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AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2025

SECONDARY 4 EXPRESS /5 NORMAL ACADEMIC

Name:	Class:	Register No.:
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MATHEMATICS

Paper 1

4052/01

05 Aug 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

If working is needed for any questions it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 90.

For Examiner's Use

/90

Mathematical Formulae*Compound Interest*

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

Answer **all** the questions.

- 1 Expand $(2p + 5q)(3p^2 - q + 5r)$.

Answer [2]

- 2 Lee has two pieces of string.
 Their lengths are in the ratio 5 : 3 and the total length of the two pieces of string is 8x cm.
 Lee cuts 6 cm from each piece of string.
 The ratio of their lengths is now 9 : 5.
 Find the value of x.

Answer $x =$ [3]

- 3 A salesperson earns a fixed weekly salary of \$1000 plus 8% commission on the total value of items he sells.

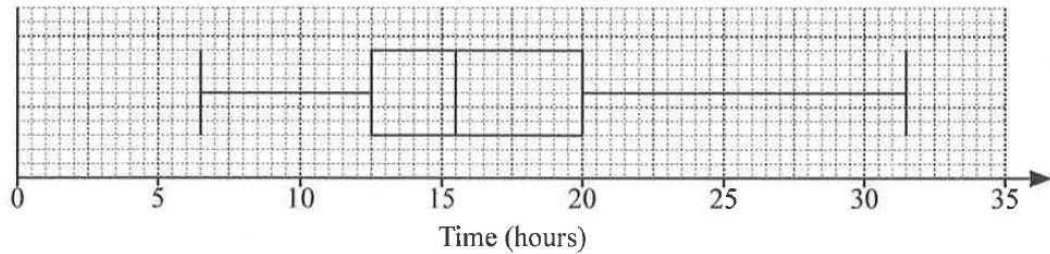
- (a) In one week, he sold items worth \$1750.
 Calculate the total amount the salesperson earned that week.

Answer \$..... [1]

- (b) The following week, the salesperson earned a total of \$1450.
 Calculate the total value of items he sold that week.

Answer \$..... [2]

- 4 The box-and-whisker-plot gives information about the time, in hours, that 120 adults spent on social media in one week.



- (a) State the median time.

Answerhours [1]

- (b) State the range.

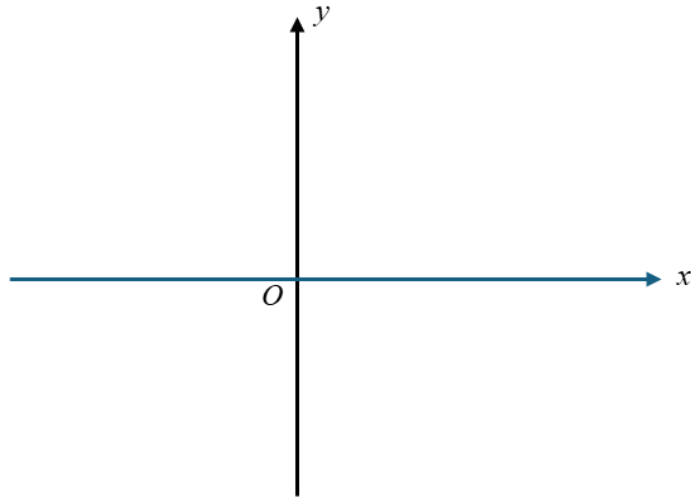
Answerhours [1]

- (c) There was an error in the collection of data.
Every adult spent 2 hours less on social media in one week.
Describe the effect this change would have on the box-and-whisker plot.

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

- 5 Sketch the graph of $y = -(x-8)(x+3)$ on the axes below.

Indicate clearly the values where the graph crosses the x - and y - axes and its turning point.



[3]

- 6 Express as a single fraction in its simplest form $\frac{4}{3-2y} - \frac{5}{y+3}$.

Answer [2]

- 7 (a) A map has a scale of 1 : 2 500 000.
The distance between Singapore and Phuket is 1314 km.
Calculate the distance, in centimetres, between Singapore and Phuket on the map.

Answercm [2]

- (b) When a ball is dropped, the distance, d metres, it falls is directly proportional to the square of the time, t seconds, from when the ball is released.
The distance from which the ball is dropped is increased by 44%.
Calculate the percentage change in the time taken for the ball to reach the ground.

Answer % [2]

8 Simplify $\frac{x^2 - 9}{3x^2 - 9x}$.

Answer [3]

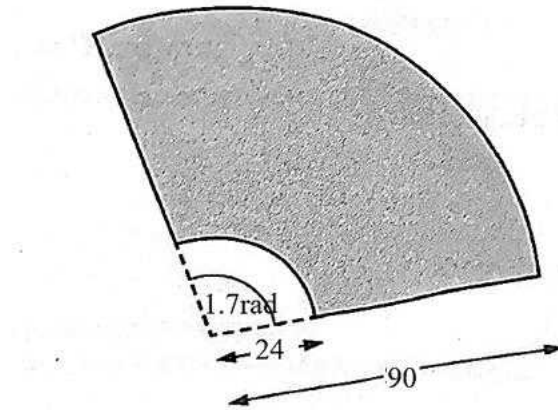
- 9 Factorise $6x^2y^2 + xy - 3x^2y - 2xy^2$.

Answer [3]

- 10 Five positive integers have a mean of 6, a median of 7 and a mode of 10.
Find the five numbers.

Answer,,,, [2]

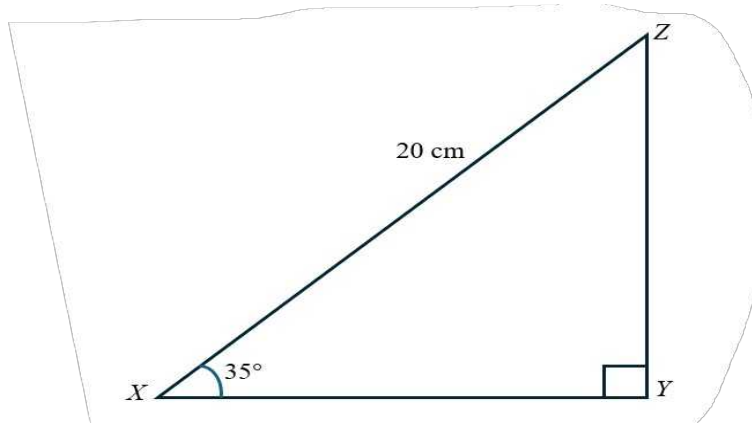
11



Calculate the perimeter of the shaded area.
All lengths are in centimetres.

Answer cm [2]

12



X , Y and Z are three points on horizontal ground.
 Angle $ZXY = 35^\circ$, angle $XYZ = 90^\circ$ and $XZ = 20$ cm.

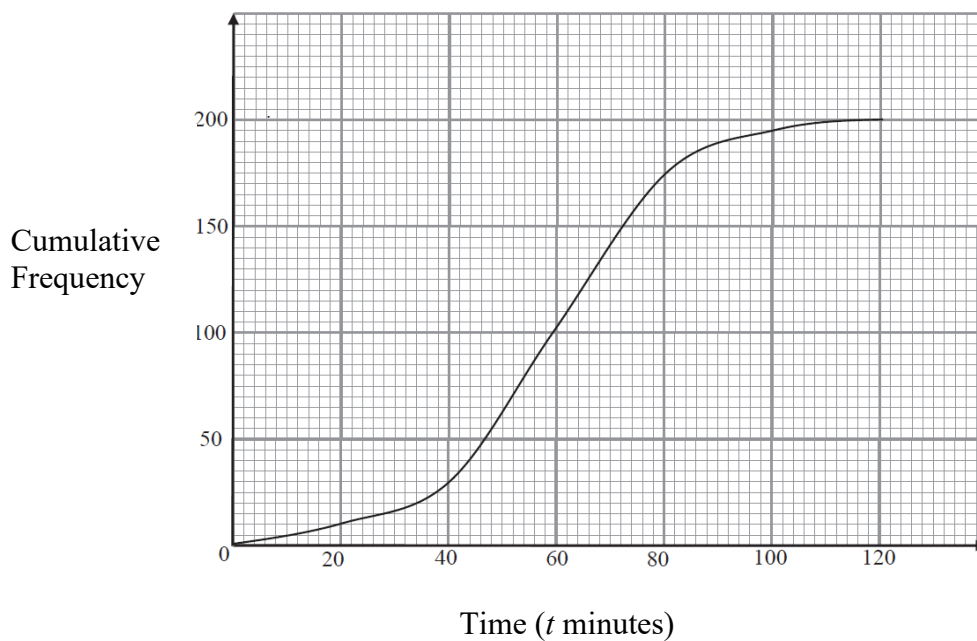
(a) Calculate the distance YZ .

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

(b) Calculate the area of triangle XYZ .

Answer $\dots\dots\dots$ cm² [2]

- 13 A group of 200 people estimated the time, t minutes, they spent at an exhibition. The cumulative frequency diagram represents their estimates.



- (a) Use the diagram to find the estimated interquartile range of the estimated times.

Answerminutes [2]

- (b) One of these people is chosen at random.

The probability that the person's estimate is greater than t minutes is $\frac{4}{5}$.

Find the value of t .

