CEDAR GIRLS' SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2025
SECONDARY FOUR

CANDIDATE NAME	Marking Scheme		
CLASS		INDEX NUMBER	

MATHEMATICS
Paper 1

4052/01
21 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** the questions.
The number of marks is given in brackets [ ] at the end of each question or part question.

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

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. Gives answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

For Examiner's Use
90

This document consists of **20** printed pages.

[Turn over]

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 (a) Given $a = \dfrac{v^2 - t^2}{2s}$, express v in terms of a, t and s.

$$a = \frac{v^2 - t^2}{2s}$$
$$2as = v^2 - t^2 \qquad \text{[transform to non-fractional equation]}$$
$$v^2 = 2as + t^2$$
$$v = \pm\sqrt{2as + t^2}$$

Answer $v =$ ..... [2]

(b) Simplify $\dfrac{xy}{x^2 - 4xy + 4y^2} - \dfrac{2y}{4y - 2x}$.

$$= \frac{xy}{(x-2y)^2} - \frac{y}{2y-x} \quad \text{(factorise into a square)}$$
$$= \frac{xy}{(x-2y)^2} + \frac{y}{x-2y}$$
$$= \frac{xy + xy - 2y^2}{(x-2y)^2} \quad \text{(Attempt to change to common denominator)}$$
$$= \frac{2xy - 2y^2}{(x-2y)^2} \quad \left(\text{or } \frac{2y(x-y)}{(x-2y)^2} \text{ or } \frac{2xy - 2y^2}{x^2 - 4xy + 4y^2}\right)$$

Answer..... [3]

2 The diameter of a solid sphere is 7.12 cm, measured correct to 3 significant figures. Its density is 2.2 g/cm^3.
Find the smallest possible mass of the sphere.

Mass
$$= \frac{4}{3}\pi\left(\frac{7.115}{2}\right)^3 \times 2.2 \quad \text{(See 7.115)}$$
$$= 415\,\text{g}$$

Answer..... g [2]

3 An area of 512 km^2 is represented by 50 cm^2 on a map.
Find the scale of the map in the form $1 : n$.

512 km^2 : 50 cm^2
256 km^2 : 25 cm^2
16 km : 5 cm (Square root)
3.2 km : 1 cm
320 000 : 1

Answer ... 1 : 320 000 ... [2]

4 **(a)** Factorise completely $m^3+30+5m+6m^2$.

$= m^3+6m^2+5m+30$
$= m^2(m+6)+5(m+6)$ (2 groups of factorisation)
$= (m+6)(m^2+5)$

..... [2]

(b) Given that m is a positive integer, explain why $m^3+30+5m+6m^2$ is not a prime number.

Its factors $(m+6)$ and (m^2+5) are whole numbers more than 1.
Hence, it's not a prime number.

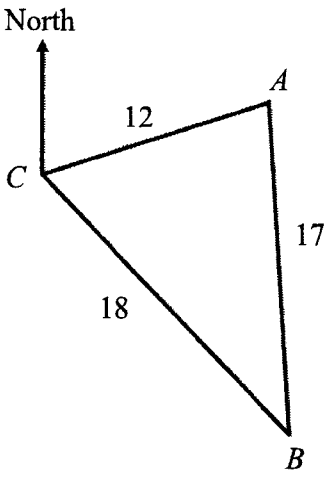
..... [1]

5 Mary cycles 2.8 km at an average speed of 12 km/h and takes a break.
She then continues to cycle a further 1.4 km in 5 minutes.
Given that her average speed for the whole journey is $9\frac{1}{3}$ km/h, find the duration of her break.

Time taken for first part $= \frac{2.8}{12} = \frac{7}{30}$ h
Let x h be her break time.
$9\frac{1}{3} = \frac{2.8+1.4}{\frac{7}{30}+x+\frac{1}{12}}$ -- M1
$\frac{19}{60}+x = \frac{4.2}{9\frac{1}{3}}$
$x = \frac{2}{15}$ (or 0.133 h)

..... h [2]

6 (i)



The diagram below shows 3 lighthouses A, B and C at sea.
$AC = 12$ km. $BC = 18$ km. $AB = 17$ km.
The bearing of B from C is 136°.
Find the bearing of A from C.

$$\cos \angle ACB = \frac{12^2 + 18^2 - 17^2}{2(12)(18)}$$
$$= 0.41435 \text{ (5 s.f.)}$$

$$\angle ACB = 65.522^\circ \text{ (3 dp)}$$

Bearing of A from $C = 136^\circ - 65.522^\circ$
$= 070.5^\circ$ (1 dp) (with zero in front)

..... ° [2]

(ii) Find the area of the region enclosed by triangle ABC.

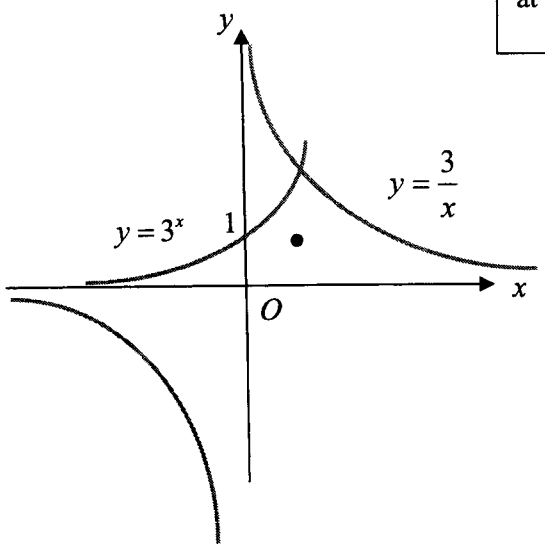
$$\text{Area of } ABC = \frac{1}{2}(12)(18)\sin 65.522^\circ$$
$$= 98.3 \text{ km}^2$$

Answer .....km^2 [2]

7 On the axes given, sketch the graphs $y = 3^x$ and $y = \frac{3}{x}$, indicating the x- and y-intercepts where relevant.
The point (1, 1) is marked in the diagram.

(shape and see intersection at above $x = 1$)

Answer



[2]

8 **(a)** ε = {all real numbers}

A = {all perfect cubes}

B = {all rational numbers}

C = {all recurring decimals}

D = {1, 2, 3, 4, 5, 6, 7, 8, 9}

(i) List all the elements contained in the set $A \cap D$.

Answer ..... 1, 8 ..... [1]

(ii) Explain why $C \cap B' = \phi$.

Answer

B' are irrational numbers which are **non-recurring** decimal numbers.

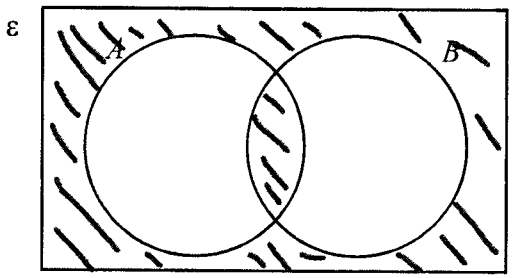
Therefore, $C \cap B' = \phi$.

(Or saying rational numbers are recurring decimals)

]

(b) On the Venn diagram, shade the region(s) which represent $(A' \cap B') \cup (A \cap B)$.

Answer



[1]

9 A quadratic curve $y = -x^2 + mx + 3.5$ has a turning point at $(-1.5, p)$, where both m and p are constants. Find the value of m and of p.

