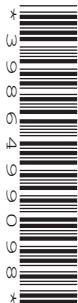


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**MATHEMATICS****0580/43**

Paper 4 (Extended)

**October/November 2020****2 hours 30 minutes**

You must answer on the question paper.

You will need: Geometrical instruments

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For  $\pi$ , use either your calculator value or 3.142.

**INFORMATION**

- The total mark for this paper is 130.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Blank pages are indicated.

1 (a) The Earth has a surface area of approximately  $510\,100\,000\text{ km}^2$ .

(i) Write this surface area in standard form.

.....  $\text{km}^2$  [1]

(ii) Water covers 70.8% of the Earth's surface.

Work out the area of the Earth's surface covered by water.

.....  $\text{km}^2$  [2]

(b) The table shows the surface area of some countries and their estimated population in 2017.

Country	Surface area ( $\text{km}^2$ )	Estimated population in 2017
Brunei	$5.77 \times 10^3$	433 100
China	$9.60 \times 10^6$	1 388 000 000
France	$6.41 \times 10^5$	67 000 000
Maldives	$3.00 \times 10^2$	374 600

(i) Find the total surface area of Brunei and the Maldives.

.....  $\text{km}^2$  [1]

(ii) The ratio surface area of the Maldives : surface area of China can be written in the form  $1 : n$ .

Find the value of  $n$ .

$n =$  ..... [2]

(iii) Find the surface area of France as a percentage of the surface area of China.

..... % [2]

- (iv) Find the population density of the Maldives.  
[Population density = population  $\div$  surface area]

.....people/km<sup>2</sup> [2]

- (c) The population of the Earth in 2017 was estimated to be  $7.53 \times 10^9$ .

The population of the Earth in 2000 was estimated to be  $6.02 \times 10^9$ .

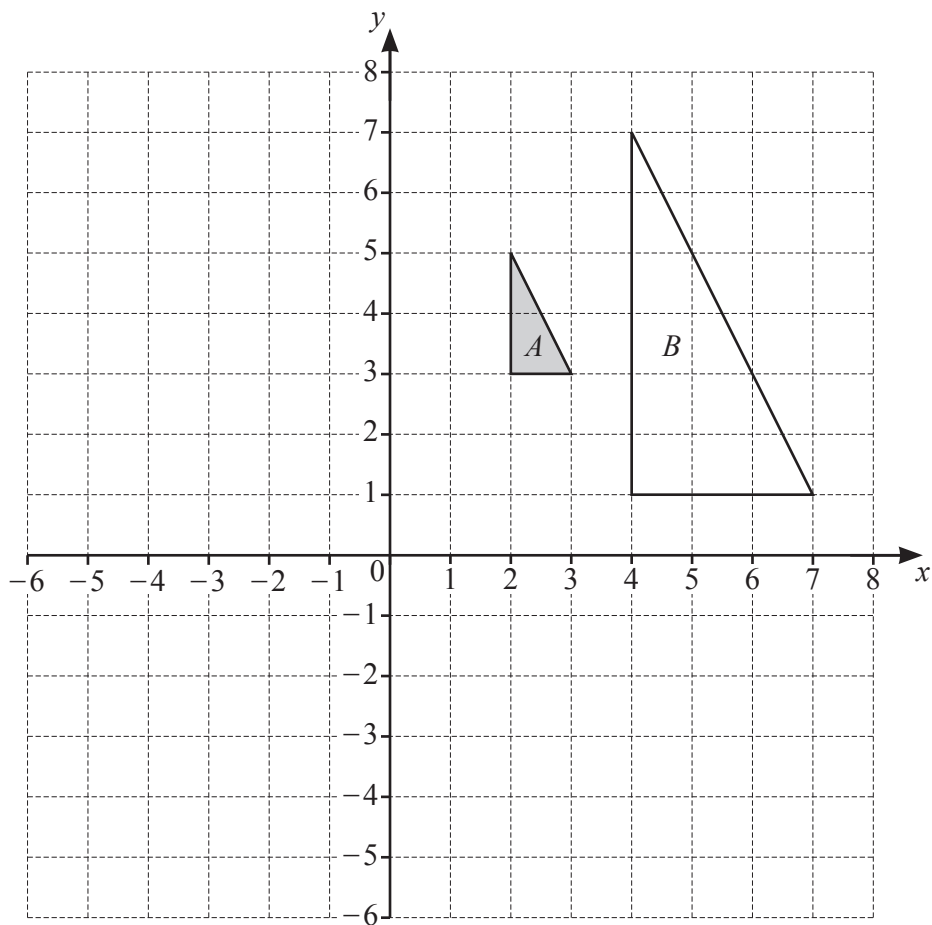
- (i) Work out the percentage increase in the Earth's estimated population from 2000 to 2017.

