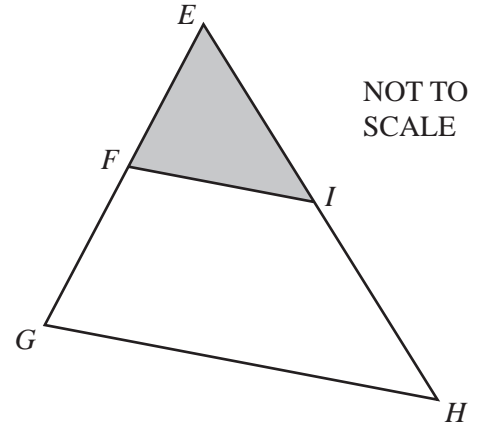
$AB = BC = CD$

$k = \dots\dots\dots$



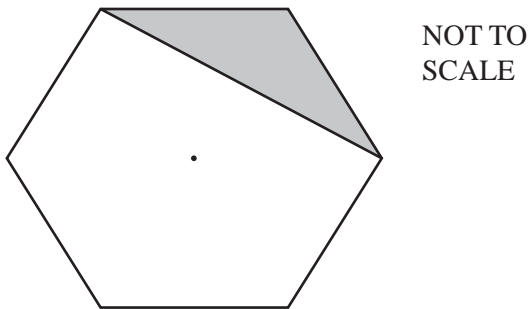
Angle  $JOK = 72^\circ$

$k = \dots\dots\dots$

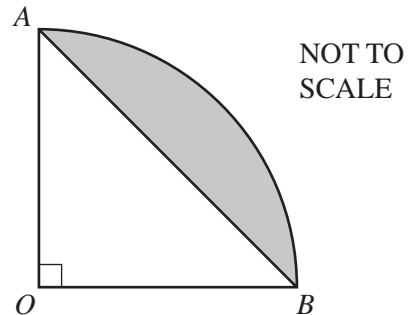


$EF = FG$  and  $EI = IH$

$k = \dots\dots\dots$



The shape is a regular hexagon.



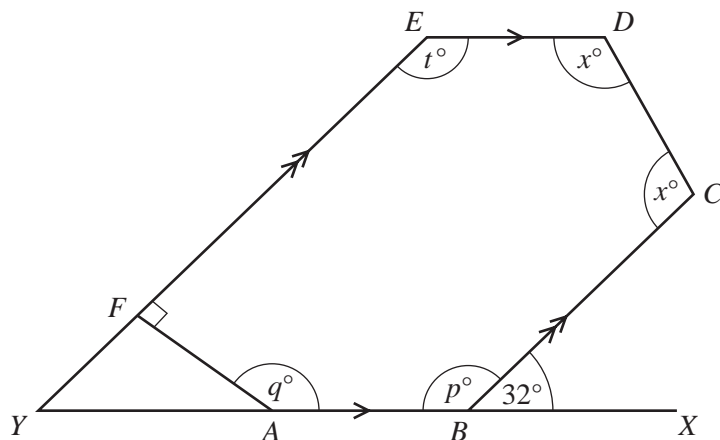
The diagram shows a sector of a circle centre  $O$ .  
Angle  $AOB = 90^\circ$

$k = \dots\dots\dots$

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[10]

7 (a)



NOT TO SCALE

$ABCDEF$  is a hexagon.  
 $AB$  is parallel to  $ED$  and  $BC$  is parallel to  $FE$ .  
 $YFE$  and  $YABX$  are straight lines.  
 Angle  $CBX = 32^\circ$  and angle  $EFA = 90^\circ$ .

Calculate the value of

(i)  $p$ ,

Answer(a)(i)  $p = \dots\dots\dots$  [1]

(ii)  $q$ ,

Answer(a)(ii)  $q = \dots\dots\dots$  [2]

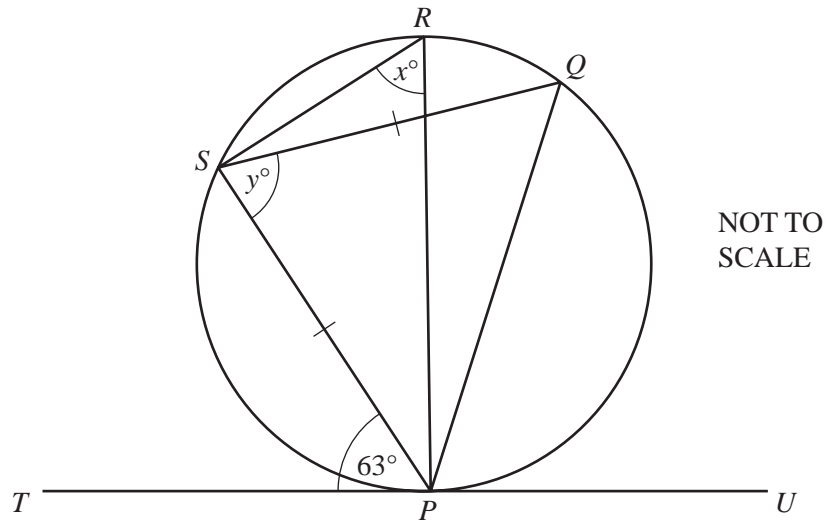
(iii)  $t$ ,

Answer(a)(iii)  $t = \dots\dots\dots$  [1]

(iv)  $x$ .

