Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	CANDIDATE NUMBER

8348855356

MATHEMATICS (SYLLABUS D) **4024/21**

Paper 2 **October/November 2015**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.
Omission of essential working will result in loss of marks.
You are expected to use an electronic calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

Section A [52 marks]

Answer **all** questions in this section.

1 **(a)** Tim invests \$2500 in a bank paying simple interest at 2.3% per year.
What is the total amount of money in the bank at the end of 4 years?

Answer \$ ..... [2]

(b)

TABLET

\$750

FINANCE OFFER

Pay 15% of \$750 as deposit and
36 monthly payments of \$25.

Chris buys the tablet using the finance offer.
How much more does he pay than if he had paid \$750 for it?

Answer \$ ..... [2]

(c) Lavin buys some sweets, pens and paper at her local shop.
The shop is offering 20% discount on all items.
This is her receipt.

Items and prices	Cost (\$)
0.3 kg of sweets at \$15.50 per kg 6 pens at \$$x$ per pen Paper	w 4.50 z
Total before discount	y
Total after discount	32.40

Find the missing values w, x, y and z.

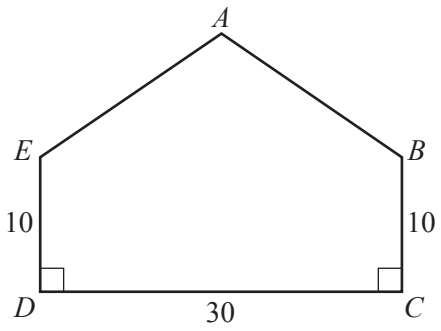
Answer w = ...

x = ...

y = ...

z = ... [5]

2 **(a)** $ABCDE$ is a pentagon with one line of symmetry.
$BC = DE = 10$ cm, $DC = 30$ cm and $B\hat{C}D = C\hat{D}E = 90°$.
The shortest distance between A and DC is 22 cm.



(i) Calculate AB.

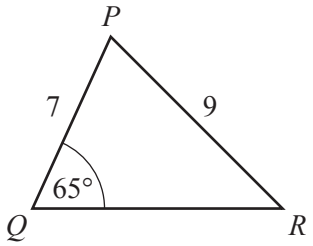
Answer ..... cm [2]

(ii) Calculate $A\hat{B}C$.

Answer ..... [3]

(b) In triangle PQR, $PQ = 7$ cm, $PR = 9$ cm and $P\hat{Q}R = 65°$.

Calculate $P\hat{R}Q$.



Answer ..... [3]

3 **(a)** $\mathbf{A} = \begin{pmatrix} 1 & 3 \\ -2 & 2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} -1 & 2 \\ -3 & 2 \end{pmatrix}$

Find

(i) $2\mathbf{A} - \mathbf{B}$,

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) $\mathbf{B}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) The matrix **C** satisfies the following equation.

$$3\mathbf{C} + 4\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix} = \mathbf{C}$$

Find **C**.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(c) Theresa sells raspberries and blackcurrants.
The first matrix shows the number of kilograms of each fruit she sells during three different weeks.
The second matrix shows the price per kilogram, in cents, of the fruit Theresa sells.

	raspberries	blackcurrants	price/kg	
Week 1	3	2	650	raspberries
Week 2	1.5	3	580	blackcurrants
Week 3	2	2.5		

(i) $\mathbf{D} = \begin{pmatrix} 3 & 2 \\ 1.5 & 3 \\ 2 & 2.5 \end{pmatrix} \begin{pmatrix} 650 \\ 580 \end{pmatrix}$

Find **D**.

Answer [2]

(ii) Explain the meaning of the information given by matrix **D**.

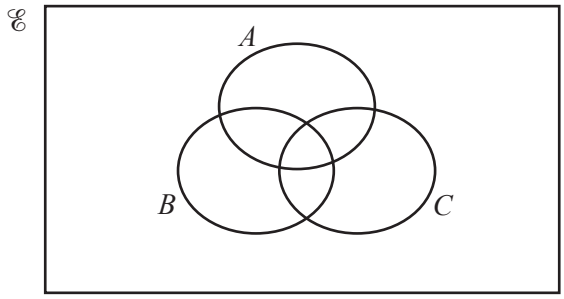
Answer ..... [1]

(iii) Find the total amount, in dollars, that Theresa gets for the fruit she sells.