Completed square form:

$y = -(x + \frac{3}{2})^2 + p$ (Completed square form)

$= -(x^2 + 3x + \frac{9}{4}) + p$ [or see $y = -(x - \frac{m}{2})^2 + \frac{m^2}{4} + 3.5$]

$= -x^2 - 3x - \frac{9}{4} + p$

Comparing coefficients with $y = -x^2 + mx + 3.5$: (Comparing)

$m = -3$;

$-\frac{9}{4} + p = 3.5$

$\rightarrow p = \frac{23}{4}$

Alternative method

Completed square form:

$y = -(x - \frac{m}{2})^2 + \frac{m^2}{4} + 3.5$

Comparing coefficients with $y = -(x - \frac{m}{2})^2 + \frac{m^2}{4} + 3.5$: (Comparing)

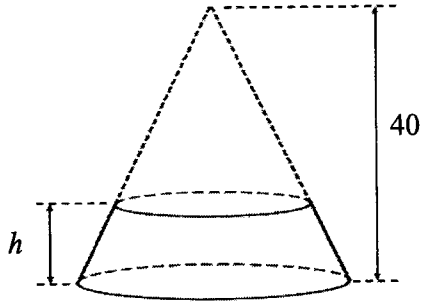
$\frac{m}{2} = -1.5 \rightarrow m = -3$;

$\frac{m^2}{4} + 3.5 = p$

$\rightarrow p = \frac{23}{4}$

10 A pet dish bowl is in the shape of a frustum, as shown in the diagram.
It is formed by removing a smaller cone from the top of a larger cone.
The smaller cone is similar to the original cone, and its volume is $\frac{3}{8}$ of the volume of the original cone. The original cone has a height of 40 cm.

(a) Find h, the height of the frustum.



$\sqrt[3]{\frac{3}{8}} = \frac{40-h}{40}$ --[using cube root]

$h = 40 - 40 \times \sqrt[3]{\frac{3}{8}}$

$h = 11.2$ (3s.f.)

Answer $h =$ ..... [2]

(b) Given that the curved surface area of the frustum is 966 cm^2, find the curved surface area of the smaller cone.

$\frac{A_{\text{smaller cone}}}{A_{\text{larger cone}}} = \left[\left(\frac{3}{8}\right)^{\frac{1}{3}}\right]^2$ --[squaring the ratio of lengths]

$\frac{A_{\text{smaller cone}}}{A_{\text{smaller cone}} + 966} = \left(\frac{3}{8}\right)^{\frac{2}{3}}$

$A_{\text{smaller cone}} = \left(\frac{3}{8}\right)^{\frac{2}{3}} \left(A_{\text{smaller cone}} + 966\right)$

$A_{\text{smaller cone}} = \frac{\left(\frac{3}{8}\right)^{\frac{2}{3}} (966)}{1 - \left(\frac{3}{8}\right)^{\frac{2}{3}}} = 1050 \text{cm}^2$ (3 s.f.)

Answer ..... cm^2 [2]

11 The table shows the income tax rates for different tax brackets.

Chargeable income	Income tax rate (%)
First \$20 000	0
Next \$10 000	2
Next \$10 000	3.5
Next \$40 000	7
Next \$40 000	11.5

In 2022, given that David's chargeable income is \$60,500, find his income tax payable for YA 2022.

Income tax payable

$= \$10000 \times \frac{2}{100} + \$10000 \times \frac{3.5}{100} + \$20500 \times \frac{7}{100}$

$= \$1985$

Answer \$ ..... [2]

12 **(a)** Express 630 as a product of its prime factors.

$630 = 2 \times 3^2 \times 5 \times 7$

Answer ..... [1]

(b) Find the smallest integer value of m such that $630m$ is a perfect square.

$m = 2 \times 5 \times 7 = 70$

Answer m =..... [1]

(c) Given that $588 = 2^2 \times 3 \times 7^2$, find the smallest integer value of k such that $630k$ is a multiple of 588.

$k = 2 \times 7 = 14$

Answer k =..... [1]

(d) A rectangular piece of paper measuring 588 mm and 630 mm is being cut into identical squares with no waste.
Find the minimum number of squares that can be obtained.

HCF $= 2 \times 3 \times 7 = 42$ -- (find HCF)

No of pieces $= \frac{588 \times 630}{42^2} = 210$

Answer ..... [2]

13 Consider the pattern

$L_1 : 4^2 - 1^2 = 15$
$L_2 : 5^2 - 2^2 = 21$
$L_3 : 6^2 - 3^2 = 27$
$L_4 : 7^2 - 4^2 = 33$
$\vdots$
L_n : .....

(a) Write down L_n of the pattern.

$L_n = (n+3)^2 - n^2 = 6n+9$

Answer L_n = ... [1]

(b) Explain, with working, whether 3336 is a term of the sequence 15, 21, 27, 33.....

Answer

$3336 = 6n+9$ -- [M1](Finding n)
$n = 554.5$

No, as n is <u>not a (positive) integer / whole number</u>.

..... [2]

(c) Find the exact value of $L_1 + L_4 + L_7 + L_{10} + L_{13} + \ldots\ldots L_{97} + L_{100}$.

$L_1 + L_4 + L_7 + L_{10} + L_{13} + \ldots\ldots L_{97} + L_{100}$
$= 4^2 - 1^2 + 7^2 - 4^2 + 10^2 - 7^2 + \ldots\ldots 100^2 - 97^2 + 103^2 - 100^2$ --(replacing the L terms with $a^2 - b^2$)
$= 103^2 - 1^2$
$= 10608$ -- [A1]

Answer ..... [2]

14 **(a)** A polygon has three of its interior angles, measuring 150°, 160° and 170°. The other interior angles are 130° each.
Find n, the number of sides of the polygon.

$$150^o + 160^o + 170^o + (n-3)(130^o) = (n-2)(180^o)$$
$$480^o + 130n - 390^o = 180^o n - 360^o$$
$$450^o = 50n$$
$$n = 9$$

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

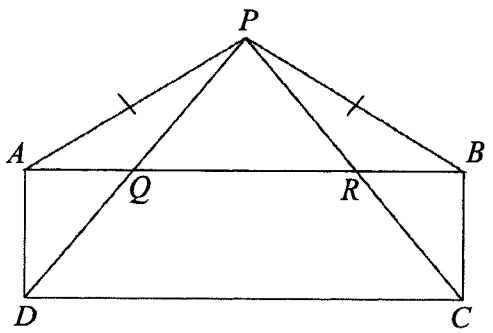
(b) Explain why it is not possible for a regular polygon to have an interior angle of 145°.

Answer

Its exterior angle is 35°. $n = \frac{360}{35} = 10\frac{2}{7}$ -- (finding n)
Since the number of sides is not a whole number / (positive) integer, it is not possible to be a regular polygon to have an interior angle of 145°.

[2]

15 The diagram shows a rectangle $ABCD$ and an isosceles triangle PAB in which $PA = PB$.
PD and PC meet AB at Q and R respectively.
Prove that triangle PDC is an isosceles triangle.



Answer

$PA = PB$ (given) (S)
$AD = BC$ (opp. sides of rectangle) (S)
$\angle PAB = \angle PBA$ (base angles of isosceles triangle)
$\angle PAD = \angle PAB + 90^o$
$= \angle PBA + 90^o$ (A) **(finding $\angle PAD = \angle PBC$)**
$= \angle PBC$
Therefore, Triangle $PAD \equiv$ Triangle PBC (SAS)
$\therefore PD = PC$,
triangle is an isosceles triangle.

[3]

16 The table below shows the number of books students read in a certain week.

Number of books	0	1	2	3	4	5
Number of students	9	13	16	21	x	17

(a) If the mode is 3, state the largest possible value of x.

Answer $x =$ .... 20 .... [1]

(b) If the mean is 3, find the value of x.

$$\frac{0+13+32+63+4x+85}{9+13+16+21+x+17}=3$$

$$\frac{193+4x}{76+x}=3$$

$$193+4x=228+3x$$

$$x=35$$

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

(c) Melanie claims that it is not possible for the median to be 2.
Explain whether you agree with Melanie's claim.

