YEAR 11 MATHEMATICS - PAPER 4

REVISION BOOKLET(0580)

Cambridge Assessment International Education

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MATHEMATICS **0580/04**

Paper 4 Calculator (Extended) **For examination from 2025**

SPECIMEN PAPER **2 hours**

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.
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- Do **not** write on any bar codes.
- You should use a scientific 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 π, use either your calculator value or 3.142.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

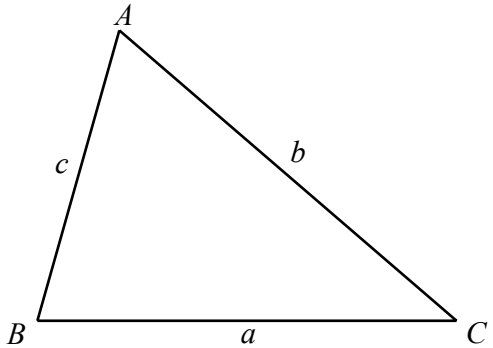
This document has **16** pages.

[Turn over

List of formulas

Area, A, of triangle, base b, height h.	$A = \frac{1}{2}bh$
Area, A, of circle of radius r.	$A = \pi r^2$
Circumference, C, of circle of radius r.	$C = 2\pi r$
Curved surface area, A, of cylinder of radius r, height h.	$A = 2\pi rh$
Curved surface area, A, of cone of radius r, sloping edge l.	$A = \pi rl$
Surface area, A, of sphere of radius r.	$A = 4\pi r^2$
Volume, V, of prism, cross-sectional area A, length l.	$V = Al$
Volume, V, of pyramid, base area A, height h.	$V = \frac{1}{3}Ah$
Volume, V, of cylinder of radius r, height h.	$V = \pi r^2 h$
Volume, V, of cone of radius r, height h.	$V = \frac{1}{3}\pi r^2 h$
Volume, V, of sphere of radius r.	$V = \frac{4}{3}\pi r^3$
For the equation $ax^2 + bx + c = 0$, where $a \neq 0$,	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

For the triangle shown,



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

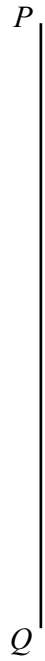
$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\text{Area} = \frac{1}{2}ab\sin C$$

1 Write down the integer values of x that satisfy the inequality $-2 \leqslant x < 2$.

..... [2]

2



In triangle PQR, $QR = 10$ cm and $PR = 11$ cm.

Using a ruler and compasses only, construct triangle PQR.
The line PQ has been drawn for you. [2]

3 Simplify.

$$(x^8y^7) \div (x^{-1}y^3)$$

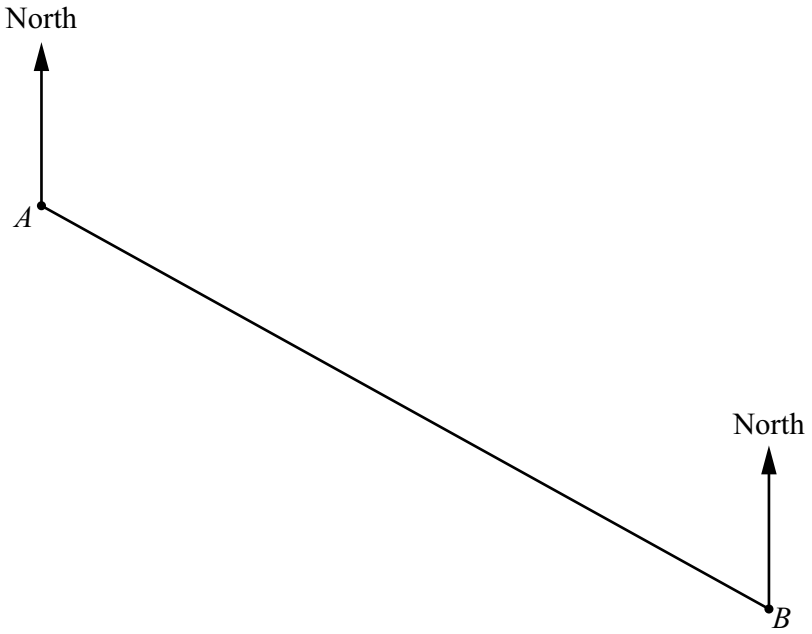
..... [2]

4 $f(x) = 3x - 5$
The domain of $f(x)$ is $\{-3, 0, 2\}$.

Find the range of $f(x)$.

{ ..... } [2]

5



Two towns, A and B, are shown on a map.
The scale of the map is 1 cm to 3 km.

(a) Find the actual distance between A and B.

..... km [1]

(b) Measure the bearing of B from A.

..... [1]

(c) Calculate the bearing of A from B.
You must show all your working.

..... [2]

6 A solid metal cuboid has a volume of $600\,cm^3$.

(a) The base of the cuboid is 10 cm by 12 cm.

Calculate the height of the cuboid.

..... cm [2]

(b) The solid metal cuboid is melted and made into 1120 spheres, each with radius 0.45 cm.

Find the volume of metal **not** used in making these spheres.

..... cm^3 [2]

7 On any day the probability that it rains is $\frac{1}{3}$.

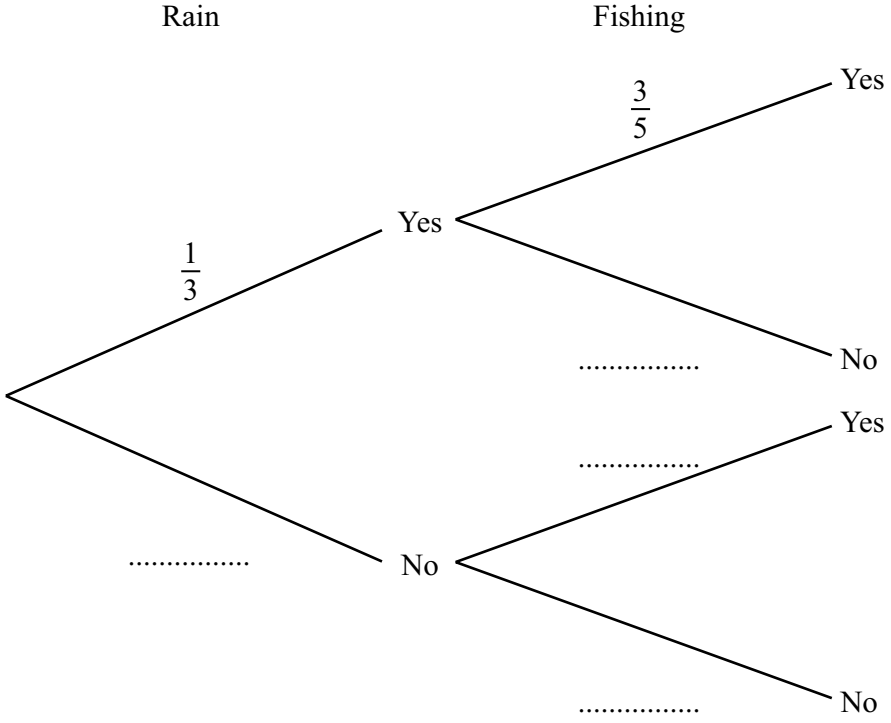
When it rains the probability that Amira goes fishing is $\frac{3}{5}$.

When it does not rain the probability that Amira goes fishing is $\frac{3}{4}$.

(a) In a period of 60 days on how many days is it expected to rain?

..... [1]

(b) Complete the tree diagram.

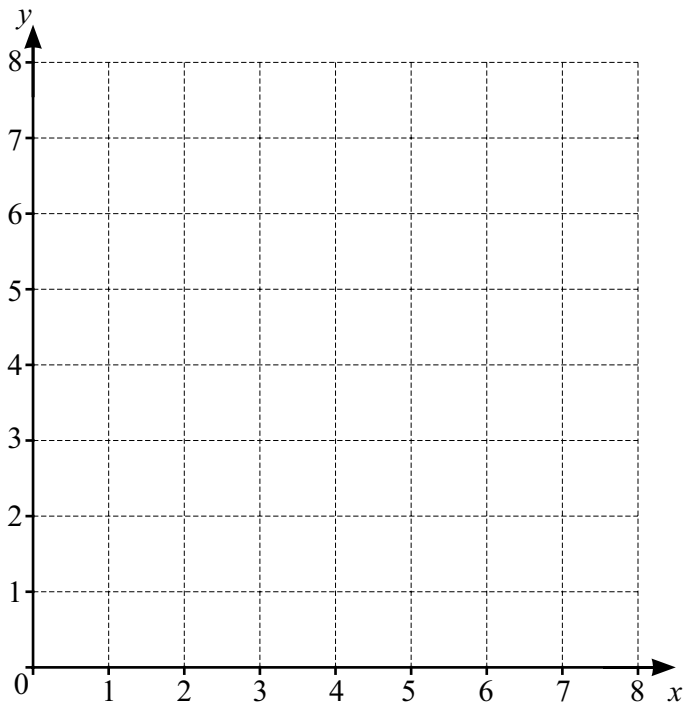


[2]

(c) Find the probability that on any day Amira goes fishing.

..... [3]

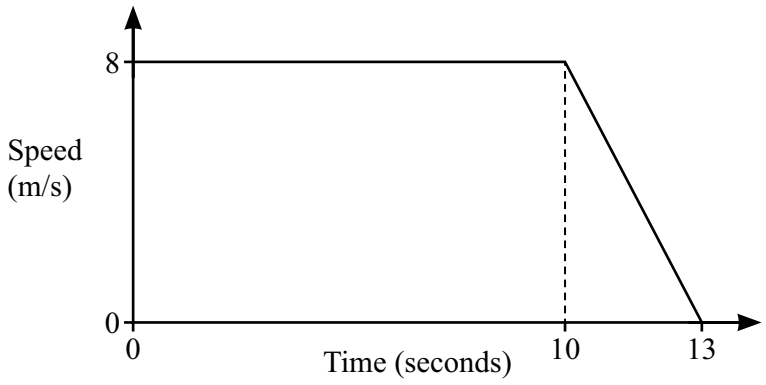
8



(a) On the grid, draw the lines $y = x$ and $x + y = 7$. [3]

(b) Region R satisfies the three inequalities $y \geqslant 0$, $y \leqslant x$ and $x + y \geqslant 7$.
On the grid, label the region R. [1]

9



NOT TO SCALE

The diagram shows the speed–time graph of part of a car journey.

(a) Find the deceleration of the car between 10 and 13 seconds.

..... m/s^2 [1]

(b) Calculate the total distance travelled during the 13 seconds.

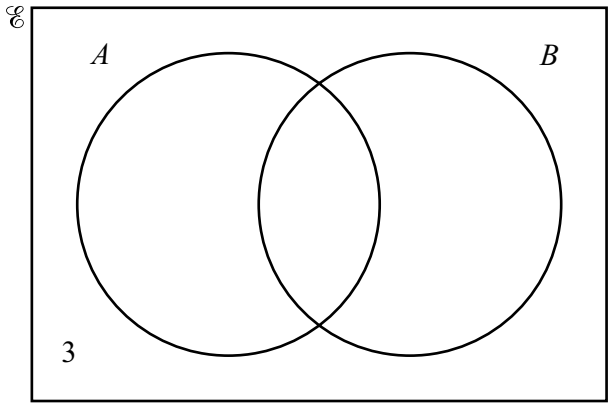
..... m [2]

10 Factorise.

$2x + 6 - 3xy - 9y$

..... [2]

11



$n(\mathscr{E}) = 20$, $n(A \cup B)' = 3$, $n(A) = 10$ and $n(B) = 13$.
The Venn diagram shows some of this information.

Find

(a) $n(A \cap B)$

..... [2]

(b) $n(A' \cap B)$.

..... [1]

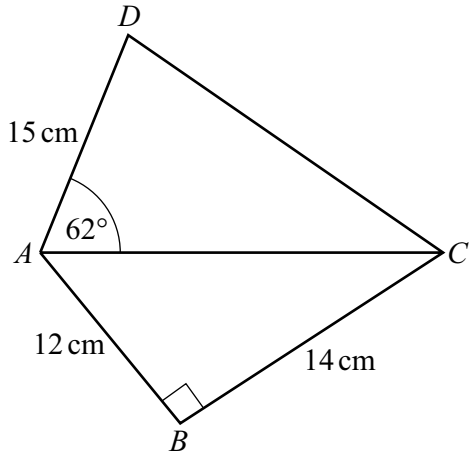
12 The height, h cm, of each of 100 students is measured.
The table shows the results.

Height (h cm)	$100 < h \leqslant 150$	$150 < h \leqslant 160$	$160 < h \leqslant 165$	$165 < h \leqslant 185$
Frequency	7	30	41	22

Calculate an estimate of the mean.

..... cm [4]

13



NOT TO SCALE

The diagram shows a quadrilateral, *ABCD*, formed from two triangles, *ABC* and *ACD*.
ABC is a right-angled triangle.

(a) Calculate angle *BAC*.

Angle *BAC* = ... [2]

(b) Calculate *BD*.

BD = ... cm [4]

(c) Calculate the shortest distance from *D* to *AC*.

..... cm [3]

14 (a) Hong has \$4000 to invest.
She invests \$2000 at a rate of 2.5% per year **simple** interest.
She also invests \$2000 at a rate of 2% per year **compound** interest.

(i) Find the value of each investment at the end of 8 years.

Simple interest investment \$ .....

Compound interest investment \$ .....
[5]

(ii) Find the overall percentage increase in the \$4000 investment at the end of 8 years.

.....% [2]

(iii) Find the number of complete years it takes for the compound interest investment of \$2000 to become greater than \$2500.

..... [3]

(b) Alain invests \$5000 at a rate of r% per year compound interest.
At the end of 15 years, the value of the investment is \$7566.

Find the value of r.

r = ... [3]

15 $y = \sqrt{u^2 x}$

(a) Find the value of y when $u = 7$ and $x = 25$.

$y =$ ..... [2]

(b) Rearrange the formula to write x in terms of u and y.

$x =$ ..... [2]

16 A is the point (7, 2) and B is the point (−5, 8).

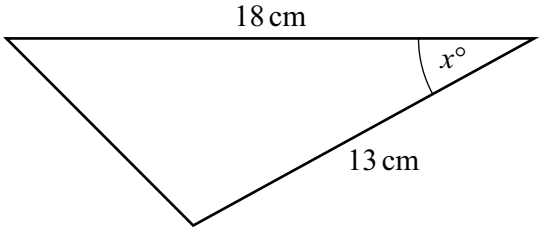
(a) Calculate the length of AB.

..... [3]

(b) Find the equation of the line that is perpendicular to AB and that passes through the point (−1, 3). Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

17



NOT TO SCALE

The area of the triangle is $50\,\text{cm}^2$.

Calculate the value of $\sin x$.

$\sin x =$ ..... [2]

18 Solve.

$$\frac{3y}{2y-1} = \frac{3}{4}$$

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

19 The cross-section of a prism is an equilateral triangle of side 6 cm.
The length of the prism is 20 cm.

Calculate the total surface area of the prism.

..... cm^2 [4]

20 $y = 2x^k + ux^7$ and $\frac{\text{d}y}{\text{d}x} = 18x^{k-1} + 21x^6$

Find the value of k and the value of u.

$k =$ .....

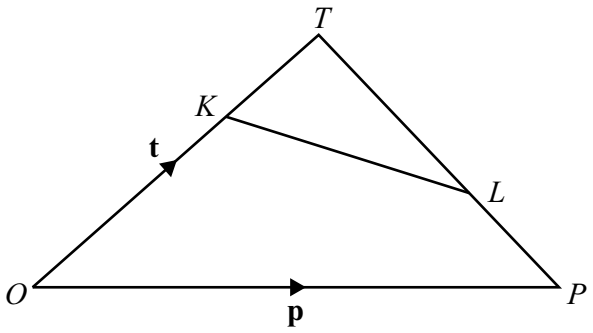
$u =$ .....
[2]

21 Simplify.

$$\frac{5p^2 - 20p}{2p^2 - 32}$$

..... [3]

22 The diagram shows triangle OPT.



NOT TO SCALE

In the diagram $\overrightarrow{OT} = \mathbf{t}$ and $\overrightarrow{OP} = \mathbf{p}$.
$OK : KT = 2 : 1$ and $TL : LP = 2 : 1$.

(a) Find, in terms of **t** and **p**, in its simplest form

(i) $\overrightarrow{PL}$

..... [2]

(ii) $\overrightarrow{KL}$.

..... [2]

(b) KL is extended to the point M.
$\overrightarrow{KM} = -\frac{2}{3}\mathbf{t} + \frac{4}{3}\mathbf{p}$.

Show that M lies on OP extended.

[2]

23 Serge walks 7.9 km, correct to the nearest 100 metres.
The walk takes 133 minutes, correct to the nearest minute.

Calculate the maximum possible average speed of Serge's walk.
Give your answer in kilometres/hour.

..... km/h [3]

24 The straight line $y = 2x + 1$ intersects the curve $y = x^2 + 3x - 4$ at the points A and B.

Find the coordinates of A and B.
Give your answers correct to 2 decimal places.

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

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

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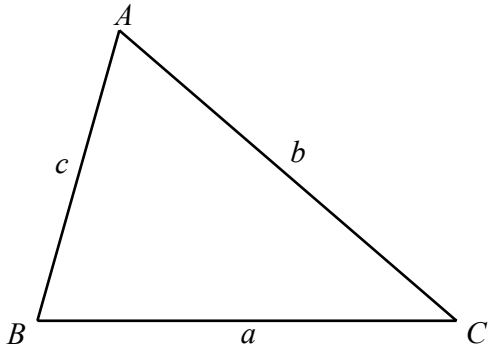

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$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\text{Area} = \frac{1}{2}ab\sin C$$

1 Find the reciprocal of 0.35 .

..... [1]

2 Calculate.

$$\frac{4^2 - 1.9}{3.2 - 2.6}$$

..... [1]

3 Navin and Esther share some money in the ratio Navin : Esther = 5 : 7.

(a) Find Navin's share as a percentage of the total money.

.....% [1]

(b) Find Esther's share as a percentage of Navin's share.

.....% [1]

(c) Navin's share is \$160.

Work out Esther's share.

\$ ..... [2]

4 **(a)** Simplify.

(i) $5x^2 - 7x + 6x - x^2$

..... [2]

(ii) $\frac{4x}{3y} \div \frac{2a}{9y}$

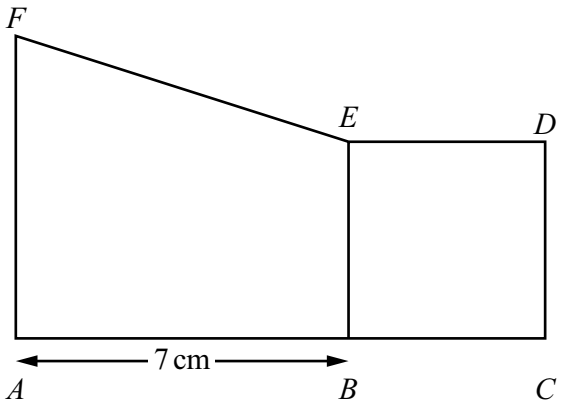
..... [2]

(b) Solve.

$5(3 - 2x) = 17$

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

5



NOT TO SCALE

The diagram shows a trapezium $ABEF$ joined to a square $BCDE$.
ABC is a straight line and $AB = 7$ cm.
$AF : BE = 3 : 2$.
The area of the square is $32\,\text{cm}^2$.

Calculate the area of the trapezium $ABEF$.

..... cm^2 [4]

6 Write 0.0473 in standard form.

..... [1]

7 **(a)** Talia invests \$1500 in a savings account for 4 years.
The account pays simple interest at a rate of $2\frac{1}{6}$% per year.

Calculate the total interest she receives at the end of 4 years.

\$ ..... [2]

(b) Kylian invests \$1500 in a different savings account.
The account pays compound interest at a rate of r% per year.

At the end of 5 years, the value of the investment is \$1825.

Calculate the value of r.

r = ... [3]

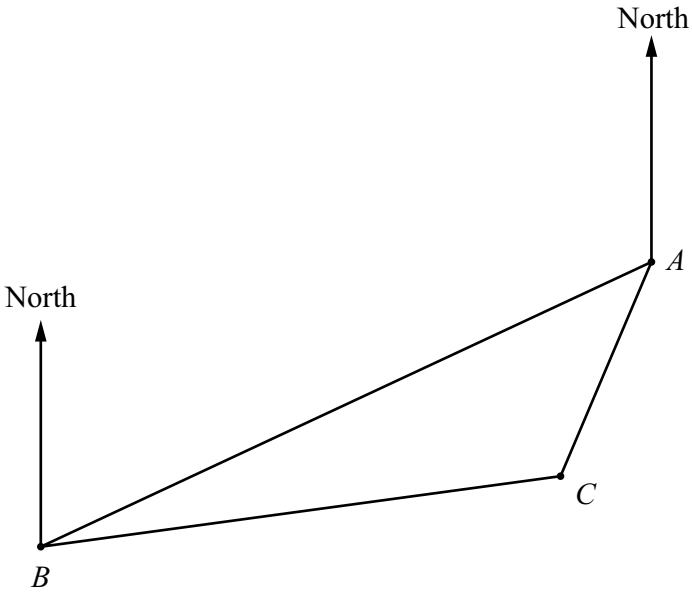
8 **(a)** On a map, the distance between two cities is 7.3 cm.

The actual distance between the two cities is 365 km.
The scale of this map is $1 : n$.

Find the value of n.

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

(b) The diagram shows the positions of towns A, B and C.
The towns are joined by straight roads.



NOT TO SCALE

(i) The bearing of A from B is 070°.