Answer $t =$ [2]

14

$$n = \frac{m(x - y^2)}{p}, \text{ where } p \neq 0.$$

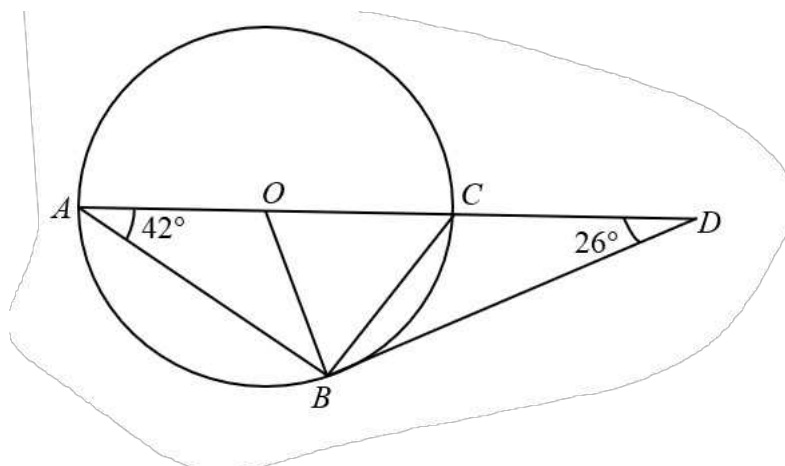
- (a) Find n when $m = 14$, $p = 9$, $x = 2$ and $y = -3$.

Answer $n = \dots\dots\dots$ [1]

- (b) Rearrange the formula to make y the subject.

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

15



A , B and C are points on a circle, centre O .

ACD is a straight line, angle $BDC = 26^\circ$ and angle $BAO = 42^\circ$.

(a) Find angle OBC .

Give a reason for each step of your working.

.....

.....

..... [2]

(b) Explain why BD is **not** a tangent to the circle.

.....

.....

..... [2]

16 Solve these simultaneous equations.

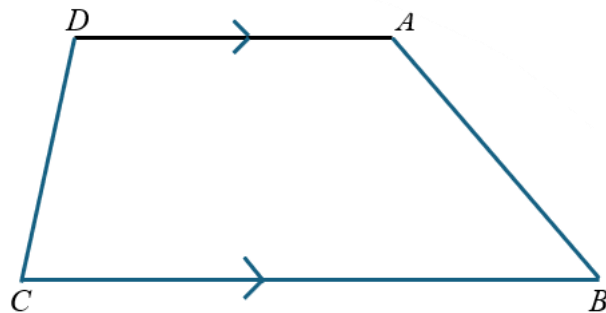
$$3x + 5y + 8 = 0$$

$$4x + 13y - 2 = 0$$

You must show your working.

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

17



$ABCD$ is a trapezium.

The ratio angle CDA : angle DCB : angle $CBA = 18 : 6 : 2$.

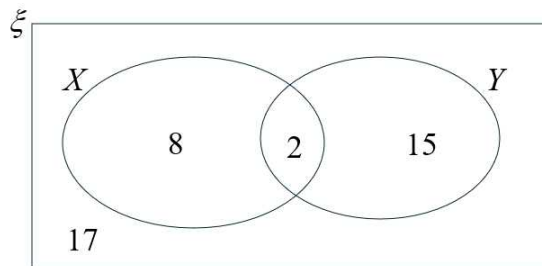
Find angle DAB .

Answer Angle $DAB = \dots\dots\dots$ [3]

- 18** Alice borrowed a sum of money from the bank which charges a compound interest of 3.5% per annum, compounded quarterly. Given that Alice had to pay \$67.30 in interest at the end of the first year, find the original sum of money borrowed, giving your answer correct to the nearest dollar.

Answer \$ [3]

- 19** The Venn diagram shows the universal set and the number of elements in each of its subsets.



Find the value of

(a) $n((X' \cap Y)')$,

Answer [1]

(b) $n((X \cup Y) \cap (X \cup Y)')$.

Answer [1]

- 20 (a) Write 0.0000000357 in standard form.

Answer [1]

- (b) Write 5.7×10^{97} in the form $A \times 10^{98}$.

Answer [1]

- (c) Hence work out $(100.2 \times 10^{98}) - (5.7 \times 10^{97})$.

Give your answer in standard form.

Answer [1]

- 21 x is a number between 200 and 300.
The highest common factor of x and 126 is 21.
Find the smallest possible value of x .

Answer $x =$ [2]

22

$$\sin\left(\frac{1}{2}x^\circ\right) = 0.961$$

Find two possible values of x in the range $0 \leq x \leq 360$.

Answer $x =$ or $x =$ [2]

23

12 24 8 21 28 17 $2p$ $4p^2$

The list shows information about the number of text messages Mei received each day for 8 days.

The total number of text messages is 140.

- (a) Show that $p = 2.5$.

Answer

[3]

- (b) The standard deviation for Mei's data is 7.89.

For the same 8 days, Mei's brother also received some text messages.
For his data, the mean is 19 and the standard deviation 8.51.

Make two comparisons between the distributions for the number of text messages received by Mei and her brother.

1.

.....

.....

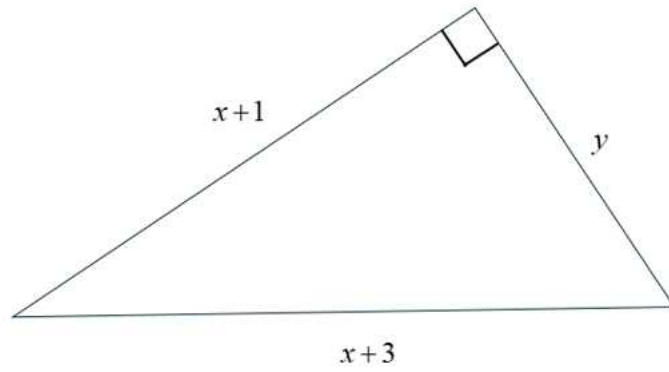
2.

.....

.....

[2]

24



The right-angled triangle has sides $(x+1)$, $(x+3)$ and y where x and y are integers.

- (a) Show that y is an even number.

Answer

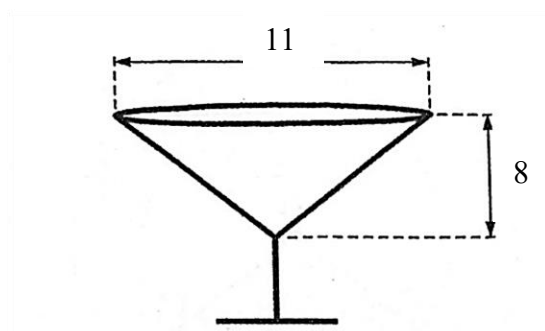
- (b) Find a possible value of y and the corresponding value of x . [4]

Answer $x = \dots\dots\dots y = \dots\dots\dots$ [2]

- 25 Solve the equation $a^2 + 17a - 30 = 0$ by completing the square.
Give your solutions correct to 2 decimal places.

Answer $a = \dots\dots\dots$ or $a = \dots\dots\dots$ [3]

26



A glass in the shape of a cone on a stem is filled to the brim with water.
 The diameter of the top of the glass is 11 cm.
 The height of the cone is 8 cm.
 The thickness of the glass is negligible.

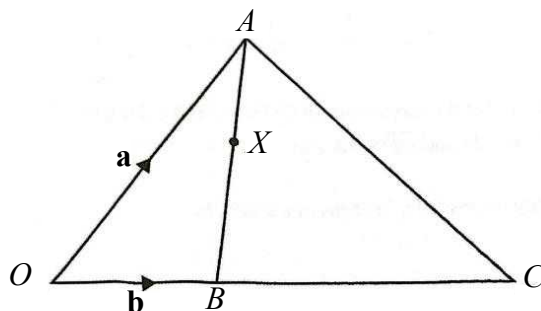
- (a) Calculate the curved surface area of the inside of the glass.

Answer cm^2 [2]

- (b) Ethan pours 40% of the water in this glass into a second glass.
 The second glass is in the shape of a cylinder.
 The depth of water in the cylindrical glass is 2.5 cm.
 Calculate the diameter of the cylindrical glass.

Answer cm [4]

27



OAC is a triangle and B is a point on OC .

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $OB:BC = 2:3$.

X is the point on AB such that $AX:XB = 1:2$.

- (a) Express $\overrightarrow{AC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

Answer $\overrightarrow{AC} = \dots\dots\dots$ [2]

- (b) Express $\overrightarrow{XB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

Answer $\overrightarrow{XB} = \dots\dots\dots$ [2]

- (c) Y is the point on OC such that $AXYC$ is a trapezium.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, $\overrightarrow{XY}$.

Answer $\overrightarrow{XY} = \dots\dots\dots$ [2]

END OF PAPER
Setter: Low SG

Answer **all** the questions.

- 1 Expand and simplify $(2p + 5q)(3p^2 - q + 5r)$.

$$6p^3 - 2pq + 10pr + 15p^2q - 5q^2 + 25qr$$

B2 if all terms are correct
B1 if at least 3 terms are right

Answer [2]

- 2 Lee has two pieces of string.
Their lengths are in the ratio 5 : 3 and the total length of the two pieces of string is 8x cm.
Lee cuts 6 cm from each piece of string.
The ratio of their lengths is now 9 : 5.
Find the value of x. the first piece of string be 5x cm.

The first piece of string is 5x cm.

The second piece of string is 3x cm.

$$\frac{5x - 6}{3x - 6} = \frac{9}{5}$$

$$25x - 30 = 27x - 54$$

$$24 = 2x$$

$$x = 12$$

M1 for setting up the right equation

M1 for manipulation of algebraic terms

A1

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

- 3 A salesperson earns a fixed weekly salary of \$1000 plus 8% commission on the total value of items he sells.