Answer(a)(iv)  $x = \dots\dots\dots$  [3]

(b)



$P, Q, R$  and  $S$  are points on a circle and  $PS = SQ$ .  
 $PR$  is a diameter and  $TPU$  is the tangent to the circle at  $P$ .  
Angle  $SPT = 63^\circ$ .

Find the value of

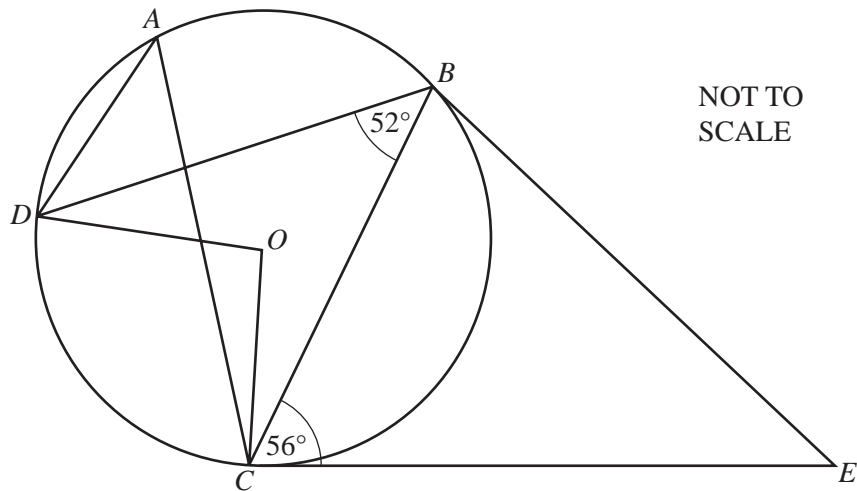
(i)  $x$ ,

Answer(b)(i)  $x = \dots\dots\dots$  [2]

(ii)  $y$ .

Answer(b)(ii)  $y = \dots\dots\dots$  [2]

3



$A, B, C$  and  $D$  are points on a circle, centre  $O$ .  
 $CE$  is a tangent to the circle at  $C$ .

(a) Find the sizes of the following angles and give a reason for each answer.

(i) Angle  $DAC = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(ii) Angle  $DOC = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(iii) Angle  $BCO = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(b)  $CE = 8.9$  cm and  $CB = 7$  cm.

(i) Calculate the length of  $BE$ .

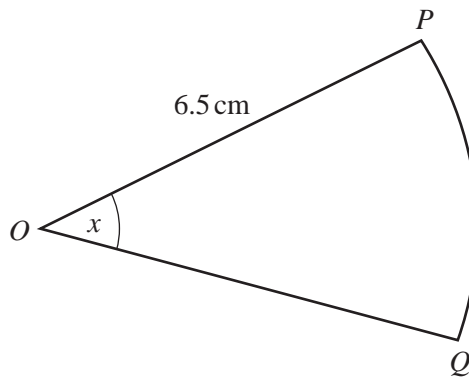
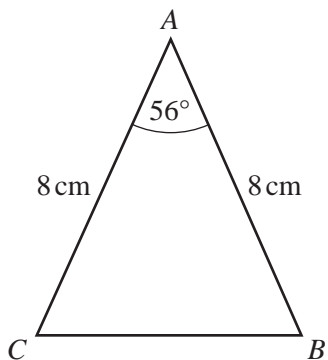
*Answer(b)(i)*  $BE = \dots\dots\dots$  cm [4]

(ii) Calculate angle  $BEC$ .

*Answer(b)(ii)* Angle  $BEC = \dots\dots\dots$  [3]

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NOT TO SCALE

The diagram shows a triangle and a sector of a circle.  
 In triangle  $ABC$ ,  $AB = AC = 8$  cm and angle  $BAC = 56^\circ$ .  
 Sector  $OPQ$  has centre  $O$ , sector angle  $x$  and radius  $6.5$  cm.

- (a) Show that the area of triangle  $ABC$  is  $26.5 \text{ cm}^2$  correct to 1 decimal place.

*Answer(a)*

[2]

- (b) The area of sector  $OPQ$  is equal to the area of triangle  $ABC$ .

- (i) Calculate the sector angle  $x$ .