Answer $ ..... [1]

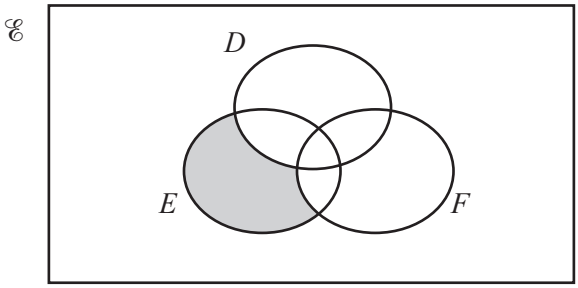
4 **(a)** Shade the subset $(A \cap B) \cup C$.

Answer



[1]

(b) Use set notation to describe the subset shaded in the diagram.

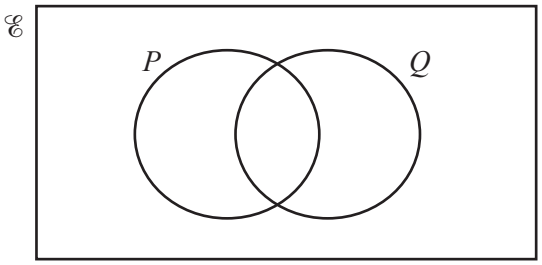


Answer ..... [1]

(c) $\mathscr{E} = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 \}$
$P = \{ x : x \text{ is an odd number} \}$
$Q = \{ x : x \text{ is a square number} \}$

(i) Write the members of $\mathscr{E}$ in the correct regions on the Venn diagram.

Answer



[2]

(ii) State $n(Q')$.

Answer ..... [1]

(iii) A number, m, is chosen at random from $\mathscr{E}$.

Find the probability that m is a member of $P \cap Q'$.

Answer ..... [2]

5 **(a)** Factorise completely $6x^2y^3 - 15x^3y$.

Answer ..... [2]

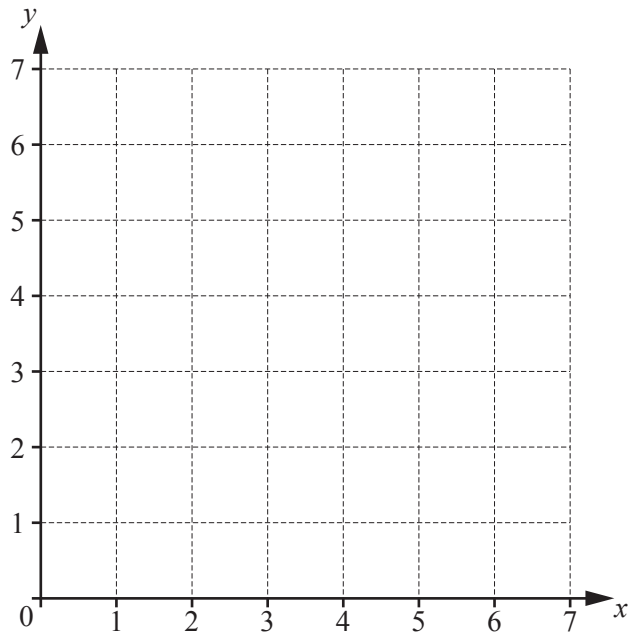
(b) Solve $\frac{4}{x} + \frac{2}{x+2} = 3$.

Answer $x =$ ..... or ..... [3]

(c) **(i)** Shade and **label** the region R defined by these four inequalities.

$x \geqslant 1$ $y \leqslant 4$ $x + y \leqslant 6$ $y \geqslant x$

Answer



[3]

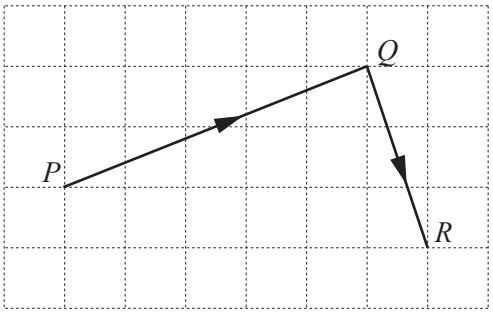
(ii) The point M is the intersection of $x = 1$ and $y = 4$.
The point N is the intersection of $x + y = 6$ and $y = x$.

Find the gradient of MN.

Answer ..... [2]

6 **(a)** The diagram shows the vectors $\overrightarrow{PQ}$ and $\overrightarrow{QR}$.