Find the bearing of B from A.

..... [2]

(ii) The bearing of C from A is 195° and angle $BCA = 113°$.

Find the bearing of C from B.

..... [3]

9 P is the point (4, 10) and Q is the point (–8, 5).

Find the coordinates of the midpoint of PQ.

(..... , ...) [2]

10 The test scores of 13 pupils are recorded.

21 23 23 24 26 27 34 37 38 40 42 43 48

(a) Find the median.

..... [1]

(b) Find the interquartile range.

..... [2]

11 Line L has equation $y = 6x - 1$.

(a) Find the equation of the line parallel to line L that passes through the point (0, 3).

..... [2]

(b) Write down the gradient of a line perpendicular to line L.

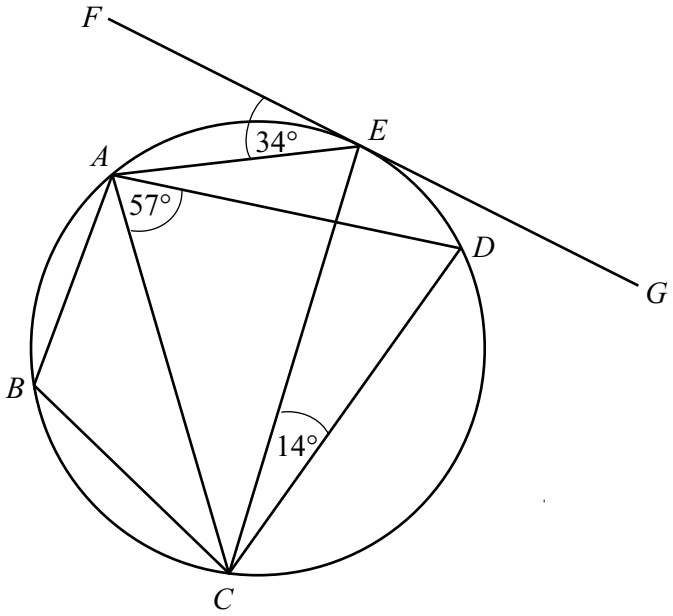
..... [1]

12 Find the integer values of x that satisfy the inequality.

$$-1 \leqslant 4 - 2x < 8$$

..... [3]

13



NOT TO SCALE

A, B, C, D and E are points on a circle.
FG is a tangent to the circle at E.

Find

(a) angle EAC

Angle EAC = ... [2]

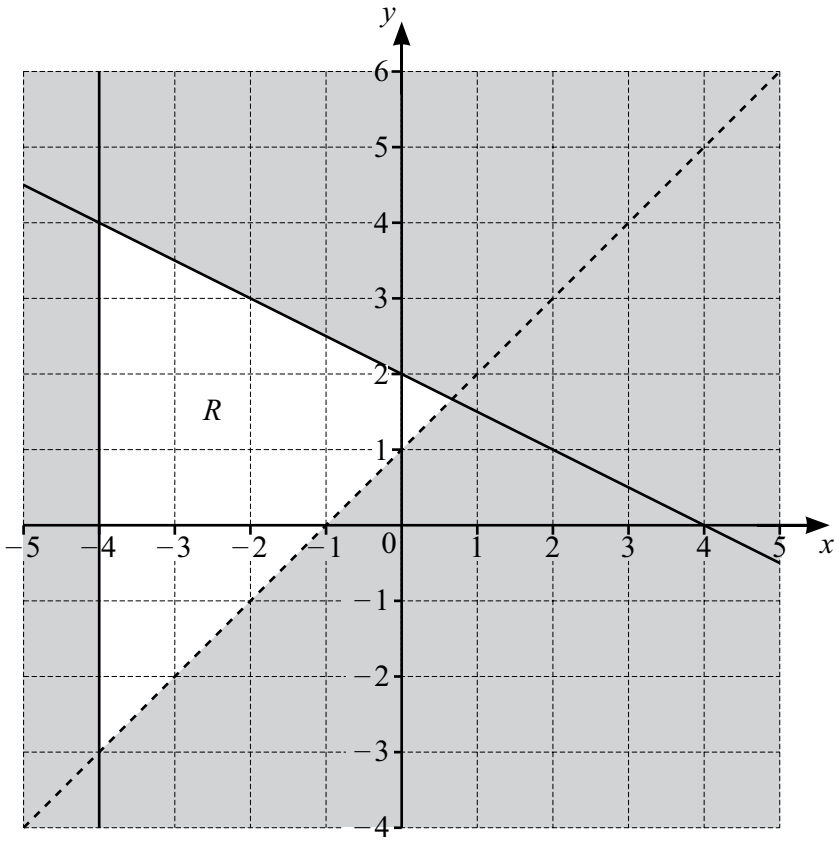
(b) angle ADC

Angle ADC = ... [2]

(c) angle ABC.

Angle ABC = ... [1]

14



Find the three inequalities that define the unshaded region, R.

.....

.....

.....

[4]

15 $f(x) = 2x^2 - 3x$ $g(x) = 7 + 2x$

(a) Find

(i) $g(-8)$

..... [1]

(ii) $gf(5)$

..... [2]

(iii) $g^{-1}(x)$.

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

(b) Find $f(x - 6)$.
Give your answer in the form $ax^2 + bx + c$.

..... [4]

(c) Use the quadratic formula to solve $f(x) - 6 = 0$.
Show all your working and give your answers correct to 2 decimal places.

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

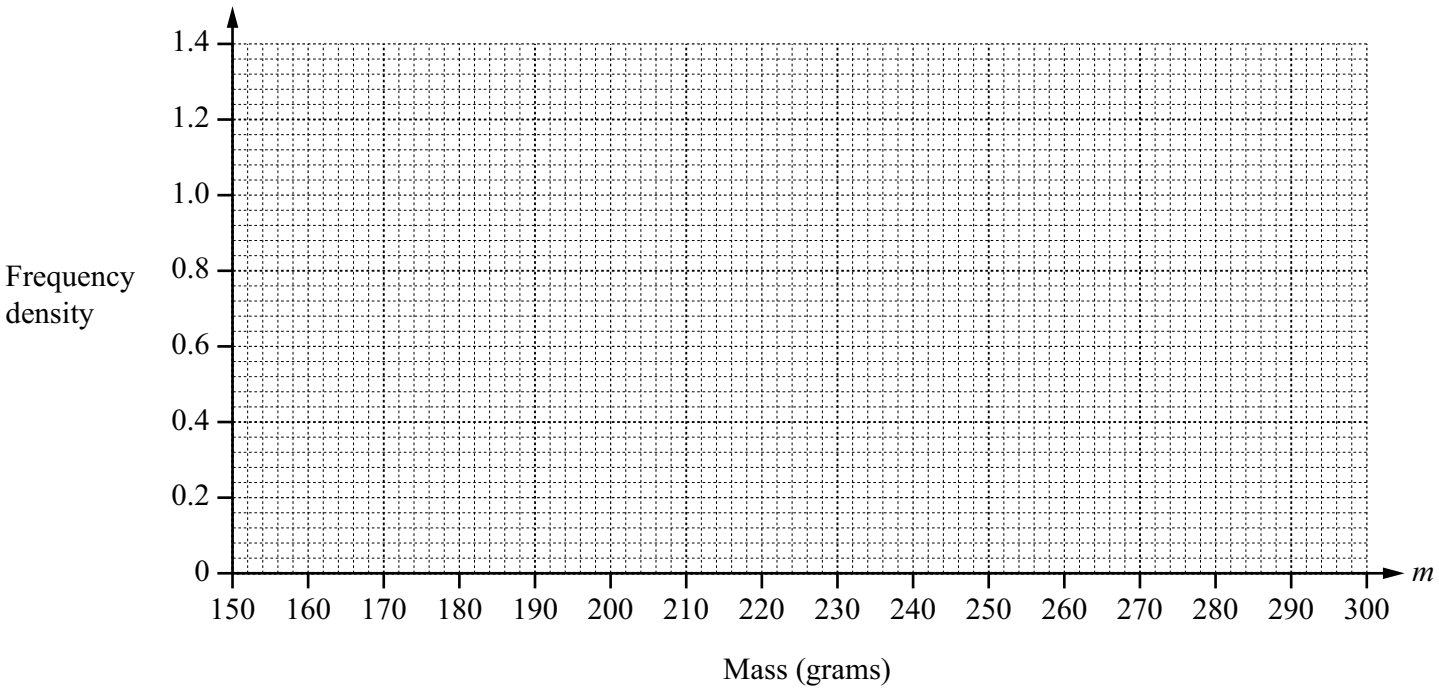
16 Tina records the mass of each of 120 apples.
The results are shown in the table.

Mass (m grams)	$150 < m \leqslant 180$	$180 < m \leqslant 220$	$220 < m \leqslant 270$	$270 < m \leqslant 300$
Frequency	18	28	65	9

(a) Calculate an estimate of the mean mass of the apples.

..... g [4]

(b) Draw a histogram to show the information in the table.



[3]

(c) (i) One of the 120 apples is picked at random.

Find the probability that this apple has a mass of 180 g or less.

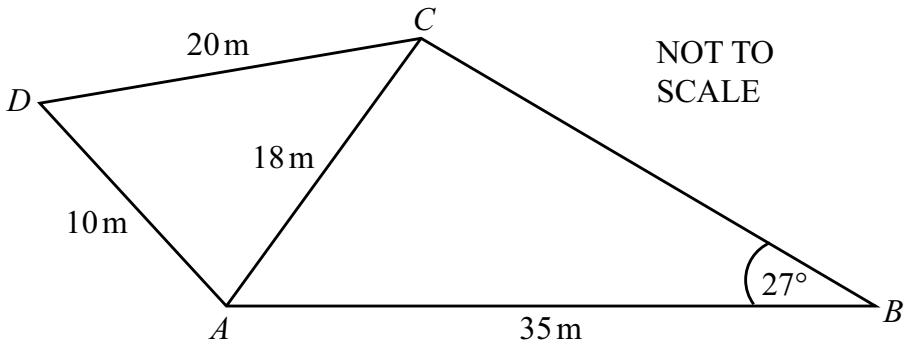
..... [1]

(ii) Two apples are picked at random from those with a mass greater than 180 g.

Find the probability that one of these apples has a mass greater than 270 g, and the other apple has a mass of 220 g or less.

..... [3]

17



The diagram shows the positions A, B, C and D on a football pitch.

(a) Show that angle $CAD = 86.2°$, correct to 1 decimal place.

[4]

(b) Calculate the **obtuse** angle ACB.

..... [4]

(c) A player runs directly from *B* to *D* in a time of 5.3 seconds.

Calculate the average speed of the player.

..... m/s [5]

18 f is inversely proportional to the cube of g.
When $f = 0.5$, $g = 3$.

(a) Find f in terms of g.

$f =$ ..... [2]

(b) g is increased by 100%.

Find the percentage change in f.

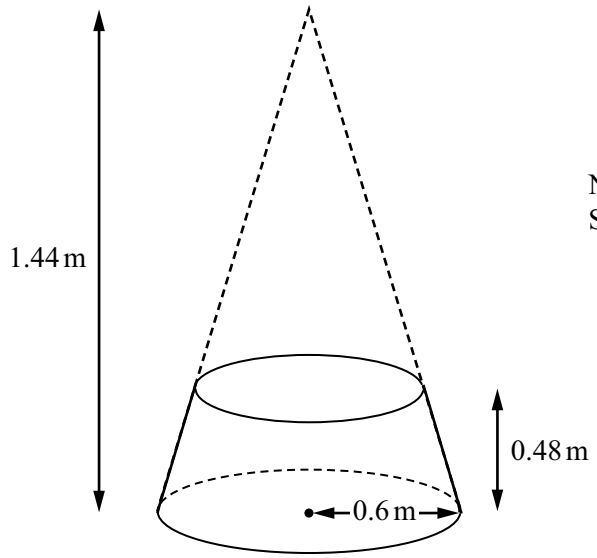
..... % [3]

19 The area of a triangle is $12\,m^2$, correct to the nearest square metre.
The base of the triangle is 5.7 m, correct to the nearest 0.1 m.

Calculate the smallest possible height of the triangle.

..... m [3]

20



The diagram shows the frustum of a cone.
The frustum has base radius 0.6 m and vertical height 0.48 m.
The vertical height of the original cone is 1.44 m.

Calculate the total surface area of the frustum.

..... m^2 [6]

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MATHEMATICS **0580/42**

Paper 4 (Extended) **February/March 2023**

2 hours 30 minutes

You must answer on the question paper.

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[Turn over

1 **(a)** **(i)** Alain and Beatrice share \$750 in the ratio Alain : Beatrice = 8 : 7.

Show that Alain receives \$400.

[1]

(ii) **(a)** Alain spends \$150.

Write \$150 as a percentage of \$400.

..... % [1]

(b) He invests the remaining \$250 at a rate of 2% per year simple interest.

Calculate the amount Alain has at the end of 5 years.

\$ ..... [3]

(iii) Beatrice invests her \$350 at a rate of 0.25% per **month** compound interest.

Calculate the amount Beatrice has at the end of 5 years.
Give your answer correct to the nearest dollar.

\$ ..... [3]

(b) Carl, Dina and Eva share 100 oranges.
The ratio Carl's oranges : Dina's oranges = 3 : 5.
The ratio Carl's oranges : Eva's oranges = 2 : 3.

Find the number of oranges Carl receives.

..... [2]

(c) Fred buys a house.
At the end of the first year, the value of the house increases by 5%.
At the end of the second year, the value of the house increases by 3% of its value at the end of the first year.
The value of Fred's house at the end of the second year is \$60 564.

Calculate how much Fred paid for the house.

\$ ..... [3]

(d) Gabrielle invests \$500 at a rate of r% per year compound interest.
At the end of 8 years the value of Gabrielle's investment is \$609.20 .

Find the value of r.

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

2 **(a)** 100 students take part in a reaction test.
The table shows the results.

Reaction time (seconds)	6	7	8	9	10	11
Number of students	3	32	19	29	11	6

(i) Write down the mode.

..... s [1]

(ii) Find the median.

..... s [1]

(iii) Calculate the mean.

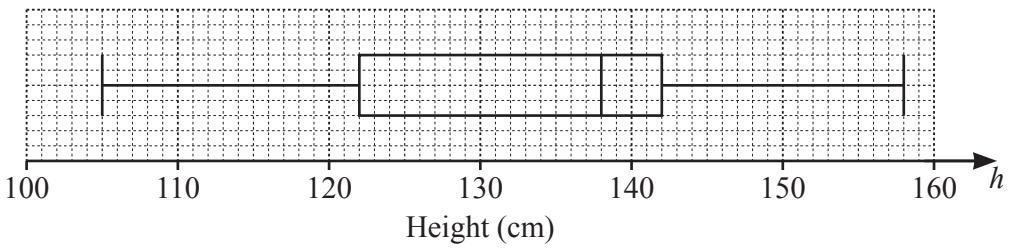
..... s [3]

(iv) Two students are chosen at random.

Find the probability that both their reaction times are greater than or equal to 9 seconds.

..... [2]

(b) The box-and-whisker plot shows the heights, h cm, of some students.



(i) Find the range.

..... cm [1]

(ii) Find the interquartile range.

..... cm [1]

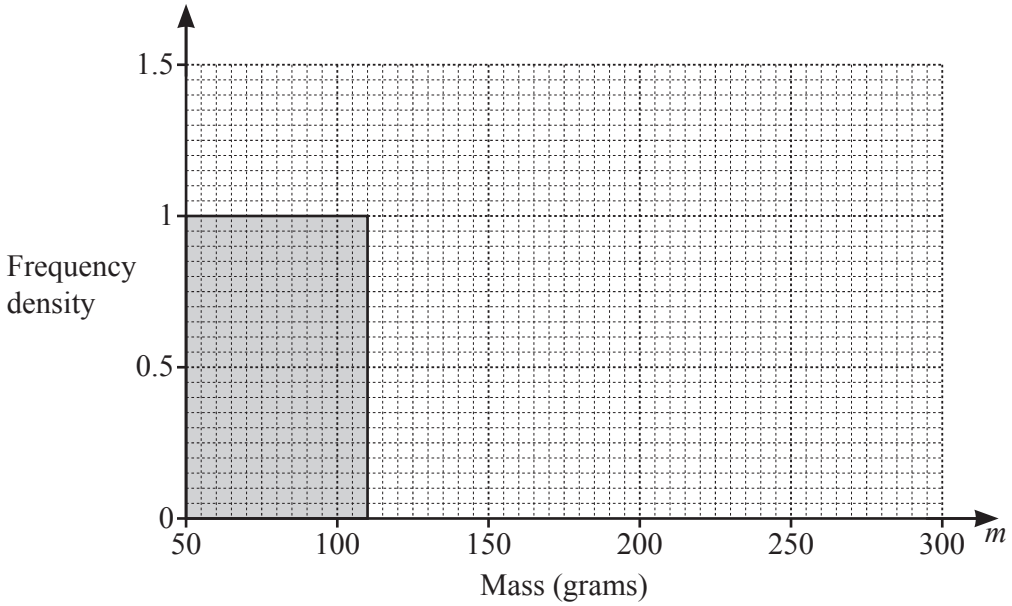
(c) The mass of each of 200 potatoes is measured.
The table shows the results.

Mass (m grams)	$50 < m \leqslant 110$	$110 < m \leqslant 200$	$200 < m \leqslant 300$
Frequency	60	99	41

(i) Calculate an estimate of the mean.

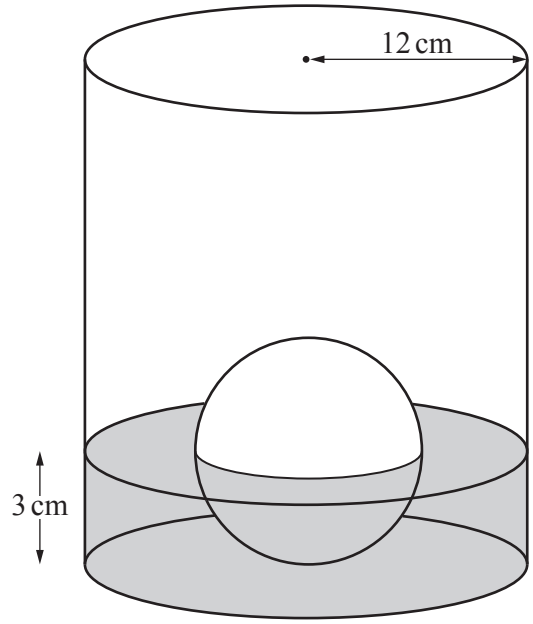
..... g [4]

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



[2]

3



NOT TO SCALE

The diagram shows a cylinder containing water.
There is a solid metal sphere touching the base of the cylinder.
Half of the sphere is in the water.

The radius of the cylinder is 12 cm and the radius of the sphere is 3 cm.

(a) The sphere is removed from the cylinder and the level of the water decreases by h cm.

Show that $h = 0.125$.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

[3]

(b) The water in the cylinder is poured into another cylinder of radius R cm.
The depth of the water in this cylinder is 18 cm.

Calculate the value of R.

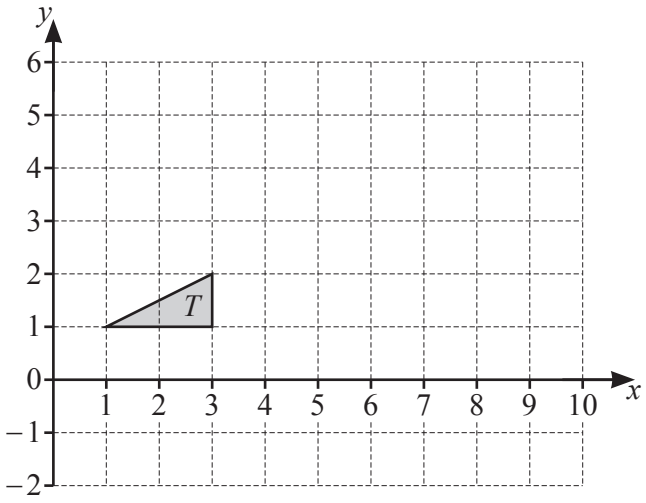
$R =$ ..... [3]

(c) The sphere is melted down and some of the metal is used to make 30 cubes with edge length 1.5 cm.

Calculate the percentage of metal **not** used.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... % [3]

4 (a)



(i) Enlarge triangle T by scale factor 3, centre (0, 2). [2]

(ii) **(a)** Rotate triangle T about (4, 2) by 90° clockwise.
Label the image P. [2]

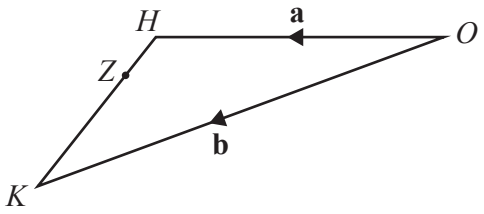
(b) Reflect triangle T in the line $x + y = 6$.
Label the image Q. [3]

(c) Describe fully the **single** transformation that maps triangle P onto triangle Q.

.....

..... [2]

(b)



NOT TO SCALE

The diagram shows triangle OHK, where O is the origin.
The position vector of H is **a** and the position vector of K is **b**.
Z is the point on HK such that $HZ : ZK = 2 : 5$.

Find the position vector of Z, in terms of **a** and **b**.
Give your answer in its simplest form.

..... [3]

5 **(a)** Expand and simplify.

$$(2p^2 - 3)(3p^2 - 2)$$

..... [2]

(b) $s = \frac{1}{2}(u + v)t$

(i) Find the value of s when $u = 20$, $v = 30$ and $t = 7$.

$s =$ ..... [2]

(ii) Rearrange the formula to write v in terms of s, u and t.