- (a) In one week, he sold items worth \$1750.
Calculate the total amount the salesperson earned that week.

$$\begin{aligned} \text{Total amount} &= \$1000 + \frac{8}{100} \times 1750 \\ &= \$1140 \end{aligned}$$

B1

Answer \$..... [1]

- (b) The following week, the salesperson earned a total of \$1450.
Calculate the total value of items he sold that week.

$$\begin{aligned}\text{Commission} &= \$1450 - \$1000 \\ &= \$450\end{aligned}$$

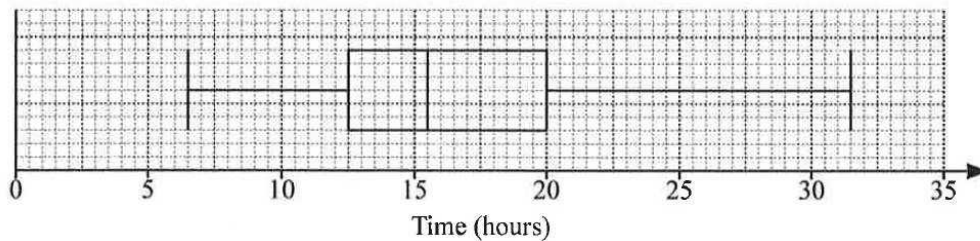
8% represents \$450

M1 for recognising that 8% rep \$450

$$\begin{aligned}100\% \text{ represents } & \$ \frac{450}{8} \times 100 \\ & = \$5625\end{aligned}$$

A1

- 4 The box-and-whisker-plot gives information about the time, in hours, that 120 adults spent on social media in one week.



- (a) State the median time.

15.5 hours

B1

Answerhours [1]

- (b) State the range.

$$\begin{aligned}\text{Range} &= 31.5 - 6.5 \\ &= 25\end{aligned}$$

B1

Answer hours [1]

- (c) There was an error in the collection of data.

Every adult spent 2 hours less on social media in one week.

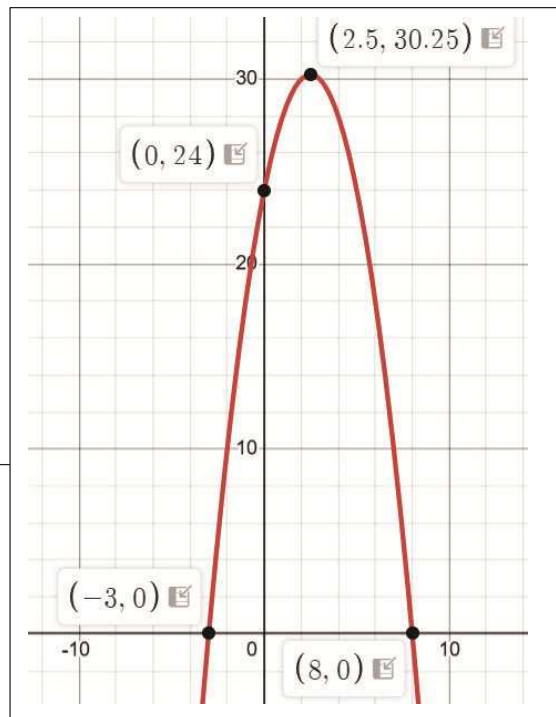
Describe the effect this change would have on the box-and-whisker plot.

The whole box-and-whisker plot will move to the **left by 4 square units**.

B1 all key words must be present

- 5 Sketch the graph of $y = -(x+8)(x-3)$ on the axes below.

Indicate clearly the values where the graph crosses the x - and y - axes.



[3]

Coor of turning point (2.5, 30.25)

B1 correct shape and y -intercept
B1 correct turning point
B1 correct x -intercepts

- 6 Express as a single fraction in its simplest form $\frac{4}{3-2y} - \frac{5}{y+3}$.

$$\begin{aligned} & \frac{4}{3-2y} - \frac{5}{y+3} \\ &= \frac{4y+12-15+10y}{(3-2y)(y+3)} \\ &= \frac{14y-3}{(3-2y)(y+3)} \end{aligned}$$

M1 for combining to a single fraction

A1

Answer [2]

- 7 (a) A map has a scale of 1 : 2 500 000.

The distance between Singapore and Phuket is 1314 km.

Calculate the distance, in centimetres, between Singapore and Phuket on the map.

25 km represents 1 cm
1314 km represents **52.56 cm**

M1 for correctly converting from cm to km

A1, exact answer only

Answercm [2]

- (b) When a ball is dropped, the distance, d metres, it falls is directly proportional to the square of the time, t seconds, from when the ball is released.

The distance from which the ball is dropped is increased by 44%.

Calculate the percentage change in the time taken for the ball to reach the ground.

d	t^2
$1.44 d$	$(1.2t)^2 = 1.44 t^2$

M1 for getting $1.2^2 t^2$ or $1.2t$ as t

$$\begin{aligned}\text{Percentage change} &= \frac{1.2t - t}{t} \times 100\% \\ &= 20\%\end{aligned}$$

A1

Answer% [2]

- 8 Simplify $\frac{x^2 - 9}{3x^2 - 9x}$

$$\begin{aligned}\frac{x^2 - 9}{3x^2 - 9x} \\ &= \frac{(x-3)(x+3)}{3x(x-3)} \\ &= \frac{x+3}{3x}\end{aligned}$$

B2, factorising numerator and denominator correctly

A1

Answer [3]

- 9 Factorise $6x^2y^2 + xy - 3x^2y - 2xy^2$.

$$\begin{aligned}
 &6x^2y^2 + xy - 3x^2y - 2xy^2 \\
 &= xy(6xy + 1 - 3x - 2y) \\
 &= xy(6xy - 3x + 1 - 2y) \\
 &= xy[3x(2y - 1) - (2y - 1)] \\
 &= xy(3x - 1)(2y - 1)
 \end{aligned}$$

M1 for extracting common term

M1 for factorising by grouping

A1

Answer [3]

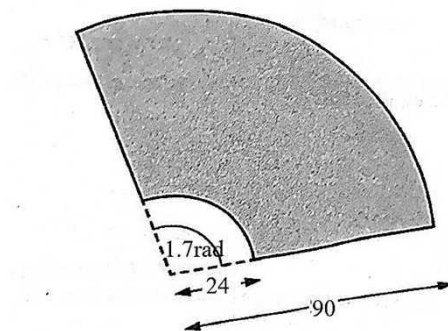
- 10 Five positive integers have a mean of 6, a median of 7 and a mode of 10. Find the five numbers.

1, 2, 7, 10, 10

B2 for getting all the numbers correct
right
B1 if for getting 7, 10, 10

Answer,,,, [2]

11



Calculate the perimeter of the shaded area.
All lengths are in centimetres.

$$\text{Perimeter of shaded area} = 1.7 \times 24 + 1.7 \times 90 + 2(66)$$

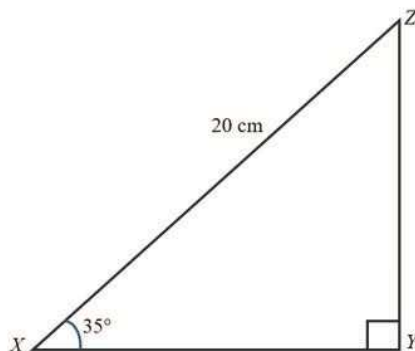
M1 for setting up the equation correctly

$$= 325.8 \text{ cm}$$

A1, exact so do not accept 3 s.f ans

..... cm [2]

12



- (a) Calculate the distance YZ .

$$\sin 35^\circ = \frac{YZ}{20}$$

M1 for setting up the correct equation

$$YZ = 20 \sin 35^\circ$$

$$= 11.472 \text{ cm}$$

$$= 11.5 \text{ cm (3 s.f.)}$$

A1

Answer $YZ = \dots\dots\dots \text{cm}$ [2]

- (b) Calculate the area of triangle XYZ .

$$\cos 35^\circ = \frac{XY}{20}$$

$$XY = 20 \cos 35^\circ$$

$$= 16.383 \text{ cm}$$

$$= 16.4 \text{ cm (3 s.f.)}$$

M1 for finding XY

$$\begin{aligned} \text{Area of triangle } XYZ &= \\ &= 94.0 \text{ cm}^2 \end{aligned}$$

A1

Alternative solution

$$\angle XZY = 55^\circ$$

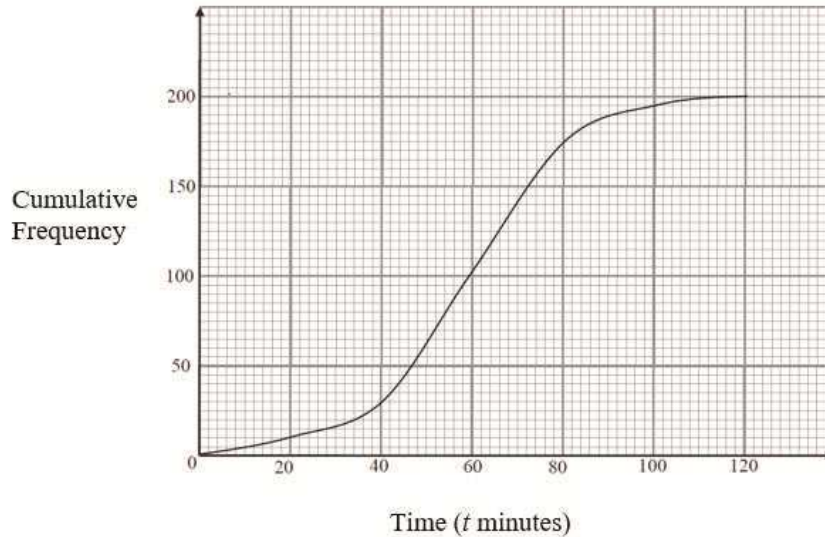
M1 for finding
angle XZY

$$\begin{aligned} \text{Area of triangle} &= \frac{1}{2} \times (20)(11.472) \sin 55^\circ \\ &= 94.0 \text{ cm}^2 \end{aligned}$$

A1

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

- 13 A group of 200 people estimated the time, t minutes, they spent at an exhibition. The cumulative frequency diagram represents their estimates.