To find the smallest possible median is when $x = 0$,
(the smallest possible value of x)
– **(attempt to find smallest possible median)**
Alternative solution:
Stating that Left side has 9+13+16 = 38 students;
Right side has 21 + 17 = 38 students.
Hence the smallest median is 2.5

The smallest possible median $= \frac{2+3}{2} = 2.5$

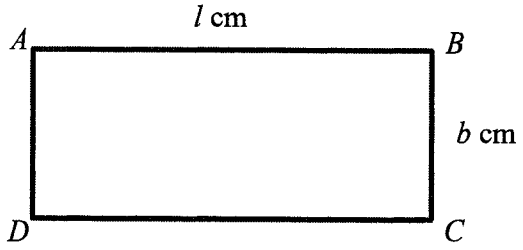
A The smallest possible median is 2.5, and it will not be 2. Melanie is correct. -- (also accept finding median to be more than 2)

.. ..

.. .. [2]

17 The diagram shows a sheet of rectangular paper $ABCD$.
The length is l cm. The breadth is b cm.
This sheet can be rolled to form an open cylinder in two different ways:

Method 1: By joining the breadths together.
Method 2: By joining the lengths together.



Justify with mathematical workings, why the volume of the open cylinder, formed using **Method 1** is larger than that formed using **Method 2**, for all real values of l and b.

Answer

	Method 1	**Method 2**	
Finding radius	$2\pi r_1 = l$ $r_1 = \frac{l}{2\pi}$	$2\pi r_2 = b$ $r_2 = \frac{b}{2\pi}$	(Correct radii for both)
Volume	$= \pi\left(\frac{l}{2\pi}\right)^2 \times b$ $= \frac{bl^2}{4\pi}$	$= \pi\left(\frac{b}{2\pi}\right)^2 \times l$ $= \frac{b^2 l}{4\pi}$	(Finding volume)

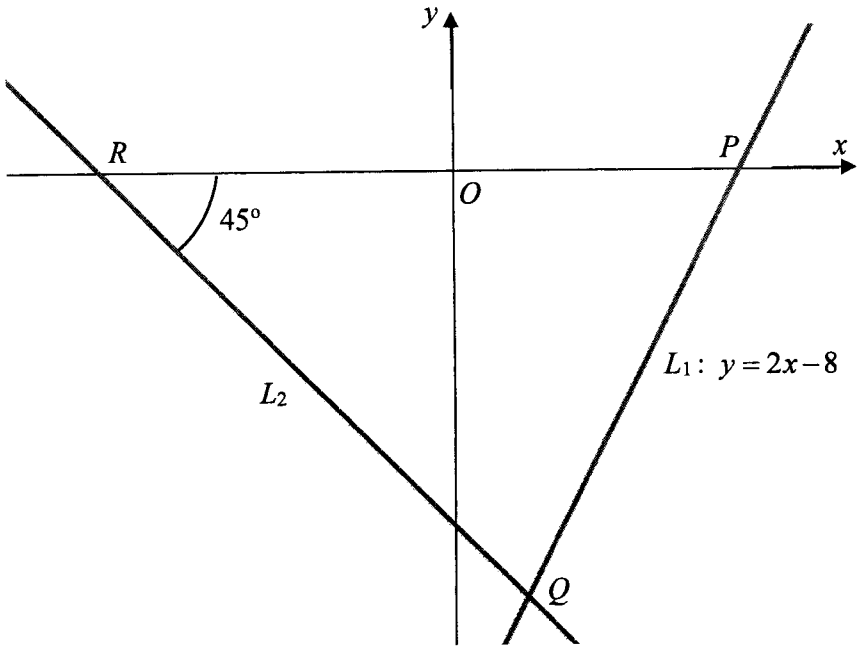
Since $l > b \rightarrow \frac{bl^2}{4\pi} > \frac{b^2 l}{4\pi}$, -- (follow through from above)

[Alternatively, $\left(\frac{bl}{4\pi}\right) l > \left(\frac{bl}{4\pi}\right) b$]

the volume from method 1 is larger.

..... [4]

18 In the figure below, line L_1 and line L_2 cut the x-axis at P and R respectively.
The equation of L_1 is $y = 2x - 8$.
Angle PRQ is 45°. PR is 9 units.
Line L_2 meets line L_1 at Q.



(a) By finding the coordinates of R, show that the equation of Line L_2 is $y = -x - 5$.

Answer

$P = (4, 0)$
$R = (-5, 0)$

Gradient $= -\tan 45^\circ = -1$ --(or other similar methods to find gradient)
Therefore, $y = -x + c$

At $(-5, 0)$,

$0 = 5 + c$ --(connect gradient and a point to find c)
$c = -5$

Therefore, equation of $L_2 : y = -x - 5$ (Shown)

[4]

(b) Find the coordinates of Q.

$y = 2x - 8$ --(1)
$y = -x - 5$ --(2)

(1) = (2)

$2x - 8 = -x - 5$
$x = 1 \rightarrow y = -6$

$Q = (1, -6)$

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

(c) Find the shortest distance from R to line PQ.

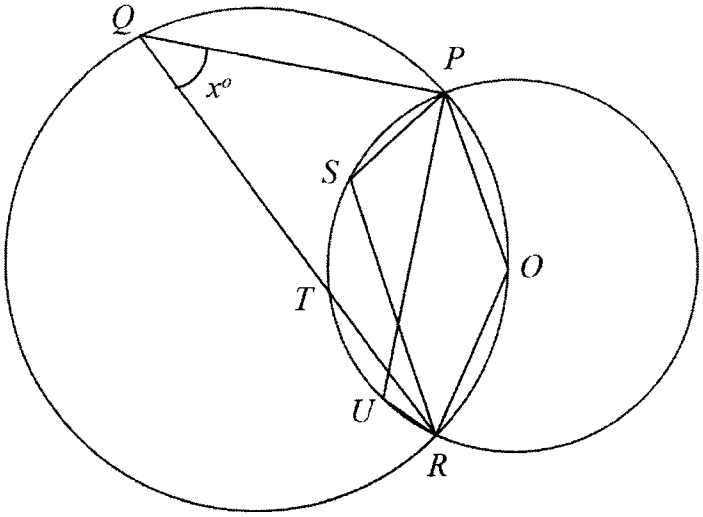
Area of triangle $= \frac{1}{2} \times 6 \times 9$
$= 27$ units^2

$PQ = \sqrt{(4-1)^2 + (0+6)^2}$ –(finding base of triangle)
$= \sqrt{45}$ units

Shortest distance $= \frac{27 \times 2}{\sqrt{45}} = 8.05$ units (3s.f.)

Answer ..... units [3]

19



In the diagram, O is the centre of the smaller circle passing through the points P, S, T, U and R.
QTR is a straight line.
The points P, Q, R and O lie on the larger circle. It is given that angle $PQR = x^o$.

(a) Find angle PSR, in terms of x.
Give a reason for each step of your working

Answer

$\angle POR = (180 - x)^o$ (angles in opp segments)
reflex$\angle POR = 360^o - (180 - x)^o$ (angles at a pt)
$= (180 + x)^o$
$\angle PSR = \dfrac{(180 + x)^o}{2}$ (angle at centre = 2 x angle at circumference)
(also accept $\left(90 + \dfrac{x}{2}\right)^o$) [3]

(b) It is now given that angle PUR is 105°, find the value of x.