..... % [2]

- (ii) Assume that the population of the Earth increased exponentially by  $y\%$  each year for these 17 years.

Find the value of  $y$ .

$y =$  ..... [3]



(a) On the grid, draw the image of

(i) triangle  $A$  after a rotation of  $90^\circ$  anticlockwise about  $(0, 0)$ , [2]

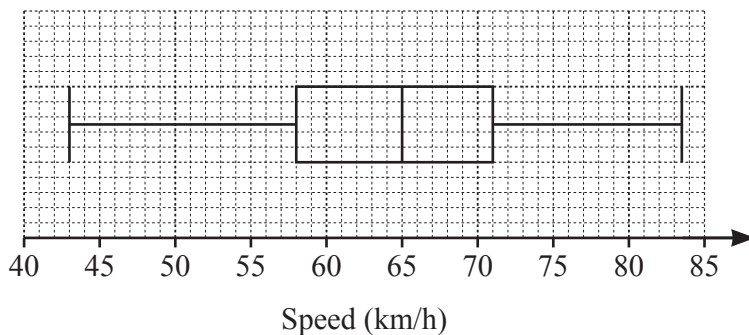
(ii) triangle  $A$  after a translation by the vector  $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$ . [2]

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

.....

..... [3]

- 3 (a) The average speeds, in km/h, of cars travelling along a road are recorded. The box-and-whisker plot shows this information.



Find

- (i) the lowest speed recorded,

..... km/h [1]

- (ii) the median,

..... km/h [1]

- (iii) the interquartile range.

..... km/h [1]

- (b) Another car takes 18 seconds to travel 400 m along this road.

Calculate the average speed of this car in km/h.

..... km/h [3]

4



Morgan picks two of these letters, at random, **without** replacement.

(a) Find the probability that he picks

(i) the letter Y first,

..... [1]

(ii) the letter B then the letter Y,

..... [2]

(iii) two letters that are the same.

..... [3]

(b) Morgan now picks a third letter at random.

Find the probability that

(i) all three letters are the same,

..... [2]

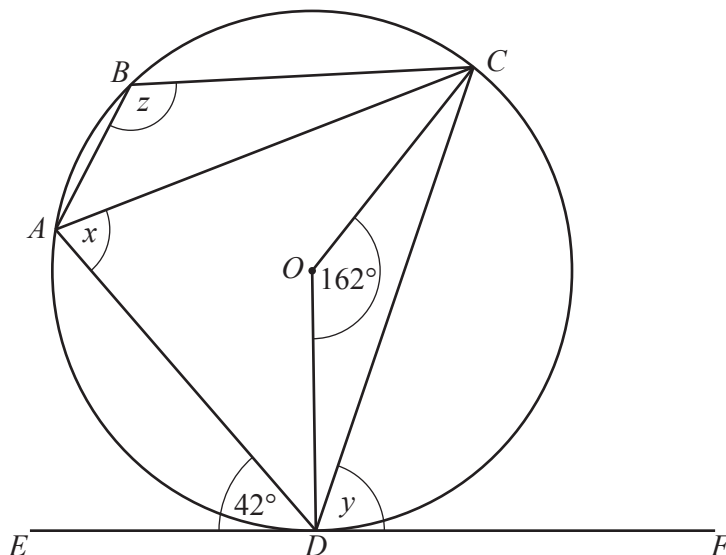
(ii) exactly two of the three letters are the same,

..... [5]

(iii) all three letters are different.

..... [2]

5 (a)



NOT TO SCALE

$A, B, C$  and  $D$  are points on the circle, centre  $O$ .  
 $EF$  is a tangent to the circle at  $D$ .  
 Angle  $ADE = 42^\circ$  and angle  $COD = 162^\circ$ .

Find the following angles, giving reasons for each of your answers.

(i) Angle  $x$

$x = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(ii) Angle  $y$

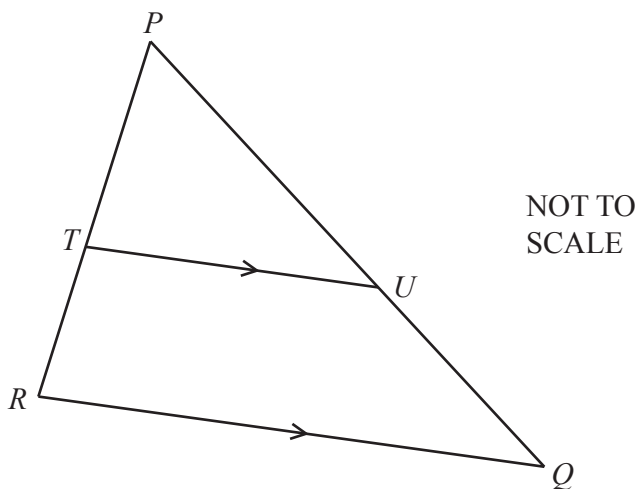
$y = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [2]

(iii) Angle  $z$

$z = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$   
 $\dots\dots\dots$  [3]



(b)



$PQR$  is a triangle.  
 $T$  is a point on  $PR$  and  $U$  is a point on  $PQ$ .  
 $RQ$  is parallel to  $TU$ .

