



CANDIDATE  
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## 0580/42

October/November 2021

**2 hours 30 minutes**

You must answer on the question paper.

You will need: Geometrical instruments

- 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.

- 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. Any blank pages are indicated.

- 1 (a) Malena has 450 fruit trees.  
The fruit trees are in the ratio apple : pear : plum = 8 : 7 : 3.

(i) Show that Malena has 200 apple trees.

[2]

(ii) Find the number of plum trees.

..... [1]

(iii) Malena wants to increase the number of pear trees by 32%.

Calculate the number of extra pear trees she needs.

..... [2]

(iv) Each apple tree produces 48.5 kg of apples.  
The apples have an average mass of 165 g each.

Calculate the total number of apples produced by the 200 trees.  
Give your answer correct to the nearest 1000 apples.

..... [3]

(b) Malena's land is valued at three million and seventy-five thousand dollars.

(i) Write this number in figures.

..... [1]

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

..... [1]

(c) In 2020, each plum tree produced 37.7 kg of plums.  
This was 16% more than in 2019.

Calculate the mass of plums produced by each plum tree in 2019.

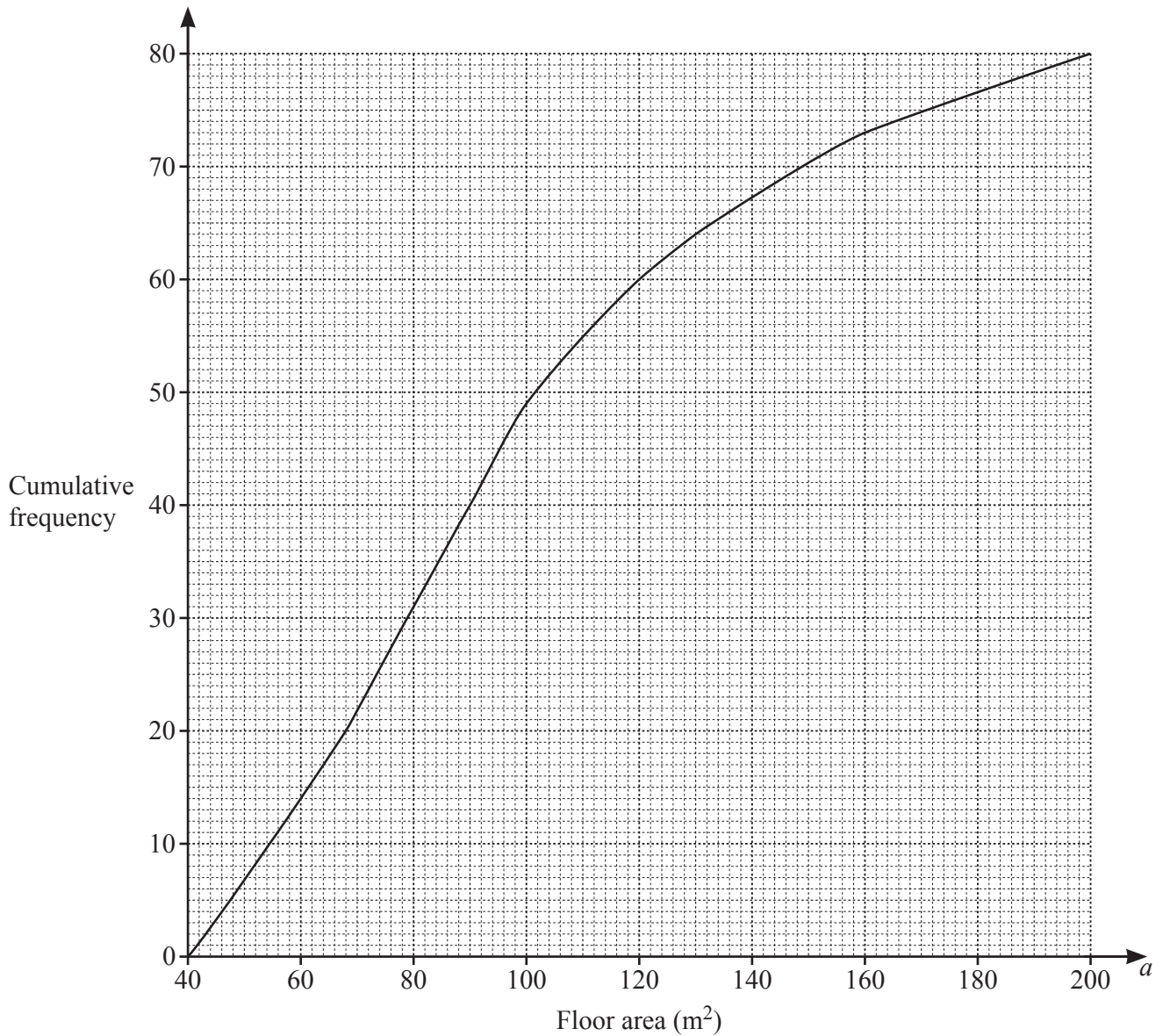
..... kg [2]