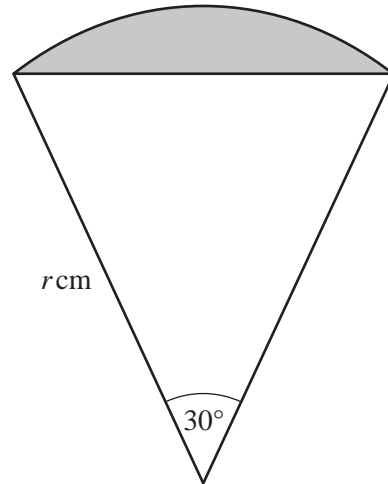
*Answer(b)(i)* ..... [3]

- (ii) Calculate the perimeter of the sector  $OPQ$ .

*Answer(b)(ii)* ..... cm [3]



- (c) The diagram shows a sector of a circle, radius  $r$  cm.



NOT TO  
SCALE

- (i) Show that the area of the shaded segment is  $\frac{1}{4}r^2\left(\frac{1}{3}\pi - 1\right)\text{cm}^2$ .

*Answer(c)(i)*

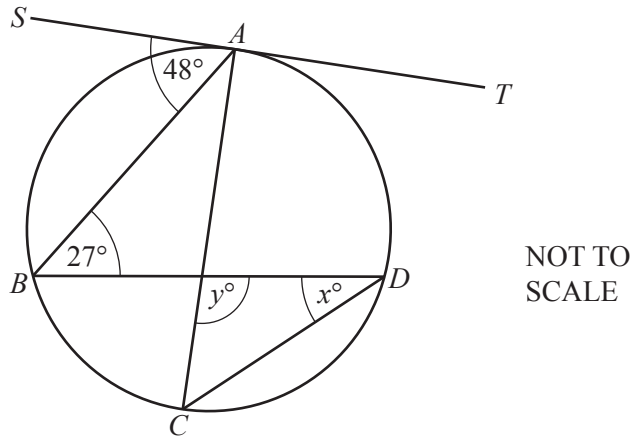
[4]

- (ii) The area of the segment is  $5\text{cm}^2$ .

Find the value of  $r$ .

*Answer(c)(ii)*  $r = \dots\dots\dots$  [3]

- 9 (a) The points  $A, B, C$  and  $D$  lie on a circle.  
 $AC$  is a diameter of the circle.  
 $ST$  is the tangent to the circle at  $A$ .



Find the value of

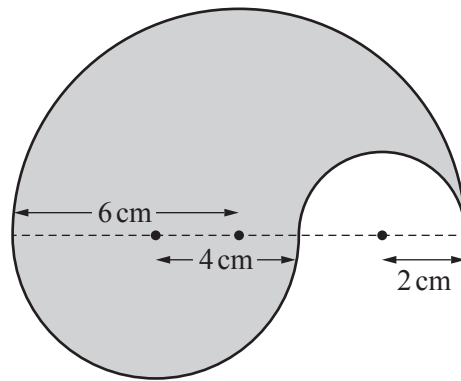
- (i)  $x$ ,

Answer(a)(i)  $x = \dots\dots\dots$  [2]

- (ii)  $y$ .

Answer(a)(ii)  $y = \dots\dots\dots$  [2]

- (b) The diagram shows a shaded shape formed by three semi-circular arcs. The radius of each semi-circle is shown in the diagram.



NOT TO  
SCALE

- (i) Calculate the perimeter of the shaded shape.

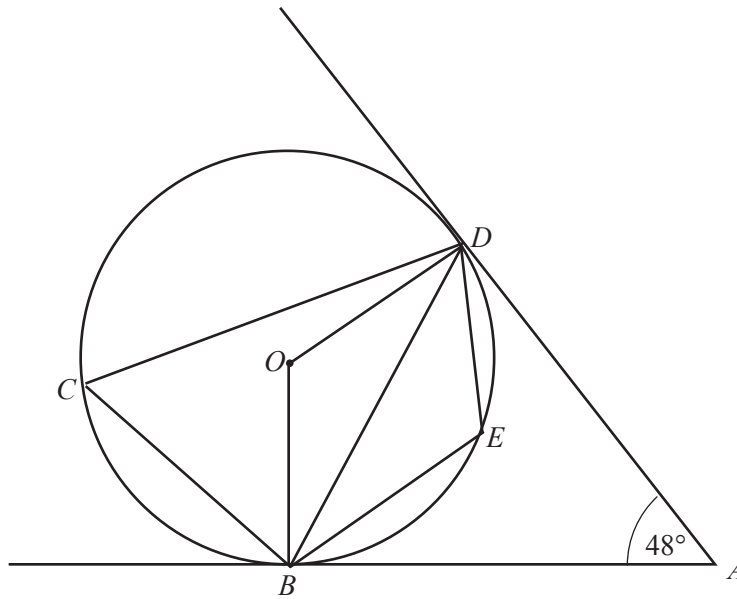
*Answer(b)(i)* ..... cm [2]

- (ii) The shaded shape is made from metal 1.6 mm thick.

Calculate the volume of metal used to make this shape.  
Give your answer in cubic millimetres.