$\angle PUR = \dfrac{(180 + x)^o}{2}$ (angles in the same segment)
$105 = \dfrac{(180 + x)}{2}$
$x = 30$

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

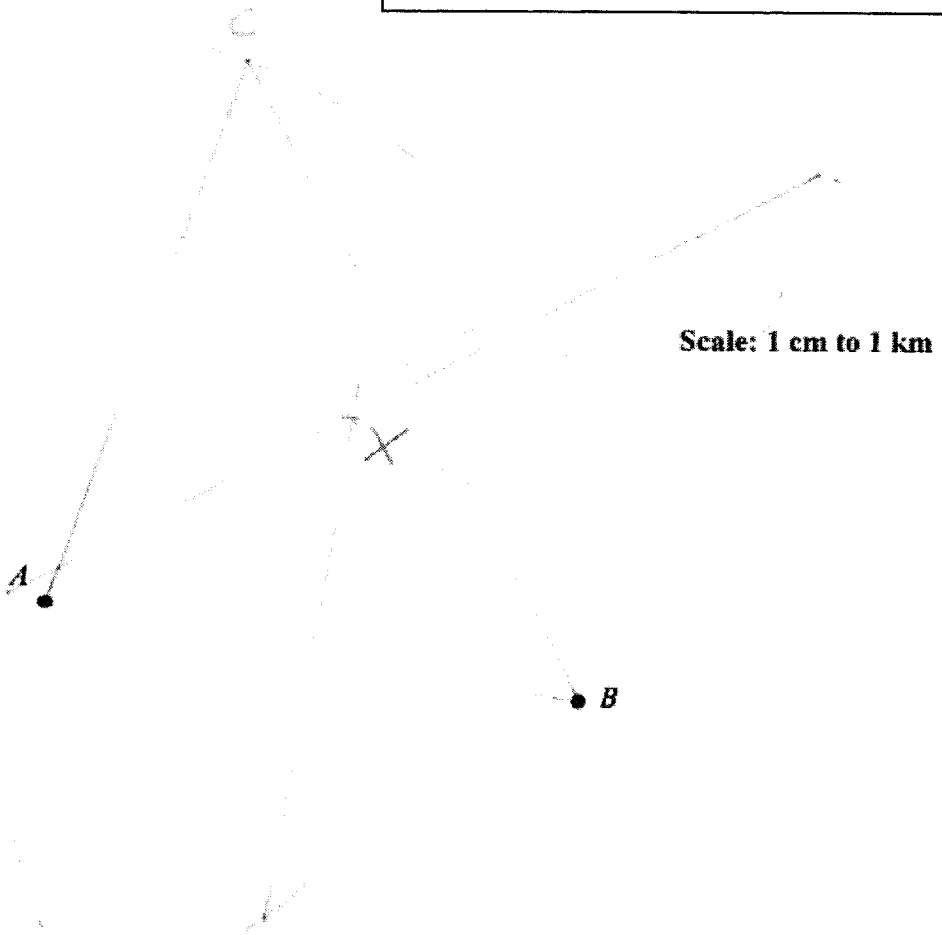
20 There are 3 statues located at points A, B and C respectively.
The diagram in the space below shows the positions of points A and B.

(a) It is given that AC is 8 km and BC is 10 km.
Using appropriate constructions, find and label the position of point C.

[1]

Answer

Draw 2 arcs Find C, the intersection of the 2 arcs



Scale: 1 cm to 1 km

(b) There is a treasure chest buried in a location that is equidistant from A, B and C. Find and label this point X in the diagram above.

[2]

Draw at least 2 perpendicular bisectors Find X, the intersection of the 2 perpendicular bisectors

21 P is inversely proportional to the square of Q.
Given that Q increases by 10%, find the percentage decrease in P.

$P = \frac{k}{Q^2}$, $Q_{new} = 1.1Q$;

$P_{new} = \frac{k}{(1.1Q)^2}$

$= \frac{k}{1.21Q^2}$

Percentage change $= \frac{\frac{k}{1.21Q^2} - \frac{k}{Q^2}}{\frac{k}{Q^2}} \times 100\%$ (finding % change)

$= \left(\frac{1}{1.21} - 1\right) \times 100\% = -17.4\%$ (3s.f.)

Decrease % = 17.4%

.. % [3]

22 In Australia, a 16-oz bottle of shampoo costs A$60.
The shampoo company wants to price a 500ml bottle of the same shampoo at the same rate in France.

€ 1 = A$1.65.
1 oz = 29.5735 ml.

What should the price be in euros (€) ?
Leave your answer to the nearest 10 cents.

In Australia, a 16-oz bottle costs A$60 = $€\frac{60}{1.65}$ --(Converting to euros)

29.5735ml (also 1 oz) of shampoo costs = $€\frac{60}{1.65} \div 16$

500 ml of shampoo costs = $€\frac{60}{1.65} \div 16 \times \frac{500}{29.5735}$ --(Converting to ml)

$= €38.40$ (to nearest 10 cents)

Answer € ..... [3]

23 A bag contains 12 counters, n of which are green and the remainder are blue. One counter is drawn at random and not replaced.

(a) Write down, in terms of n, the probability that the counter is blue.

Answer $\frac{12-n}{12}$ ... [1]

A second counter is then drawn at random.

(b) Given that the probability that both counters drawn are blue is $\frac{5}{22}$, form an equation in the form $n^2+bn+c=0$, where b and c are integers.

Answer

$$\frac{12-n}{12}\times\frac{11-n}{11}=\frac{(12-n)(11-n)}{132}$$

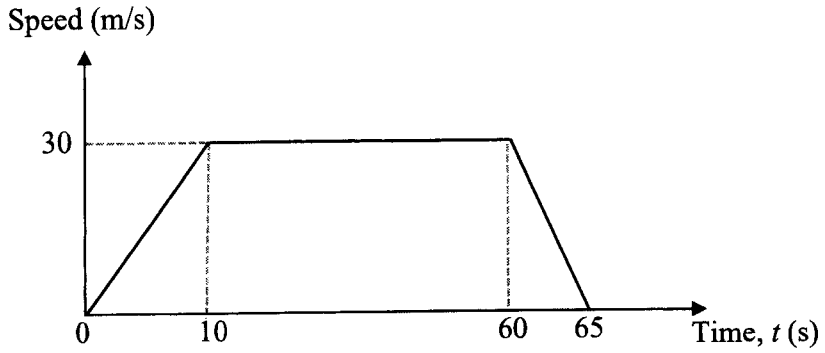
$$\frac{(12-n)(11-n)}{132}=\frac{5}{22}$$

$$(12-n)(11-n)=30$$

$$n^2-23n+102=0$$

[3]

24 The diagram shows the speed-time graph of a car as it travelled from point A to B.



(a) Find the deceleration of the car from 60s to 65s.

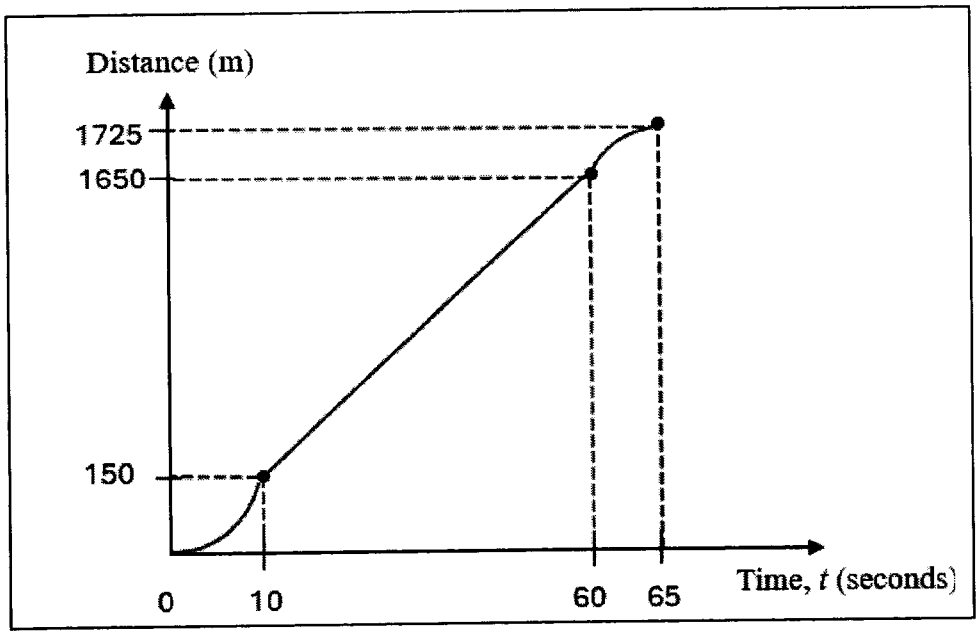
$\frac{30}{5} = 6 \text{ m/s}^2$

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

The area beneath the speed-time graph represents the distance travelled by the object.