(d) Malena invests \$1800 at a rate of 2.1% per year compound interest.

Calculate the value of her investment at the end of 15 years.

\$ ..... [2]

- 2 (a) The cumulative frequency diagram shows information about the floor area,  $a \text{ m}^2$ , of each of 80 houses.



Use the diagram to find an estimate of

- (i) the median, .....  $\text{m}^2$  [1]
- (ii) the lower quartile, .....  $\text{m}^2$  [1]
- (iii) the interquartile range, .....  $\text{m}^2$  [1]
- (iv) the number of houses with a floor area greater than  $120 \text{ m}^2$ .

..... [2]

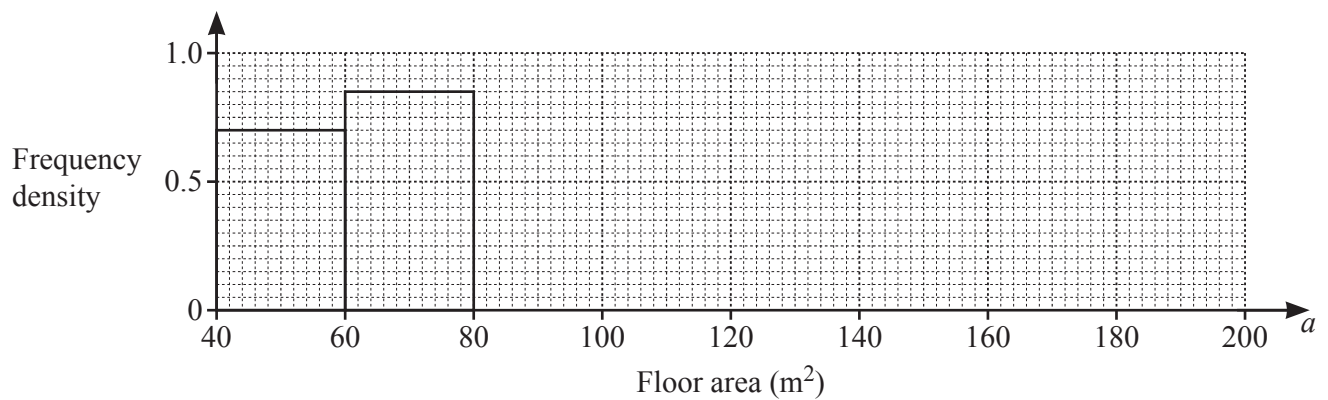
(b) The information about the 80 floor areas is shown in this frequency table.

| Floor area<br>( $a \text{ m}^2$ ) | $40 < a \leq 60$ | $60 < a \leq 80$ | $80 < a \leq 100$ | $100 < a \leq 130$ | $130 < a \leq 160$ | $160 < a \leq 200$ |
|-----------------------------------|------------------|------------------|-------------------|--------------------|--------------------|--------------------|
| Frequency                         | 14               | 17               | 18                | 15                 | 9                  | 7                  |

(i) Calculate an estimate of the mean floor area.