- (a) Use the diagram to find the estimated interquartile range of the estimated times.

$$\text{Interquartile range} = 72 - 47$$

$$= 25 \text{ minutes}$$

M1 for finding the UQ and LQ

A1

Answerminutes [2]

- (b) One of these people is chosen at random.

The probability that the person's estimate is greater than t minutes is $\frac{4}{5}$.

Find the value of t .

Probability of a person's estimate less than or equal to t minutes is $\frac{1}{5}$.

Number of people = 40

From graph, $t = 44$

M1 for 40

A1

Answer $t =$ [2]

14

$$n = \frac{m(x - y^2)}{p}, \text{ where } p \neq 0.$$

(a) Find n when $m = 14$, $p = 9$, $x = 2$ and $y = -3$.

$$\begin{aligned} n &= \frac{14(2 - 9)}{9} \\ n &= \frac{14(2 - 9)}{9} \\ &= -10\frac{8}{9} \text{ or } -\frac{98}{9} \end{aligned}$$

A1, exact value, hence do not accept answers corrected to 3 s.f

Answer $n = \dots\dots\dots$ [1]

(b) Rearrange the formula to make y the subject.

$$n = \frac{m(x - y^2)}{p}$$

$$np = mx - my^2$$

$$my^2 = mx - np$$

$$y^2 = \frac{mx - np}{m}$$

$$y = \pm \sqrt{\frac{mx - np}{m}} \text{ or } \pm \sqrt{x - \frac{pn}{m}}$$

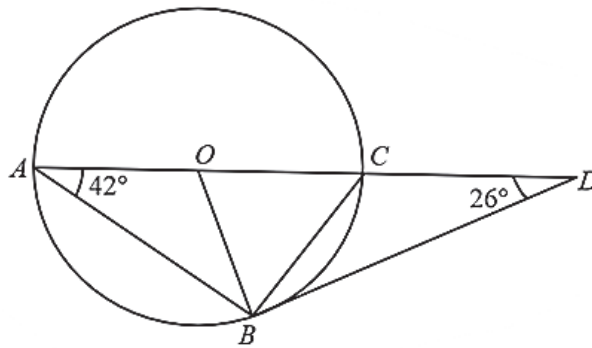
M1 for multiplying n by p

M1 for finding y^2

A1, no marks if $\pm$ is not seen

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

15



A, B and C are points on a circle, centre O .
 ACD is a straight line, angle $BDC = 26^\circ$ and angle $BAO = 42^\circ$.

- (a) Find angle OBC .
 Give a reason for each step of your working.

Minus 1 mark if no
 mention of radii or
 radius of circle

$$\begin{aligned}
 OA &= OB \text{ (radii of a circle)} \\
 \angle OBA &= 42^\circ \text{ (base angle of isosceles triangle } OAB) \\
 \angle ABC &= 90^\circ \text{ (angle in a semicircle)} \\
 \angle OBC &= 90^\circ - 42^\circ \\
 &= 48^\circ
 \end{aligned}$$

A1

M1 for finding
 either finding
 angle OBA or
 angle ABC

- (b) Explain why BD is **not** a tangent to the circle.

$$\begin{aligned}
 \angle BOC &= 84^\circ \text{ (ext angle of isosceles triangle } OBC) \\
 \angle OBD &= 180^\circ - 84^\circ - 26^\circ \text{ (sum of angles in a triangle)} \\
 &= 70^\circ
 \end{aligned}$$

M1 for finding
 angle OBD

Since $\angle OBD \neq 90^\circ$, therefore by the converse of the
 radius perpendicular to tangent, BD is not a tangent to the circle.

A1 stating it's not 90° with (by converse) tangent
 $\perp$ radius

Alternative solution

$$\begin{aligned}
 \angle BOC &= 84^\circ \text{ (angle at centre = 2 angle at circumference)} \\
 \angle OBD &= 180^\circ - 84^\circ - 26^\circ \text{ (sum of angles in a triangle)} \\
 &= 70^\circ
 \end{aligned}$$

M1 for finding
 angle OBD

Since $\angle OBD \neq 90^\circ$, therefore by the converse of the radius perpendicular to
 tangent, BD is not a tangent to the circle.

A1 stating it's not 90° with (by converse) tangent $\perp$ radius

16 Solve these simultaneous equations.

$$3x + 5y + 8 = 0$$

$$4x + 13y - 2 = 0$$

You must show your working.

$$3x + 5y + 8 = 0 \quad -(1)$$

$$4x + 13y - 2 = 0 \quad -(2)$$

$$(1) \times 4 \quad 12x + 20y + 32 = 0 \quad -(3)$$

$$(2) \times 3 \quad 12x + 39y - 6 = 0 \quad -(4)$$

$$(4) - (3) \quad 19y - 38 = 0$$

$$y = 2$$

Sub $y = 2$ into (1)

$$3x + 10 + 8 = 0$$

$$3x = -18$$

$$x = -6$$

$$\text{Ans : } x = -6 \text{ or } y = 2$$

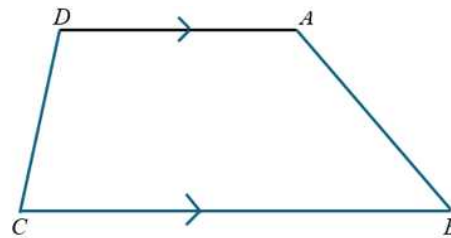
M1 for making coeff of x or y the same/ M1 for making x or y the subject of the equation

M1 for eliminating x or y / M1 for correct substitution

A1 for getting both x and y correct

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

17



$ABCD$ is a trapezium.

The ratio angle CDA : angle DCB : angle $CBA = 18 : 6 : 2$.

Find angle DAB .

24 units represent 180°

1 unit represents 7.5°

2 units represent 15°

$$\begin{aligned} \angle DAB &= 180^\circ - 15^\circ \text{ (int angles, } AB \parallel BC) \\ &= 165^\circ \end{aligned}$$

M1 for recognising that angle CDA and DCB are int angles.
 It is good practice to write the angle reasoning so that markers understand your work.

M1 for either applying int angles or sum of angles in quad correctly

A1

Note: Answer mark is deducted if there is no clear indication of the unit of measure used throughout the entire working.

Answer Angle $DAB = \dots\dots\dots$ [3]

- 18** Alice borrowed a sum of money from the bank which charges a compound interest of 3.5% per annum, compounded quarterly.
Given that Alice had to pay \$67.30 in interest at the end of the first year, find the original sum of money borrowed, giving your answer correct to the nearest dollar.

Let the original sum of money Alice borrowed be \$ P .

$$P + 67.30 = P \left(1 + \frac{0.875}{100} \right)^4$$

M1 for setting up the correct equation

$$67.30 = P \left(1 + \frac{0.875}{100} \right)^4 - P$$

$$67.30 = P \left[\left(1 + \frac{0.875}{100} \right)^4 - 1 \right]$$

M1 for factorising, only awarded if original set up has total = principal + interest.

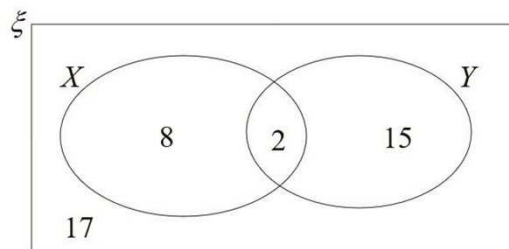
$$P = \frac{67.30}{\left[\left(1 + \frac{0.875}{100} \right)^4 - 1 \right]}$$

$$P = \$1898 \text{ (nearest dollar)}$$

A1

Answer \$ [3]

- 19** The Venn diagram shows the universal set and the number of elements in each of its subsets.



Find the value of

(a) $n(X' \cap Y)'$,

$$= 17 + 8 + 2 = 27$$

B1

Answer [1]

(b) $n((X' \cup Y) \cap (X \cup Y)')$.

$$= 17$$

B1

Answer [1]

- 20 (a) Write 0.0000000357 in standard form.

$$3.57 \times 10^{-8}$$

B1

Answer [1]

- (b) (i) Write 5.7×10^{97} in the form $A \times 10^{98}$.

$$= 0.57 \times 10^{98}$$

B1

Answer [1]

- (ii) Hence work out $((100.2 \times 10^{98}) - (5.7 \times 10^{97}))$.

Give your answer in standard form.

$$(100.2 \times 10^{98}) - (0.57 \times 10^{98})$$

$$= 99.63 \times 10^{98}$$

$$= 9.963 \times 10^{99}$$

B1

Answer [1]

- 21 x is a number between 200 and 300.

The highest common factor of x and 126 is 21.

Find the smallest possible value of x .

$$126 = 2 \times 3^2 \times 7$$

$$\text{HCF} = 3 \times 7$$

$$x = 3 \times 7 \times 11$$

$$= 231$$

M1 for writing 126 in terms of its prime factors

A1

Answer $x =$ [2]

22

$$\sin\left(\frac{1}{2}x^\circ\right) = 0.961$$

Find two possible values of x in the range $0 \leq x \leq 360$.

$$\sin\left(\frac{1}{2}x^\circ\right) = 0.961$$

$$\frac{1}{2}x^\circ = 73.946^\circ, 180^\circ - 73.946^\circ$$

$$x^\circ = 147.9^\circ \text{ or } 212.1^\circ$$

B1, B1

Note: 1 mark is deducted if both answers are left to 3 significant figures. Students are to follow instructions on cover page.