$v =$ ..... [3]

(c) Factorise completely.

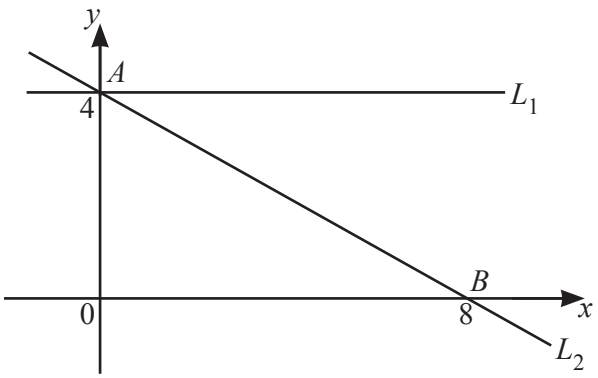
(i) $2qt - 3t - 6 + 4q$

..... [2]

(ii) $x^3 - 25x$

..... [3]

6



NOT TO SCALE

A is the point (0, 4) and B is the point (8, 0).
The line L_1 is parallel to the x-axis.
The line L_2 passes through A and B.

(a) Write down the equation of L_1.

..... [1]

(b) Find the equation of L_2.
Give your answer in the form $y = mx + c$.

$y =$ ..... [2]

(c) C is the point (2, 3).
The line L_3 passes through C and is perpendicular to L_2.

(i) Show that the equation of L_3 is $y = 2x - 1$.

[3]

(ii) L_3 crosses the x-axis at D.

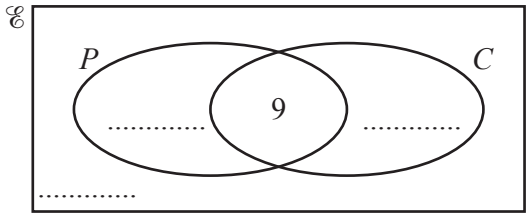
Find the length of CD.

..... [5]

7 $\mathscr{E}$ = {students in a class} P = {students who study Physics} C = {students who study Chemistry}

$n(\mathscr{E}) = 24$ $n(P) = 17$ $n(C) = 14$ $n(P \cap C) = 9$

(a) Complete the Venn diagram.



[2]

(b) **(i)** Find $n(P \cap C')$.

..... [1]

(ii) Find $n(P \cup C')$.

..... [1]

(c) Two students are picked from the class at random.

Find the probability that one student studies both subjects and one student studies Chemistry but not Physics.

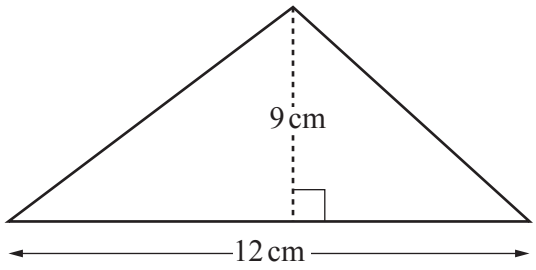
..... [3]

(d) Two of the students who study Physics are picked at random.

Find the probability that they both study Chemistry.

..... [2]

8 (a)

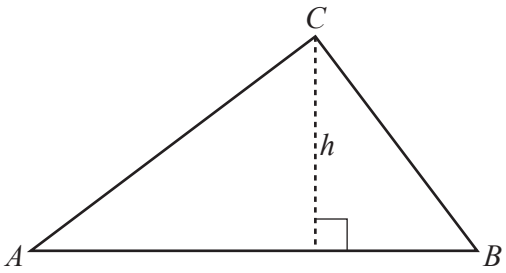


NOT TO SCALE

Calculate the area of the triangle.

..... cm^2 [2]

(b)



NOT TO SCALE

$AB = (2x + 3)$ cm and $h = (x + 5)$ cm.
The area of triangle $ABC = 50\,cm^2$.

Find the value of x, giving your answer correct to 2 decimal places.
You must show all your working.

$x =$ ..... [6]

9 $f(x) = x^3 - 3x^2 - 4$

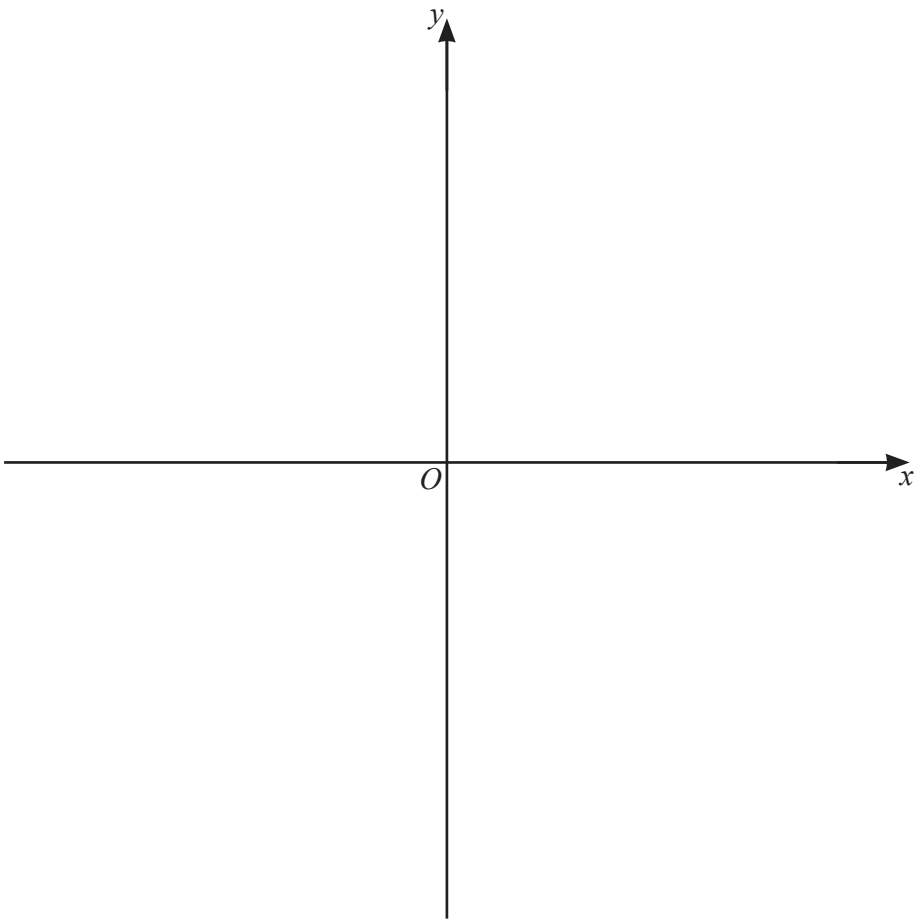
(a) Find the gradient of the graph of $y = f(x)$ where $x = 1$.

..... [3]

(b) Find the coordinates of the turning points of the graph of $y = f(x)$.

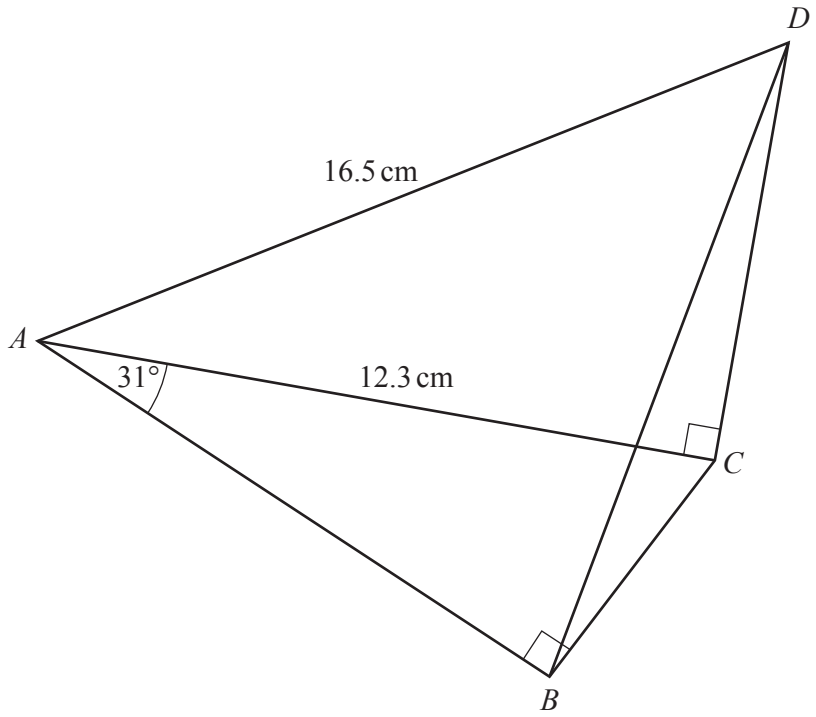
(..... , ...) , (..... , ...) [4]

(c) Sketch the graph of $y = f(x)$.



[2]

10



NOT TO SCALE

The diagram shows a quadrilateral $ABCD$.
$AC = 12.3$ cm and $AD = 16.5$ cm.
Angle $BAC = 31°$, angle $ABC = 90°$ and angle $ACD = 90°$.

(a) Show that $AB = 10.54$ cm, correct to 2 decimal places.

[2]

(b) Show that angle $DAC = 41.80°$ correct to 2 decimal places.

[2]

(c) Calculate BD.

$BD =$ .....cm [3]

(d) Calculate angle CBD.

Angle $CBD =$ ..... [4]

(e) Calculate the shortest distance from C to BD.

..... cm [4]

11 $f(x) = 2x - 1$ $g(x) = 3x + 2$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = x^2$

(a) Find $j(-1)$.

..... [1]

(b) Find x when $f(x) + g(x) = 0$.

$x =$ ..... [2]

(c) Find $gg(x)$, giving your answer in its simplest form.

..... [2]

(d) Find $hf(x) + gh(x)$, giving your answer as a single fraction in its simplest form.

..... [4]

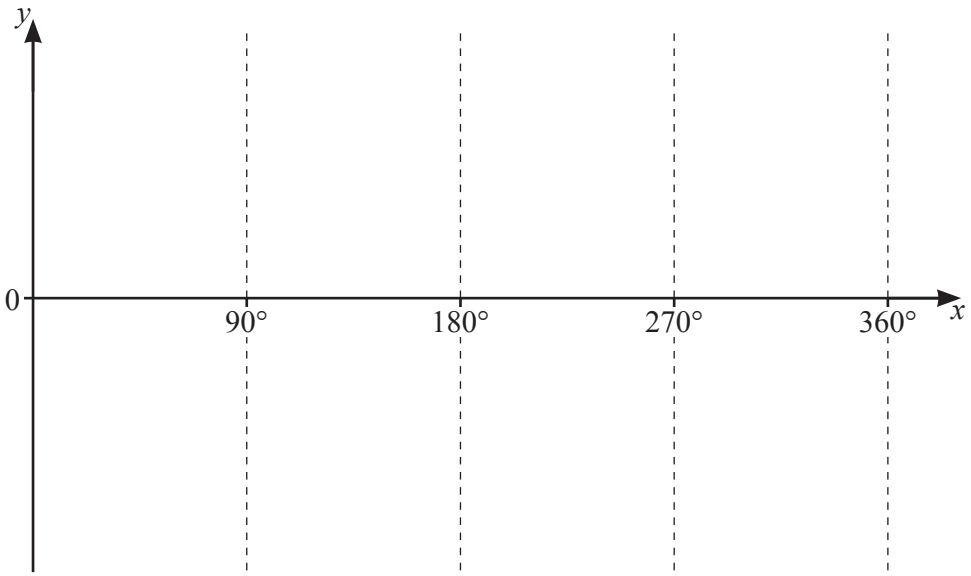
(e) When $pp(x) = x$, $p(x)$ is a function such that $p^{-1}(x) = p(x)$.

Draw a ring around the function that has this property.

$f(x) = 2x - 1$ $g(x) = 3x + 2$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = x^2$

[1]

12 **(a)** Sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$.



[2]

(b) Find x when $\tan x = \frac{1}{\sqrt{3}}$ and $0° \leqslant x \leqslant 360°$.

..... [2]

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9928435260

MATHEMATICS **0580/42**

Paper 4 (Extended) **February/March 2024**

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 π, 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. Any blank pages are indicated.

[Turn over

1 A grocer sells potatoes, mushrooms and carrots.

(a) A customer buys 3 kg of mushrooms at \$1.04 per kg and 4 kg of carrots at \$1.28 per kg.

Calculate the total cost.

\$ ..... [2]

(b) In one week, the ratio of the masses of vegetables sold by the grocer is

potatoes : mushrooms : carrots = 11 : 8 : 6.

(i) Work out the mass of mushrooms sold as a percentage of the total mass.

..... % [2]

(ii) The total mass of potatoes, mushrooms and carrots sold is 1500 kg.

Find the mass of carrots the grocer sells this week.

..... kg [2]

(iii) The profit the grocer makes selling 1 kg of carrots is \$0.75 .

Find the total profit the grocer makes selling carrots this week.

\$ ..... [1]

(iv) On the last day of the week, the grocer reduces the price of 1 kg of potatoes by 8% to \$1.15 .

Calculate the original price of 1 kg of potatoes.

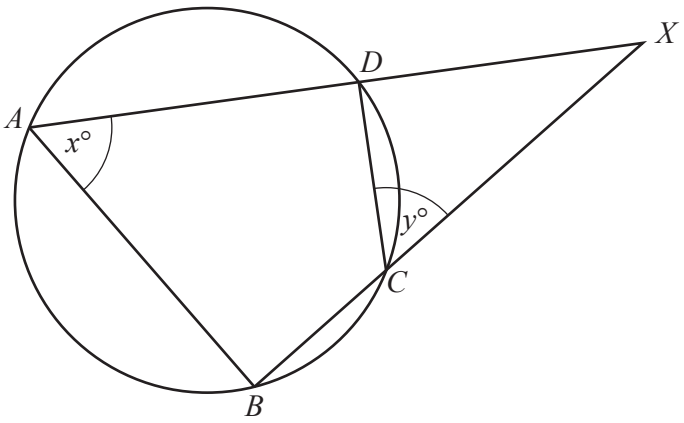
\$ ..... [2]

(c) The grocer buys 620 kg of onions, correct to the nearest 20 kg.
He packs them into bags each containing 5 kg of onions, correct to the nearest 1 kg.

Calculate the upper bound for the number of bags of onions that he packs.

..... [3]

2



NOT TO SCALE

A, B, C and D are points on a circle.
ADX and BCX are straight lines.
Angle $BAD = x°$ and angle $DCX = y°$.

(a) Explain why $x = y$.
Give a geometrical reason for each statement you make.

[2]

(b) Show that triangle ABX is similar to triangle CDX.

[2]

(c) $AD = 15\,\text{cm}$, $DX = 9\,\text{cm}$ and $CX = 12\,\text{cm}$.

(i) Find BC.

$BC =$ ..... cm [3]

(ii) Complete the statement.

The ratio area of triangle ABX : area of triangle CDX = ... : 1. [1]

3 **(a)** The table shows information about the marks gained by each of 10 students in a test.

Mark	15	16	17	18	19	20
Frequency	4	1	2	1	0	2

(i) Calculate the range.

..... [1]

(ii) Calculate the mean.

..... [3]

(iii) Find the median.

..... [1]

(iv) Write down the mode.

..... [1]

(b) Paulo's mean mark for 7 homework tasks is 17.
After completing the 8th task, his mean mark is 17.5 .

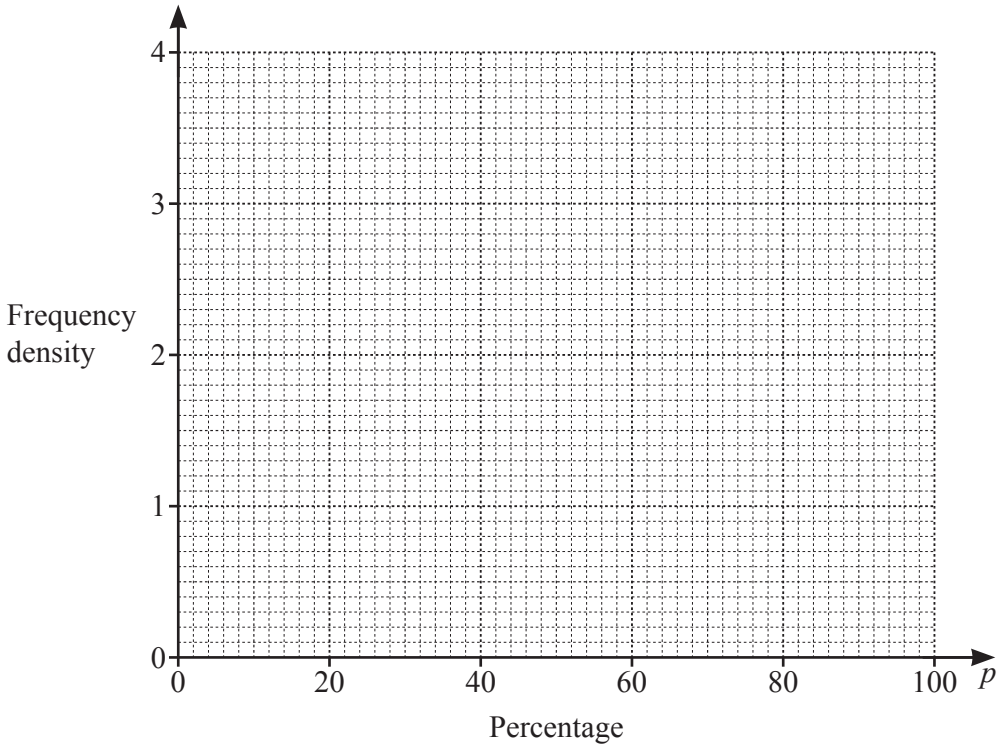
Calculate Paulo's mark for the 8th task.

..... [3]

(c) The table shows the percentage scored by each of 100 students in their final exam.

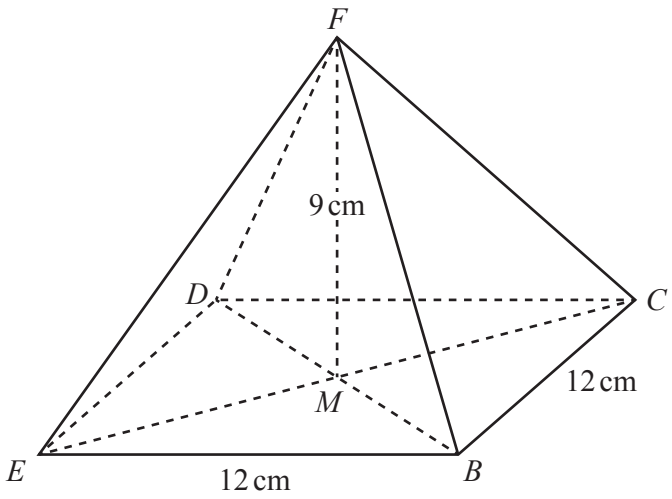
Percentage (p)	$0 < p \leqslant 30$	$30 < p \leqslant 50$	$50 < p \leqslant 60$	$60 < p \leqslant 70$	$70 < p \leqslant 100$
Frequency	12	18	35	20	15

On the grid, draw a histogram to show this information.



[4]

4 (a)



NOT TO SCALE

The diagram shows a pyramid with a square base $BCDE$.
The diagonals CE and BD intersect at M, and the vertex F is directly above M.
$BE = 12$ cm and $FM = 9$ cm.

(i) Calculate the volume of the pyramid.

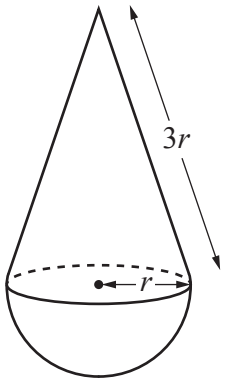
[The volume, V, of a pyramid with base area A and height h is $V = \frac{1}{3}Ah$.]

..... cm^3 [2]

(ii) Calculate the total surface area of the pyramid.

..... cm^2 [5]

(b)



NOT TO SCALE

The diagram shows a toy made from a cone and a hemisphere.
The base radius of the cone and the radius of the hemisphere are both r cm.
The slant height of the cone is $3r$ cm.

The total surface area of the toy is $304\,\text{cm}^2$.

Calculate the value of r.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]
[The curved surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

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

5 **(a)** **(i)** Factorise.

$$x^2 - x - 12$$

..... [2]

(ii) Simplify.

$$\frac{x^2 - 16}{x^2 - x - 12}$$

..... [2]

(b) Simplify.

$$(2x - 3)^2 - (x + 1)^2$$

..... [3]

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

$$\frac{2x + 4}{x + 1} - \frac{x}{x - 3}$$

..... [4]

(d) Expand and simplify.

$$(x-3)(x-5)(2x+1)$$

..... [3]

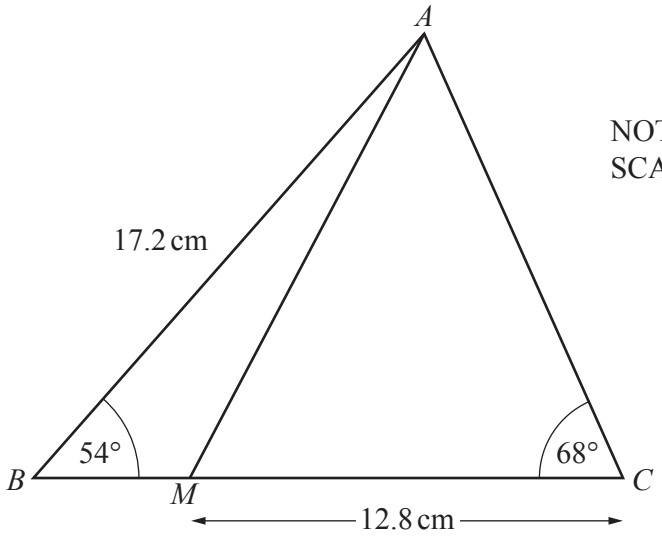
(e) Solve the simultaneous equations.
You must show all your working.

$$x-3y=13$$
$$2x^2-9y=116$$

$x =$ ..... $y =$ .....