$\overrightarrow{PQ} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} a \\ b \end{pmatrix}$.



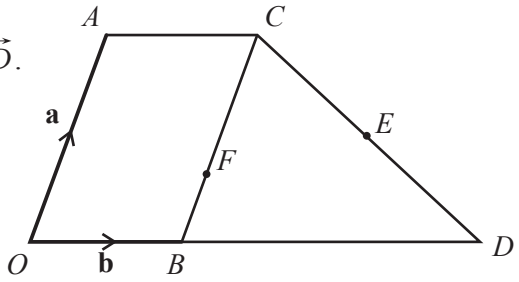
(i) Find a and b.

Answer $a =$ ..... $b =$ ..... [2]

(ii) Calculate $|\overrightarrow{PQ}|$.

Answer ..... [2]

(b) $OACB$ is a parallelogram.
$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and D is the point such that $2\overrightarrow{OB} = \overrightarrow{BD}$.
E is the midpoint of CD.



(i) Express $\overrightarrow{CE}$, as simply as possible, in terms of **a** and **b**.

Answer ..... [1]

(ii) Express $\overrightarrow{OE}$, as simply as possible, in terms of **a** and **b**.

Answer ..... [1]

(iii) F is a point on BC such that $\overrightarrow{OF} = k\overrightarrow{OE}$.
Find $BF : FC$.

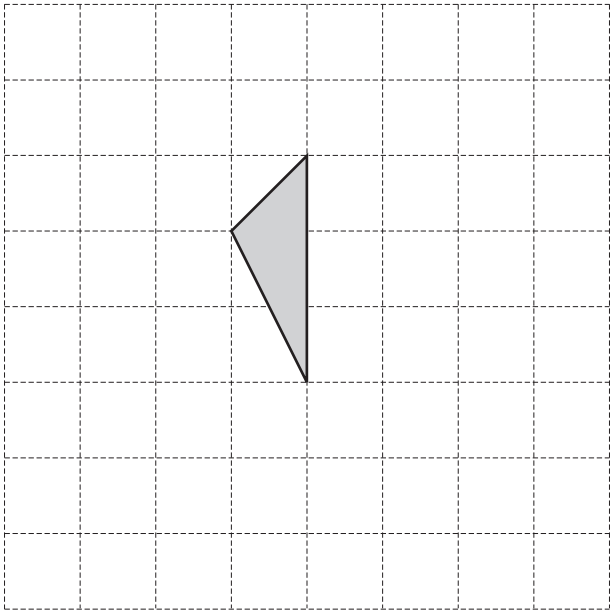
Answer ..... : ..... [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

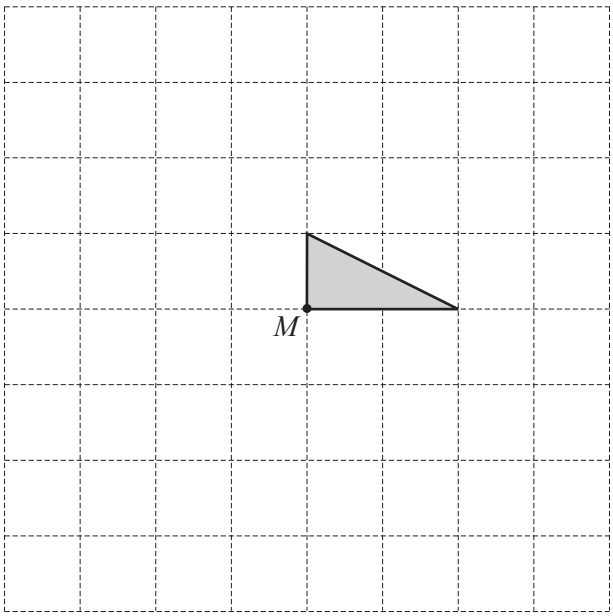
7 (a)



The shaded triangle, drawn on the grid, is part of a quadrilateral with one line of symmetry. The area of the quadrilateral is twice the area of the triangle.