23

12 24 8 21 28 17 $2p$ $4p^2$

The list shows information about the number of text messages Mei received each day for 8 days.

The total number of text messages is 140.

(a) Show that $p = 2.5$.

Answer

$$12 + 24 + 8 + 21 + 28 + 17 + 2p + 4p^2 = 0$$

$$4p^2 + 2p + 110 = 140$$

$$2p^2 + p - 15 = 0$$

$$(p+3)(2p-5) = 0$$

$$p+3 = 0 \text{ or } 2p-5 = 0$$

$$p = -3 \text{ (rej bec } p > 0) \text{ or } p = 2.5 \text{ (shown)}$$

M1 for showing the correct set up of equation

M1 for correct factorisation or correct application of quadratic formula

M1 for applying zero product rule and sound rejection reason.

[3]

(b) The standard deviation for Mei's data is 7.89.

For the same 8 days, Mei's brother also received some text messages.

For his data, the mean is 19 and the standard deviation 8.51.

Make two comparisons between the distributions for the number of text messages received by Mei and her brother.

1. Mei's brother received **more text messages** on average because the **mean is higher** at 19 compared to Mei's mean which is 17.5.

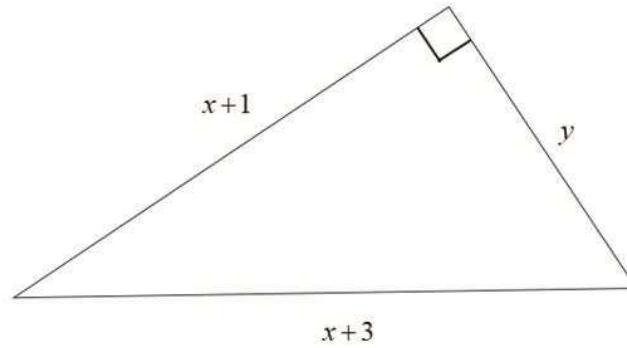
B1

2. The **number of text messages** Mei's brother received **is less consistent** since the **standard deviation is higher** at 8.51 compared to Mei's which is 7.89.

B1

[2]

24



The right-angled triangle has sides $(x+1)$, $(x+3)$ and y where x and y are integers.

- (a) Show that y is an even number.

Answer

$$\begin{aligned} y^2 &= (x+3)^2 - (x+1)^2 \\ &= x^2 + 6x + 9 - (x^2 + 2x + 1) \\ &= 4x + 8 \\ &= 4(x+2) \end{aligned}$$

M1 for setting up the correct equation

M1 for correct expansion/applying difference of squares to reach $4x+8$

Since 4 is even, multiplying it by $(x+2)$, an integer, will make y^2 even.

Taking square root of an even number gives an even number.

Therefore y even. (shown)

M1 for convincingly establishing y^2 is even.

A1 for stating that the square root of an even number must be even and concluding for y .

OR

$$\begin{aligned} y^2 &= 4(x+2) \\ y &= 2\sqrt{x+2} \end{aligned}$$

Since y is an integer, $\sqrt{x+2}$ must be an integer.
As such, 2 is a factor of y , therefore y is even.

M1 correct y .

A1 for stating that $\sqrt{x+2}$ is an integer and therefore 2 is a factor. Proper conclusion for y .

[4]

- (b) Find a possible value of y and the corresponding value of x .

$$\begin{aligned} \text{Let } y^2 &= 16^2 \\ \therefore y &= 4 \\ \text{Hence } 4x + 8 &= 16 \\ x &= 2 \end{aligned}$$

B1: accept any logical y , where y^2 is a multiple of 4

B1

Answer $x = \dots\dots\dots y = \dots\dots\dots$ [2]

-
- 25** Solve the equation $a^2 + 17a - 30 = 0$ by completing the square.
Give your solutions correct to 2 decimal places.

$$a^2 + 17a - 30 = 0$$

$$\left(a + \frac{17}{2}\right)^2 - \left(\frac{17}{2}\right)^2 - 30 = 0$$

M1 for completing the square correctly

$$\left(a + \frac{17}{2}\right)^2 = \left(\frac{17}{2}\right)^2 + 30$$

$$\left(a + \frac{17}{2}\right)^2 = 102.25$$

$$a + \frac{17}{2} = \pm\sqrt{102.25}$$

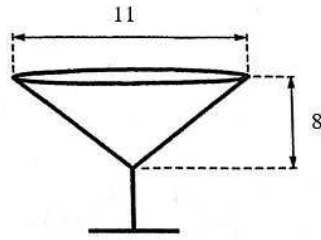
M1 for taking square root

$$a = 1.61 \text{ or } -18.61 \text{ (2 d.p.)}$$

A1 for both correct answers

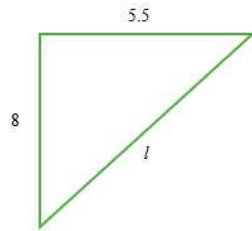
Answer $a = \dots\dots\dots$ or $a = \dots\dots\dots$ [3]

26



A glass is in the shape of a cone on a stem is filled to the brim with water.
 The diameter of the top of the glass is 11 cm.
 The height of the cone is 8 cm.
 The thickness of the glass is negligible.

(a) Calculate the curved surface area of the inside of the glass.



$$\begin{aligned} l^2 &= 5.5^2 + 8^2 \\ &= 94.25 \\ l &= \sqrt{94.25} \end{aligned}$$

M1 for finding the slant height of the cone

$$\begin{aligned} \text{Curved surface area of the inside of the glass} &= \pi(5.5)(\sqrt{94.25}) \\ &= 168 \text{ cm}^2 \text{ (3s.f.)} \end{aligned}$$

A1

Answer cm² [2]

- (b) Ethan pours 40% of the water in this glass into a second glass.
 The second glass is in the shape of a cylinder.
 The depth of water in the cylindrical glass is 2.5 cm.
 Calculate the diameter of the cylindrical glass.

$$\begin{aligned}\text{Volume of water in the glass} &= \frac{1}{3} \times \pi \times 5.5^2 \times 8 \\ &= 80\frac{2}{3}\pi\text{cm}^3\end{aligned}$$

M1 for finding the vol of water in the glass

$$\pi r^2 (2.5) = 80\frac{2}{3}\pi \times 0.4$$

M1 for correct formula of volume of cylinder and taking 40% of their volume of cone.

$$r^2 = \frac{80\frac{2}{3} \times 0.4}{2.5}$$

$$r = \sqrt{\frac{80\frac{2}{3} \times 0.4}{2.5}}$$

M1 for correct r

$$\text{diameter} = 2r$$

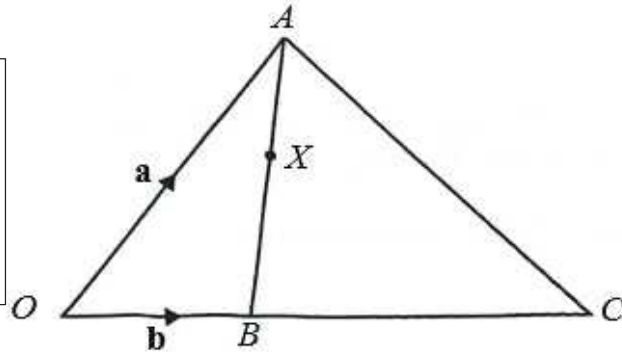
$$\begin{aligned}&= 2 \times \sqrt{\frac{80\frac{2}{3} \times 0.4}{2.5}} \\ &= 7.19 \text{ cm (3 s.f.)}\end{aligned}$$

A1

Answer cm [4]

27

Note: 1 mark is deducted from overall of this question if students did not use proper vector notations.



OAC is a triangle and B is a point on OC .

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $OB:BC = 2:3$.

X is the point on AB such that $AX:XB = 1:2$.

- (a) Express $\overrightarrow{AC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

$$\overrightarrow{OC} = 2.5\mathbf{b}$$

$$\overrightarrow{AC} = 2.5\mathbf{b} - \mathbf{a}$$

M1 for correct $\overrightarrow{OC}$ in terms of $\mathbf{b}$

A1

Answer $\overrightarrow{AC} = \dots\dots\dots$ [2]

- (b) Express $\overrightarrow{XB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

$$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$$

$$\overrightarrow{XB} = \frac{2}{3}(\mathbf{b} - \mathbf{a})$$

M1 for correct $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$

A1

Answer $\overrightarrow{XB} = \dots\dots\dots$ [2]

- (c) Y is the point on OC such that $AXYC$ is a trapezium.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, $\overrightarrow{XY}$.

For $AXYC$ to be a trapezium, triangle BXY is similar to triangle BAC .

$$\frac{XY}{AC} = \frac{BX}{BA} = \frac{2}{3}$$

$$\overrightarrow{XY} = \frac{2}{3}\overrightarrow{AC}$$

$$= \frac{2}{3}\left(\frac{5}{2}\mathbf{b} - \mathbf{a}\right)$$

$$= \frac{5}{3}\mathbf{b} - \frac{2}{3}\mathbf{a}$$

M1 for identifying triangle BXY to be similar to triangle BAC

A1

$\overrightarrow{XY} = \dots\dots\dots$ [2]

END OF PAPER

Setter: Low SG

AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2025

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

Name

Class:

Register No.

MATHEMATICS

Paper 2

4052/02

7 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

If working is needed for any questions it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question

The total number of marks for this paper is 90.

For Examiner's Use

/

This document consists of **21** printed pages.

[Turn over

Mathematical Formulae**Compound Interest**

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\frac{4}{3}\pi r^3$$

C

ans

dians

$$\sin A \sin B \sin C$$

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

Statistics

$$\text{Mean} =$$

$$\Sigma f$$

[Turn Over

Answer **all** the questions.