.....  $\text{m}^2$  [4]

(ii) Complete the histogram to show the information in the frequency table.



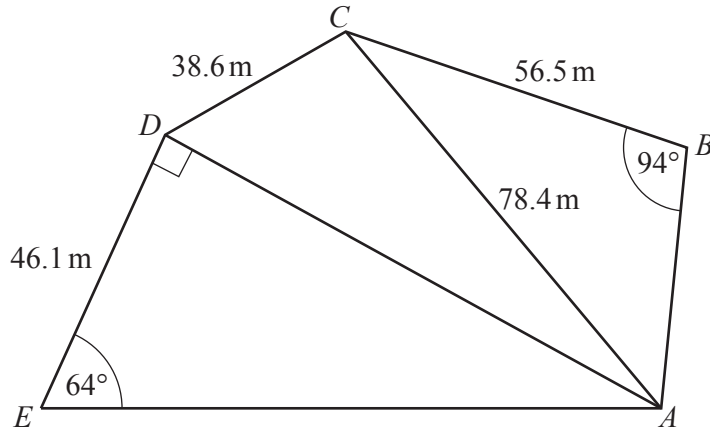
[4]

(iii) Two of the houses are picked at random.

Find the probability that one of the houses has a floor area greater than  $130 \text{ m}^2$  and the other has a floor area  $60 \text{ m}^2$  or less.

..... [3]

3 (a)

NOT TO  
SCALE*ABCDE* is a pentagon.

- (i) Calculate  $AD$  and show that it rounds to 94.5 m, correct to 1 decimal place.

[2]

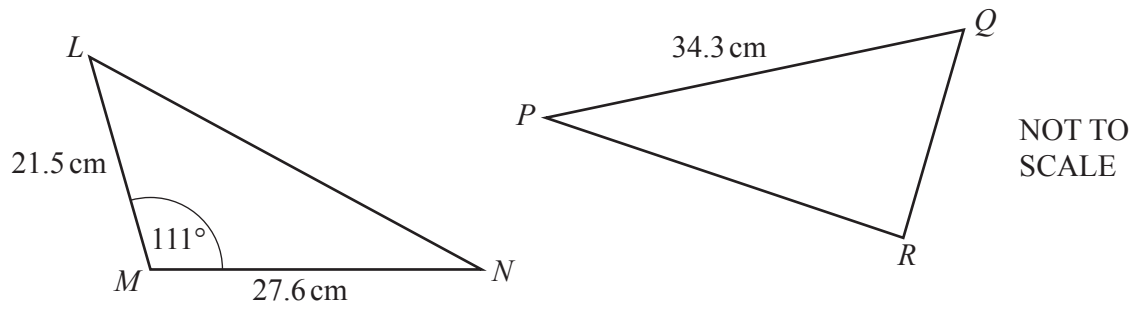
- (ii) Calculate angle  $BAC$ .

Angle  $BAC = \dots\dots\dots$  [3]

- (iii) Calculate the largest angle in triangle  $CAD$ .

 $\dots\dots\dots$  [4]