Given that the line of symmetry is **not** vertical, complete the quadrilateral. [1]

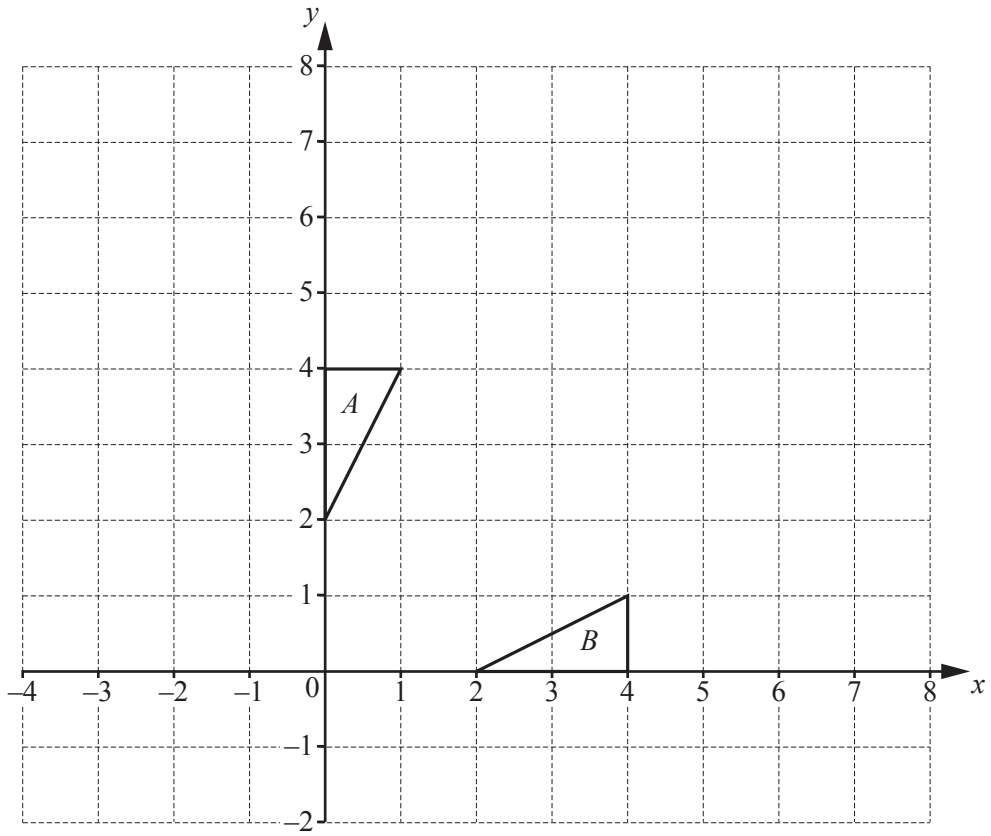
(b)



The shaded triangle, drawn on the grid, is part of a shape whose area is 4 times the shaded area and has rotational symmetry of order 4 about M.

Complete the shape. [2]

(c)



The diagram shows triangle A and triangle B.

(i) Triangle A is mapped onto triangle C by the translation P with vector $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$.

Draw and label triangle C. [2]

(ii) Triangle A is mapped onto triangle B by a reflection Q.

Write down the equation of the line of this reflection.

Answer ..... [1]

(iii) Triangle C is mapped onto triangle D by reflection Q.

Describe fully the **single** transformation that maps triangle B onto triangle D.

Answer ..... [2]

(iv) Transformation R is a reflection in the line $y = 0$.

RQ(A) = E.

(a) Find the coordinates of the vertices of triangle E.

Answer ..... [1]

(b) Describe fully the **single** transformation that maps triangle A onto triangle E.

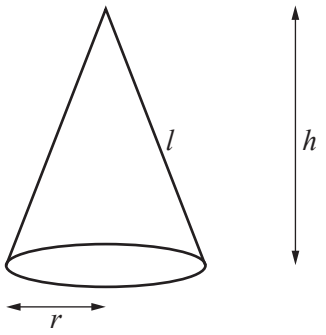
Answer .....

..... [2]

(c) Find the matrix which represents the transformation that maps triangle A onto triangle E.

Answer [1]

8 [Curved surface area of a cone = πrl]



The diagram shows a solid cone with radius r cm, height h cm and slant height l cm.
Suleman makes some solid cones.
The slant height of each of his cones is 4 cm more than its radius.
Use $\pi = 3$ throughout this question.

(a) Show that the **total** surface area, A cm^2, of each of Suleman's cones is given by $A = 6r(r + 2)$.

[2]

(b) Complete the table for $A = 6r(r + 2)$.