- 1 (a) Find all the prime numbers that will satisfy the inequality $-5 \leq 2x - 1 < x + 3$

Answer

.. [3]

- (b) Simplify $\div \frac{25xz^3}{22y}$.

Answer

[3]

- (c) Simplify $\left(\quad \right)^{\frac{3}{4}}$

Answer

[2]

(d) Solve $\frac{x}{x-1} + 2 = \frac{4}{2-x}$

Answer $x =$ [3]

[Turn Over]

- 2 (a) The position vector of A is $\begin{pmatrix} -1 \\ 4 \end{pmatrix}$

$\overrightarrow{AB}$

- (i) Find the coordinates of B .

Answer (,) [1]

- (ii) Find the equation of line AB

Answer [2]

- (b) C is the point $(-2, 5)$.
 D is a point that lies on the line $x = 3$.
 The length of CD is 13 units.
 Find the two possible pairs of coordinates of D

Answer (.) and () [3]

3

6

B

37

A

C

73

D

Points *A*, *B*, *C* and *D* are on horizontal ground.
 $AB = 37$ m, $BC = 50$ m, $AC = 62$ and $CD = 73$ m.
 Angle $ADC = 52^\circ$.

A is due west of *C*.

(a) Find angle ABC

Answer

$^\circ[3]$

(b) The bearing of *E* from *C* is 124°
 Find the bearing of *C* from *E*.

Answer

$^\circ[1]$

[Turn Over]

- (c) Find the bearing of D from A .

Answer

°[3]

- (d) Point C is the base of a vertical flagpole CF .
The angle of elevation of F from B is 8° .

Calculate the angle of elevation of F from D .

Answer

°[3]

- 4 Jennie travels from Town A to Town B at a speed of x km/h.
The journey takes 1 hour.
She then spends 30 minutes having her lunch in Town B , before setting off to Town C ,
which takes x minutes at $(x - 20)$ km/h.

The total distance of the journey is 120 km.

- (a) Show that $x^2 + 40x - 7200 = 0$.

Answer

[3]

- (b) Solve the equation $x^2 + 40x - 7200 = 0$.

Given your solutions correct to 2 decimal places.

Answer $x =$ or [3]

[Turn Over]

- (c) Explain why one of the solutions in **part (b)** must be rejected.

..... [1]

- (d) Calculate the difference between the times Jennie spent driving from Town *A* to Town *B* and from Town *B* to Town *C*.

Give your answer in minutes and seconds, correct to the nearest second.

Answer minutes seconds [1]

- (e) Calculate Jennie's average speed for the entire journey.

Answer km/h [3]

- 5 (a) There are 25 students in a class.
The table shows the distribution of the heights of these students.

Height (x cm)	Frequency
$140 < x \leq 150$	3
$150 < x \leq 160$	10
$160 < x \leq 170$	7
$170 < x \leq 180$	4
$180 < x \leq 190$	1

- (i) Find the interval that contains the median height.

Answer $< x \leq$.. [1]

- (ii) Calculate an estimate of the mean height.

Answer cm [1]

- (iii) State an estimate of the standard deviation of the heights.

Answer cm [1]

[Turn Over]

- (iv) Explain why the mean height and standard deviations in **part (ii)** and **part (iii)** are estimates.

[1]

- (v) Five students have transferred out of the class.
The estimated mean height of the students in the class is now 163 cm.

Explain what this tells you about the mean heights of the five students who transferred out.

[1]

(b) A bag contains 5 red, 7 blue and 3 yellow identical balls.

(i) One ball is selected at random.

Find the probability that it is a yellow ball.

Answer

[1]

(ii) Two balls are selected at random with replacement.

Find the probability that both balls are different colours

[2]

(iii) Three balls are selected at random, with replacement.

Find the probability that two red balls and one blue ball are chosen.

Answer

[3]

[Turn Over]

- 6 The diagram shows the speed-time graph of a train.

Speed (m/s)

30

0

10

30

Time (s)

- (a) Find the acceleration of the train in the first 10 seconds.

Answer

m/s² [1]

- (b) Given that the train decelerates at a rate of 2 m/s², find the total distance travelled by the train.

Answer

.. m [3]

7 (a)

15 cm 25 cm

The diagram shows two geometrically similar bottles, containing cooking oil.
 The height of the smaller bottle is 15 cm.
 The height of the larger bottle is 25 cm.

- (i) The diameter of the base of the larger bottle is 10 cm.
 Calculate the diameter of the base of the smaller bottle.

Answer ... cm [2]

- (ii) The smaller bottle has a capacity of 400 ml.
 The manufacturer makes another geometrically similar bottle that holds
 1.2 litres.
 Calculate the height of this bottle.

Answer . cm [2]

[Turn Over

- (b) Two congruent semicircles with radius 4 cm and centres P and Q overlap as shown below.



Calculate the area of the shaded region.

Answer

.. cm² [5]

- 8 A bakery makes cakes.
The bakery operates for 6 days each week.
The matrix, $\mathbf{M}$, shows the number of cakes of different types that are made each day

$$\mathbf{M} = \begin{pmatrix} & \text{Small} & \text{Medium} & \text{Large} \\ \text{Chocolate} & 8 & 5 & 2 \end{pmatrix}$$

- (a) Evaluate the matrix

[1]

- (b) Small cakes cost £1.20
Medium cakes cost £1.50
Large cakes cost £1.80
Represent these as a matrix

[1]

- (c) Evaluate the matrix

Answer $\mathbf{T} =$ [2]

[Turn Over]

- (d) State what each of the elements of **T** represents.

[1]

- (e) The bakery sells each cake for 70% more than it costs to make.
One week they sold $\frac{2}{3}$ of each size of the chocolate cakes and $\frac{5}{6}$ of each size of the blackforest cakes made that week.

The unsold cakes were given away.

Calculate the total amount of profit the bakery made that week.

Answer \$

[4]

- 9 (a) Complete the table of values for $y = 3x^2 - x^3 - 1$. [1]

x	1	0	1	1.5	2	2.5	3
y	3		1	2.4	3	2.1	

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

2.1
1.5
0.9

2.1
1.5
0.9

[Turn Over]

- (c) By drawing a tangent, find the gradient of the graph when $x = 1$

Answer

[2]

- (d) Using your graph, solve $3 - x = \frac{1}{x^2} - \frac{1}{x}$

Answer $x =$

or $x =$

[3]

- 10 A new 52-level private condominium, with units starting from the first level, has just been launched.

The sale price of a unit depends on the floor area and the level the unit is on.

The price of each similar unit increases by a specific amount per level.

Below is some information of the different types of units available.

Type of unit	2-room	3-room	4-room	5-room
Number of toilets	1	2	2	2
Floor area (m^2)	40	60	90	110
Price per square feet (\$/feet ²)	890	990	1100	1300
Increase in price per level (\$)	13 000	16 000	19 000	22 000

- (a) Given that $1 \text{ m} = 3.28 \text{ feet}$, show that the floor area of a 3-room unit is 646 square feet, correct to 3 significant figures.

Answer

[2]

- (b) Calculate the sale price of a 3-room unit on the first level.

Answer \$

..... [1]

[Turn Over

Lisa is planning to buy a 3-room unit.

To purchase the unit, she decides to pay 45% of the price of the unit and take a housing loan from the bank to pay the remaining amount by monthly instalments.

The bank charges a simple interest rate of 3% per year for 25 years.

Lisa has a gross monthly salary of \$7500, and she does not plan to spend more than 30% of her gross monthly salary to pay for the monthly instalment.

- (c) Suggest the maximum level that Lisa can afford to purchase.

Justify the decisions you make and show your calculations clearly

Answer

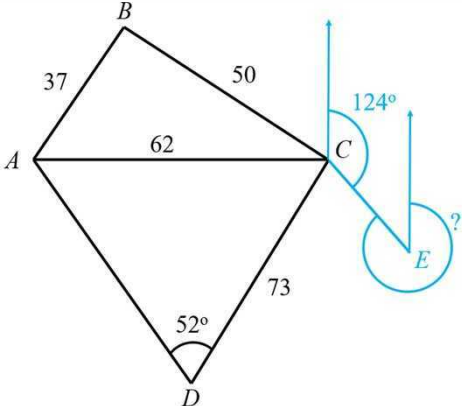
[7]

End of Paper

Setter: Miss Melody Ho

2025 Sec 4E Math Prelim Paper 2 Marking Scheme

Qn		Working	Mark Awarded	Sub-total	Remarks
1	(a)	$-5 \leq 2x - 1 < x + 3$ $-5 \leq 2x - 1$ and $2x - 1 < x + 3$ $-4 \leq 2x$ $x < 4$ $-2 \leq x$ $-2 \leq x < 4$ Primes that satisfy the inequality: 2, 3	M2 A1	3	M1 for $-2 \leq x$ M1 for $x < 4$
	(b)	$\frac{30x^2y^2}{11z} \div \frac{25xz^3}{22y}$ $= \frac{30x^2y^2}{11z} \times \frac{22y}{25xz^3}$ $= \frac{12xy^3}{5z^4}$	B3	2	4 terms to simplify: $\frac{12}{5}, x, y^3, z^4$. B1 for one correct term in the correct position (numerator or denominator). B2 for two or three correct terms. B3 for all four correct terms.
	(c)	$\left(\frac{p^{12}}{81q^{16}} \right)^{-\frac{3}{4}}$ $= \left(\frac{81q^{16}}{p^{12}} \right)^{\frac{3}{4}}$ $= \frac{27q^{12}}{p^9}$	B2	2	B1 for numerator, B1 for denominator.
	(d)	$\frac{x}{x-1} + 2 = \frac{4}{2-x}$ $\frac{x+2(x-1)}{x-1} = \frac{4}{2-x}$ $\frac{3x-2}{x-1} = \frac{4}{2-x}$ $(3x-2)(2-x) = 4(x-1)$ $6x - 3x^2 - 4 + 2x = 4x - 4$ $-3x^2 + 4x = 0$ $x(-3x + 4) = 0$ $x = 0 \quad \text{or} \quad -3x + 4 = 0$ $x = \frac{4}{3}$	M1 M1 A1	3	M1 for correct quadratic equation. M1 for correct factorisation or correct substitution into quadratic formula A1 for both correct answers.