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

6



The diagram shows triangle ABC with $AB = 17.2$ cm.
Angle $ABC = 54°$ and angle $ACB = 68°$.

(a) Calculate AC.

$AC =$ ..... cm [3]

(b) M lies on BC and $MC = 12.8$ cm.

Calculate AM.

$AM =$ ..... cm [3]

(c) Calculate the shortest distance from A to BC.

.....cm [3]

7 **(a)** $\mathbf{p} = \begin{pmatrix} 8 \\ -5 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$

(i) Find $3\mathbf{q}$.

$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

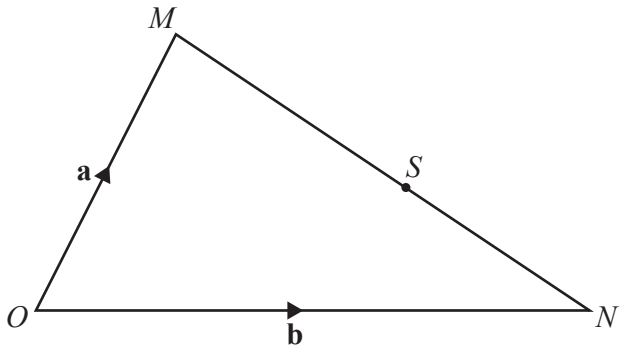
(ii) **(a)** Find $\mathbf{p} - \mathbf{q}$.

$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(b) Find $|\mathbf{p} - \mathbf{q}|$.

..... [2]

(b)



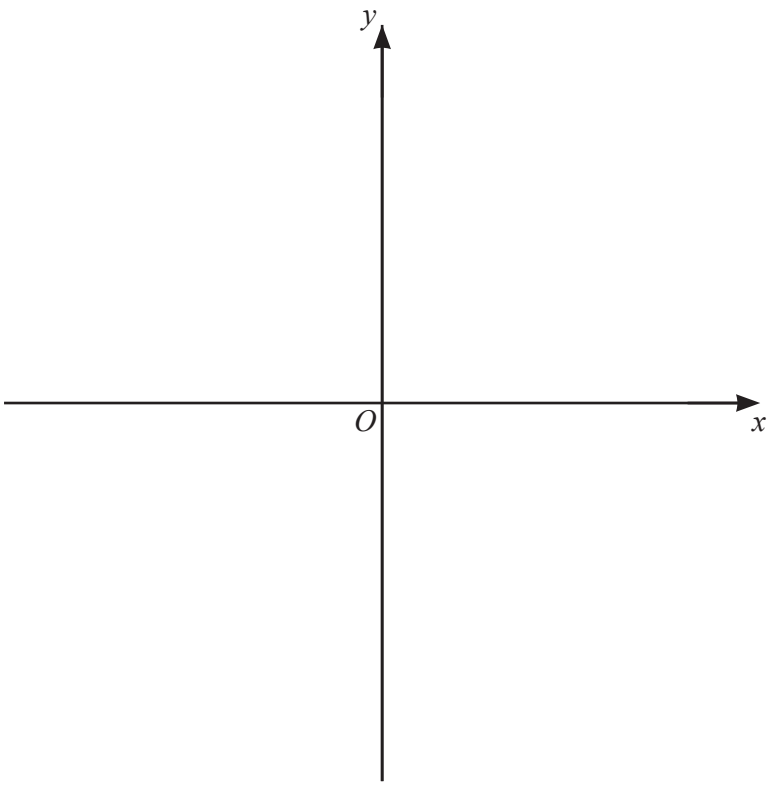
NOT TO SCALE

In triangle OMN, O is the origin, $\overrightarrow{OM} = \mathbf{a}$ and $\overrightarrow{ON} = \mathbf{b}$.
S is a point on MN such that $MS : SN = 5 : 3$.

Find, in terms of **a** and/or **b**, the position vector of S.
Give your answer in its simplest form.

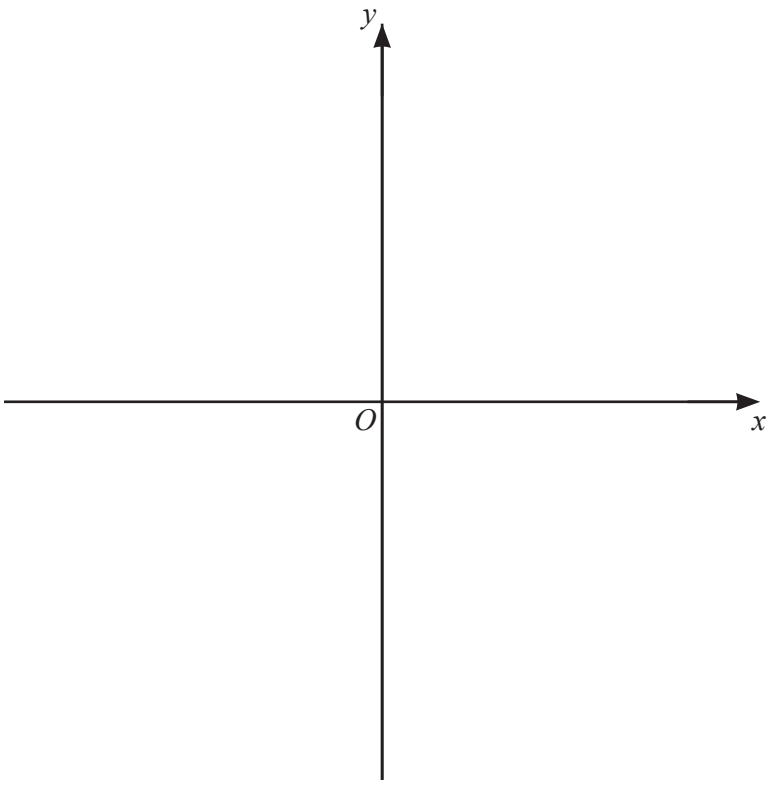
..... [3]

8 **(a)** On the axes, sketch the graph of $y = 4 - 3x$.



[2]

(b) On the axes, sketch the graph of $y = -x^2$.



[2]

(c) (i) Find the coordinates of the turning points of the graph of $y = 10 + 9x^2 - 2x^3$.
You must show all your working.

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

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

[3]

9 **(a)** Janna and Kamal each invest \$8000.
At the end of 12 years, they each have \$12 800.

(i) Janna invests in an account that pays simple interest at a rate of r% per year.

Calculate the value of r.

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

(ii) Kamal invests in an account that pays compound interest at a rate of R% per year.

Calculate the value of R.

$R =$ ..... [3]

(b) The population of a city is growing exponentially at a rate of 1.8% per year.
The population now is 260 000.

Find the number of complete years from now when the population will first be more than 300 000.

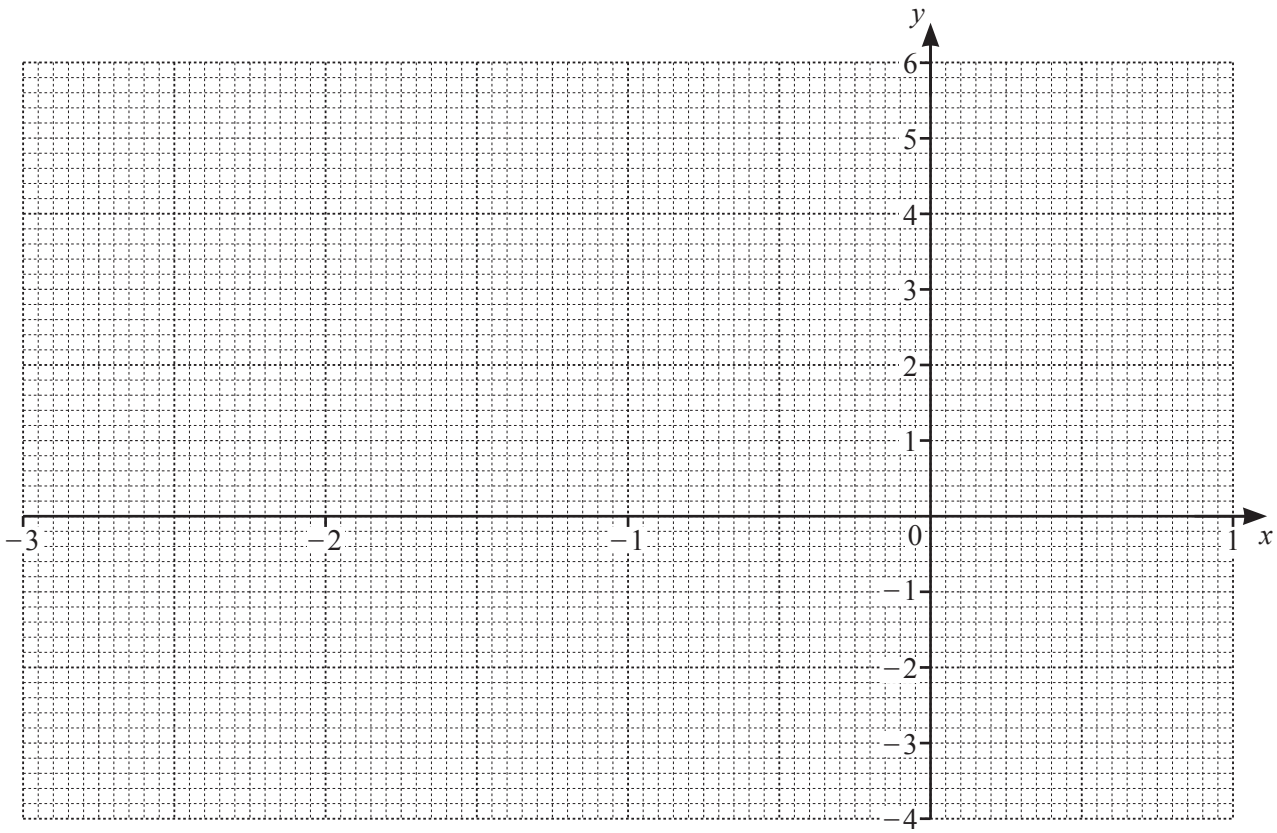
..... years [3]

10 The table shows some values for $y = 2x^3 + 6x^2 - 2.5$.

x	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1
y		3.75	5.5	4.25	1.5		-2.5	-0.75	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 2x^3 + 6x^2 - 2.5$ for $-3 \leqslant x \leqslant 1$.



[4]

(c) By drawing a suitable line on the graph, solve the equation $2x^3 + 6x^2 = 4.5$.

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

(d) The equation $2x^3 + 6x^2 - 2.5 = k$ has exactly two solutions.

Write down the two possible values of k.

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

11 $f(x) = \frac{1}{x}, x \neq 0$ $g(x) = 3x - 5$ $h(x) = 2^x$

(a) Find.

(i) $gf(2)$

..... [2]

(ii) $g^{-1}(x)$

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

(b) Find in its simplest form $g(x-2)$.

..... [2]

(c) Find the value of x when

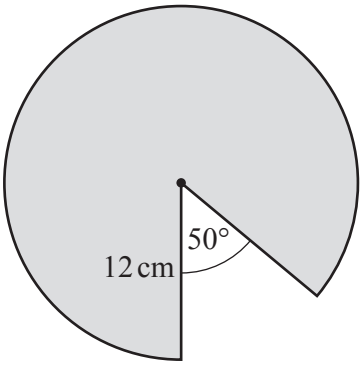
(i) $fg(x) = 0.1$

$x =$ ..... [2]

(ii) $h(x) - g(7) = 0$.

$x =$ ..... [2]

12 (a)



NOT TO SCALE

The diagram shows a circle of radius 12 cm, with a sector removed.

Calculate the perimeter of the remaining shaded shape.

..... cm [4]

(b) The diagram in **part(a)** shows the top of a cylindrical cake with a slice removed.
The volume of cake that remains is 3510 cm^3.

Calculate the height of the cake.

..... cm [3]

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2743470414

MATHEMATICS **0580/41**

Paper 4 (Extended) **May/June 2024**

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 π, 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. Any blank pages are indicated.

[Turn over

1 **(a)** The table shows the areas, in km^2, of the four largest rainforests in the world.

Rainforest	Area (km^2)
Amazon	5 500 000
Congo	2 000 000
Atlantic	1 315 000
Valdivian	250 000

(i) Find the area of the Valdivian rainforest as a percentage of the area of the Amazon rainforest.

..... % [1]

(ii) Write, in its simplest form, the ratio of the areas of the rainforests Valdivian : Atlantic : Congo.

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

(iii) The Amazon rainforest has 60% of its area in Brazil and 10% of its area in Colombia.
$43\frac{1}{3}$% of the **remaining area** of the rainforest is in Peru.

Find the percentage of the Amazon rainforest that is in Brazil, Colombia and Peru.

..... % [3]

(iv) The area of the Amazon rainforest represents $\frac{27}{50}$ of the total area of rainforest in the world.

Calculate the total area of rainforest in the world.
Give your answer correct to the nearest 100 000 km^2.

..... km^2 [3]

(v) In the world, 60.7 hectares of rainforest are lost every minute.

Calculate the total area, in hectares, of rainforest that is lost in 365 days.
Give your answer in standard form.

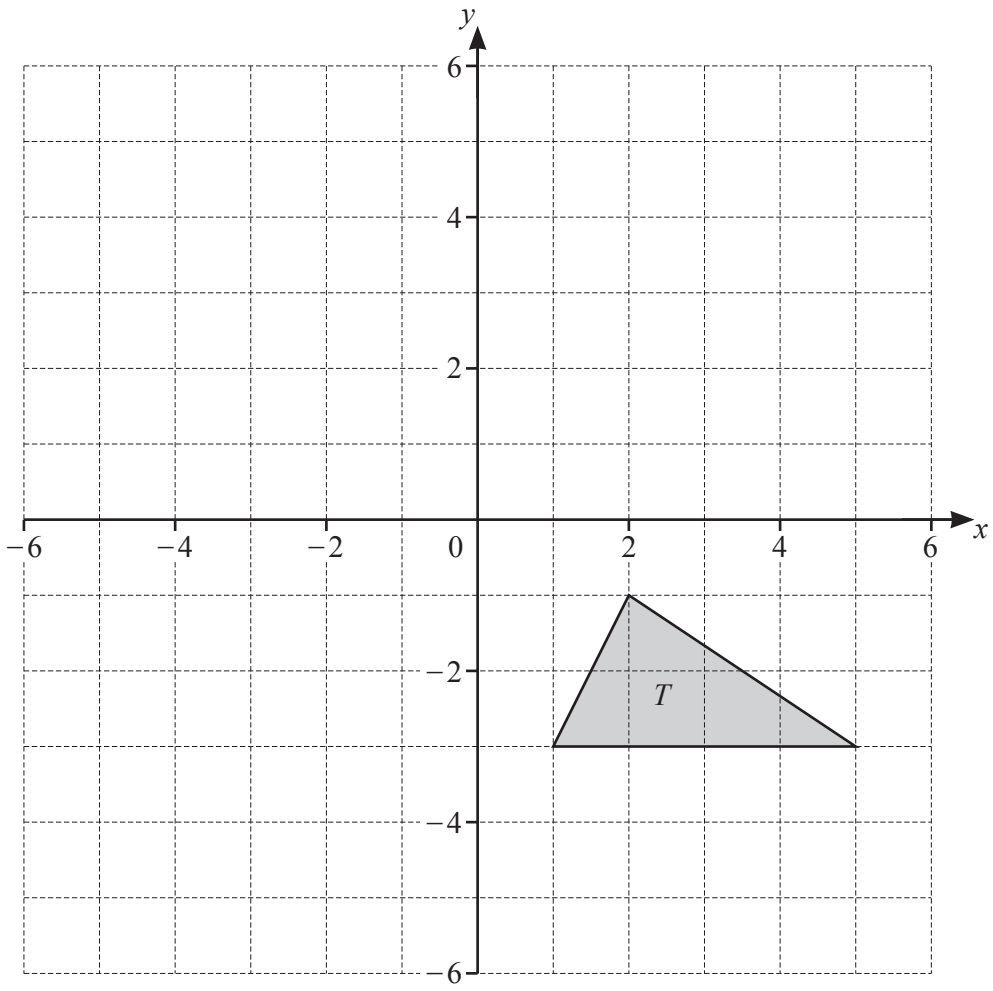
..... hectares [3]

(b) The Amazon river has a length of 6440 km, correct to the nearest 10 km.
The Congo river has a length of 4400 km, correct to the nearest 100 km.

Calculate the upper bound of the difference between the lengths of the Amazon river and the Congo river.

..... km [3]

2 (a)



On the grid, draw the image of

(i) triangle T after a reflection in the x-axis [1]

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

(iii) triangle T after an enlargement by scale factor $-\frac{1}{2}$ with centre $(-1, 1)$. [2]

(b) A shape P is enlarged by scale factor 3 to give shape Q.
Shape Q is then enlarged by scale factor $\frac{2}{5}$ to give shape R.

The area of shape P is $10\,\text{cm}^2$.

Calculate the area of shape R.

..... cm^2 [3]

3 **(a)** $C = \frac{1}{4}xy^2$

(i) Find C when $x = 5$ and $y = 8$.

$C =$ ..... [2]

(ii) Find the positive value of y when $C = 15$ and $x = 2.4$.

$y =$ ..... [2]

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

$$\frac{4}{x-1} - \frac{3}{2x+5}$$

..... [3]

(c) Expand and simplify.

$$(2x+3)(4-x)^2$$

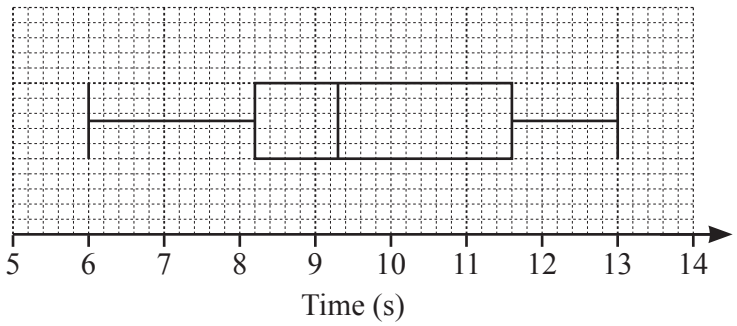
..... [3]

(d) Simplify.

$$\left(\frac{y^8}{16x^{16}}\right)^{-\frac{3}{4}}$$

..... [3]

4 **(a)** Jianyu records the time, in seconds, that some cars take to travel 195 m.
The box and whisker plot shows this information.



(i) Find the median time.

..... s [1]

(ii) Find the interquartile range.

..... s [1]

(iii) Find the difference between the average speed of the fastest car and the average speed of the slowest car.
Give your answer in **kilometres per hour**.

..... km/h [5]

(b) Matilda records the distances that 80 different cars can travel with a full tank of fuel.
The table shows this information.

Distance (d km)	$250 < d \leqslant 300$	$300 < d \leqslant 400$	$400 < d \leqslant 420$	$420 < d \leqslant 450$	$450 < d \leqslant 500$
Frequency	7	13	19	21	20

(i) Write down the class interval that contains the median.

..... $< d \leqslant$ ..... [1]

(ii) Calculate an estimate of the mean.

..... km [4]

(iii) A histogram is drawn to show the information in the table.
The height of the bar for the interval $250 < d \leqslant 300$ is 2.8 cm.

Calculate the height of the bar for each of the following intervals.

$300 < d \leqslant 400$ ..... cm

$400 < d \leqslant 420$ ..... cm

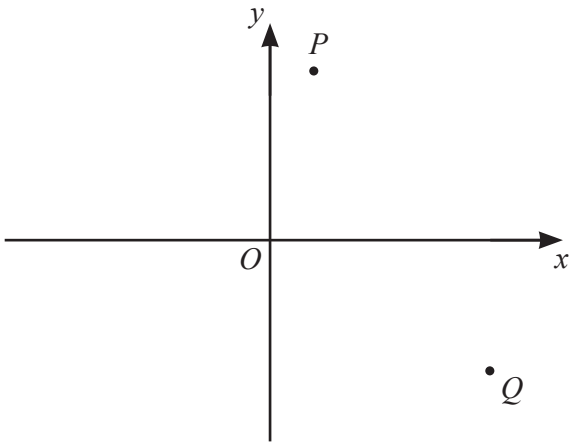
$420 < d \leqslant 450$ ..... cm [3]

(iv) Two of the 80 cars are chosen at random.

Find the probability that, with a full tank of fuel, one of the cars can travel more than 450 km and the other car can travel **not** more than 300 km.

..... [3]

5 **(a)** P is the point (1, 7).
Q is the point (5, –5).



NOT TO SCALE

(i) Find $\overrightarrow{PQ}$.

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

(ii) Show that $|\overrightarrow{OP}| = |\overrightarrow{OQ}|$.

[3]

(iii) PQ is a chord of a circle with centre O.

Calculate the circumference of this circle.

..... [2]

(iv) PQ is the diameter of a different circle with centre R.

Find the coordinates of R.