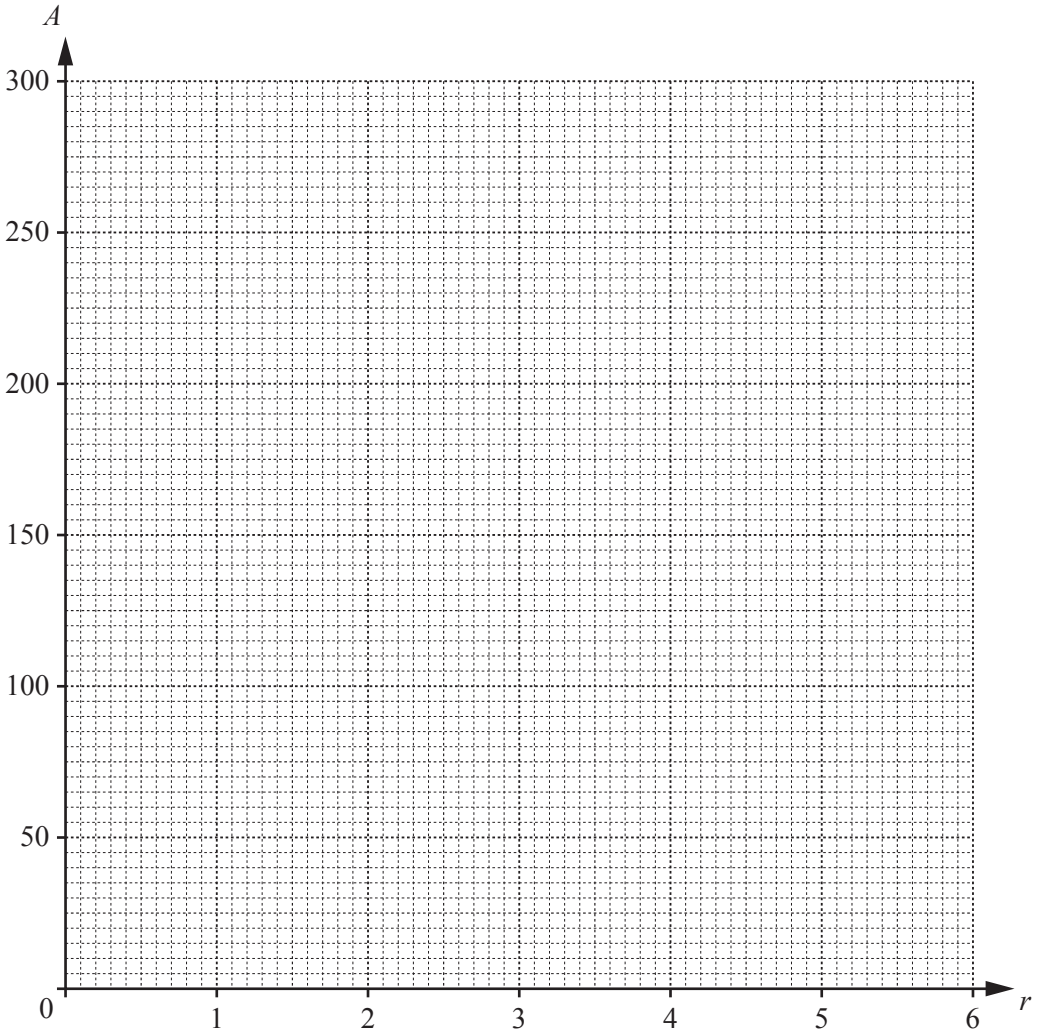
r	0	1	2	3	4	5	6
A	0	18			144	210	288

[1]

(c) On the grid opposite, draw the graph of $A = 6r(r + 2)$. [2]

(d) Find an expression for h in terms of r.

Answer $h =$ ..... [2]



(e) The height of one of Suleman's cones is 12 cm.
Calculate its radius.

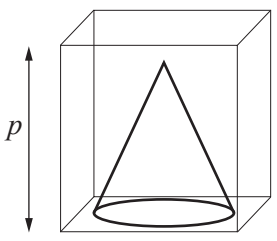
Answer ..... cm [2]

(f) Another of Suleman's cones has a surface area of 200 cm^2.

(i) Use your graph to find the radius of this cone.