(b) Draw the distance-time graph to represent the journey.

Answer



[3]

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2025
SECONDARY FOUR

CANDIDATE NAME | **MARK SCHEME**

CLASS | INDEX NUMBER

MATHEMATICS

Paper 2

4052/02
22 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

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

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

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. Gives answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

For Examiner's Use
90

This document consists of **19** printed pages and **1** blank page.

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ 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

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

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

Answer **all** the questions.

1 **(a)** Solve the inequality $1+4y \le \frac{2y-1}{2} < 0$.

$2+8y \le 2y-1 < 0$

$2+8y \le 2y-1$ and $2y-1<0$

$y \le -\frac{1}{2}$ $y < \frac{1}{2}$

$\therefore y \le -\frac{1}{2}$

Answer ..... [2]

(b) Solve $-(1-x)\left(\frac{4}{5}x-1\right)=3$.

$(x-1)\left(\frac{4}{5}x-1\right)=3$

$\frac{4}{5}x^2-\frac{9}{5}x+1=3$

$4x^2-9x-10=0$

$x=\frac{-(-9)\pm\sqrt{(-9)^2-4(4)(-10)}}{2(4)}$

$x=-0.816$ or $x=3.07$ (3 s.f.)

Answer $x=$ ..... and $x=$ ..... [3]

(c) **(i)** Given that $243^p \times 2^{5p} = 6^{6-p}$, find the value of p.

$3^{5p} \times 2^{5p} = 6^{6-p}$
$6^{5p} = 6^{6-p}$
$5p = 6 - p$
$p = 1$

Answer $p =$ ..... [2]

(ii) Simplify $\left(\frac{16p^4}{q^8}\right)^{-\frac{3}{2}} \div pq^5$ and leave your answer in positive index notation.

$= \left(\frac{q^8}{16p^4}\right)^{\frac{3}{2}} \div pq^5$
$= \frac{q^{12}}{64p^6} \times \frac{1}{pq^5}$
$= \frac{q^7}{64p^7}$

Answer ..... [3]

2 (a) The diameter of a red blood cell is 8.2×10^{-6} m.
Express this value as a decimal, in millimetres.

8.2×10^{-3} mm
$= 0.0082$ mm

Answer ..... mm [1]

(b) In 2024, Changi Airport handled 67.7 million passengers.
Calculate the mean number of passengers handled by the airport each month.
Leave your answer in standard form, correct to 2 significant figures.

$$\frac{67.7\times10^{6}}{12}$$
$$= 5.6\times10^{6}$$

Answer ..... [2]

(c) LBB Bank currently charges 3% per year compound interest on all loans, compounded once every three months.
The bank manager proposes to adjust the frequency of interest compounded to once every month instead, so as to increase the earnings of the bank.

Do you agree with the bank manager's proposal?
Explain your answer with clear workings.

Answer

Compounded every 3 months:
$$P\left(1+\frac{3\%}{4}\right)^{4n} = P(1.0075)^{4n}$$
Compounded every month:
$$P\left(1+\frac{3\%}{12}\right)^{12n} = P(1.0025)^{12n}$$
$$= P(1.007518766)^{4n}$$

I agree with the bank manager's proposal, as the total earnings over the same period of .....
time is more when the frequency of interest compounded is once every month.
.....
..... [3]

3 A bakery selling assorted tarts operates for 7 days a week.
The matrix, **T**, shows the number of tarts of different types that are made each day.

$$\mathbf{T} = \begin{matrix} \\ \text{Small} \\ \text{Large} \end{matrix} \begin{matrix} \begin{matrix} \text{Apple} & \text{Banana} & \text{Cheese} \end{matrix} \\ \begin{pmatrix} 55 & 35 & 70 \\ 40 & 30 & 30 \end{pmatrix} \end{matrix}$$

The cost of making a small tart is \$0.80.
The cost of making a large tart is \$1.75.

(a) Represent these costs in a 1×2 row matrix **N**.

Answer $\mathbf{N} = \begin{pmatrix} 0.8 & 1.75 \end{pmatrix}$ [1]

(b) Evaluate the matrix $\mathbf{C} = 7\mathbf{NT}$.

$$\mathbf{C} = 7\begin{pmatrix} 0.8 & 1.75 \end{pmatrix}\begin{pmatrix} 55 & 35 & 70 \\ 40 & 30 & 30 \end{pmatrix}$$
$$= 7\begin{pmatrix} 114 & 80.5 & 108.5 \end{pmatrix}$$
$$= \begin{pmatrix} 798 & 563.5 & 759.5 \end{pmatrix}$$

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

(c) State what each of the elements of **C** represent.
It represents the total cost of making apple, banana and cheese tarts respectively,
.....
in a week.
..... [1]

(d) The tarts are sold at 55% more than the cost to make them.
On a particular day, the number of banana tarts to cheese tarts sold is in the ratio 5 : 7 while the number of apple tarts to banana tarts sold is in the ratio 5 : 4 . A total of 41 unsold tarts were given away.

If the number of small cheese tarts sold is twice the number of large cheese tarts sold, calculate the total amount earned by the bakery from selling cheese tarts on that day.

Apple : Banana : Cheese
5 : 4
5 : 7
$\therefore$ 25 : 20 : 28

No. of cheese tarts sold $= \frac{260-41}{25+20+28} \times 28$
$= \frac{219}{73} \times 28 = 84$

Total amount earned from selling cheese tarts for the day
$= \left(\frac{2}{3} \times 84 \times 1.55 \times 0.80\right) + \left(\frac{1}{3} \times 84 \times 1.55 \times 1.75\right)$
= \$145.39

Answer \$ ..... [3]