(..... , ...) [2]

(v) Find the equation of the perpendicular bisector of PQ.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

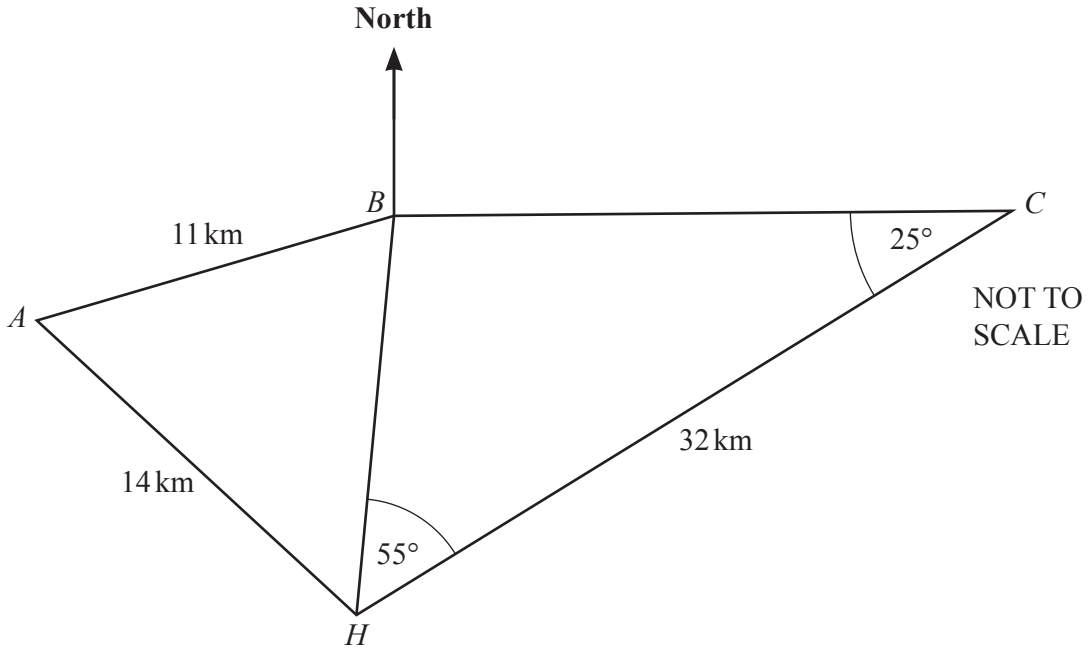
(b) The position vector of A is **a**.
The position vector of B is **b**.

M is a point on AB such that $AM : MB = 2 : 3$.

Find, in terms of **a** and **b**, the position vector of M.
Give your answer in its simplest form.

..... [4]

6



The diagram shows the positions of two lighthouses A and B, a boat C and a harbour H.
C is due east of B.

(a) Find the bearing of the harbour from boat C.

..... [1]

(b) **(i)** Show that angle $CBH = 100°$.

[1]

(ii) Show that $BH = 13.7$ km, correct to 1 decimal place.

[3]

(c) Calculate the bearing of A from B.

..... [5]

(d) At 1 pm boat C sails 32 km directly to the harbour at a speed of 10 knots.

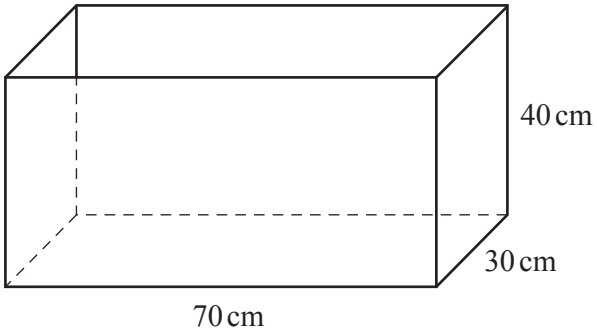
(i) Calculate the time when boat C arrives at the harbour.
Give this time correct to the nearest minute.
[1 knot = 1.852 km/h]

..... [4]

(ii) Calculate the distance of boat C to the harbour when boat C is at the shortest distance from lighthouse B.

..... km [3]

7 (a)



NOT TO SCALE

The diagram shows a box in the shape of a cuboid.
The box is open at the top.

(i) Work out the surface area of the inside of the open box.

..... cm^2 [3]

(ii) Cylinders with height 20 cm and diameter 15 cm are placed in the box.

Work out the maximum number of these cylinders that can completely fit inside the box.

..... [3]

(b) A solid bronze cone has a mass 750 g.
The density of the bronze is 8.9 g/cm^3.

The ratio radius of cone : height of cone = 1 : 3.

(i) Show that the radius of the cone is 2.99 cm, correct to 3 significant figures.
[Density = mass ÷ volume]

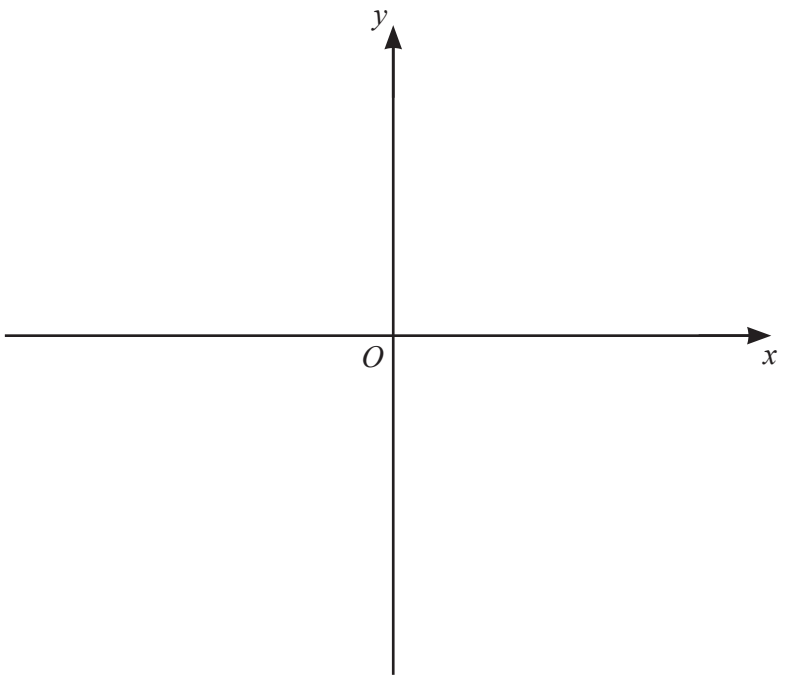
[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

[4]

(ii) Calculate the total surface area of the cone.
[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]

..... cm^2 [5]

8 **(a)** On the axes, sketch the graph of $y = x^2 + 7x - 18$.
On your sketch, write the values where the graph meets the x-axis and the y-axis.



[4]

(b) **(i)** Find the derivative of $y = x^2 - 3x - 28$.

..... [2]

(ii) Find the coordinates of the turning point of $y = x^2 - 3x - 28$.

(..... , ...) [3]

(c) The line $y = 5 - 2x$ intersects the graph of $y = x^2 - 3x - 28$ at point P and point Q.

Find the coordinates of P and Q.
You must show all your working and give your answers correct to 2 decimal places.

(..... , ...)

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

9 $f(x) = 4x + 1$ $g(x) = 6 - 2x$ $h(x) = 3^{x-2}$

(a) Find

(i) $f(3)$

..... [1]

(ii) $gf(3)$.

..... [1]

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

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

(c) Find x when $f(x) = g(2x - 7)$.

$x =$ ..... [4]

(d) Find the value of hh(2).

..... [2]

(e) Find x when $h^{-1}(x) = 10$.

$x =$ ..... [2]

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6406182559

MATHEMATICS **0580/42**

Paper 4 (Extended) **May/June 2024**

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

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INFORMATION

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[Turn over

1 **(a)** A fruit drink is made using 1.5 litres of apple juice and 450 millilitres of mango juice.

Write the ratio apple juice : mango juice in its simplest form.

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

(b) One litre of fruit drink is shared between three cups.
The amount in the cups is in the ratio 9 : 6 : 10.

Calculate the number of millilitres in each cup.

..... ml , ... ml , ... ml [3]

(c) A shop buys bottles of the fruit drink for $3.20 each.
It sells them at a profit of 15%.

Calculate the selling price of each bottle of fruit drink.

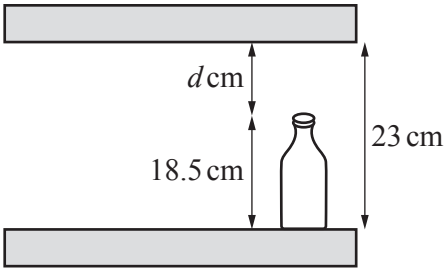
$ ..... [2]

(d) The number of bottles of fruit drink sold has grown exponentially at a constant rate of 2.5% per year.
5 years ago, the shop sold 16 620 bottles.

Calculate the number of bottles sold this year.

..... [2]

(e)



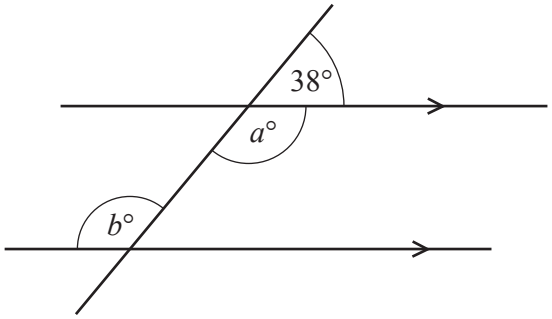
NOT TO SCALE

The bottles of juice are 18.5 cm tall, correct to the nearest millimetre.
They are stored on shelves.
The distance between the shelves is 23 cm, correct to the nearest centimetre.

Calculate the lower bound for the distance, d cm, between the top of a bottle and the shelf above it.

..... cm [3]

2 (a)



NOT TO SCALE

The diagram shows a straight line intersecting two parallel lines.

Find the value of a and the value of b.

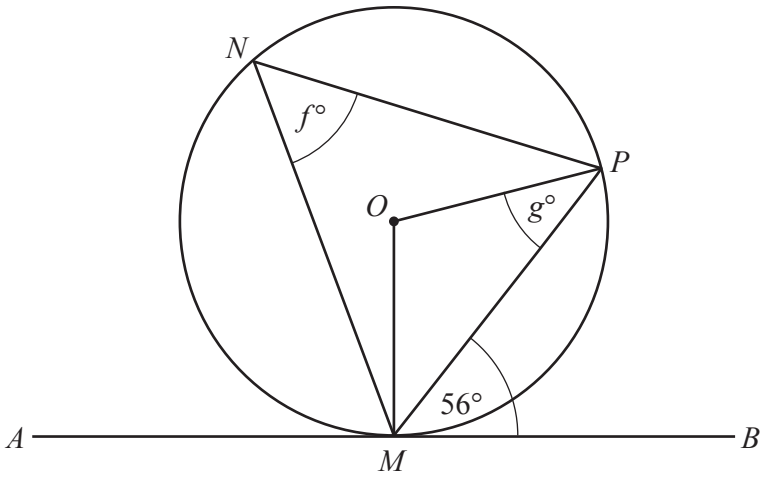
$a =$ .....

$b =$ ..... [2]

(b) Calculate the interior angle of a regular 12-sided polygon.

..... [2]

(c)



NOT TO SCALE

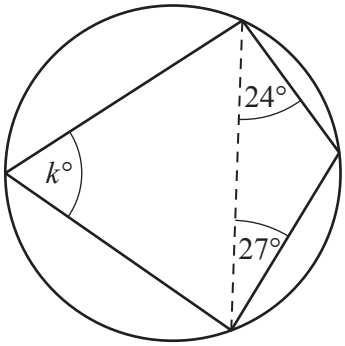
The diagram shows a circle, centre O.
The points M, N and P lie on the circumference of the circle.
AMB is a tangent to the circle at M.

Find the value of f and the value of g.

$f =$ .....

$g =$ ..... [3]

(d)



NOT TO SCALE

The diagram shows a cyclic quadrilateral.

Find the value of k.

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

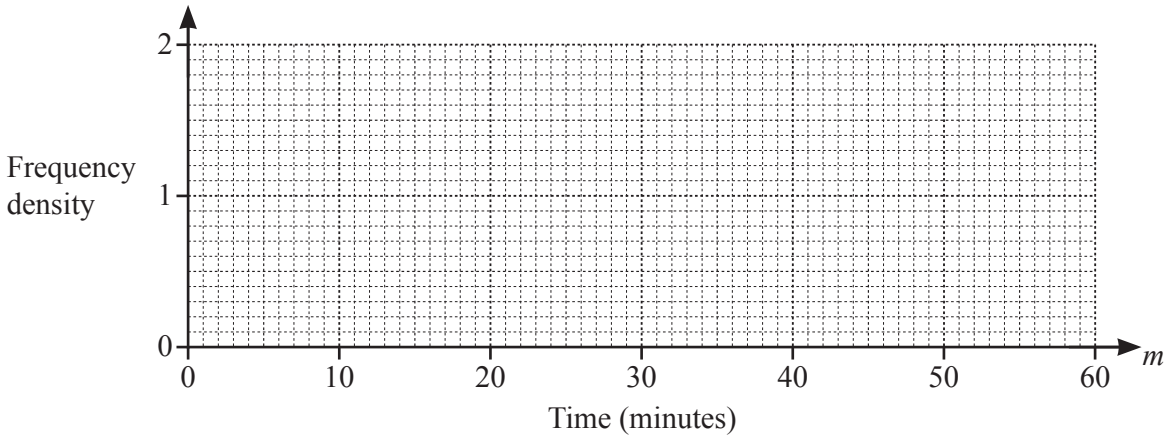
3 **(a)** The table shows the time that each of 40 students takes to travel to school.

Time (m minutes)	$0 < m \leqslant 10$	$10 < m \leqslant 25$	$25 < m \leqslant 40$	$40 < m \leqslant 60$
Frequency	3	18	15	4

(i) Calculate an estimate of the mean.

..... min [4]

(ii) On the grid, draw a histogram to show the information in the table.



[3]

(iii) Two students are selected at random from the 40 students.

Calculate the probability that one student takes more than 25 minutes and the other student takes 10 minutes or less to travel to school.

..... [3]

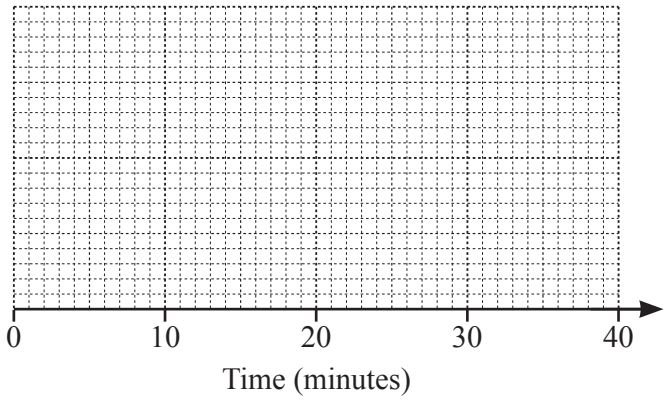
(b) This is some information about the time that 200 people took to fill in a questionnaire:

- The longest time taken was 30 minutes.
- The median time was 22 minutes.
- The lower quartile was 8 minutes.
- The interquartile range was 19 minutes.
- The range was 25 minutes.

(i) Write down the shortest time taken.

..... minutes [1]

(ii) On the grid, draw a box-and-whisker plot to show this information.



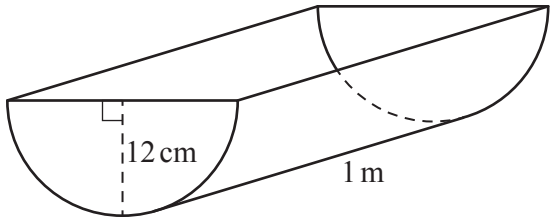
[3]

(iii) George says that 101 of the 200 people took more than 22 minutes to fill in the questionnaire.

Explain why he is wrong.

..... [1]

4 (a)



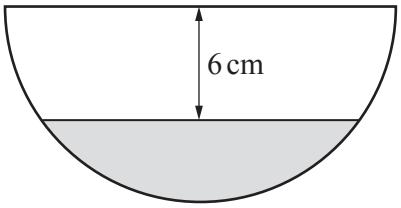
NOT TO SCALE

The diagram shows a tank in the shape of a half-cylinder of radius 12 cm and length 1 metre. The tank is fixed horizontally and is completely filled with water.

(i) Calculate the volume of water in the tank.
Give your answer correct to the nearest 10 cm^3.

..... cm^3 [3]

(ii)



NOT TO SCALE

Water is removed from the tank until the level of water is 6 cm below the top of the tank. The diagram shows the cross-section of the tank.

Calculate the volume of water that is now in the tank.

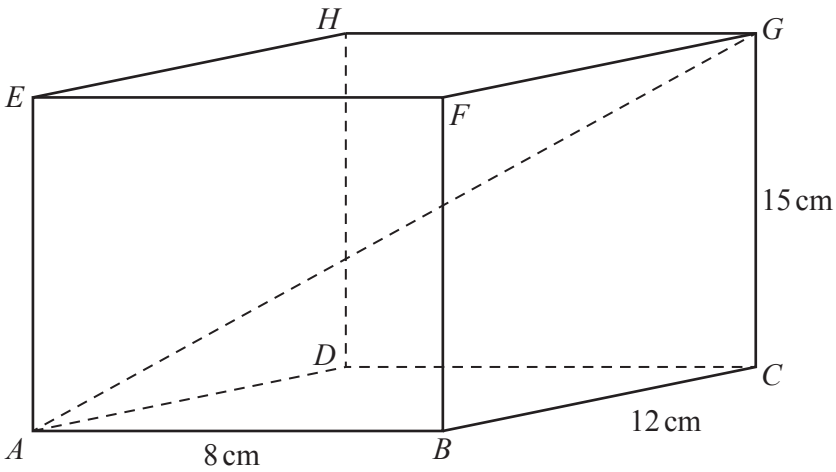
..... cm^3 [5]

(b) A rectangular fish tank with length 42 cm and width 35 cm is full of water.
A stone lies at the bottom of the tank.
When the stone is removed from the tank, the depth of the water decreases by 0.2 cm.
The density of the stone is 2.2 g/cm^3.

Calculate the mass of the stone in grams.
[Density = mass ÷ volume]

..... g [3]

(c)



NOT TO SCALE

The diagram shows a cuboid, *ABCDEFGH*.

Calculate the angle that *AG* makes with the base of the cuboid.

..... [4]

5 **(a)** Simplify $\left(25x^6\right)^{\frac{3}{2}}$.

..... [2]

(b) These are the first five terms of a sequence.

$$\frac{1}{6} \qquad 1 \qquad 6 \qquad 36 \qquad 216$$

Find the nth term of the sequence.

..... [2]

(c) Expand and simplify.

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

..... [3]

(d) **(i)** Show that $(3x+5)+\frac{7}{x-2}=x$ simplifies to $2x^2+x-3=0$.

[4]

(ii) Solve by factorisation $2x^2+x-3=0$.

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

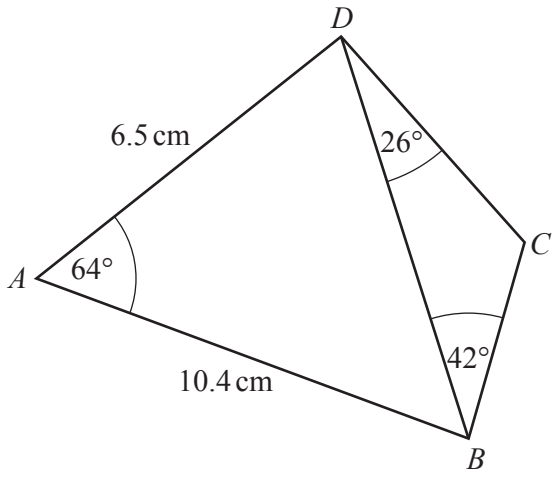
(e) A solid cylinder has base radius x and height $3x$.
The **total** surface area of the cylinder is the same as the **total** surface area of a solid hemisphere of radius $5y$.

Show that $x^2=\frac{75y^2}{8}$.

[The surface area, A, of a sphere with radius r is $A=4\pi r^2$.]

[4]

6



NOT TO SCALE

$ABCD$ is a quadrilateral with $AB = 10.4$ cm and $AD = 6.5$ cm.
Angle $DAB = 64°$, angle $BDC = 26°$ and angle $DBC = 42°$.

(a) Show that $BD = 9.55$ cm, correct to 2 decimal places.

[3]

(b) (i) Show that angle $BCD = 112°$.

[1]

(ii) Calculate CD.

$CD =$ ..... [3]

(c) Find the shortest distance from D to AB.

..... cm [3]

7 **(a)** Solve $3x - 8 = 6 - 4x$.

$x =$ ..... [2]

(b) Factorise fully $10a^2 + 5a$.

..... [2]

(c) Factorise fully $(2x - 3)^2 - 9$.

..... [2]

(d) $\mathrm{f}(x) = \frac{1}{4x - 1}$, $x \neq \frac{1}{4}$ $\mathrm{g}(x) = 3^x$

(i) Find $\mathrm{f}(4)$.

..... [1]

(ii) Find $\mathrm{gg}(2)$.

..... [2]

(iii) Find k when $\mathrm{g}(k) = \mathrm{f}(7)$.