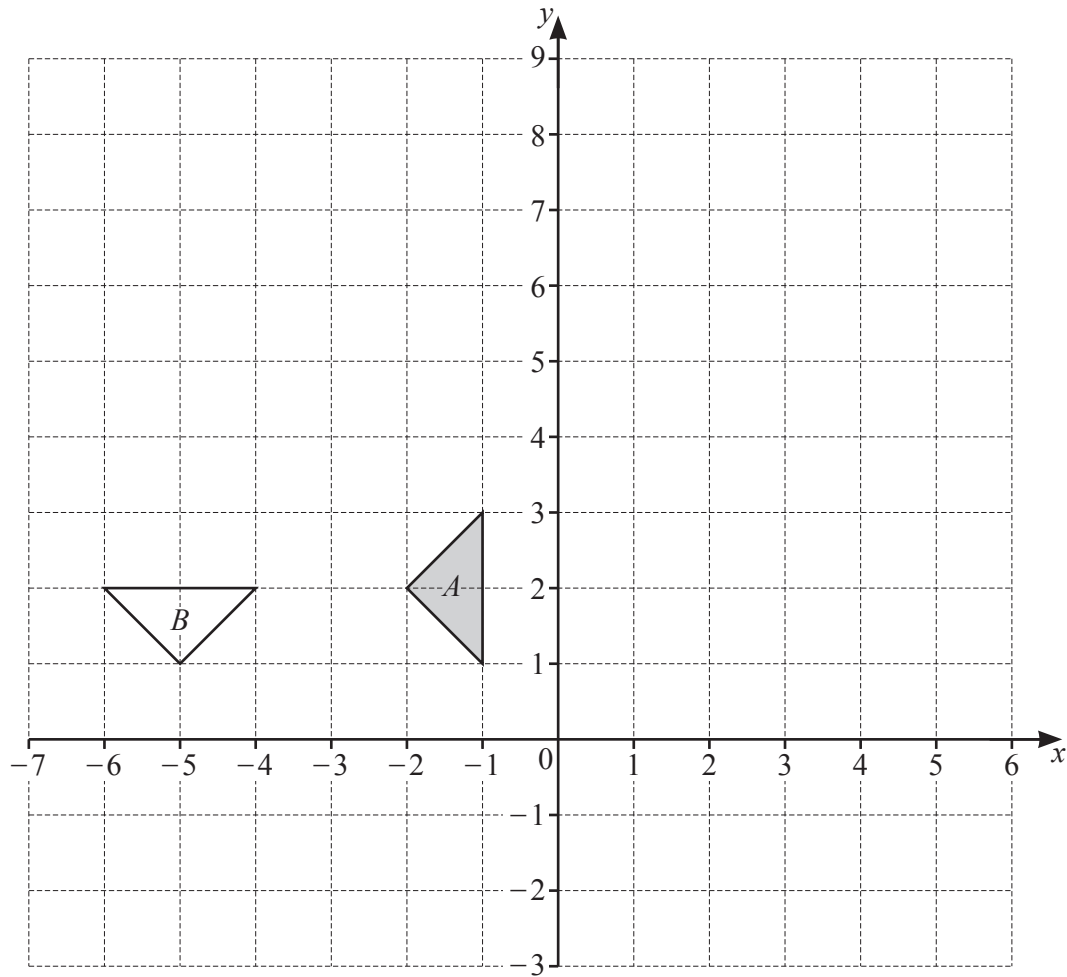
(b)



Triangle  $PQR$  has the same area as triangle  $LMN$ .

Calculate the shortest distance from  $R$  to the line  $PQ$ .

..... cm [3]



(a) On the grid, draw the image of triangle  $A$  after

(i) a translation by the vector  $\begin{pmatrix} -4 \\ 5 \end{pmatrix}$ , [2]

(ii) a reflection in the line  $x = 1$ , [2]

(iii) an enlargement, scale factor 2 and centre  $(-5, -2)$ . [2]