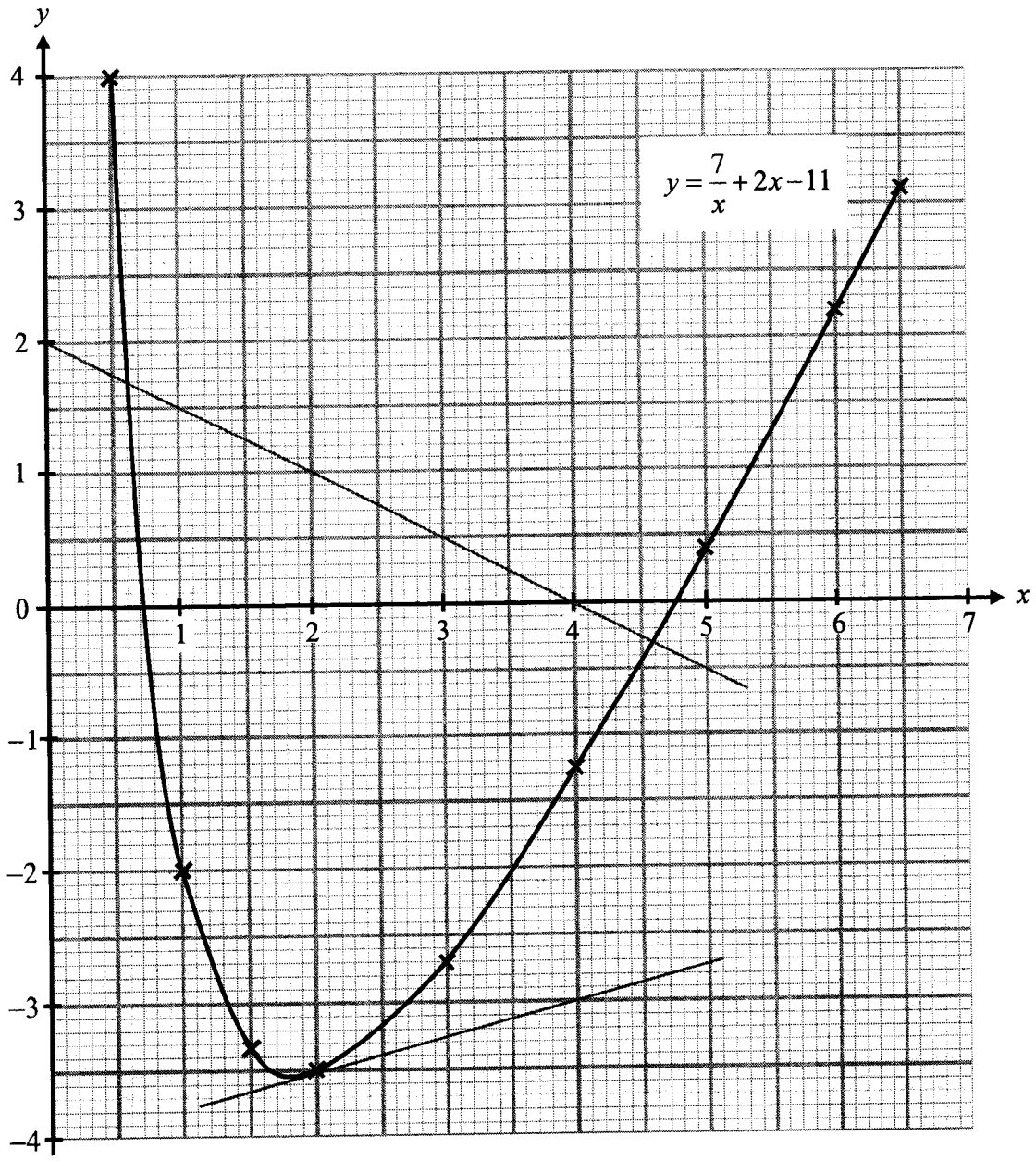
4 **(a)** The variables x and y are connected by the equation $y = \frac{7}{x} + 2x - 11$.

Some corresponding values are given in the table below.
Values are given to 1 decimal place where appropriate.

x	0.5	1	1.5	2	3	4	5	6	6.5
y	4	–2	–3.3	–3.5	–2.7	–1.25	0.4	2.2	3.1

Fill in the missing value in the table. [1]

(b) On the grid below, draw the graph of $y = \frac{7}{x} + 2x - 11$ for $0.5 \leq x \leq 6.5$. [2]



(c) By drawing a tangent, find the gradient of the curve at $x = 2$.

Gradient $= \dfrac{-3-(-3.5)}{4-2}$

$= 0.25\ (\pm 0.13)$

Answer Gradient = ... [2]

(d) Using your graph,

(i) explain why the equation $2x + \dfrac{7}{x} - 7 = 0$ has no solution.

Answer

$2x + \dfrac{7}{x} - 11 = -4$

The line $y = -4$ is below the minimum point of/lies entirely below the curve

.....

$y = 2x + \dfrac{7}{x} - 11$ and therefore, will not intersect the curve at any point.

.....

[2]

(ii) find the x-coordinate of the points where the line $2y = 4 - x$ intersects the curve.

Draw $y = -\dfrac{1}{2}x + 2$

From graph, x-coordinate of points = 0.6 and 4.6 (± 0.1)

Answer x = ... and x = ... [2]

(iii) These values of x are the solutions of the equation $Ax^2 + Bx + 14 = 0$.

Find the value of A and of B.

$y = -\dfrac{1}{2}x + 2$ ---(1) $\qquad y = 2x + \dfrac{7}{x} - 11$ ---(2)

Sub (1) into (2): $-\dfrac{1}{2}x + 2 = 2x + \dfrac{7}{x} - 11$

$-\dfrac{1}{2}x + 2 = 2x + \dfrac{7}{x} - 11$

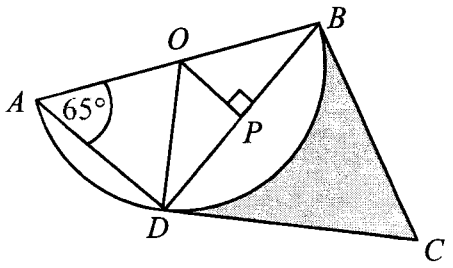
$-x^2 + 4x = 4x^2 + 14 - 22x$

$0 = 5x^2 - 26x + 14$

By comparing coefficients, $A = 5$ and $B = -26$

Answer A = ..., B = ... [3]

5 The figure shows a semi-circle $AOBD$ with centre O and OP is perpendicular to BD. BC and CD are tangents to the semi-circle at B and D.



(a) Show that triangles ABD and OBP are similar.
Give a reason for each statement you make.

Answer

$\angle ADB = 90°$ (angle in semicircle)
So, $\angle ADB = \angle OPB$
$\angle ABD$ is common angle.
.....
$\therefore \Delta ABD$ is similar to ΔOBP. (Angle-angle similarity)
.....

[2]

(b) Find the ratio $\dfrac{\text{area of triangle } OBP}{\text{area of triangle } AOD}$.

Since $\dfrac{\text{area of triangle } OBP}{\text{area of triangle } OBD} = \dfrac{1}{2}$
and area of triangle OBD = area of triangle AOD,

$$\frac{\text{area of triangle } OBP}{\text{area of triangle } AOD} = \frac{1}{2}$$

Answer ..... [2]

(c) Show that angle $BOD = 2.2689$ radians, correct to 5 significant figures.

Answer

$\angle BOP = 65°$ (similar triangles)

$$\angle BOD = (65° \times 2) \times \frac{\pi}{180°}$$
$$= 2.268928 \text{ (7 s.f.)}$$
$$= 2.2689 \text{ radians (5 s.f.)} \quad \text{(shown)}$$

[2]

(d) It is given that the radius of the semi-circle is 4 cm and $BC = 8.58$ cm.

Calculate

(i) the perimeter of the shaded part,

$BC = DC = 8.58$ cm (tangents from ext. pt.)

Perimeter $= (8.58 \times 2) + 4(2.268928)$
$= 26.2357$ (5 s.f.)
$= 26.2$ cm (3 s.f.)

Answer ..... cm [2]

(ii) the area of the shaded part.

$\angle OBC = 90°$ (tangent $\perp$ radius)

$$\text{Area} = \left(2 \times \frac{1}{2} \times 4 \times 8.58\right) - \frac{1}{2}\left(4^2\right)(2.268928)$$
$= 16.169$ (5 s.f.)
$= 16.2 \text{ cm}^2$ (3 s.f.)

Answer ..... cm^2 [3]

6 (a) (i) The position vector of point A and point B are $\begin{pmatrix} k \\ 6 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -2 \end{pmatrix}$ respectively.

Given that $\left|\overrightarrow{AB}\right| = 10$, find the negative value of k.

$$\overrightarrow{AB} = \begin{pmatrix} 2 \\ -2 \end{pmatrix} - \begin{pmatrix} k \\ 6 \end{pmatrix} = \begin{pmatrix} 2-k \\ -8 \end{pmatrix}$$

So, $(2-k)^2 + (-8)^2 = 10^2$

$4 - 4k + k^2 + 64 = 100$

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

$(k+4)(k-8) = 0$

$\therefore k = -4, \quad 8$ (rej)

Answer $k =$ ..... [3]

(ii) C is the point $(5, -6)$.
Using the value of k found in part **(a)(i)**, show that A, B and C are collinear.