..... [2]

8 A baker decorates x small cakes and y large cakes.
In one day, he decorates:

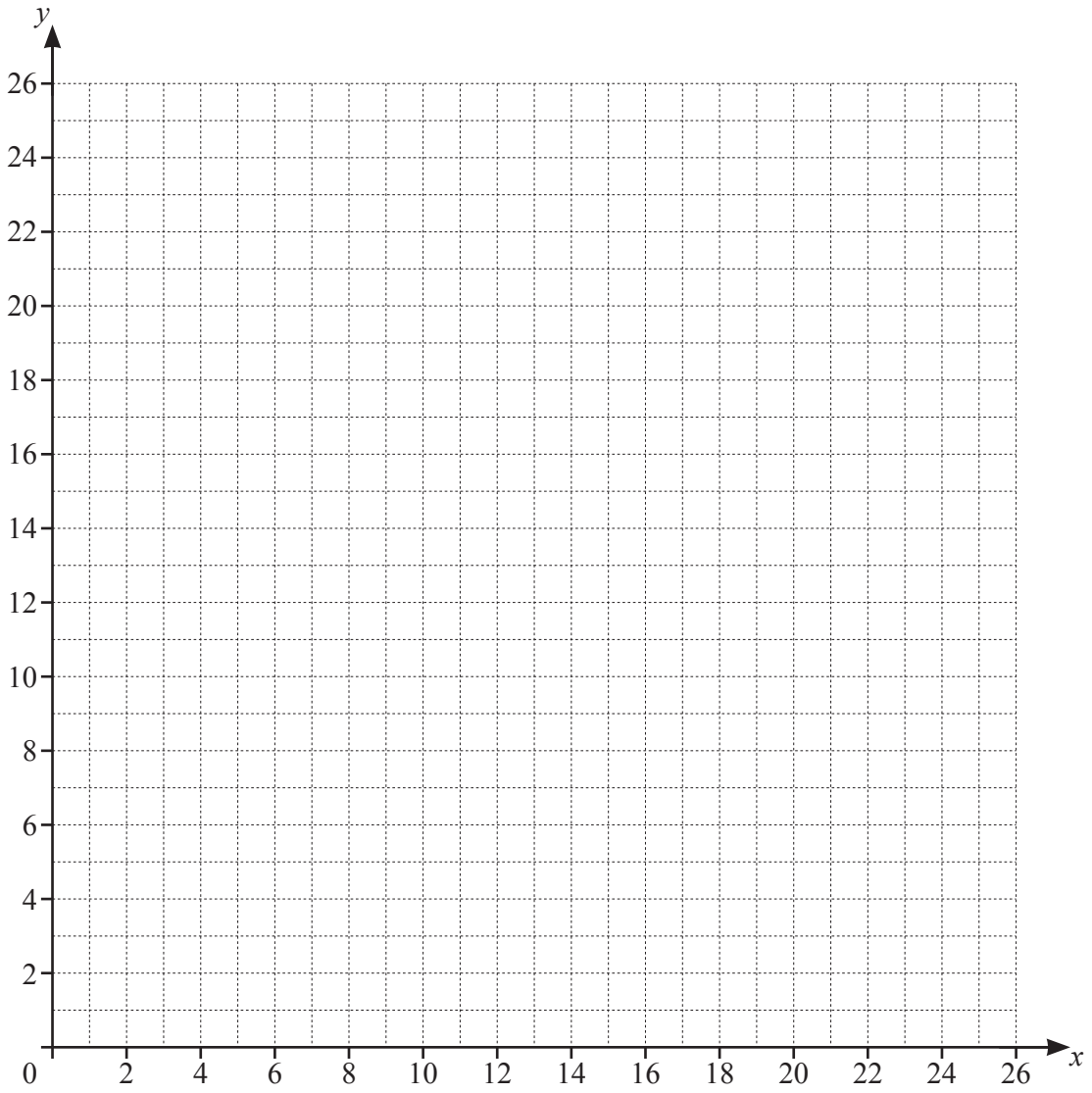
- not more than 16 small cakes
- less than 10 large cakes
- more small cakes than large cakes
- a total of not more than 24 cakes.

One of the inequalities that shows this information is $x \leqslant 16$.

(a) Write down the other three inequalities in x and/or y.

.... [3]

(b) On the grid, draw four straight lines and shade the unwanted regions to show these inequalities.
Label the region, R, which satisfies the four inequalities.



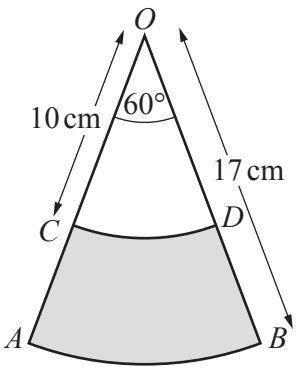
[6]

(c) The baker earns \$8 for decorating a small cake and \$12 for decorating a large cake.

Use your diagram to find the largest amount the baker can earn in one day by decorating cakes.

\$ ..... [2]

9 (a)



NOT TO SCALE

OAB is a sector of a circle, centre *O*, radius 17 cm.
OCD is a sector of a circle, centre *O*, radius 10 cm.
OCA and *ODB* are straight lines and angle $AOB = 60°$.

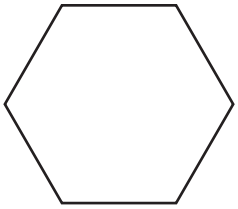
The perimeter of the shaded shape *ABDC* can be written in the form $(a\pi + b)$ cm.

Find the value of *a* and the value of *b*.

$a =$ .....

$b =$ ..... [3]

(b)



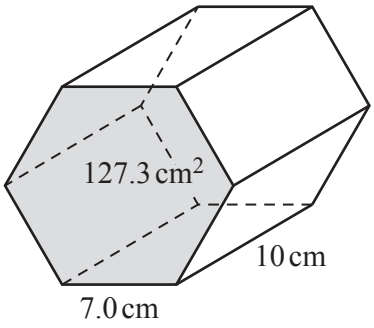
NOT TO SCALE

The diagram shows a regular hexagon.
The area of the hexagon is 127.3 cm^2.

(i) Show that the length of one side of the hexagon is 7.0 cm, correct to 1 decimal place.

[4]

(ii) The hexagon is the cross-section of a prism of length 10 cm.



NOT TO SCALE

(a) Find the volume of the prism.

..... cm^3 [1]

(b) Calculate the surface area of the prism.

..... cm^2 [2]

10 **(a)** A is the point (6, 2) and B is the point (3, -4).

(i) Find the coordinates of the midpoint of AB.

(..... , ...) [2]

(ii) Calculate the length AB.

..... [3]

(b) The equation of line l is $4x + 3y - 12 = 0$.

(i) Find the gradient of l.

..... [2]

(ii) Find the coordinates of the point where l crosses the y-axis.

(..... , ...) [2]

(iii) Line p is perpendicular to l and passes through (6, 5).

Find the equation of p in the form $y = mx + c$.

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

11 **(a)** The point $(-1, 6)$ lies on a curve.

This curve has the derived function $\frac{dy}{dx} = -4x^3 - 9x^2 + 5$.

Show that $(-1, 6)$ is a stationary point of the curve.

[2]

(b) A different curve has equation $y = 2x^3 - 6x + 8$.

(i) Calculate the gradient of the tangent to this curve at the point $(-2, 2)$.

..... [3]

(ii) Find the x-coordinates of the stationary points of this curve.

$x =$ ..... and $x =$ ..... [2]

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CENTRE NUMBER

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MATHEMATICS **0580/43**

Paper 4 (Extended) **May/June 2024**

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 π, 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 **24** pages. Any blank pages are indicated.

[Turn over

1 **(a)** In 2023 a football club had 50 adult members and 70 child members.
The membership fee for an adult was \$40 and the membership fee for a child was \$15.

(i) Calculate the total of the membership fees received by the club in 2023.

\$ ..... [2]

(ii) The cost of running the club in 2023 was \$2780.

Calculate \$2780 as a percentage of the total of the membership fees received by the club.

..... % [1]

(iii) In 2023 there were 120 members.
This was a decrease by 4% of the number of members in 2022.

Calculate the number of members in 2022.

..... [2]

(iv) In 2024 the total number of members increased from the 120 members in 2023.
The number of adult members and the number of child members each increased by the same number.
The ratio number of adult members : number of child members changed to 14 : 19.

(a) Find the total number of members in 2024.

..... [2]

(b) Calculate the percentage increase in the total number of members from 2023 to 2024.

..... % [2]

(b) The population of a village is 2500.
The population is decreasing exponentially at a rate of 3% per year.

(i) Calculate the population at the end of 3 years.

..... [2]

(ii) Find the number of complete years it takes for the population to first fall below 2000.

..... years [2]

2 **(a)** The nth term of a sequence is $120 - n^3$.

(i) Find the 4th term of this sequence.

..... [1]

(ii) Find the value of n when the nth term is -1211.

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

(b) The nth term of a different sequence is $3 \times (0.2)^{n-1}$.

Find the 5th term of this sequence.

..... [1]

(c) The table shows the first four terms of sequences A, B and C.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	7	4	1	-2			
B	$\frac{1}{4}$	$\frac{2}{5}$	$\frac{3}{6}$	$\frac{4}{7}$			
C	0	2	6	12			

Complete the table for each sequence.

[8]

3 **(a)** Rahul rolls a dice 60 times.
The results are shown in the table.

Score	1	2	3	4	5	6
Frequency	10	6	11	13	14	6

Find the mode, the median and the mean.

mode = ...

median = ...

mean = ... [5]

(b) Sangita measures the speed of each of 100 cars.
The results are shown in the table.

Speed (v km/h)	$20 < v \leqslant 30$	$30 < v \leqslant 50$	$50 < v \leqslant 75$
Frequency	10	72	18

(i) Calculate an estimate of the mean speed.

..... km/h [4]

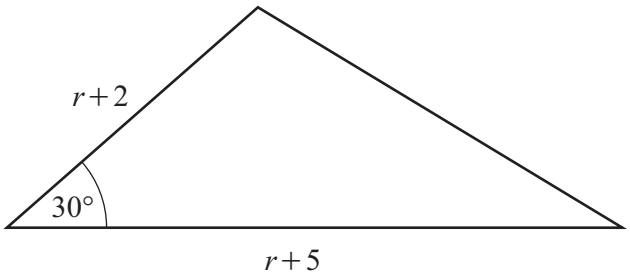
(ii) Sangita draws a histogram to show the information in the table.
The height of the bar that represents $20 < v \leqslant 30$ is 3 cm.

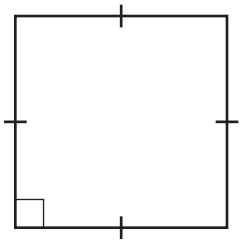
Calculate the height of each of the other two bars on this histogram.

height of bar for $30 < v \leqslant 50$ ..... cm

height of bar for $50 < v \leqslant 75$ ..... cm [2]

4 In this question all the measurements are in centimetres.





NOT TO SCALE

The area of the triangle is equal to the area of the square.

(a) Show that $3r^2 + r - 6 = 0$.

[4]

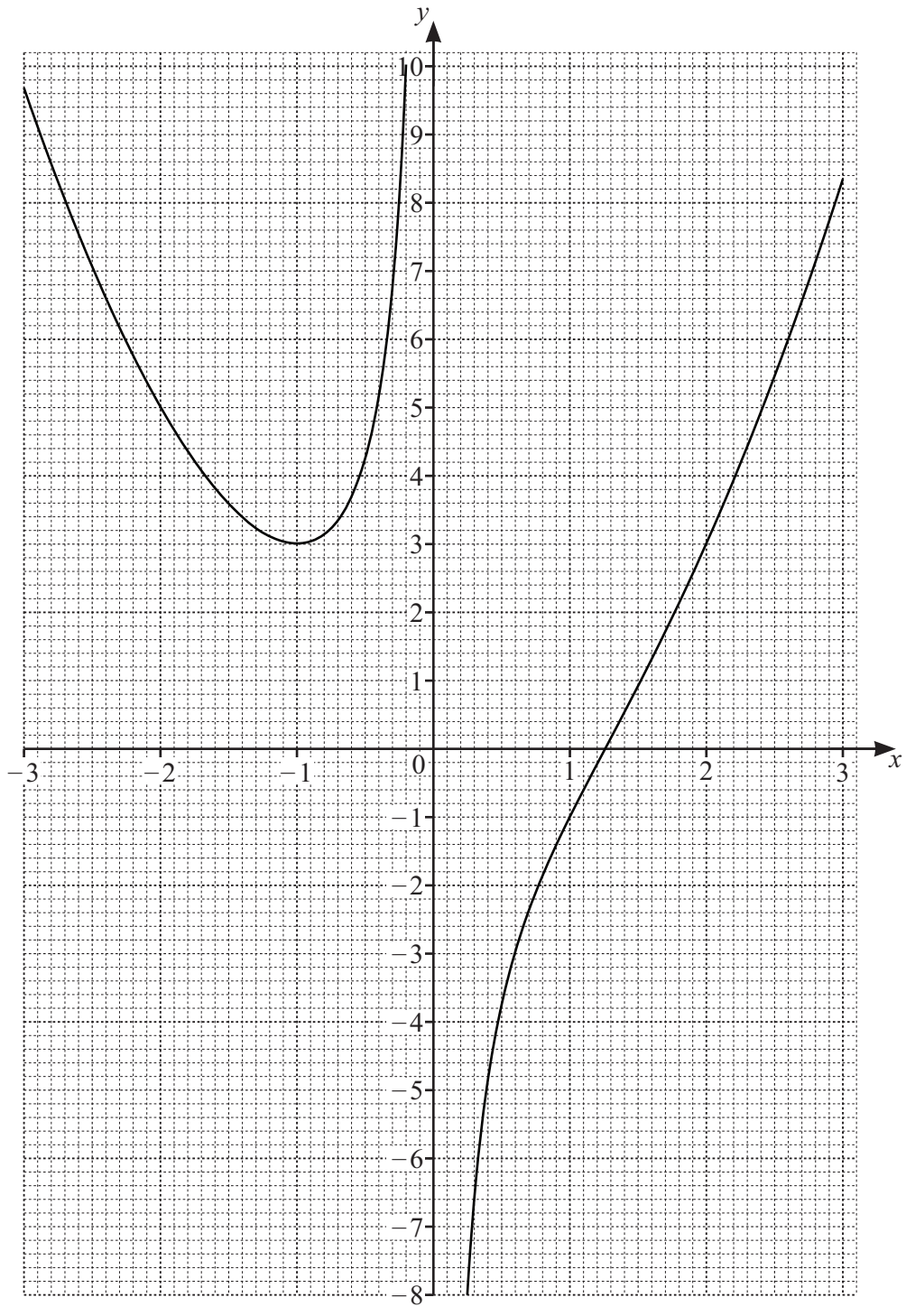
(b) Solve the equation $3r^2 + r - 6 = 0$.
Give your answer to 2 decimal places.
You must show all your working.

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

(c) Find the perimeter of the square.

..... cm [2]

5



The diagram shows the graph of $y = f(x)$ for values of x from -3 to 3.

(a) (i) Use the graph to find $f(2)$.

..... [1]

(ii) Use the graph to solve the equation $f(x) = 5$.

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

(iii) The equation $f(x) = k$ has exactly two solutions.

Write down the value of k.

$k =$ ..... [1]

(iv)

tangent	asymptote	root	perpendicular

Choose the correct word from the box to complete the statement.

The line $x = 0$ is the ..... to the graph of $y = f(x)$. [1]

(b) (i) On the grid, draw the graph of $y = x - 2$ for values of x from -3 to 3. [2]

(ii) Find x when $f(x) = x - 2$.

$x =$ ..... [1]

(c) $f(x) = x^2 - \frac{c}{x}, x \neq 0$

Use the graph to show that $c = 2$.

[2]

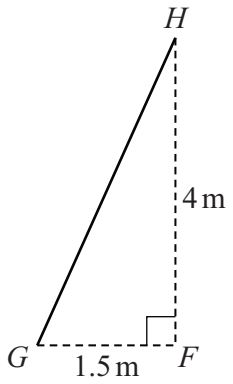
(d) The equation $f(x) = x - 2$ can be written as $x^3 + px^2 + qx = 2$.

Find the value of p and the value of q.

$p =$ .....

$q =$ ..... [2]

6 (a)



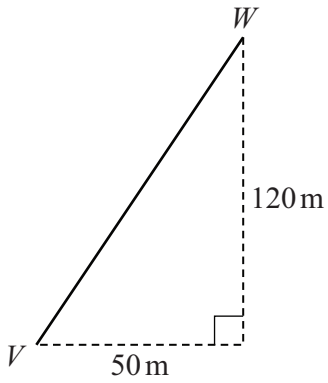
NOT TO SCALE

The diagram shows a ladder, GH, on horizontal ground, leaning against a vertical wall, HF. $GF = 1.5$ m and $HF = 4$ m.

Calculate the length of the ladder, GH.

..... m [2]

(b)



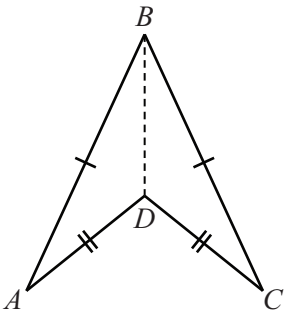
NOT TO SCALE

W is 120 m north of V and 50 m east of V.

Calculate the bearing of V from W.

..... [3]

(c)



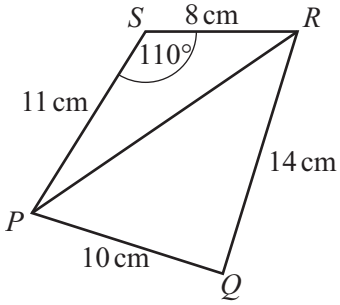
NOT TO SCALE

In the quadrilateral $ABCD$, $AD = DC = 5$ cm and $AB = BC$.
Angle $ABD = 25°$ and angle $BAD = 15°$.

Calculate the perimeter of the quadrilateral $ABCD$.

..... cm [5]

(d)



NOT TO SCALE

$PQRS$ is a quadrilateral.

Calculate angle PQR.

Angle PQR = ... [5]

7 (a) (i) A car travels 50 km at an average speed of 75 km/h.

Find the time taken.
Give your answer in minutes.

..... min [2]

(ii) Another car travels 47 km, correct to the nearest kilometre.
The average speed of this car is 75 km/h, correct to the nearest 5 km/h.

Calculate the lower bound of the time taken.
Give your answer in minutes.

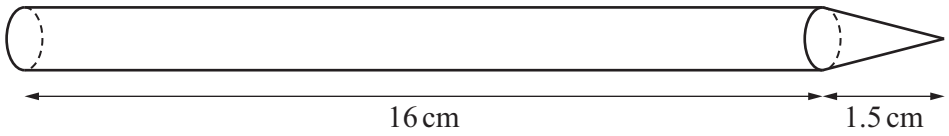
..... min [3]

(b) A train travels a total of 240 km.
The train travels for t **minutes** at an average speed of 100 km/h.
It then travels for $(t + 60)$ **minutes** at an average speed of 110 km/h.

Find the average speed for the whole journey.

..... km/h [6]

8 (a)



NOT TO SCALE

The diagram shows a solid made from a cylinder and a cone.
The height of the cylinder is 16 cm and the height of the cone is 1.5 cm.
The radius of the cylinder and the base radius of the cone are each 0.35 cm.

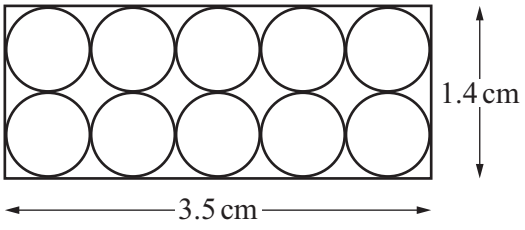
(i) Calculate the total surface area of the solid.
[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]

..... cm^2 [5]

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

..... cm^3 [3]

(iii)



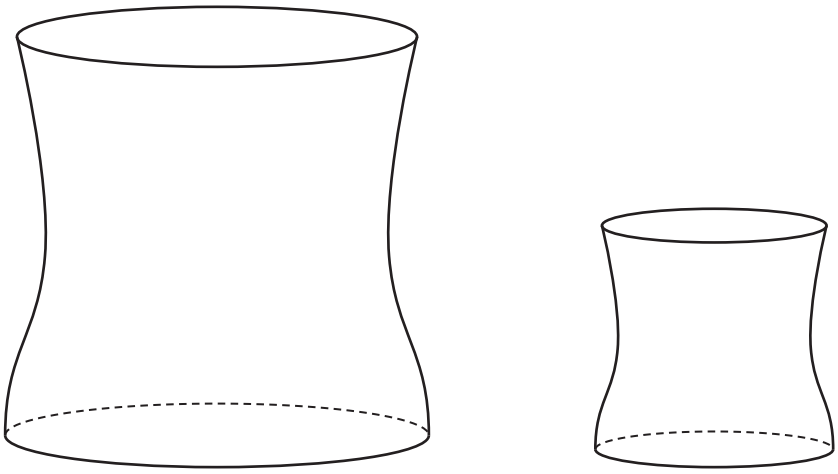
NOT TO SCALE

10 of the solids are placed in a box in the shape of a cuboid of length 17.5 cm.
The diagram shows one end of the box.

Calculate the volume of the empty space in the box.

..... cm^3 [3]

(b)



NOT TO SCALE

The diagram shows two mathematically similar solids.
The surface area of the larger solid is $200\,cm^2$ and the surface area of the smaller solid is $98\,cm^2$.
The volume of the larger solid is $450\,cm^3$.

Calculate the volume of the smaller solid.

..... cm^3 [3]

9

N	A	M	I	B	I	A

The diagram shows 7 cards.

(a) Amir picks a card at random.

Find the probability that the card shows

(i) the letter H

..... [1]

(ii) the letter B.

..... [1]

(b) Fumika picks one of the 7 cards at random.
She replaces it and picks a second card at random.

Find the probability that both cards show the letter I.

..... [2]

(c) Marcos picks two of the 7 cards at random, **without** replacement.

(i) Find the probability that one card shows the letter I and the other card shows the letter N.

..... [3]

(ii) Find the probability that the two cards show different letters.