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

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

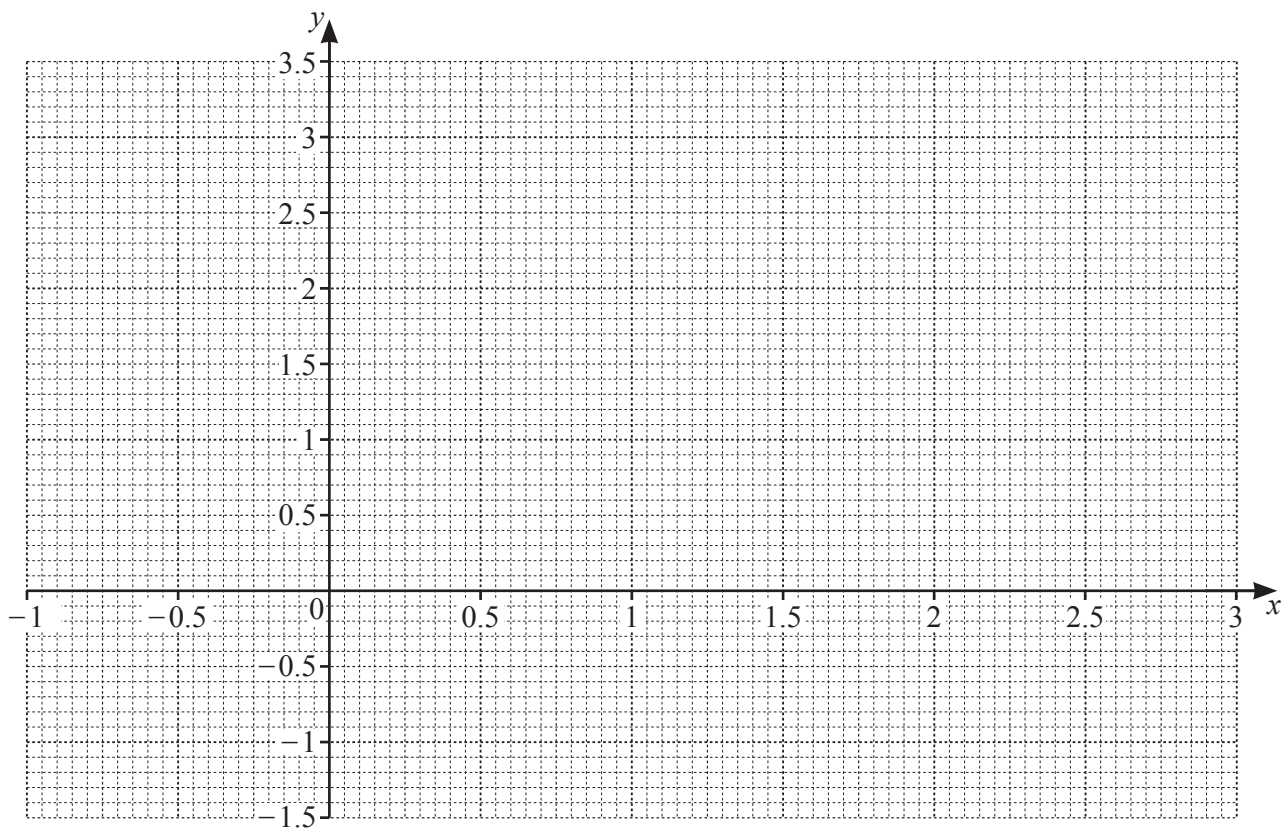
- 5 The table shows some values for  $y = x^3 - 3x^2 + 3$ .

|     |    |       |   |       |   |     |    |        |   |
|-----|----|-------|---|-------|---|-----|----|--------|---|
| $x$ | -1 | -0.5  | 0 | 0.5   | 1 | 1.5 | 2  | 2.5    | 3 |
| $y$ |    | 2.125 | 3 | 2.375 | 1 |     | -1 | -0.125 |   |

- (a) Complete the table.

[3]

- (b) On the grid, draw the graph of  $y = x^3 - 3x^2 + 3$  for  $-1 \leq x \leq 3$ .



[4]

- (c) By drawing a suitable straight line on the grid, solve the equation  $x^3 - 3x^2 + x + 1 = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

6 (a) Solve.

(i)  $4(2x - 3) = 24$

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

(ii)  $6x + 14 > 6$

$\dots\dots\dots$  [2]

(b) Rearrange the formula  $V = 2x^3 - 3y^3$  to make  $y$  the subject.