Answer

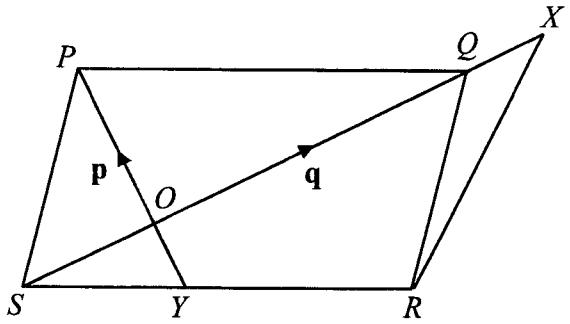
$$\overrightarrow{BC} = \begin{pmatrix} 5 \\ -6 \end{pmatrix} - \begin{pmatrix} 2 \\ -2 \end{pmatrix} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$$

$$\overrightarrow{AB} = \begin{pmatrix} 6 \\ -8 \end{pmatrix} = 2\begin{pmatrix} 3 \\ -4 \end{pmatrix} = 2\overrightarrow{BC}$$

Since $AB \parallel BC$ and B is a common point, A, B and C must be collinear.

[3]

(b) The diagram shows a parallelogram $PQRS$ and a triangle QXR.
QS is a diagonal of the parallelogram and Y is a point on RS such that $OS:QS=3:10$.



It is given that $\overrightarrow{OP}=\mathbf{p}$ and $\overrightarrow{OQ}=\mathbf{q}$,

(i) Express $\overrightarrow{QR}$, as simply as possible, in terms of $\mathbf{p}$ and $\mathbf{q}$,

$$\overrightarrow{SR}=\overrightarrow{PQ}=-\mathbf{p}+\mathbf{q}$$
$$\overrightarrow{QR}=\overrightarrow{QS}+\overrightarrow{SR}$$
$$=-\frac{10}{7}\mathbf{q}+(-\mathbf{p}+\mathbf{q})$$
$$=-\mathbf{p}-\frac{3}{7}\mathbf{q}$$

Answer $\overrightarrow{QR}$ = ... [3]

(ii) If $\overrightarrow{QX}=m\overrightarrow{SQ}$ and $\overrightarrow{RX}=n\left(\frac{1}{5}\mathbf{p}+\frac{1}{7}\mathbf{q}\right)$, where m and n are rational numbers, find the value of m and of n.

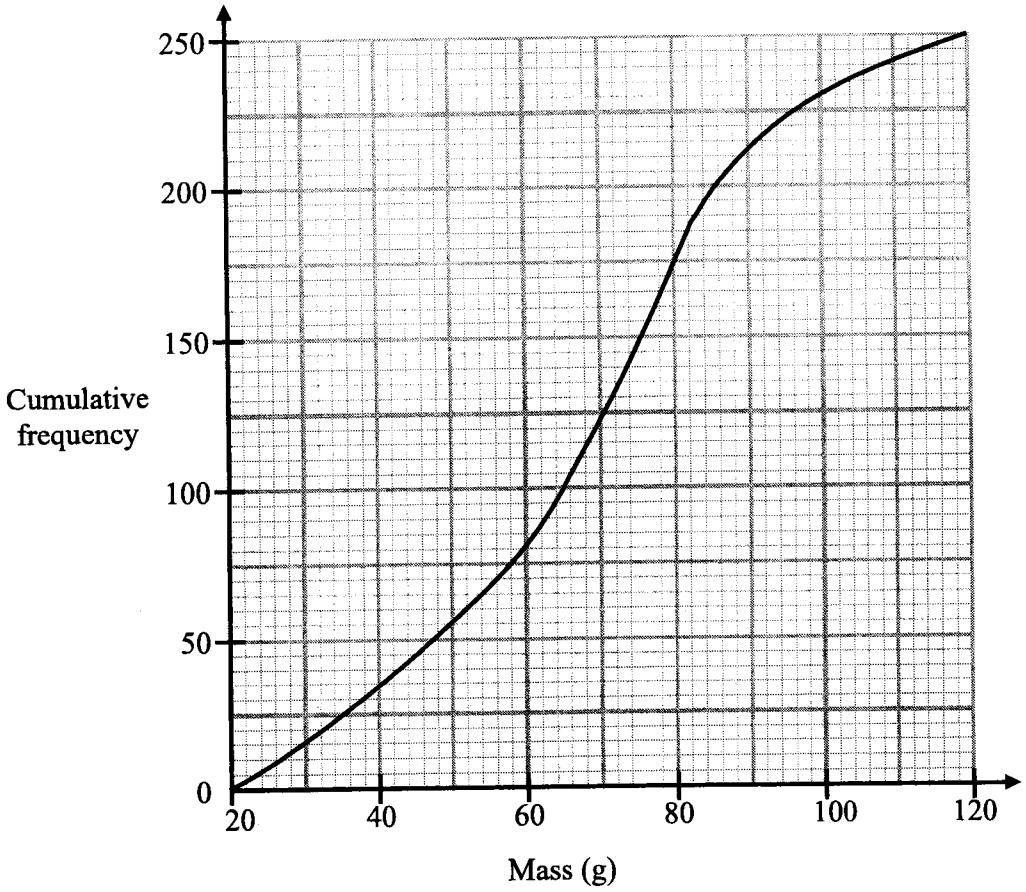
$$\overrightarrow{QX}=\frac{10}{7}m\mathbf{q} \text{ --- (1)}$$
$$\overrightarrow{QX}=\overrightarrow{QR}+\overrightarrow{RX}$$
$$=-\mathbf{p}-\frac{3}{7}\mathbf{q}+n\left(\frac{1}{5}\mathbf{p}+\frac{1}{7}\mathbf{q}\right)$$
$$=\left(\frac{1}{5}n-1\right)\mathbf{p}+\left(\frac{1}{7}n-\frac{3}{7}\right)\mathbf{q} \text{ --- (2)}$$

Comparing coefficients, $\frac{1}{5}n-1=0 \rightarrow n=5$

$$\frac{1}{7}(5)-\frac{3}{7}=\frac{10}{7}m \rightarrow m=\frac{1}{5}$$

Answer m = ..., n = ... [4]

7 A farmer harvested 250 potatoes which were grown using Fertiliser X.
The cumulative frequency curve below shows the mass distribution of the potatoes.



(a) The farmer only sells potatoes that weigh 56 g and above.

Using the curve, find the percentage of potatoes that can be sold.

$\frac{250-70}{250} \times 100\% = 72\%$

Answer ..... % [1]

(b) (i) Complete the grouped frequency table for the mass of the potatoes.

Mass (m g)	$20 \le m < 40$	$40 \le m < 60$	$60 \le m < 80$	$80 \le m < 100$	$100 \le m < 120$
Frequency	35	45	95	55	20

[1]

(ii) Find the interval that contains the median mass.

Answer .....60.... $\le m <$ .....80.... [1]

(iii) Calculate an estimate of the mean mass.

Answer .....68.4..... g [1]

(iv) Calculate an estimate of the standard deviation of the masses.

Answer .....22.6..... g [1]

(c) Two of the potatoes are selected at random, without replacement.

Find the probability that

(i) none has a mass between 60 g and 100 g,

$$\text{P(none has mass between 60 g and 100 g)} = \frac{100}{250} \times \frac{99}{249}$$
$$= \frac{66}{415}$$

Answer ..... [2]

(ii) one has a mass less than 60 g and the other has a mass greater than 100 g.