..... [3]

(d) Nina picks one of the 7 cards at random without replacement.
She continues picking cards at random without replacement until she picks a card that shows the letter A.

The probability that this occurs when she picks the nth card is $\frac{4}{21}$.

Find the value of n.

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

10 $y = x^7 - 7x^6$

(a) Find the derivative of y with respect to x.

..... [2]

(b) Find the equation of the tangent to the graph of $y = x^7 - 7x^6$ at the point where $x = -1$.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

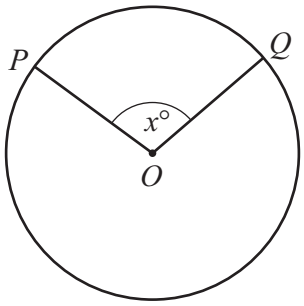
(c) The graph of $y = x^7 - 7x^6$ has two turning points.

Find the coordinates of these points.
You must show all your working.

(..... , ...)

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

11 (a)

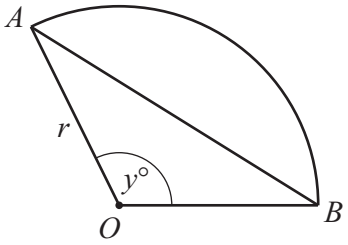


NOT TO SCALE

In the circle, centre O, the length of the minor arc PQ is $\frac{3}{7}$ of the length of the major arc PQ.
Show that $x = 108$.

[3]

(b)



NOT TO SCALE

The diagram shows a sector, OAB, of a circle with centre O and radius r.
The area of triangle OAB is half the area of the sector.
Angle $AOB = y°$ and is obtuse.

(i) Show that $360 \sin y = \pi y$.

[2]

(ii) Complete the table, giving your answers correct to two decimal places.

y	$360 \sin y$	πy
108.4	341.60	340.55
108.5	341.40	340.86
108.6	341.20	
108.7		

[3]

(iii) Complete the statement.

The value of y, correct to one decimal place, that satisfies the equation $360 \sin y = \pi y$ is ..... . [1]

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CANDIDATE NAME									
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2592033674

MATHEMATICS **0580/41**

Paper 4 (Extended) **October/November 2023**

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 π, use either your calculator value or 3.142.

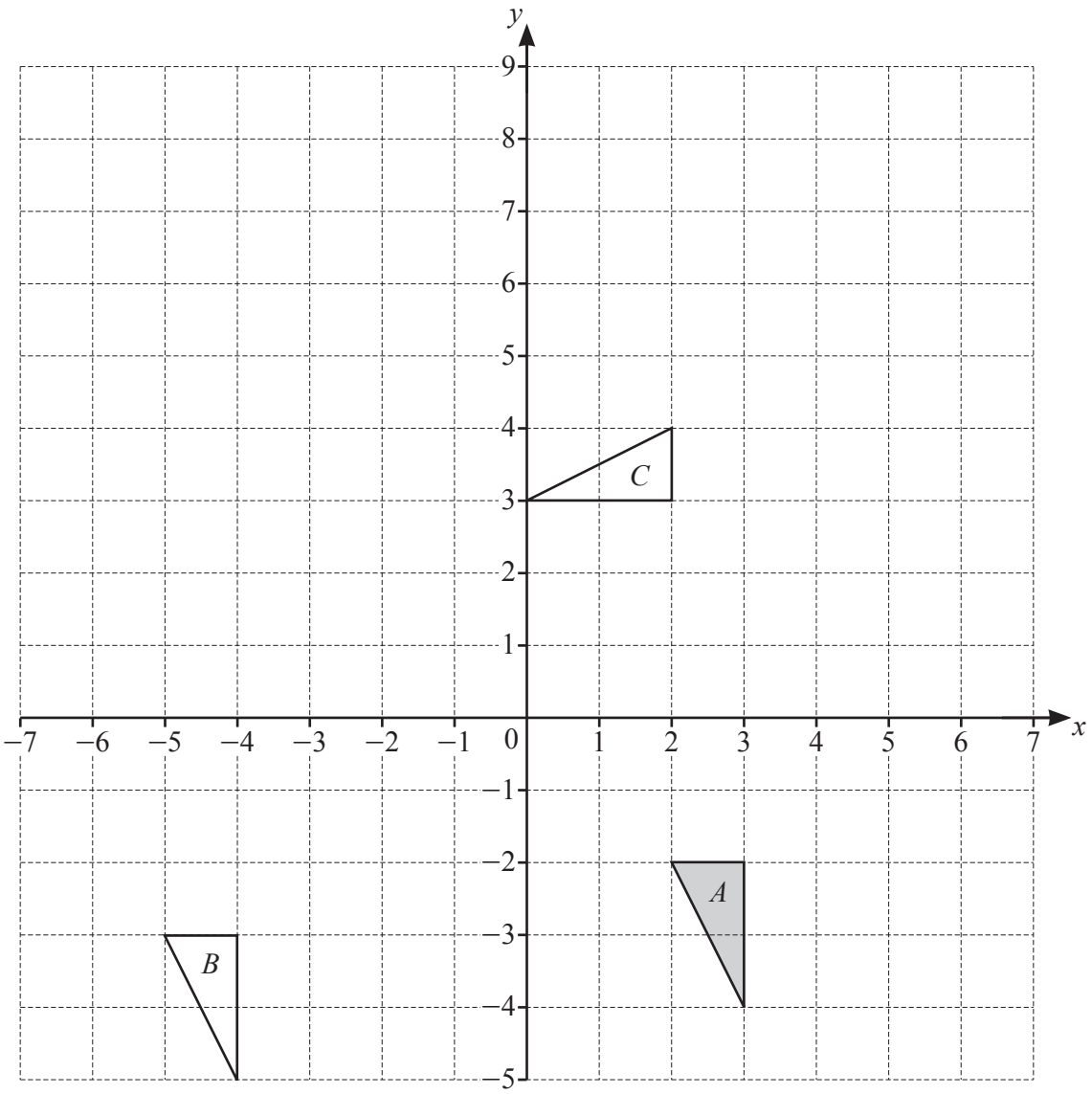
INFORMATION

- 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. Any blank pages are indicated.

[Turn over

1



(a) Describe fully the **single** transformation that maps

(i) shape *A* onto shape *B*

.....

..... [2]

(ii) shape *A* onto shape *C*.

.....

..... [3]

(b) On the grid, draw the image of

(i) shape *A* after a reflection in the line $y = 2$ [2]

(ii) shape *A* after an enlargement, scale factor -2, centre (0, 0). [2]

2 **(a)** $s = \frac{1}{2}at^2$

Find the value of s when $a = 9.8$ and $t = 20$.

$s =$ ..... [2]

(b) Solve.

$5(4y - 3) = 15$

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

(c) Expand and simplify.

$3(5x - 8) - 2(3x - 7)$

..... [2]

(d) Rearrange $A = 2b^2 - 3c^3$ to make c the subject.

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

(e) Factorise completely.

$6pq - 4q - 3p + 2$

..... [2]

3 **(a)** The table shows information about some of the planets in the solar system.

Planet	Diameter (km)	Average distance from the Sun (km)
Earth	12 800	1.496×10^8
Mars	6 800	2.279×10^8
Jupiter	143 000	7.786×10^8
Saturn	120 500	1.434×10^9
Neptune	49 500	4.495×10^9

(i) The average distance of Mars from the Sun is 2.279×10^8 km.

Write this distance as an ordinary number.

..... km [1]

(ii) The planet Uranus has a diameter that is 35.8% of the diameter of Jupiter.

Calculate the diameter of Uranus.

..... km [2]

(iii) The ratio diameter of Neptune : diameter of Saturn can be written in the form 1 : n.

Find the value of n.

$n =$ ..... [1]

(iv) Find the average distance of Neptune from the Sun as a percentage of the average distance of the Earth from the Sun.

.....% [2]

(v) Distances within the solar system are also measured in astronomical units (AU).
The average distance of Jupiter from the Sun is 5.20 AU.

Calculate the average distance of Mars from the Sun in astronomical units.

..... AU [2]

(vi) The diameter of Mars is 39.2% greater than the diameter of Mercury.

Calculate the diameter of Mercury.

..... km [2]

(b) One light year is the distance that light travels in a year of 365.25 days.
The speed of light is 2.9979×10^5 kilometres per second.

(i) Show that one light year is 9.461×10^{12} km, correct to 4 significant figures.

[2]

(ii) The distance from the Andromeda Galaxy to Earth is 2.40×10^{19} km.

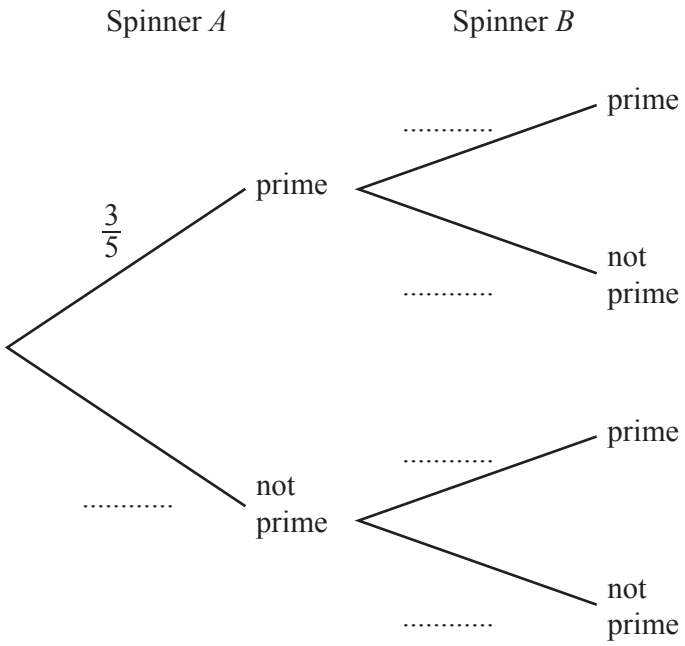
Calculate the time taken for light to travel from this galaxy to Earth.
Give your answer in millions of years.

..... million years [2]

4 **(a)** Lucia has two fair spinners.
Spinner *A* is five-sided and is numbered 1, 2, 3, 4, 5.
Spinner *B* is nine-sided and is numbered 3, 3, 3, 4, 4, 4, 4, 5, 5.

Lucia spins the two spinners and records whether they land on a prime number.

(i) Complete the tree diagram.



[2]

(ii) Find the probability that

(a) the two numbers are both prime

..... [2]

(b) the two numbers are **not** both prime.

..... [1]

(b) Lucia spins Spinner *A* 120 times.

Find the expected number of times the spinner lands on a prime number.

..... [1]

(c) Lucia spins Spinner *B* twice.

Find the probability that the two numbers it lands on add up to 9 or more.

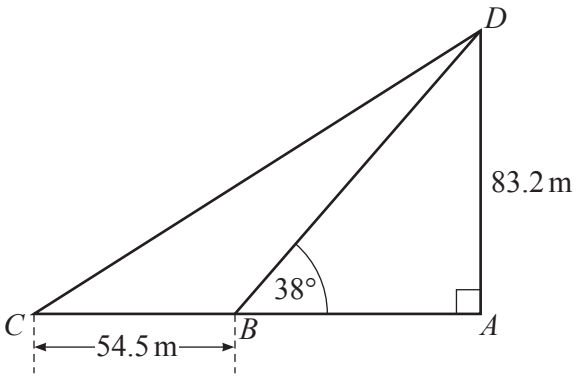
..... [3]

(d) Lucia keeps spinning Spinner *B* until it lands on a 4.

Find an expression, in terms of n, for the probability that this happens on the nth spin.

..... [2]

5 (a)



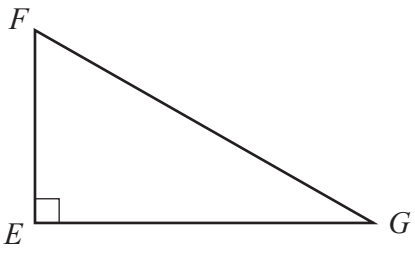
NOT TO SCALE

ACD is a right-angled triangle.
B is on *AC* and *BC* = 54.5 m.
AD = 83.2 m and angle *ABD* = 38°.

Calculate angle *ACD*.

Angle *ACD* = ... [5]

(b)



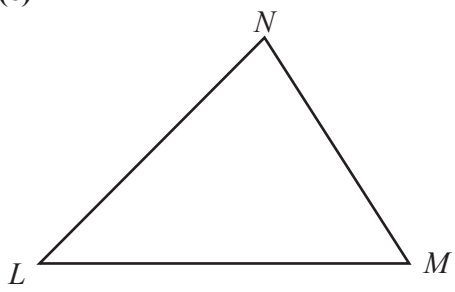
EFG is a right-angled triangle.
A circle can be drawn that passes through the three vertices of the triangle.

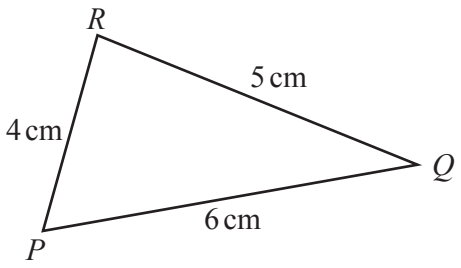
On the diagram, mark the position of the centre of the circle with a cross.
Explain how you decide.

.....

..... [2]

(c)





NOT TO SCALE

In triangle LMN, the ratio angle L : angle M : angle $N = 4 : 5 : 6$.
In triangle PQR, $PQ = 6\,\text{cm}$, $PR = 4\,\text{cm}$ and $QR = 5\,\text{cm}$.

Calculate the difference between the largest angle in triangle PQR and the largest angle in triangle LMN.

..... [7]

6 (a)

Sequence	1st term	2nd term	3rd term	4th term	5th term		*n*th term
A	-7	-3	1	5			
B	7	13	23	37			
C	$\frac{2}{27}$	$\frac{3}{81}$	$\frac{4}{243}$	$\frac{5}{729}$			

Complete the table for the three sequences.

[10]

(b) In a sequence, the sum of the first 49 terms is 7644.
The sum of the first 50 terms is 7975.

Find the 50th term of this sequence.

..... [1]

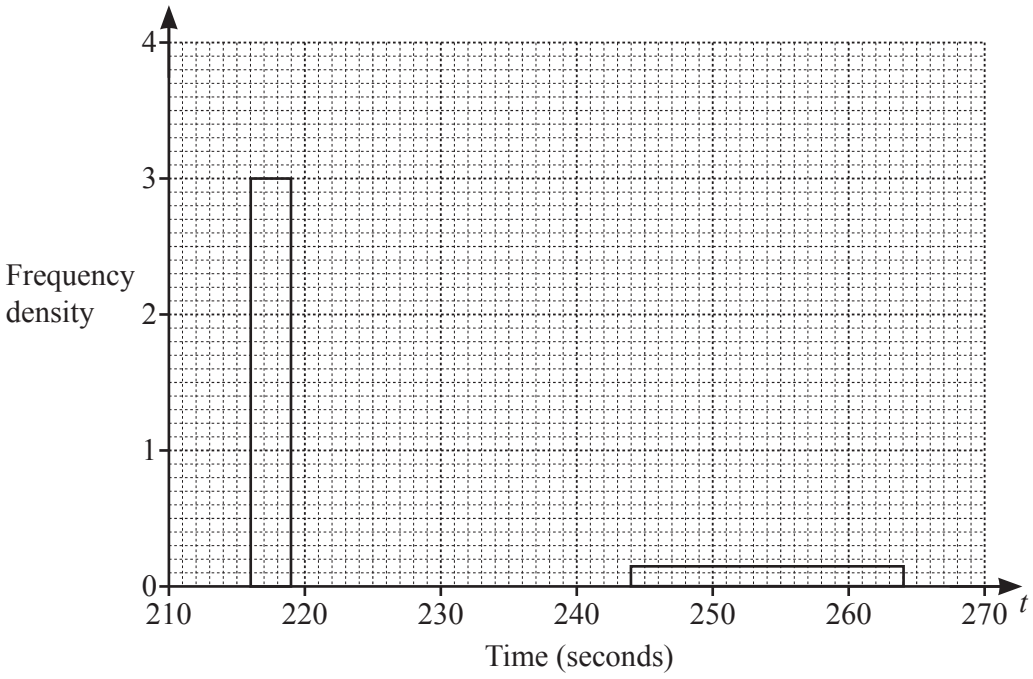
7 The frequency table shows the time of each of 42 athletes in a race.

Time (t seconds)	Number of athletes
$216 < t \leqslant 219$	9
$219 < t \leqslant 224$	14
$224 < t \leqslant 234$	14
$234 < t \leqslant 244$	2
$244 < t \leqslant 264$	3

(a) Calculate an estimate of the mean time.

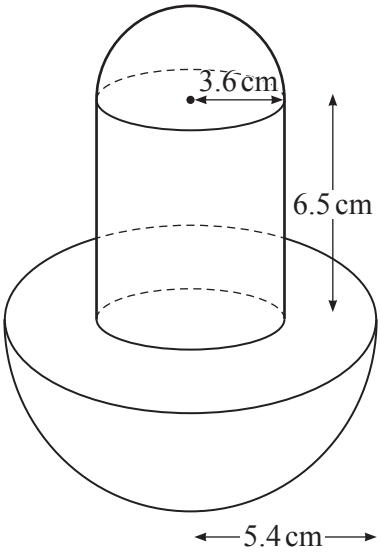
..... seconds [4]

(b) Complete the histogram to show the information in the frequency table.
Two of the blocks have been drawn for you.



[3]

8 (a)



NOT TO SCALE

The diagram shows a solid formed by joining two hemispheres and a cylinder.
The radius of the large hemisphere is 5.4 cm.
The radius of the small hemisphere and the radius of the cylinder are both 3.6 cm.
The height of the cylinder is 6.5 cm.

(i) Show that the volume of the solid is $692\,\text{cm}^3$, correct to the nearest cubic centimetre.

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

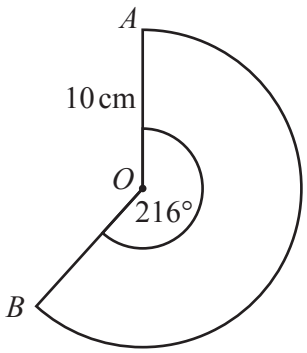
[4]

(ii) A mathematically similar solid is made of silver.
In this solid, the cylinder has radius 0.6 cm.
$1\,\text{cm}^3$ of silver has a mass of 10.49 grams.

Calculate the total mass of this silver solid.

..... g [4]

(b)



NOT TO SCALE

AOB is a sector of a circle, centre O.
$AO = 10\,\text{cm}$ and the sector angle is 216°.

(i) Calculate the length of the arc of this sector.
Give your answer as a multiple of π.

.....cm [2]

(ii) A cone is made from this sector by joining OA to OB.

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

..... cm^3 [4]

9 $f(x) = (3x+1)(x+5)(x-4)$ $g(x) = 2x-3$ $h(x) = 4^{2x-1}$

(a) Find

(i) $f(0)$

..... [1]

(ii) $g^{-1}(x)$

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

(iii) $gh(2)$.

..... [2]

(b) $g(2x) = 7$

Find the value of x.

$x =$ ..... [2]

(c) Simplify $g(x^2) + gg(x) + 1$.

..... [3]

(d) Find $h^{-1}(16)$.

..... [2]

(e) $f(x) = (3x+1)(x+5)(x-4)$

This can be written in the form $f(x) = ax^3 + bx^2 + cx + d$.

Find the value of each of a, b, c and d.

$a =$ ..... $b =$ ..... $c =$ ..... $d =$ ..... [3]

10 **(a)** ABC is a triangle.

B is the point $(1, -10)$, A is the point $(4, 14)$ and $\overrightarrow{CA} = \begin{pmatrix} -11 \\ 8 \end{pmatrix}$.

(i) Find the coordinates of C.

(..... , ...) [2]

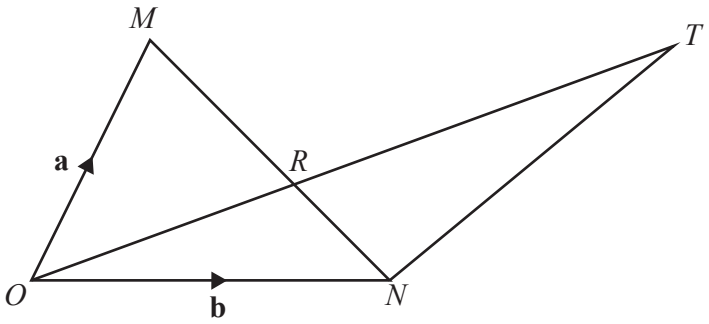
(ii) Find $\overrightarrow{BA}$.

$\overrightarrow{BA} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(iii) Find $\left|\overrightarrow{CA}\right|$.

..... [2]

(b)



NOT TO SCALE

OMN is a triangle.
$\overrightarrow{OM} = \mathbf{a}$ and $\overrightarrow{ON} = \mathbf{b}$.
R is a point on MN such that $MR : RN = 3 : 2$.
ORT is a straight line.

(i) Show that $\overrightarrow{OR} = \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$.

[3]

(ii) **(a)** $\overrightarrow{NT} = 4\mathbf{a} + k\mathbf{b}$ and $\overrightarrow{OT} = c\overrightarrow{OR}$.

Find the value of k and the value of c.

$k =$ ..... $c =$ ..... [4]

(b) Find $\overrightarrow{MT}$.

$\overrightarrow{MT} =$ ..... [1]

11 **(a)** Differentiate $x^3 - 4x^2 - 3x$.

..... [2]

(b) A curve has equation $y = x^3 - 4x^2 - 3x$.