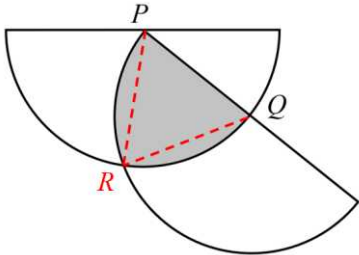
Qn	Working	Mark Awarded	Sub-total	Remarks
3	(a) <u>Cosine Rule</u> $62^2 = 37^2 + 50^2 - 2(37)(50)\cos \angle ABC$ $62^2 - 37^2 - 50^2 = -2(37)(50)\cos \angle ABC$ $\frac{62^2 - 37^2 - 50^2}{-2(37)(50)} = \cos \angle ABC$ $\angle ABC = \cos^{-1}\left(\frac{62^2 - 37^2 - 50^2}{-2(37)(50)}\right)$ $\angle ABC = 89.61286341^\circ$ $\angle ABC = 89.6^\circ \text{ (to 1 d.p.)}$	M1 M1 A1	3	M1 for correct substitution of values into Cosine Rule. M1 for rearranging and making $\angle ABC$ the subject of the equation.
	(b)  <u>Method 1: Interior angles</u> $180^\circ - 124^\circ = 56^\circ \text{ (interior angles, parallel lines)}$ $360^\circ - 56^\circ = 304^\circ \text{ (angles at a point)}$ <u>Method 2: Alternate angles</u> $180^\circ + 124^\circ = 304^\circ$	B1 [B1]	1	B1 for 304° Angle properties not required.
	(c) <u>Sine Rule</u> $\frac{\sin \angle CAD}{73} = \frac{\sin 52^\circ}{62}$ $\sin \angle CAD = \frac{73 \sin 52^\circ}{62}$ $\angle CAD = \sin^{-1}\left(\frac{73 \sin 52^\circ}{62}\right)$ Let the North of A be N. Since A is due west of C, $\angle NAC = 90^\circ$	M1 M1		M1 for substituting the values correctly into Sine Rule. M1 for rearranging the equation and finding the value of $\angle CAD$.

Qn		Working	Mark Awarded	Sub-total	Remarks									
		Bearing of D from A $= \angle NAC + \angle CAD$ $= 90^\circ + \sin^{-1}\left(\frac{73 \sin 52^\circ}{62}\right)$ $= 158.0973671^\circ$ $= 158.1^\circ$ (to 1 d.p.)	A1	3										
	(d)	Using TOA CAH SOH, $\tan 8^\circ = \frac{CF}{50}$ $CF = 50 \tan 8^\circ$ $\tan \angle FDC = \frac{CF}{73}$ $\tan \angle FDC = \frac{50 \tan 8^\circ}{73}$ $\angle FDC = \tan^{-1}\left(\frac{50 \tan 8^\circ}{73}\right)$ $\angle FDC = 5.498398955^\circ$ $\angle FDC = 5.5^\circ$ (to 1 d.p.)	M1 A1	 3	M1 to find correct height of flagpole. M1 for correct equation involving $\angle FDC$ and CF .									
4	(a)	<table><tr><td>Town A to Town B</td><td>Town B</td><td>Town B to Town C</td></tr><tr><td>Speed x km/h</td><td></td><td>Speed $(x - 20)$ km/h</td></tr><tr><td>Time 1 h</td><td>30 min</td><td>x min</td></tr></table> Total distance $= (x)(1) + (x - 20)\left(\frac{x}{60}\right)$ $= x + \frac{x(x - 20)}{60}$ $x + \frac{x(x - 20)}{60} = 120$ $60x + x(x - 20) = 7200$ $60x + x^2 - 20x = 7200$ $x^2 + 40x - 7200 = 0$ (shown)	Town A to Town B	Town B	Town B to Town C	Speed x km/h		Speed $(x - 20)$ km/h	Time 1 h	30 min	x min	M1 M1 A1	 3	M1 for correct distance from Town B to Town C $\frac{x(x - 20)}{60}$. M1 for equating total distance to 120. Correct expansion and simplification of equation
Town A to Town B	Town B	Town B to Town C												
Speed x km/h		Speed $(x - 20)$ km/h												
Time 1 h	30 min	x min												

Qn	Working	Mark Awarded	Sub-total	Remarks
	(b) $x^2 + 40x - 7200 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-40 \pm \sqrt{40^2 - 4(1)(-7200)}}{2(1)}$ $x = \frac{-40 \pm \sqrt{30400}}{2}$ $x = 67.17797887$ or $x = -107.1779789$ $x = 67.18$ (to 2 d.p.) or $x = -107.18$ (to 2 d.p.)	M1 A2	3	M1 for substitution of values into quadratic formula correctly. A1 for each correct x. Deduct one mark if not 2 d.p.
	(c) $x = -107.18$ is rejected as <u>time/speed cannot be negative.</u>	B1	1	
	(d) Difference in time $= 67.17797887 - 60$ minutes $= 7.17797887$ minutes $= 7$ minutes (0.17797887×60) seconds $= 7$ minutes 10.67873225 seconds $= 7$ minutes 11 seconds	B1	1	
	(e) Total distance = 120 km Total time $= 1 \text{ h} + 0.5 \text{ h} + \frac{67.17797887}{60} \text{ h}$ $= 2.619632981 \text{ h}$ Average speed $= \frac{\text{total distance}}{\text{total time}}$ $= \frac{120}{2.619632981}$ $= 45.8 \text{ km/h}$	M1 M1 A1	3	M1 for correct calculation of total time. M1 for substitution of total distance / total time.
5	(a)(i) $150 < x \leq 160$	B1	1	
	(a)(ii) Estimate of Mean Height $= \frac{3(145) + 10(155) + 7(165) + 4(175) + 1(185)}{25}$ $= 161 \text{ cm}$	B1	1	

Qn	Working	Mark Awarded	Sub-total	Remarks
	(a)(iii) 10.19803903 = 10.2 (to 3 s.f.)	B1	1	
	(a)(iv) We do not know the actual heights of the students.	B1	1	
	(a)(v) The <u>mean height</u> of the five students is <u>less than 161 cm.</u>	B1	1	
5	(b)(i) $\frac{3}{15} = \frac{1}{5}$	B1	1	
	(b)(ii) P(both different colours) = 1 – P(both same colours) = 1 – [P(red, red) + P(blue, blue) + P(Y, Y)] = 1 – $\left[\left(\frac{5}{15} \times \frac{4}{14} \right) + \left(\frac{7}{15} \times \frac{6}{14} \right) + \left(\frac{3}{15} \times \frac{2}{14} \right) \right]$ = $1 - \frac{34}{105}$ = $\frac{71}{105}$ <u>Alternative Method</u> P(red, blue) + P(red, yellow) + P(blue, red) + P(blue, yellow) + P(yellow, red) + P(yellow blue) = $\left(\frac{5}{15} \times \frac{7}{14} \right) + \left(\frac{5}{15} \times \frac{3}{14} \right) + \left(\frac{7}{15} \times \frac{5}{14} \right)$ + $\left(\frac{7}{15} \times \frac{3}{14} \right) + \left(\frac{3}{15} \times \frac{5}{14} \right) + \left(\frac{3}{15} \times \frac{7}{14} \right)$ = $\frac{71}{105}$	M1 A1 [M1] [A1]	2 [2]	M1 for correct calculation. M1 for correct calculation.
	(b)(iii) P(two red, one blue) = P(R, R, B) + P(R, B, R) + P(B, R, R) = $\frac{5}{15} \times \frac{5}{15} \times \frac{7}{15} \times 3$ = $\frac{7}{45}$	M2 A1	3	M1 for $\frac{5}{15} \times \frac{5}{15} \times \frac{7}{15}$ M1 for $\times 3$
6	(a) $\frac{30}{10} = 3 \text{ m/s}^2$	B1	1	

Qn		Working		Mark Awarded	Sub-total	Remarks
	(b)	Duration of deceleration $= \frac{30}{2} = 15 \text{ s}$ Total time = 45 s OR <u>Method 2: Use gradient</u> $\frac{30 - 0}{t - 30} = 2$ $30 = 2(t - 30)$ $30 = 2t - 60$ $t = 45$ ----- Total distance = area of trapezium $= \frac{1}{2} \times (20 + 45) \times 30$ $= 975 \text{ km}$		M1 		

Qn		Working	Mark Awarded	Sub-total	Remarks
		<u>Alternative Method</u> $\left(\frac{h}{15}\right)^3 = \frac{1200}{400}$ $\frac{h}{15} = \sqrt[3]{3}$ $h = \sqrt[3]{3} \times 15$ $h = 21.6 \text{ cm}$	[M1] [A1]	[2]	[M1 for $\left(\frac{h}{15}\right)^3 = \frac{1200}{400}$]
	(b)	 $PR = PQ = QR$ (radii) $\triangle RQR$ is an equilateral triangle. Area of sector $= \frac{60}{360} \times \pi \times 4^2$ $= \frac{8}{3} \pi \text{ cm}^2$ Area of triangle $= \frac{1}{2} (4)(4) \sin 60^\circ$ $= 8 \sin 60^\circ \text{ cm}^2$ Area of shaded region $= \frac{8}{3} \pi + \frac{8}{3} \pi - 8 \sin 60^\circ$ $= 9.826951589$ $= 9.83 \text{ cm}^2 \text{ (to 3 s.f.)}$	M1 M1 M1 M1 A1	5	M1 for recognizing that $\triangle RQR$ is an equilateral triangle, or that $\angle PQR = \angle PRQ = \angle RPQ = 60^\circ$. M1 for area of sector M1 for area of triangle M1 for relating area of sector and area of triangle with area of shaded region
8	(a)	$\begin{pmatrix} 48 & 30 & 12 \\ 36 & 24 & 18 \end{pmatrix}$	B1	1	