$y = \dots\dots\dots$  [3]

(c) Show that  $(2n - 5)^2 - 13$  is a multiple of 4 for all integer values of  $n$ .

[3]

(d) The expression  $5 + 12x - 2x^2$  can be written in the form  $q - 2(x + p)^2$ .

(i) Find the value of  $p$  and the value of  $q$ .

$p = \dots\dots\dots$ ,  $q = \dots\dots\dots$  [3]

(ii) Write down the coordinates of the maximum point of the curve  $y = 5 + 12x - 2x^2$ .

( $\dots\dots\dots$ ,  $\dots\dots\dots$ ) [1]

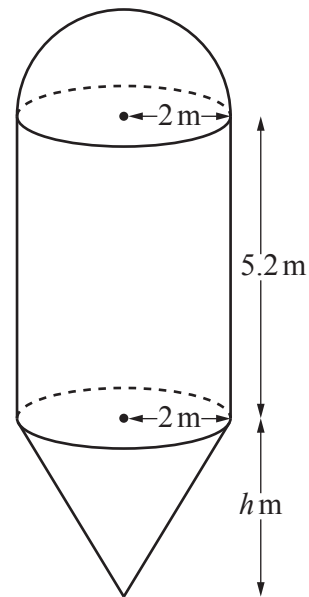
(e) The energy of a moving object is directly proportional to the square of its speed.  
The speed of the object is increased by 30%.

Calculate the percentage increase in the energy of the object.

$\dots\dots\dots$  % [2]

- 7 (a) The diagram shows a container for storing grain.

The container is made from a hemisphere, a cylinder and a cone, each with radius 2 m. The height of the cylinder is 5.2 m and the height of the cone is  $h$  m.



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- (i) Calculate the volume of the hemisphere.  
Give your answer as a multiple of  $\pi$ .

[The volume,  $V$ , of a sphere with radius  $r$  is  $V = \frac{4}{3}\pi r^3$ .]

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

- (ii) The total volume of the container is  $\frac{88\pi}{3} \text{ m}^3$ .

Calculate the value of  $h$ .

[The volume,  $V$ , of a cone with radius  $r$  and height  $h$  is  $V = \frac{1}{3}\pi r^2 h$ .]

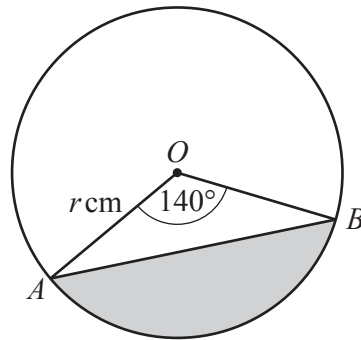
$h =$  ..... [4]

- (iii) The container is full of grain.  
 Grain is removed from the container at a rate of 35 000 kg per hour.  
 $1\text{ m}^3$  of grain has a mass of 620 kg.

Calculate the time taken to empty the container.  
 Give your answer in hours and minutes.

..... h ..... min [3]

(b)



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$A$  and  $B$  are points on a circle, centre  $O$ , radius  $r$  cm.  
 The area of the shaded segment is  $65\text{ cm}^2$ .

Calculate the value of  $r$ .

$r =$  ..... [4]

- 8 (a) Kaito runs along a 12 km path at an average speed of  $x$  km/h.

(i) Write down an expression, in terms of  $x$ , for the number of hours he takes.

..... hours [1]

- (ii) Yuki takes 1.5 hours longer to walk along the same path as Kaito.  
She walks at an average speed of  $(x - 4)$  km/h.

Write down an equation, in terms of  $x$ , and show that it simplifies to  $x^2 - 4x - 32 = 0$ .

[4]

- (iii) Solve by factorisation.

$$x^2 - 4x - 32 = 0$$

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

- (iv) Find the number of hours it takes Yuki to walk along the 12 km path.