Work out the coordinates of the two stationary points.
Show all your working.

(..... , ...)

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

(c) Determine whether each stationary point is a maximum or a minimum.
Show all your working.

[3]

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MATHEMATICS **0580/42**

Paper 4 (Extended) **October/November 2023**

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 π, 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. Any blank pages are indicated.

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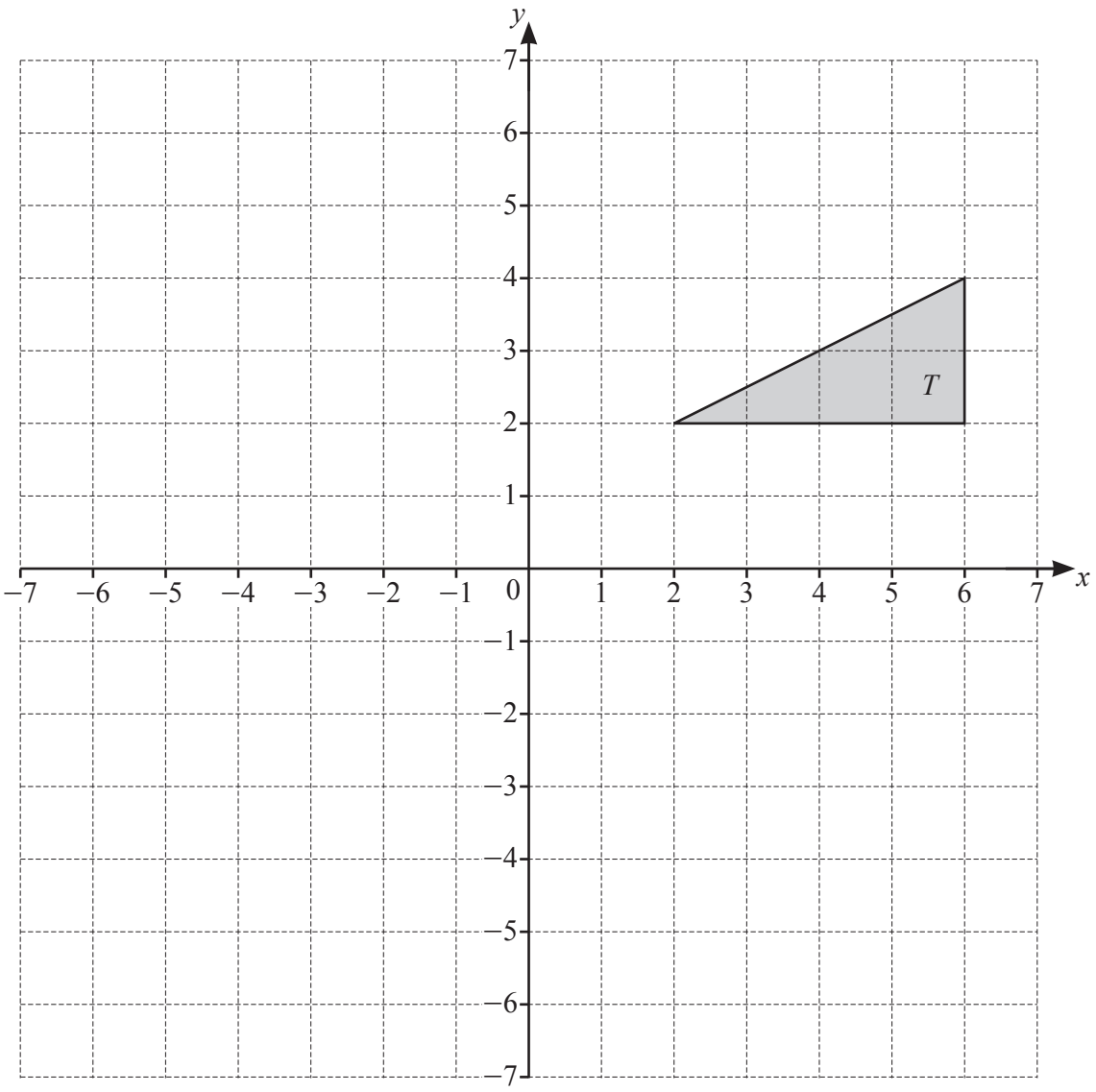
1



(a) **(i)** Translate triangle T by the vector $\begin{pmatrix} -7 \\ 1 \end{pmatrix}$. Label the image K. [2]

(ii) Describe fully the **single** transformation that maps triangle K onto triangle T.

.....

..... [1]

(b) Reflect triangle T in the line $y = 4$. [2]

(c) Rotate triangle T through 90° clockwise about (0, 0). [2]

(d) **(i)** Enlarge triangle T by scale factor $-\frac{1}{2}$, centre (0, 0). Label the image P. [2]

(ii) Describe fully the **single** transformation that maps triangle P onto triangle T.

.....

..... [2]

2 **(a)** Daisy records her 50 homework marks.
The table shows the results.

Homework mark	15	16	17	18	19	20
Frequency	1	3	19	11	10	6

(i) Write down the range.

..... [1]

(ii) Write down the mode.

..... [1]

(iii) Find the median.

..... [1]

(iv) Calculate the mean.

..... [3]

(b) 21 33 20 25 21 34 22 21 20 30 18

The list shows Ed's scores in 11 tests.

(i) Complete the stem-and-leaf diagram to show this information.

1	
2	
3	

Key: 2|5 represents 25

[2]

(ii) Find the median.

..... [1]

(iii) Find the interquartile range.

..... [2]

3 **(a)** The value of Priya's car decreases by 10% every year.
The value today is \$7695.

(i) Calculate the value of the car after one year.

\$ ..... [2]

(ii) Calculate the value of the car one year ago.

\$ ..... [2]

(b) Ali invests \$600 at a rate of 2% per year simple interest.

Calculate the value of Ali's investment at the end of 5 years.

\$ ..... [3]

(c) Sara invests \$500 at a rate of r% per year compound interest.
At the end of 12 years, the value of Sara's investment is \$601.35, correct to the nearest cent.

Find the value of r.

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

(d) The mass of a radioactive substance decreases exponentially at a rate of 3% each day.

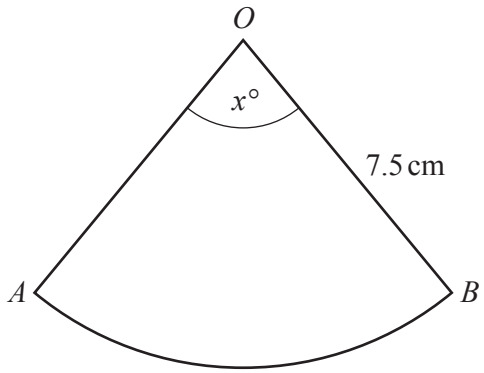
(i) Find the overall percentage decrease at the end of 10 days.

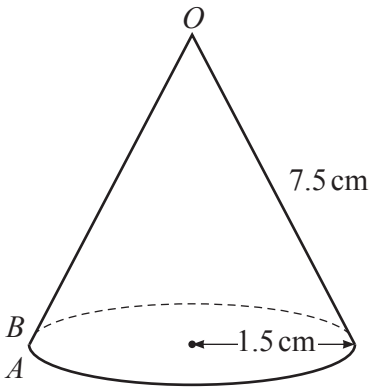
..... % [2]

(ii) Find the number of whole days it takes until the mass of this substance is one half of its original amount.

..... [3]

4 **(a)**





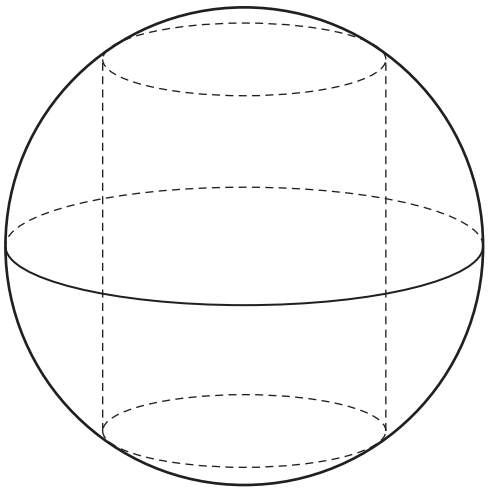
NOT TO SCALE

The diagram shows a sector of a circle that is made into a cone by joining OA to OB.
The sector angle is $x°$ and the radius of the sector is 7.5 cm.
The base radius of the cone is 1.5 cm.

Calculate the value of x.

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

(b)



NOT TO SCALE

The diagram shows a cylinder with radius 8 cm inside a sphere with radius 17 cm.
Both ends of the cylinder touch the curved surface of the sphere.

(i) Show that the height of the cylinder is 30 cm.

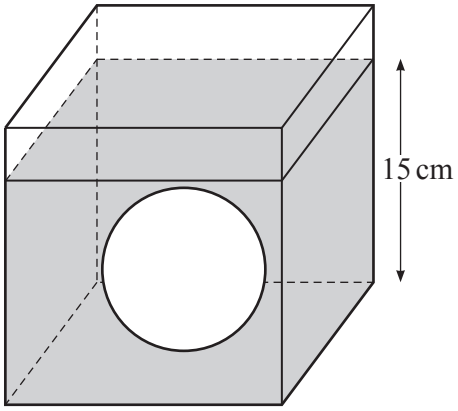
[2]

(ii) Calculate the volume of the cylinder as a percentage of the volume of the sphere.

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

..... % [4]

(c)



NOT TO SCALE

The diagram shows a solid sphere with radius 6 cm inside a cube with side length 20 cm.
The cube contains water to a depth of 15 cm.
The sphere is removed.

Calculate the new depth of water in the cube.

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

..... cm [3]

5 **(a)** In a shop the cost of a fiction book is $\$x$ and the cost of a reference book is $\$(x+2)$.
The cost of 11 fiction books is the same as the cost of 10 reference books.

Find the value of x.

$x =$ ..... [2]

(b) In another shop, the cost of a fiction book is $\$y$ and the cost of a reference book is $\$(y+2)$.
Maria spends \$95 on fiction books and \$147 on reference books.
She buys a total of 12 books.

(i) Show that $6y^2 - 109y - 95 = 0$.

[4]

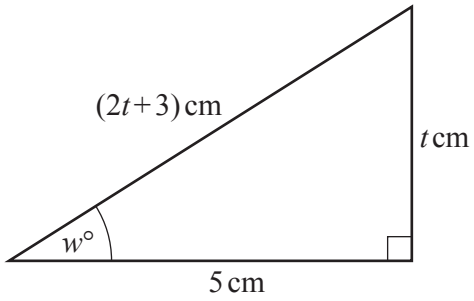
(ii) Factorise $6y^2 - 109y - 95$.

..... [2]

(iii) Find the value of y.

$y =$ ..... [1]

6



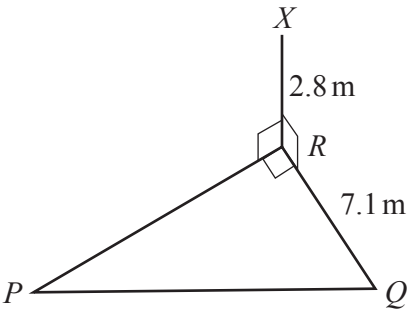
NOT TO SCALE

The diagram shows a right-angled triangle.

Find the value of w.

$w =$ ..... [7]

7 (a)



NOT TO SCALE

The diagram shows a right-angled triangle PQR on horizontal ground.
X is vertically above R and the angle of elevation of X from P is 21°.
$XR = 2.8$ m and $RQ = 7.1$ m.

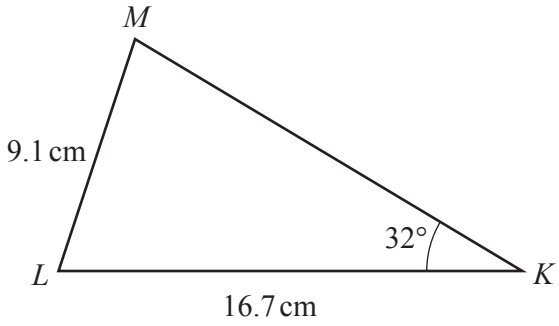
(i) Calculate the angle of elevation of X from Q.

..... [2]

(ii) Calculate PQ.

..... m [3]

(b)

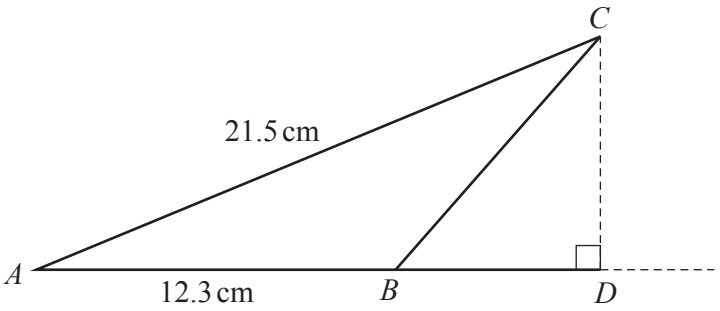


NOT TO SCALE

Calculate the acute angle KML.

Angle KML = ... [3]

(c)



NOT TO SCALE

The area of triangle ABC is $62.89\,\text{cm}^2$.

(i) Show that angle $BAC = 28.4°$, correct to 1 decimal place.

[2]

(ii) Calculate BC.

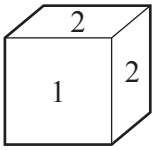
..... cm [3]

(iii) AB is extended to a point D such that angle $BDC = 90°$.

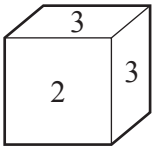
Calculate BD.

..... cm [3]

8



Dice A



Dice B

The diagram shows two fair dice.
Dice A is numbered 1, 2, 2, 2, 3, 6.
Dice B is numbered 2, 3, 3, 4, 4, 4.

(a) (i) Dice A is rolled once.

Write down the probability that it lands on the number 6.

..... [1]

(ii) Dice A is rolled 150 times.

Find the number of times it is expected to land on the number 6.

..... [1]

(b) Dice A and Dice B are each rolled once.

(i) Find the probability that the two numbers they land on have a total of 6.

..... [3]

(ii) Find the probability that when the two numbers they land on have a total of 6, both numbers are 3.

..... [2]

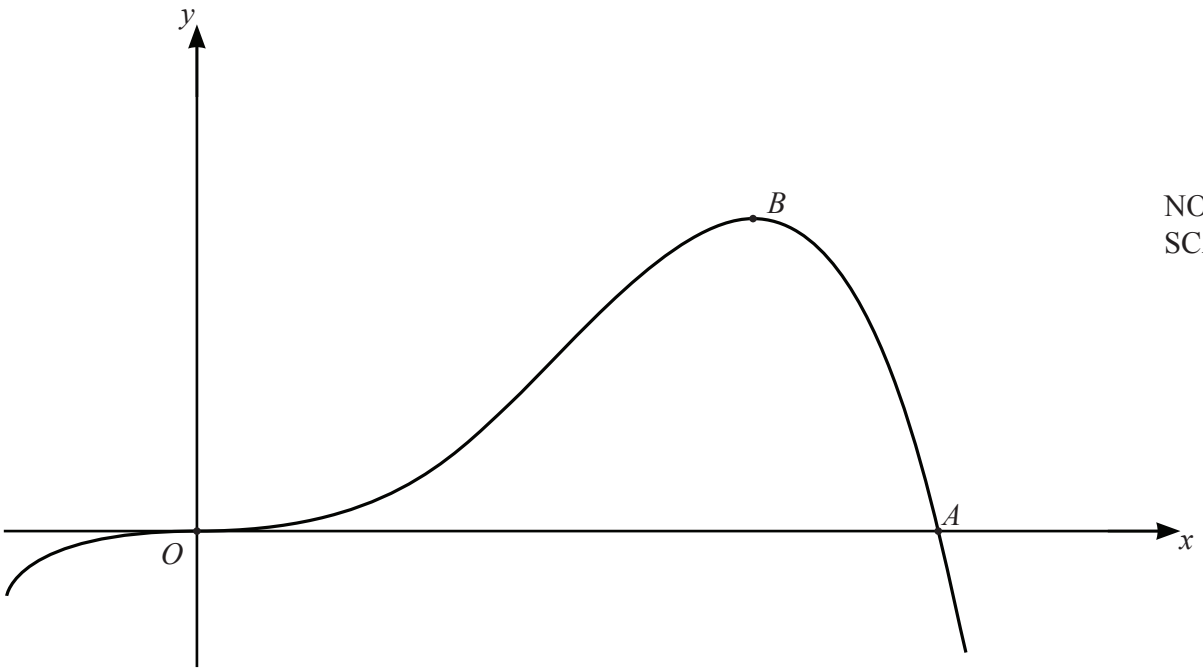
(c) Dice B is rolled n times.

The probability that on the nth roll it first lands on a number 3 is $\frac{32}{729}$.

Find the value of n.

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

9



The diagram shows a sketch of the graph of $y = 4x^3 - x^4$.
The graph crosses the x-axis at the origin O and at the point A.
The point B is a maximum point.

(a) Differentiate $4x^3 - x^4$.

..... [2]

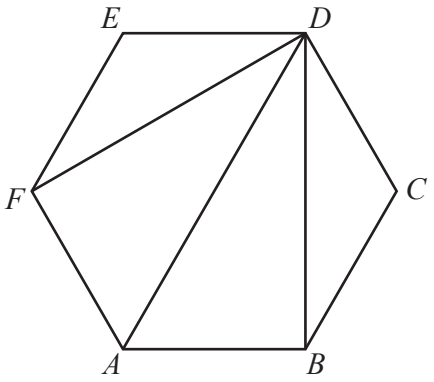
(b) Find the coordinates of B.

(..... , ...) [3]

(c) Find the gradient of the graph at the point A.

..... [3]

10 (a)



NOT TO SCALE

ABCDEF is a regular hexagon.
DF, *DA* and *DB* are diagonals.

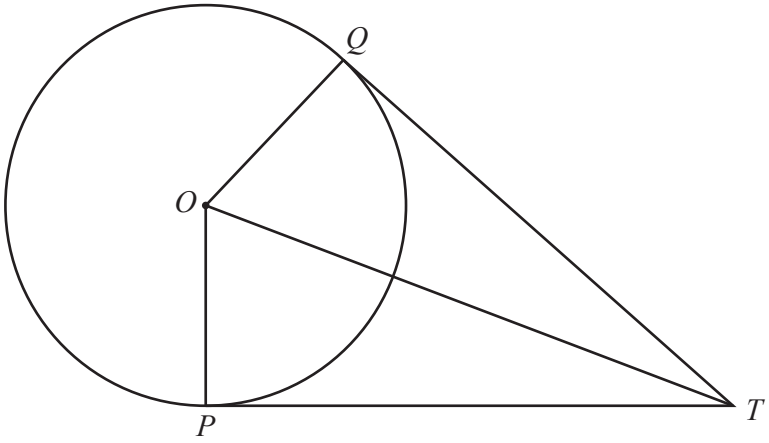
Complete the following statements using three different triangles.

Triangle *DEF* is congruent to triangle .....

Triangle ..... is congruent to triangle .....

[2]

(b)



NOT TO SCALE

P and *Q* are points on the circle with centre *O*.
TP and *TQ* are tangents to the circle from the point *T*.

Complete the following statements and reasons.

In triangles *OPT* and *OQT*

OP = ... because each is a radius of the circle

OT is a common side

Angle *OPT* = angle ..... = 90° because .....

Triangles *OPT* and *OQT* are congruent using the criterion .....

This proves that the tangents *TP* and *TQ* are .....

[5]

11 $f(x) = 1 - 3x$ $g(x) = (x-1)^2$ $h(x) = \frac{3}{x}, x \neq 0$

(a) Find g(3).

..... [1]

(b) Find $f(x-2)$, giving your answer in its simplest form.

..... [2]

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

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

(d) $gf(x) - g(x)f(x) = 3x^3 + ax^2 + bx + c$

Find the value of each of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [5]

(e) Find $h(x) - f(x)$, giving your answer as a single fraction in its simplest form.

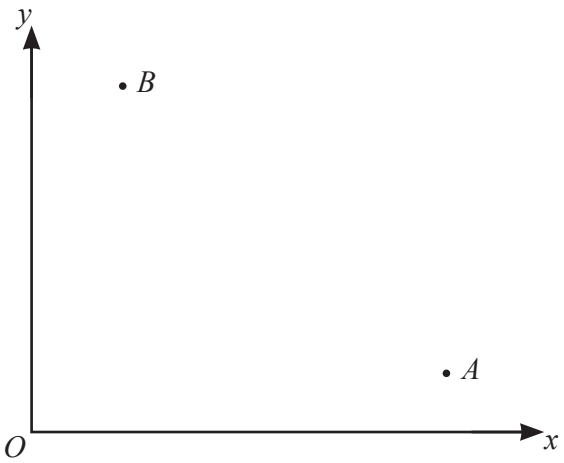
..... [3]

(f) $h(x^n) = 3x^7$

Find the value of n.

$n =$ ..... [1]

12



NOT TO SCALE

O is the origin (0, 0), A is the point (8, 1) and B is the point (2, 5).

(a) Write as column vectors.

(i) $\overrightarrow{OB}$

$\overrightarrow{OB} = \begin{pmatrix} \\ \end{pmatrix}$ [1]

(ii) $\overrightarrow{AB}$

$\overrightarrow{AB} = \begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) Find the equation of the line AB.
Give your answer in the form $y = mx + c$.

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

(c) Find the equation of the perpendicular bisector of AB.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

(d) The line AB meets the y-axis at P.
The perpendicular bisector of AB meets the y-axis at Q.

Find the length of PQ.

..... [2]

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