*Answer(b)(ii)* ..... mm<sup>3</sup> [5]

2



NOT TO SCALE

In the diagram,  $B$ ,  $C$ ,  $D$  and  $E$  lie on the circle, centre  $O$ .  
 $AB$  and  $AD$  are tangents to the circle.  
 Angle  $BAD = 48^\circ$ .

(a) Find

(i) angle  $ABD$ ,

Answer(a)(i) Angle  $ABD = \dots\dots\dots$  [1]

(ii) angle  $OBD$ ,

Answer(a)(ii) Angle  $OBD = \dots\dots\dots$  [1]

(iii) angle  $BCD$ ,

Answer(a)(iii) Angle  $BCD = \dots\dots\dots$  [2]

(iv) angle  $BED$ .

Answer(a)(iv) Angle  $BED = \dots\dots\dots$  [1]

(b) The radius of the circle is 15 cm.

Calculate the area of triangle  $BOD$

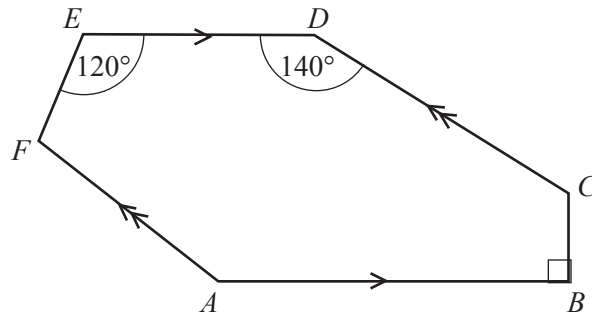
Answer(b)  $\dots\dots\dots$  cm<sup>2</sup> [2]

(c) Give a reason why  $ABOD$  is a cyclic quadrilateral.

Answer(c)

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6 (a)



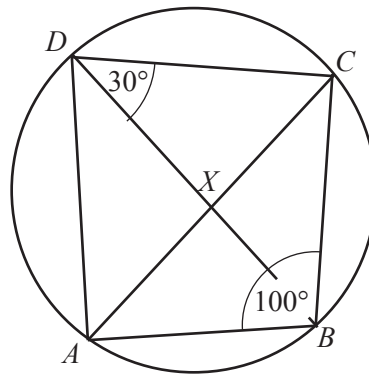
NOT TO SCALE

In the hexagon  $ABCDEF$ ,  $AB$  is parallel to  $ED$  and  $AF$  is parallel to  $CD$ .  
 Angle  $ABC = 90^\circ$ , angle  $CDE = 140^\circ$  and angle  $DEF = 120^\circ$ .

Calculate angle  $EFA$

Answer(a) Angle  $EFA = \dots\dots\dots$  [4]

(b)



NOT TO SCALE

In the cyclic quadrilateral  $ABCD$ , angle  $ABC = 100^\circ$  and angle  $BDC = 30^\circ$ .  
 The diagonals intersect at  $X$ .

(i) Calculate angle  $ACB$

Answer(b)(i) Angle  $ACB = \dots\dots\dots$  [2]

(ii) Angle  $BXC = 89^\circ$ .

Calculate angle  $CAD$ .

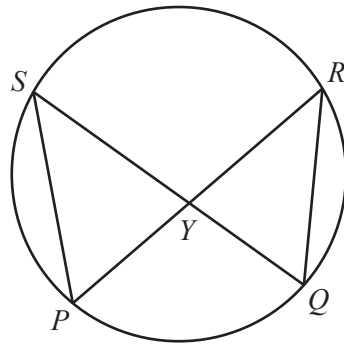
Answer(b)(ii) Angle  $CAD = \dots\dots\dots$  [2]

(iii) Complete the statement.

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Triangles  $AXD$  and  $BXC$  are  $\dots\dots\dots$  [1]

(c)



NOT TO  
SCALE

$P, Q, R$  and  $S$  lie on a circle.

$PR$  and  $QS$  intersect at  $Y$ .

$PS = 11$  cm,  $QR = 10$  cm and the area of triangle  $QRY = 23$  cm<sup>2</sup>.

Calculate the area of triangle  $PYS$ .

Answer(c) ..... cm<sup>2</sup> [2]

(d) A regular polygon has  $n$  sides.  
Each exterior angle is equal to  $\frac{n}{10}$  degrees.

(i) Find the value of  $n$ .

Answer(d)(i)  $n =$  ..... [3]

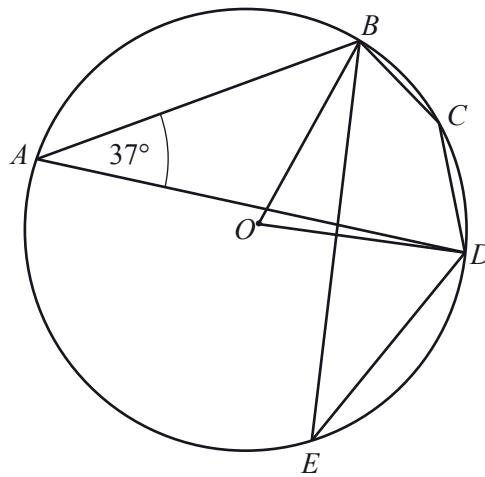
(ii) Find the size of an interior angle of this polygon.

