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2 hours 30 minutes

You will need: Geometrical instruments

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

[Turn over

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

(i) Write this surface area in standard form.

..... 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.

..... km^2 [2]

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

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

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

..... 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/km² [2]

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

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

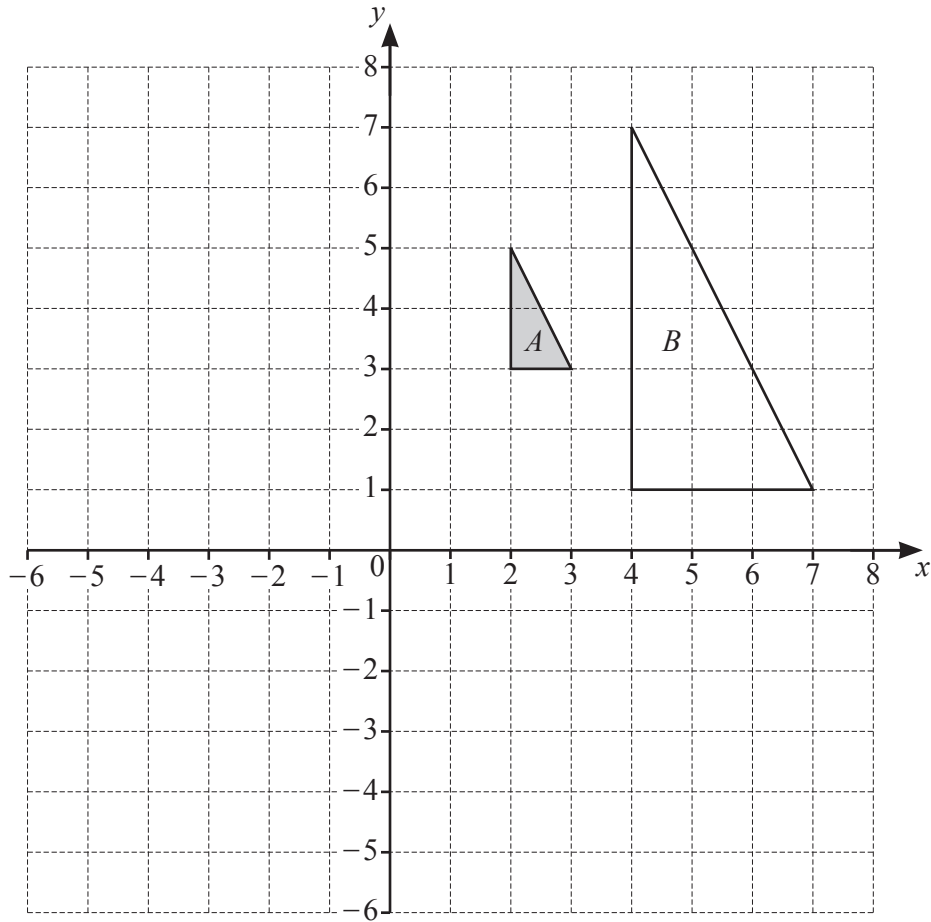
- (i) Work out the percentage increase in the Earth's estimated population from 2000 to 2017.

..... % [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° anticlockwise about $(0, 0)$, [2]

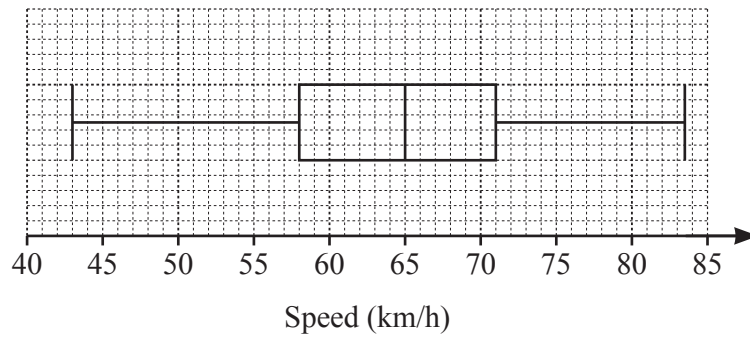
(ii) triangle A after a translation by the vector $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$. [2]