..... hours [2]

- (b) A bus travels 440 km, correct to the nearest 10 km.  
The time taken to complete the journey is 6 hours, correct to the nearest half hour.

Calculate the lower bound of the speed of the bus.

..... km/h [3]

- 9 (a)  $F$  is the point  $(5, -2)$  and  $\overrightarrow{FG} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ .

Find

- (i) the coordinates of point  $G$ ,

(....., ..... ) [1]

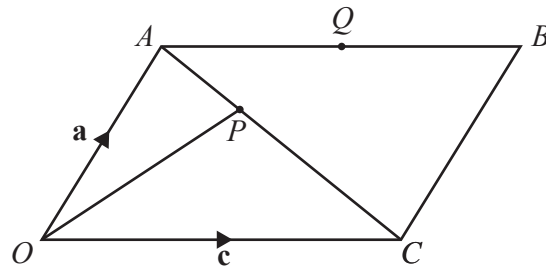
- (ii)  $5\overrightarrow{FG}$ ,

$\begin{pmatrix} \phantom{0} \\ \phantom{0} \end{pmatrix}$  [1]

- (iii)  $|\overrightarrow{FG}|$ .

..... [2]

(b)

NOT TO  
SCALE $OABC$  is a parallelogram. $P$  is a point on  $AC$  and  $Q$  is the midpoint of  $AB$ . $\overrightarrow{OA} = \mathbf{a}$  and  $\overrightarrow{OC} = \mathbf{c}$ .(i) Find, in terms of  $\mathbf{a}$  and/or  $\mathbf{c}$ (a)  $\overrightarrow{AQ}$ ,

$$\overrightarrow{AQ} = \dots\dots\dots [1]$$

(b)  $\overrightarrow{OQ}$ .

$$\overrightarrow{OQ} = \dots\dots\dots [1]$$

(ii)  $\overrightarrow{OP} = \frac{2}{3}\mathbf{a} + \frac{1}{3}\mathbf{c}$ (a) Show that  $O$ ,  $P$  and  $Q$  lie on a straight line.

[2]

(b) Write down the ratio  $OP : OQ$ .  
Give your answer in the form  $1 : n$ .

$$1 : \dots\dots\dots [1]$$

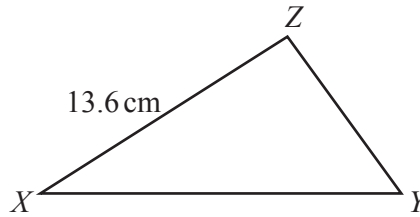
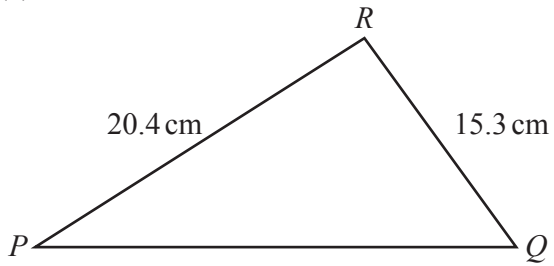
- 10 (a)** Find the coordinates of the turning points of the graph of  $y = x^3 - 12x + 6$ .  
You must show all your working.

(..... , ..... ) and (..... , ..... ) [5]

- (b)** Determine whether each turning point is a maximum or a minimum.  
Show how you decide.

[3]

11 (a)

NOT TO  
SCALE

Triangle  $PQR$  is mathematically similar to triangle  $XYZ$ .

(i) Find  $YZ$ .

$YZ = \dots\dots\dots$  cm [2]

(ii) The area of triangle  $XYZ$  is  $63.6 \text{ cm}^2$ .

Calculate the area of triangle  $PQR$ .

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

(b) Two containers are mathematically similar.

The larger container has a capacity of 64.8 litres and a surface area of  $0.792 \text{ m}^2$ .

The smaller container has a capacity of 37.5 litres.

Calculate the surface area of the smaller container.

$\dots\dots\dots \text{ m}^2$  [3]

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