- (i) Explain why triangle  $PQR$  is similar to triangle  $PUT$ .  
 Give a reason for each statement you make.

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

- (ii)  $PT : TR = 4 : 3$

- (a) Find the ratio  $PU : PQ$ .

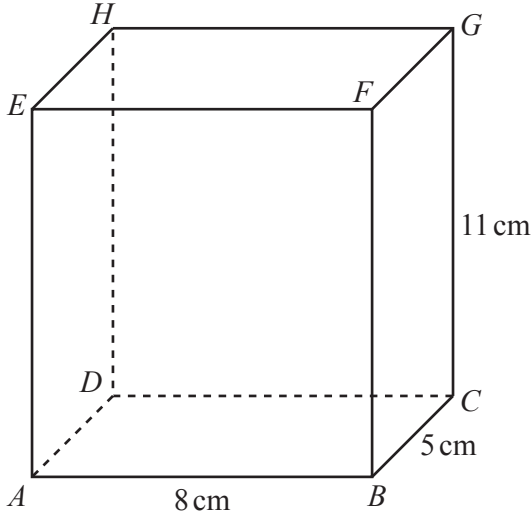
..... : ..... [1]

- (b) The area of triangle  $PUT$  is  $20 \text{ cm}^2$ .

Find the area of the quadrilateral  $QRTU$ .

.....  $\text{cm}^2$  [3]

6



NOT TO SCALE

*ABCDEFGH* is a cuboid.  
 $AB = 8\text{ cm}$ ,  $BC = 5\text{ cm}$  and  $CG = 11\text{ cm}$ .

(a) Work out the volume of the cuboid.

.....  $\text{cm}^3$  [2]

(b) Ivana has a pencil of length 13 cm.

Does this pencil fit completely inside the cuboid?  
 Show how you decide.

[4]

(c) (i) Calculate angle  $CAB$ .

Angle  $CAB = \dots\dots\dots$  [2]

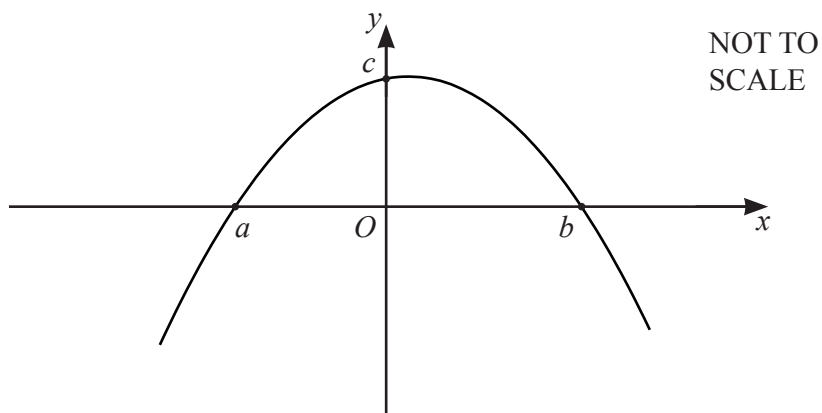
(ii) Calculate angle  $GAC$ .

Angle  $GAC = \dots\dots\dots$  [2]

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  $c$ .

$a =$  .....