(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

P	O	S	S	I	B	I	L	I	T	Y
---	---	---	---	---	---	---	---	---	---	---

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]

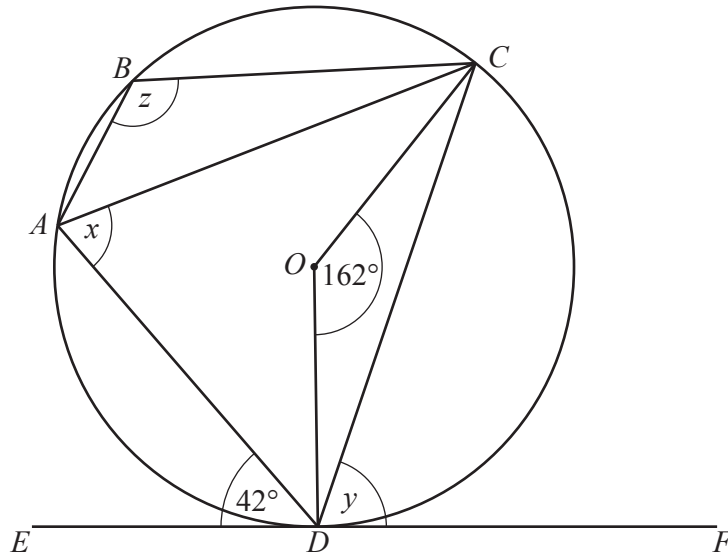
- (ii) exactly two of the three letters are the same,

..... [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]

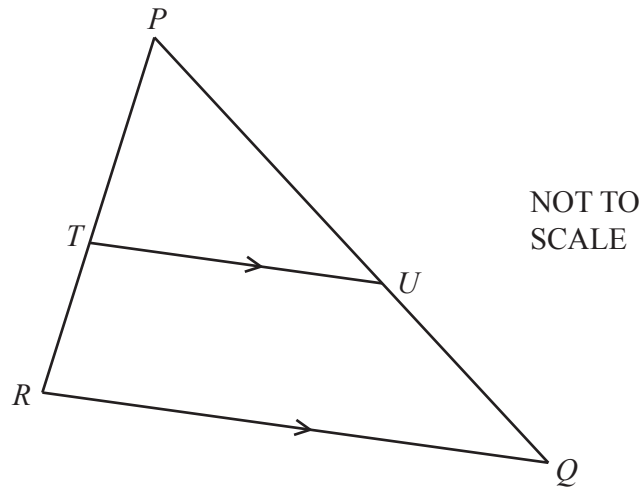
(iii) Angle z

$z = \dots\dots\dots$ 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 $PU : PQ$.

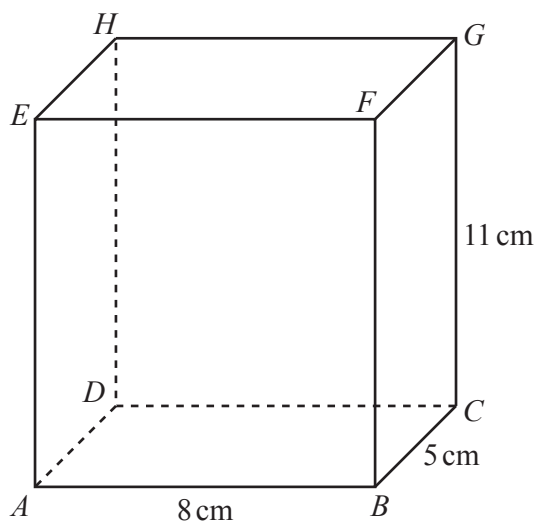
..... : [1]

- (b) The area of triangle PUT is 20 cm^2 .

Find the area of the quadrilateral $QRTU$.

..... cm^2 [3]

6



NOT TO
SCALE

$ABCDEFGH$ is a cuboid.
 $AB = 8$ cm, $BC = 5$ cm and $CG = 11$ cm.

(a) Work out the volume of the cuboid.