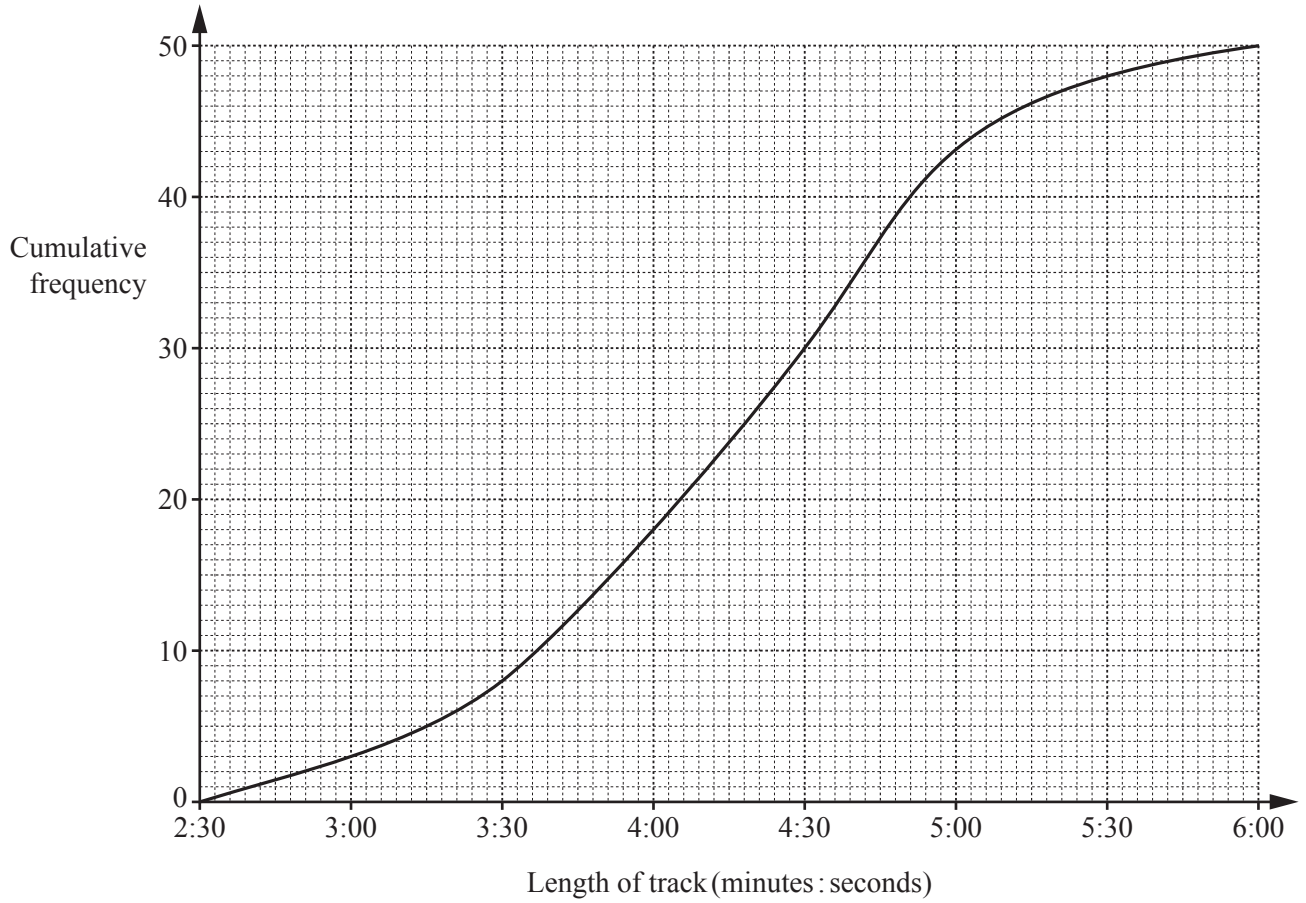
Answer ..... cm [1]

(ii) This cone is placed in a box of height p cm, where p is an integer.
Find the smallest possible value of p.



Answer $p =$ ..... [2]

9 The cumulative frequency graph for the lengths of the 50 tracks on Abi's MP3 player is shown below.



(a) Use the graph to find

(i) the median,

Answer ..... minutes ..... seconds [1]

(ii) the interquartile range.

Answer ..... minutes ..... seconds [2]

(b) Use the information on the graph to complete the frequency table for the length of the tracks.

Length (minutes : seconds)	Frequency
2:30 < length ⩽ 3:00	3
3:00 < length ⩽ 3:30	5
3:30 < length ⩽ 4:00	
4:00 < length ⩽ 4:30	
4:30 < length ⩽ 5:00	
5:00 < length ⩽ 5:30	
5:30 < length ⩽ 6:00	

[2]

(c) Abi plays three tracks from her MP3 player with no break between them.