Answer(d)(ii) ..... [2]

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5



NOT TO  
SCALE

$A, B, C, D$  and  $E$  are points on the circle, centre  $O$ .  
Angle  $BAD = 37^\circ$ .

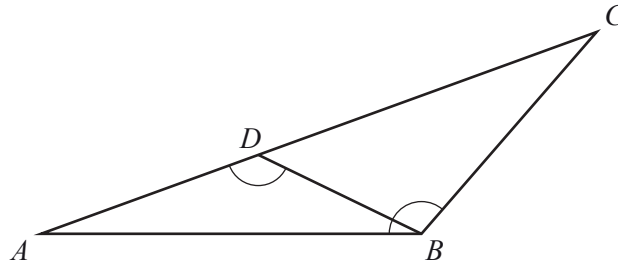
Complete the following statements.

(a) Angle  $BED = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(b) Angle  $BOD = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(c) Angle  $BCD = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

8 (a)



NOT TO SCALE

In the diagram,  $D$  is on  $AC$  so that  $\text{angle } ADB = \text{angle } ABC$ .

(i) Show that angle  $ABD$  is equal to angle  $ACB$ .

*Answer(a)(i)*

[2]

(ii) Complete the statement.

Triangles  $ABD$  and  $ACB$  are .....

[1]

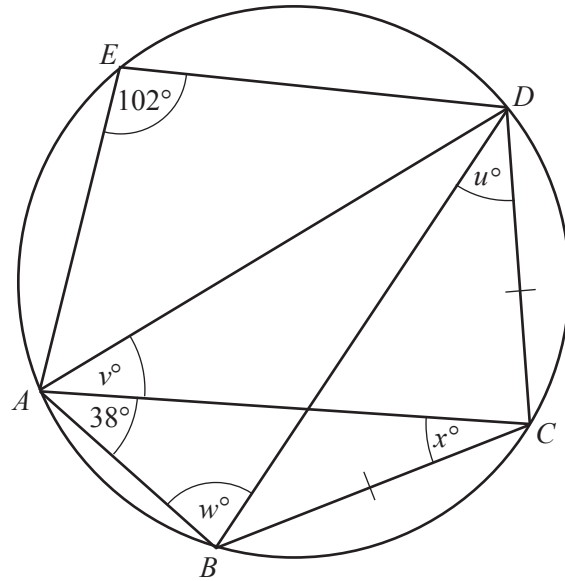
(iii)  $AB = 12$  cm,  $BC = 11$  cm and  $AC = 16$  cm.

Calculate the length of  $BD$ .

*Answer(a)(iii)*  $BD = \dots\dots\dots$  cm [2]



(b)



NOT TO  
SCALE

$A, B, C, D$  and  $E$  lie on the circle.  
Angle  $AED = 102^\circ$  and angle  $BAC = 38^\circ$ .  
 $BC = CD$ .

Find the value of

(i)  $u$ ,

Answer(b)(i)  $u = \dots\dots\dots$  [1]

(ii)  $v$ ,

Answer(b)(ii)  $v = \dots\dots\dots$  [1]

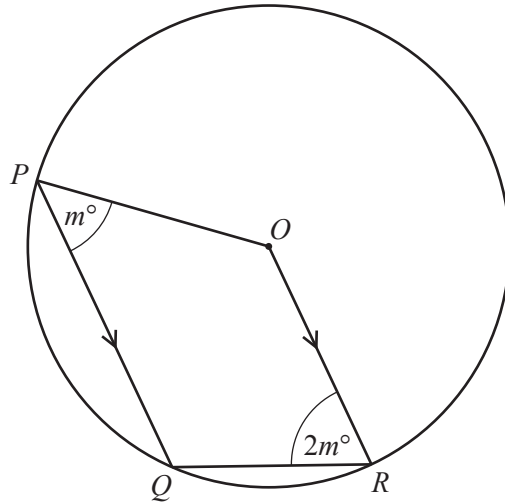
(iii)  $w$ ,

Answer(b)(iii)  $w = \dots\dots\dots$  [1]

(iv)  $x$ .