..... 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]

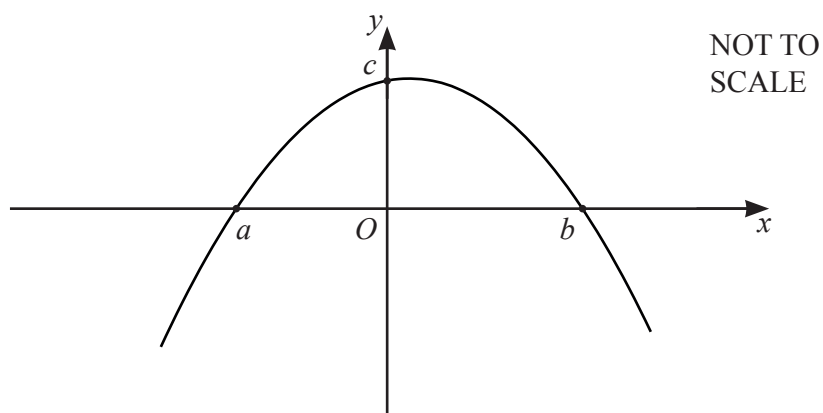
- (ii) Calculate angle GAC .

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 .

$a =$

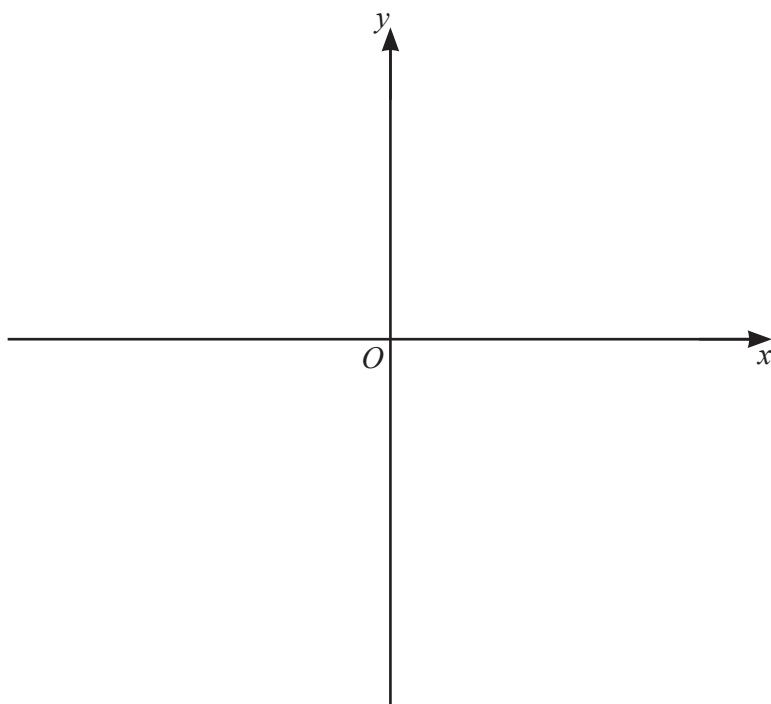
$b =$

$c =$ [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 (a) $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Find

(i) \overrightarrow{AC} ,

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

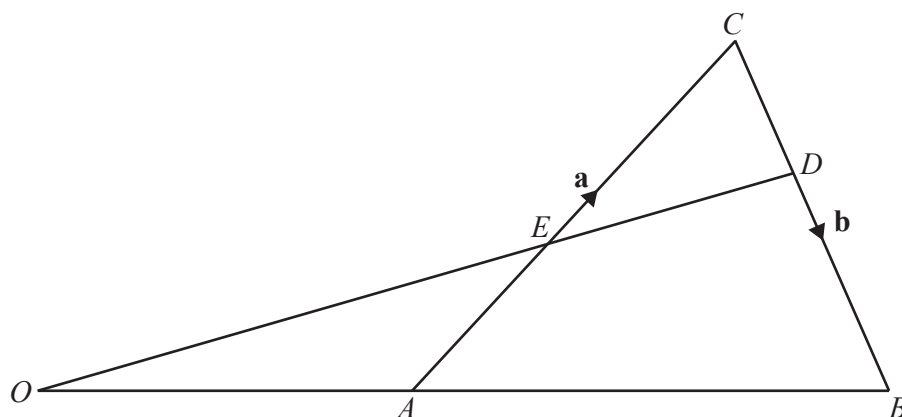
(ii) \overrightarrow{BD} ,

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

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

..... [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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