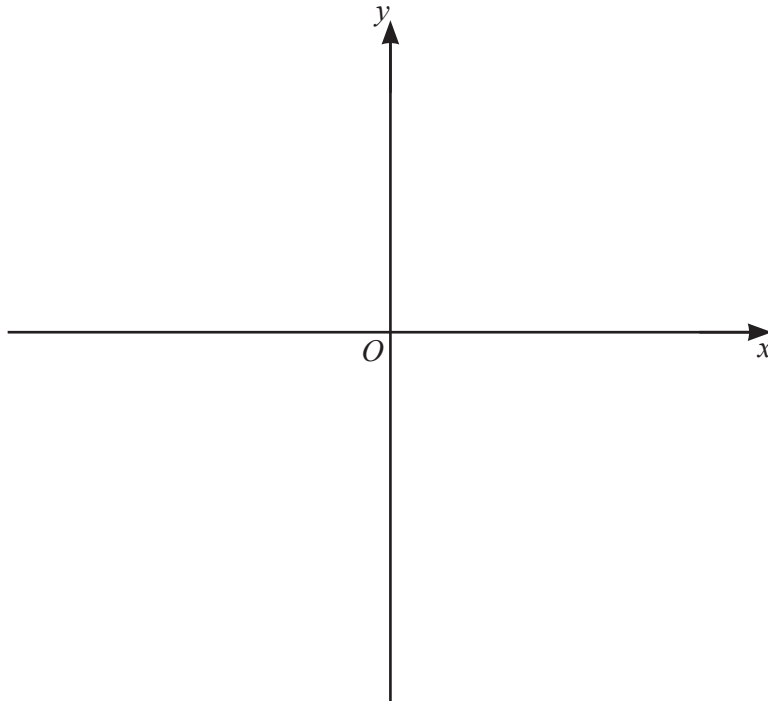
$b =$  .....

$c =$  ..... [3]

(iii) Calculate the gradient of  $y = 24 + 5x - x^2$  at  $x = -1.5$ .

..... [3]

- (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]

$$8 \quad (a) \quad \vec{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix} \quad \vec{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix} \quad \vec{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$$

Find

(i)  $\vec{AC}$ ,

$$\vec{AC} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [2]$$

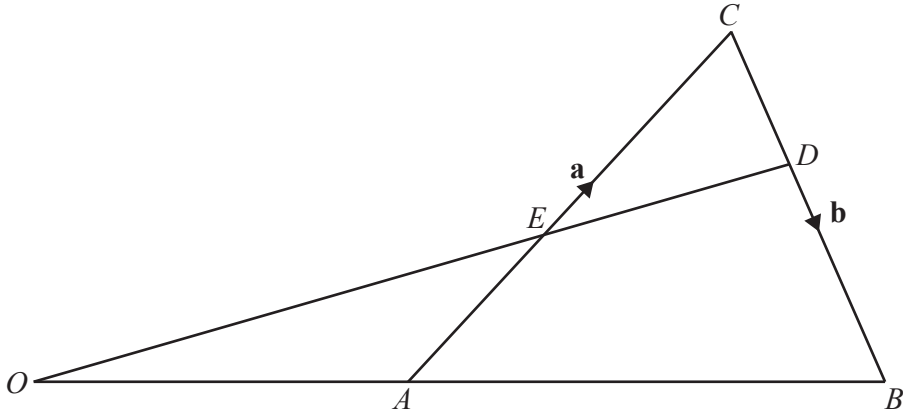
(ii)  $\vec{BD}$ ,

$$\vec{BD} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [2]$$

(iii)  $|\vec{BC}|$ .

..... [2]

(b)



NOT TO SCALE

In the diagram,  $OAB$  and  $OED$  are straight lines.  
 $O$  is the origin,  $A$  is the midpoint of  $OB$  and  $E$  is the midpoint of  $OC$ .  
 $\vec{AC} = \mathbf{a}$  and  $\vec{CB} = \mathbf{b}$ .

Find, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , in its simplest form

(i)  $\vec{AB}$ ,

$\vec{AB} = \dots\dots\dots [1]$

(ii)  $\vec{OE}$ ,

$\vec{OE} = \dots\dots\dots [2]$

(iii) the position vector of  $D$ .

$\dots\dots\dots [3]$

9 (a) Find the integer values that satisfy the inequality  $2 < 2x \leq 10$ .

..... [2]

(b) Factorise completely.

(i)  $6y^2 - 15xy$

..... [2]

(ii)  $y^2 - 9x^2$

..... [2]

(c) Simplify.

$$\frac{3}{x-1} - \frac{2}{2x+1}$$

..... [3]



- (d) The straight line  $y = 3x + 2$  intersects the curve  $y = 2x^2 + 7x - 11$  at two points.

Find the coordinates of these two points.

Give your answers correct to 2 decimal places.

(....., .....) )

(....., .....) [6]

10  $f(x) = 4 - 3x$        $g(x) = x^2 + x$        $h(x) = 3^x$

(a) Find  $fh(2)$ .

..... [2]

(b) Find  $f^{-1}(x)$ .

$f^{-1}(x) =$  ..... [2]

(c) Simplify.

(i)  $f(1 - 2x)$

..... [2]

(ii)  $gf(x) - 9g(x)$

..... [4]

(d)  $\frac{1}{h(x)} = 9^{kx}$

Find the value of  $k$ .

$k =$  ..... [2]

- 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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