Given that no track is repeated, what is the maximum possible length of time taken to play these tracks?

Answer ..... minutes ..... seconds [2]

(d) Abi travels on a train from station *A* to station *F*.
The exact times the train arrives at and leaves stations *A* to *F* are shown below.

Station	*A*	*B*	*C*	*D*	*E*	*F*
Arrive	–	10 03	10 06	10 11	10 15	10 21
Depart	09 58	10 04	10 07	10 12	10 16	–

(i) How many minutes did her journey take?

Answer ..... [1]

(ii) Abi starts playing tracks at random from her MP3 player as she leaves station *A*.

What is the probability that the first track is still playing when she arrives at station *B*?

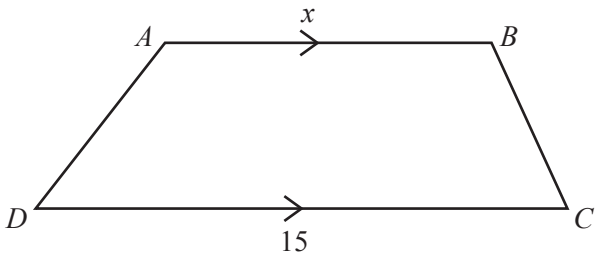
Answer ..... [2]

(e) Abi plays two different tracks at random from her MP3 player.

What is the probability that neither track is longer than 3 minutes 30 seconds?

Answer ..... [2]

10 (a)



ABCD is a trapezium with *AB* parallel to *DC*.
DC = 15 cm and *AB* = *x* cm.
The perpendicular distance between *AB* and *DC* is 3 cm less than the length of *AB*.
The area of *ABCD* is 75 cm^2.

(i) Show that $x^2 + 12x - 195 = 0$.

[2]

(ii) Find *AB*, giving your answer correct to 1 decimal place.

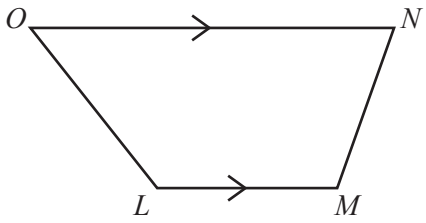
Answer ..... cm [3]

(iii) *AD* is 0.8 cm longer than *BC*.

Given that the perimeter of the trapezium is 38.0 cm, calculate *AD*.

Answer ..... cm [2]

(b) Another trapezium, $LMNO$, has LM parallel to ON.
The reflex angle $LMN = 252°$.



(i) Calculate $M\hat{N}O$.

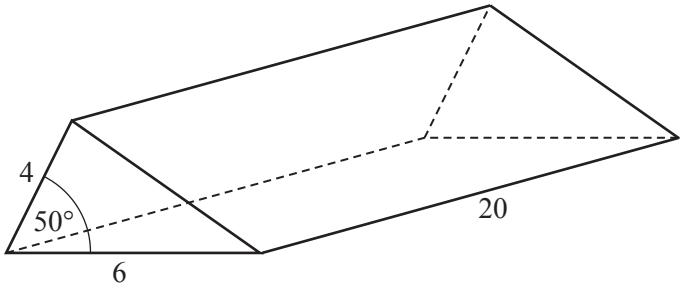
Answer ..... [2]

(ii) The ratios of the angles inside the trapezium are $L\hat{O}N : L\hat{M}N = 1:2$ and $O\hat{L}M : M\hat{N}O = 1:k$.

Find k, giving your answer as a fraction in its simplest form.

Answer ..... [3]

11 (a)



The diagram shows a solid triangular prism.
All lengths are given in centimetres.

(i) Calculate the area of the cross-section of the prism.

Answer .....cm^2 [2]

(ii) Calculate the volume of the prism.

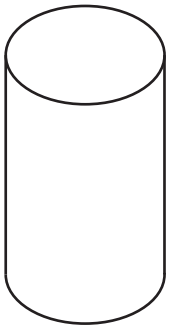
Answer .....cm^3 [1]

(iii) Calculate the **total** surface area of the prism.

Answer .....cm^2 [5]

(b) A cylinder has a height of 70 cm and a volume of 0.1 m^3.

Calculate the radius of the cylinder, giving your answer in centimetres.



Answer ..... cm [4]

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