Answer(b)(iv)  $x = \dots\dots\dots$  [1]

(c)



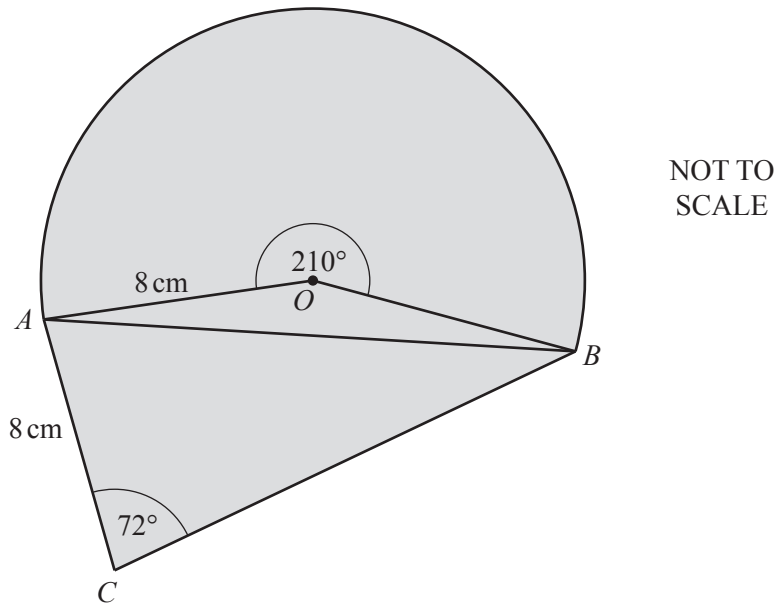
NOT TO  
SCALE

In the diagram,  $P$ ,  $Q$  and  $R$  lie on the circle, centre  $O$ .  
 $PQ$  is parallel to  $OR$ .  
Angle  $QPO = m^\circ$  and angle  $QRO = 2m^\circ$ .

Find the value of  $m$ .

Answer(c)  $m = \dots\dots\dots$  [5]

7



The diagram shows a design for a logo made from a sector and two triangles.  
 The sector, centre  $O$ , has radius  $8\text{ cm}$  and sector angle  $210^\circ$ .  
 $AC = 8\text{ cm}$  and angle  $ACB = 72^\circ$ .

(a) Show that angle  $OAB = 15^\circ$ .

[2]

(b) Calculate the length of the straight line  $AB$ .

$AB = \dots\dots\dots\text{ cm}$  [4]

(c) Calculate angle  $ABC$ .

Angle  $ABC = \dots\dots\dots$  [3]

(d) Calculate the total area of the logo design.

$\dots\dots\dots \text{cm}^2$  [6]

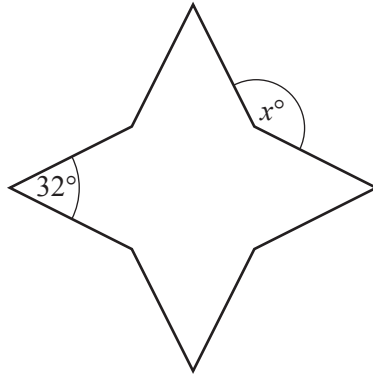
(e) The logo design is an enlargement with scale factor 4 of the actual logo.

Calculate the area of the actual logo.

$\dots\dots\dots \text{cm}^2$  [2]

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2 (a)



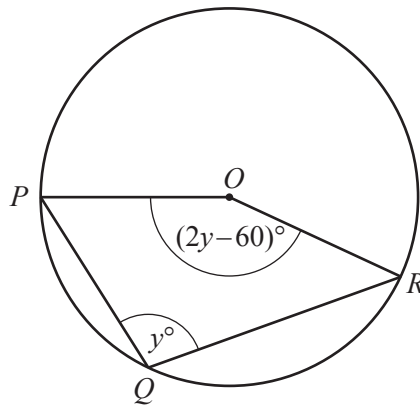
NOT TO SCALE

The diagram shows an octagon.  
All of the sides are the same length.  
Four of the interior angles are each  $32^\circ$ .  
The other four interior angles are equal.

Find the value of  $x$ .

$x = \dots\dots\dots [4]$

(b)



NOT TO SCALE

$P, Q$  and  $R$  lie on a circle, centre  $O$ .  
Angle  $PQR = y^\circ$  and angle  $POR = (2y - 60)^\circ$ .

Find the value of  $y$ .

$y = \dots\dots\dots [3]$

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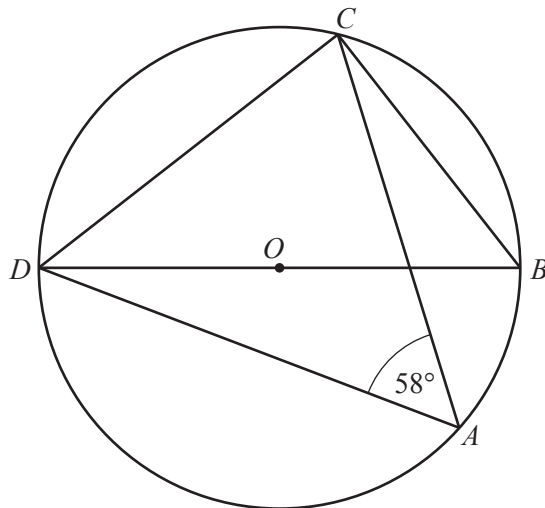
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- 8 (a) The exterior angle of a regular polygon is  $x^\circ$  and the interior angle is  $8x^\circ$ .