Qn		Working	Mark Awarded	Sub-total	Remarks
		Sales of each type of cake flavour $= \begin{pmatrix} 32 & 20 & 8 \\ 30 & 20 & 15 \end{pmatrix} \begin{pmatrix} 17 \\ 25.50 \\ 34 \end{pmatrix}$ $= \begin{pmatrix} 32(17) + 20(25.50) + 8(34) \\ 30(17) + 20(25.50) + 15(34) \end{pmatrix}$ $= \begin{pmatrix} 1326 \\ 1530 \end{pmatrix}$ Total sales: $(1 \ 1) \begin{pmatrix} 1326 \\ 1530 \end{pmatrix} = (2856)$ Total profit $= 2856 - 2250$ $= \\$606$	A1	4	
		<u>Alternative Method</u> $\frac{2}{3}(1170)(1.7) + \frac{5}{6}(1080)(1.7)$ $= 1326 + 1530$ $= 2856$ Total profit $= 2856 - 2250$ $= \\$606$	[M2] [M1] [A1]	[3]	[M1 for $\frac{2}{3}(1170)$ and $\frac{5}{6}(1080)$] [M1 for multiplying both by 1.7] [M1 for adding both together to find total sales]
9	(a)	-1, -1	B1	1	
	(b)	B1 for 4 correctly plotted points. B2 for 7 correctly plotted points. B1 for smooth curve. Deduct one mark if graph goes beyond -1 or 3.	B2 B1	3	
	(c)	Draw a tangent – M1 Gradient = 3 ± 0.5	M1 A1	2	M1 for drawing a tangent on the graph where $x = 1$.

Qn		Working	Mark Awarded	Sub-total	Remarks
	(d)	$3 - x = \frac{1}{x^2} - \frac{1}{x}$ $3x^2 - x^3 = 1 - x$ $3x^2 - x^3 - 1 = -x$ Draw the line $y = -x$. Acceptable range: $x = -0.55$ to -0.8 and $x = 0.35$ to 0.55	M1 M1 A1	3	M1 for obtaining $3x^2 - x^3 - 1 = -x$ M1 for drawing the line $y = -x$. A1 for both correct answers.
10	(a)	1 m = 3.28 feet 1 m² = 3.28² feet² 60×3.28^2 feet² = 645.504 feet² = 646 feet² (to 3 s.f.)	M1 A1	2	M1 for correct ratio of m² to feet². A1 for 60×3.28^2 and 645.504 (more 3 s.f.).
	(b)	$\\$990 \times 645.504$ = \$639 048.96 OR $\\$990 \times 646$ = \$639 540	B1 [B1]	1	Exact floor area is used. Rounded-off floor area from part (a) is used.
	(c)	Let \$x be the cost of the unit. Amount to be covered using housing loan = \$0.55x Simple interest = $\frac{PRT}{100}$ = $\frac{0.55x \times 3.0 \times 25}{100}$ = 0.4125x Total amount to be repaid for housing loan = 0.55x + 0.4125x = 0.9625x Each monthly instalment	M1 M1		M1 for calculating simple interest M1 for calculating the total loan amount to be repaid.

Qn	Working	Mark Awarded	Sub-total	Remarks
	$\begin{aligned} &= \frac{0.9625x}{12 \times 25} \\ &= \frac{77x}{24000} \end{aligned}$ 30% of gross monthly salary $= 30\% \times 7500$ $= \\$2250$ $\frac{77x}{24000} \leq 2250$ $x \leq 701\,298.70 \text{ (to 2 d.p.)}$ Amount for additional levels $= 701\,298.70 - 639\,048.96$ $= \\$62\,249.74$ Maximum number of additional levels $= \frac{62\,249.74}{16\,000}$ $= 3.89060875$ $= 3 \text{ (round down to nearest integer)}$ Maximum level that Lisa can afford to purchase $= 1 + 3$ $= 4^{\text{th}} \text{ level}$	M1 M1 M1 M1 A1	7	M1 for calculating one monthly instalment. M1 for inequality between monthly instalment and 30% of gross monthly income. M1 for calculating amount for additional levels M1 for rounding down to find number of additional levels.
	<u>Alternative Method 2:</u> (Calculate price of unit on the first level then increase of each level). <u>Unit on the First Level:</u> Total amount to be repaid for housing loan $= \frac{0.55 \times 639048.96 \times 3 \times 25}{100} + 0.55 \times 639048.96$ $= 615\,084.63$ Each monthly instalment $= \frac{615084.62}{25 \times 12}$ $= 2050.28$ <u>Increase per level</u>	[M1] [M1]		M1 for calculating simple interest. ECF from (b). M1 for calculating one monthly instalment.

Qn	Working	Mark Awarded	Sub-total	Remarks
	Increase in amount to be covered using housing loan per level $= 16000 \times 0.55$ $= \\$8800$ Increase in amount to be repaid for housing loan per level $= \frac{8800 \times 3 \times 25}{100} + 8800$ $= \\$15\,400$ Increase in each monthly instalment per level $= \frac{15400}{12 \times 25}$ $= \\$51.33$ 30% of gross monthly salary $= 30\% \times 7500$ $= \\$2250$ Let x be the maximum number of additional levels possible. $2050.28 + 51.33x \leq 2250$ $2050.28 + 51.33x \leq 2250$ $51.33x \leq 199.72$ $x \leq 3.8909$ $x = 3$ The maximum level that Lisa can afford to purchase is the 4th level.	[M1] [M1] [M1] [M1] [A1]	[7]	M1 for calculating simple interest. M1 for calculating increase in each monthly instalment per level. M1 for inequality between monthly instalment and 30% of gross monthly income. M1 for finding the maximum number of additional levels.
	<u>Method 3: Guess and Check</u> <u>If the unit is on the 4th level, then</u> the price of the flat $= \\$639\,048.96 + 3(16000)$ $= \\$687\,048.96$ Amount to be covered using housing loan $= 0.55 \times 687048.96$ Simple interest Total amount to be repaid for housing loan	[M1]		M1 for calculating price of unit on 4th level.

Qn	Working	Mark Awarded	Sub-total	Remarks
	$= \frac{0.55 \times 687048.96 \times 3 \times 25}{100} + 0.55 \times 687048.96$ $= \$661\,284.62$ Each monthly instalment $= \frac{661284.62}{12 \times 25}$ $= \$2204.28$ 30% of gross monthly salary $= 30\% \times 7500$ $= \$2250$ $2204.28 < 2250$ 4th floor is within Lisa's budget. <u>If the unit is on the 5th level, then</u> the price of the flat $= \$639\,048.96 + 4(16000)$ $= \$703\,048.96$ Amount to be covered using housing loan $= 0.55 \times 703048.96$ Simple interest Total amount to be repaid for housing loan $= \frac{0.55 \times 703048.96 \times 3 \times 25}{100} + 0.55 \times 703048.96$ $= \$676\,684.62$ Each monthly instalment $= \frac{676684.62}{12 \times 25}$ $= \$2255.62$ 30% of gross monthly salary $= 30\% \times 7500$ $= \$2250$ $2255.62 > 2250$ 5th floor is out of Lisa's budget. Therefore, the maximum level that Lisa can afford to purchase is the 4th level.	[M1] [M1] [M1] [M1] [A1]		M1 for simple interest. M1 for monthly instalment M1 for inequality. M1 for considering 5th unit (as a form of comparison). M1 for inequality showing how level 5 is not suitable.

Qn	Working	Mark Awarded	Sub-total	Remarks
				A1 for correct conclusion.
	<u>Method 4: Calculate maximum cost of 3-room unit from maximum cost to be paid by monthly instalments.</u> Assuming gross monthly salary remains constant across 25 years. Maximum cost of each monthly instalment $= 30\% \times 7500$ $= \\$2250$ Maximum total cost of all monthly instalments $= \\$2250 \times 25 \times 12$ $= \\$675\ 000$ Let P be the remaining amount to be paid by monthly instalments (55% of the price of the unit). $P + \frac{P \times 3 \times 25}{100} = 675\ 000$ $\frac{7}{4}P = 675\ 000$ $P = \$385714.2857 \text{ (to 4 d.p.)}$ Total cost of planned 3-room unit $= \frac{385714.2857}{55} \times 100$ $= \\$701297.7013 \text{ (to 4 d.p.)}$ Maximum number of additional levels $= \frac{701297.7013 - 639048.96}{16000}$ $= 3.8906 \text{ (5.s.f.)}$ $= 3 \text{ (round down to nearest whole number)}$ Maximum level that Lisa can afford to purchase $= 1 + 3$ $= 4^{\text{th}} \text{ level}$	[M1] [M1] [M1] [M1] [M1] [M1] [M1] [M1]	[7]	[M1 for total cost of all monthly instalments, aka \$675 000] [M1 for calculating simple interest correctly] [M1 for finding 55% of cost of unit] [M1 for calculating 100% of cost of unit] [M1 for calculating additional levels] [M1 for rounding down and finding exact number of additional levels].