Calculate the number of sides of the polygon.

..... [3]

(b)



NOT TO  
SCALE

$A, B, C$  and  $D$  are points on the circumference of the circle, centre  $O$ .  
 $DOB$  is a straight line and angle  $DAC = 58^\circ$ .

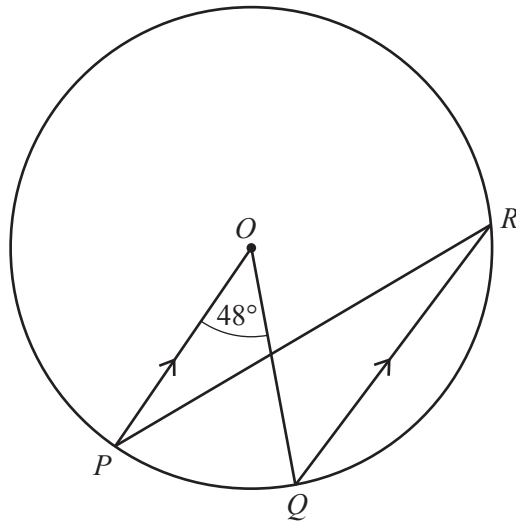
Find angle  $CDB$ .

Angle  $CDB =$  ..... [3]

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(c)



NOT TO  
SCALE

$P$ ,  $Q$  and  $R$  are points on the circumference of the circle, centre  $O$ .  
 $PO$  is parallel to  $QR$  and angle  $POQ = 48^\circ$ .

(i) Find angle  $OPR$ .

Angle  $OPR = \dots\dots\dots$  [2]

(ii) The radius of the circle is 5.4 cm.

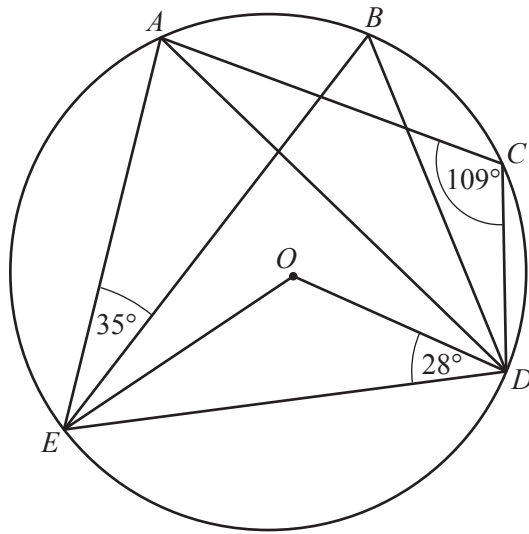
Calculate the length of the **major** arc  $PQ$ .

$\dots\dots\dots$  cm [3]

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9 (a)



NOT TO SCALE

$A, B, C, D$  and  $E$  lie on the circle, centre  $O$ .  
 Angle  $AEB = 35^\circ$ , angle  $ODE = 28^\circ$  and angle  $ACD = 109^\circ$ .

(i) Work out the following angles, giving reasons for your answers.

(a) Angle  $EBD = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$   
 $\dots\dots\dots$  [3]

(b) Angle  $EAD = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(ii) Work out angle  $BEO$ .

Angle  $BEO = \dots\dots\dots$  [3]



(b) In a regular polygon, the interior angle is 11 times the exterior angle.

(i) Work out the number of sides of this polygon.

..... [3]

(ii) Find the sum of the interior angles of this polygon.

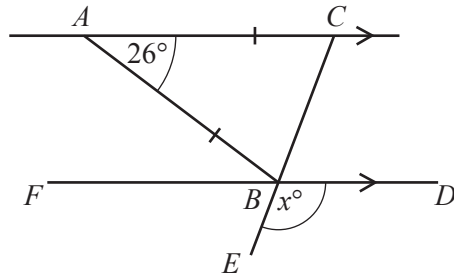
..... [2]

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433

2 (a)



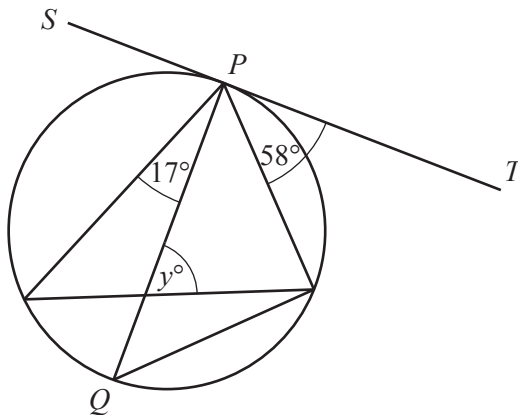
NOT TO SCALE

$AC$  is parallel to  $FBD$ ,  $ABC$  is an isosceles triangle and  $CBE$  is a straight line.

Find the value of  $x$ .

$x = \dots\dots\dots$  [3]

(b)



NOT TO SCALE

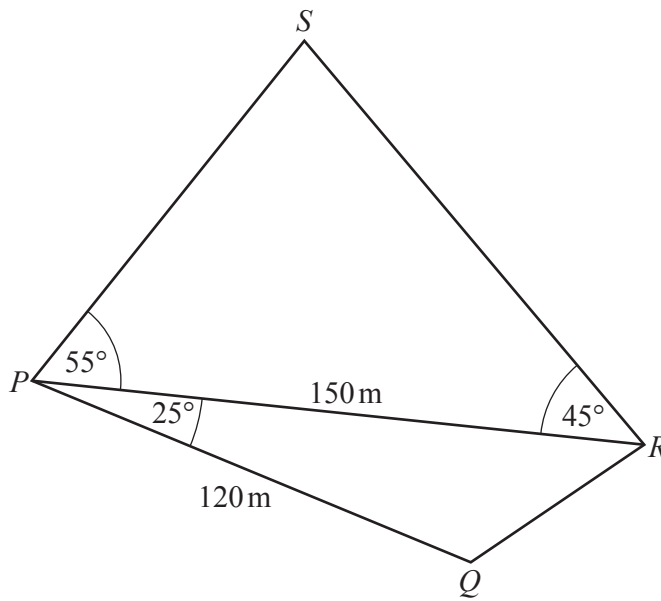
The diagram shows a circle with diameter  $PQ$ .  
 $SPT$  is a tangent to the circle at  $P$ .

Find the value of  $y$ .

$y = \dots\dots\dots$  [5]

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NOT TO SCALE

The diagram shows two triangles.

(a) Calculate  $QR$ .

$QR = \dots\dots\dots$  m [3]

(b) Calculate  $RS$ .

$RS = \dots\dots\dots$  m [4]

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(c) Calculate the total area of the two triangles.

..... m<sup>2</sup> [3]

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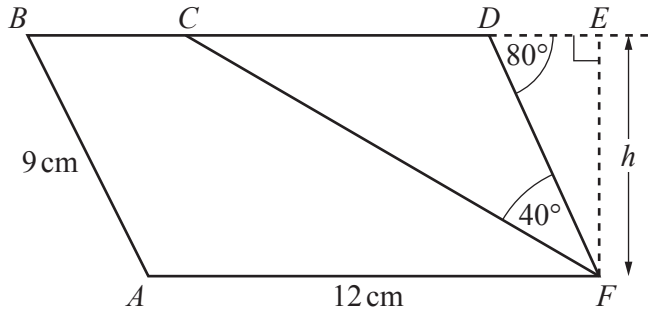
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4 (a) A rectangle measures 8.5 cm by 10.7 cm, both correct to 1 decimal place.

Calculate the upper bound of the perimeter of the rectangle.

..... cm [3]

(b)



NOT TO SCALE

*ABDF* is a parallelogram and *BCDE* is a straight line.  
*AF* = 12 cm, *AB* = 9 cm, angle *CFD* = 40° and angle *FDE* = 80°.

(i) Calculate the height, *h*, of the parallelogram.

*h* = ..... cm [2]

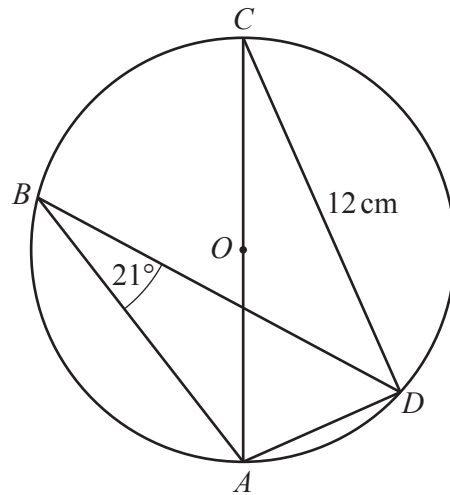
(ii) Explain why triangle *CDF* is isosceles.

.....  
 ..... [2]

(iii) Calculate the area of the **trapezium** *ABCF*.

..... cm<sup>2</sup> [3]

(c)



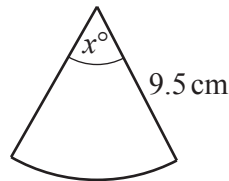
NOT TO SCALE

$A, B, C$  and  $D$  are points on the circle, centre  $O$ .  
Angle  $ABD = 21^\circ$  and  $CD = 12$  cm.

Calculate the area of the circle.

.....  $\text{cm}^2$  [5]

(d)



NOT TO SCALE

The diagram shows a square with side length 8 cm and a sector of a circle with radius 9.5 cm and sector angle  $x^\circ$ .

The perimeter of the square is equal to the perimeter of the sector.

Calculate the value of  $x$ .

$x =$  ..... [3]

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