P(one has mass less than 60 g and one has mass greater than 100 g)

$$= 2\left(\frac{80}{250} \times \frac{20}{249}\right)$$
$$= \frac{64}{1245}$$

Answer ..... [2]

(d) The farmer harvested another 250 potatoes that were grown using Fertiliser Y.
The estimated mean mass of this batch of potatoes is 62 g.
The estimated standard deviation of the masses is 23 g.

Make two comments comparing the mass of the potatoes grown using Fertiliser X and those grown using Fertiliser Y.

Answer
On average, potatoes grown using Fertiliser X are heavier than those grown using
.....
Fertiliser Y, as they have a higher mean mass of 68.4 g, compared to 62 g.
.....
The spread of the mass is comparable for both batches of potatoes, with SD being
.....
22.6 g and 23 g. / Mass of potatoes grown using Fertiliser X has a smaller spread, with
..... [2]
a lower SD of 22.6 g, rather than 23 g.

8 A factory produces bowls in two sizes, small size and large size.

(a) It is found that x large bowls can be produced in a minute.
Write down an expression in terms of x, the time taken to produce 1 large bowl, **in seconds**.

$$\frac{60}{x}$$

Answer ..... s [1]

(b) 4 more small bowls can be produced in a minute, compared to the large bowls.
Write down an expression in terms of x, the time taken to produce 1 small bowl, **in seconds**.

$$\frac{60}{x+4}$$

Answer ..... s [1]

(c) Given that it takes 2.5 seconds longer to produce a large bowl than a small bowl, form an equation in x and show that it reduces to $x^2 + 4x - 96 = 0$.

Answer

$$\frac{60}{x} - \frac{60}{x+4} = 2.5$$
$$60(x+4) - 60x = 2.5x(x+4)$$
$$60x + 240 - 60x = 2.5x^2 + 10x$$
$$2.5x^2 + 10x - 240 = 0$$
$x^2 + 4x - 96 = 0$ (shown)

[2]

(d) Solve the equation $x^2 + 4x - 96 = 0$.

$$x = \frac{-4 \pm \sqrt{(-4)^2 - 4(1)(-96)}}{2(1)}$$
$$= -12 \quad \text{or} \quad 8$$

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

(e) Hence find the time taken to produce 3500 small bowls.
Give your answer in hours and minutes, correct to the nearest minute.

$$\text{Time taken} = \frac{3500}{8+4}$$
$$= 291\frac{6}{7} \text{ min}$$
$$= 4 \text{ h } 52 \text{ min}$$

Answer ..... h ..... min [2]

(f) The factory sells each small bowl at \$0.35 and each large bowl at \$0.50.

Explain, with clear workings, why it is more profitable for the factory to produce only small bowls than only large bowls.

Answer

In t seconds,

Amount earned from selling large bowls = $\$0.50 \times \frac{t}{60/8} = \$0.067t$

Amount earned from selling small bowls = $\$0.35 \times \frac{t}{60/12} = \$0.07t$

The factory earns more from selling small bowls, given the same production time.

[3]

9 Ryan has set up a home theatre system in one of his rooms, which is in the shape of a cuboid with dimensions 4 m by 3.6 m by 3 m.

Figure 1 shows the three-dimensional layout of the room, where a television is mounted on the front wall *QRVU* and two speakers are mounted on the back wall *PSWT*, at *P* and *T* respectively.

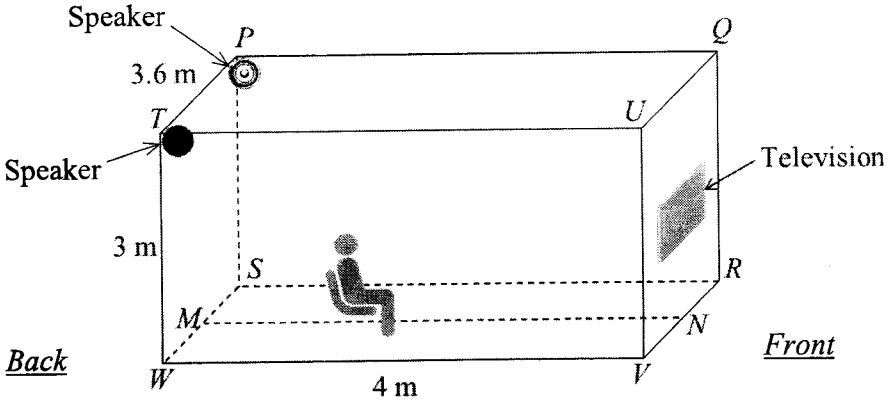


Figure 1

Ryan is planning to put an armchair along *MN*, which is a straight path that cuts across the centre of the room from the back to the front.

Figure 2 shows the cross-sectional view of him sitting in the armchair, where his eye level at *X*, is 1.24 m directly above the ground and ***d*** m away from the front wall. The centre of the television at *Y*, is 1.6 m directly above *N*.

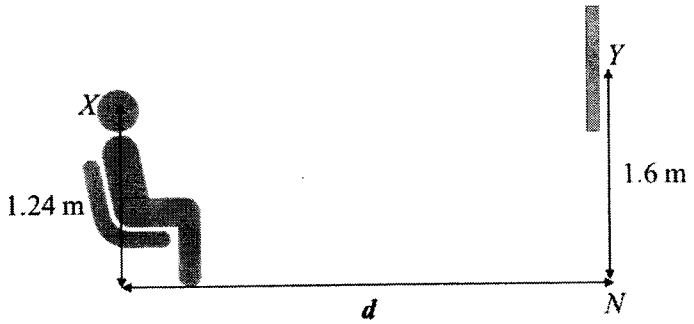


Figure 2

(a) Find the angle of elevation from *X* to *Y* when $d = 1.2$ m.

Let the angle of elevation be θ .

$$\tan\theta = \frac{1.6-1.24}{1.2}$$

$\theta = 16.699°$ (5 s.f.)

$= 16.7°$ (3 s.f.)

Answer ..... ° [2]

(b) Ryan found out that:

- To have an optimal view of the television, the angle of elevation from X to Y should be less than $15°$.
- To have an optimal audio experience, the position of the two speakers and X should form an equilateral triangle.

Suggest a suitable value for ***d*** such that the position of the armchair will provide Ryan with best possible user experience.
Justify the decisions you make and show your calculations clearly.

Answer

1) When $\theta = 15°$, $\tan 15° = \dfrac{1.6 - 1.24}{d}$ → $\mathbf{d} = 1.3435$ m

To have optimal view of television:
For $\theta < 15°$, $\mathbf{d} > 1.3435$ m

2) To have optimal audio experience:
ΔPXT needs to be equilateral → $\angle TPX = \angle PXT = \angle XTP = 60°$

Let perpendicular bisector of PT to X be m.

So, $\sin 60° = \dfrac{m}{3.6}$ → $m = 3.1177$ m

By Pythagoras' Theorem,

$$3.1177^2 = (4 - \mathbf{d})^2 + (3 - 1.24)^2$$
$$4 - \mathbf{d} = \sqrt{3.1177^2 - 1.76^2}$$
$$\mathbf{d} = 1.4266 \text{ m } (> 1.3435)$$

∴ Ryan should position the armchair at **d** = 1.43 m [DB1] because it will provide him with the best possible user experience, with **both** optimal view of the television and audio experience. [DB1]

.....

..... [7]

~ End of paper ~

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中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

2025 Preliminary Examination
Secondary Four Express / Five Normal Academic

CANDIDATE NAME

FORM CLASS / SUBJECT GROUP / INDEX NUMBER

MATHEMATICS 4052/01

Paper 1

18 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on 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 paper clips, glue or correction fluid.

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

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Omission of essential working will result in loss of marks.
You are reminded of the need for clear presentation in your answers. Up to 2 marks may be deducted for improper presentation.

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.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	3	2	3	3	2	3	4
Q9	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**
3	2	2	3	6	6	3	3
Q17	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**Q23**	**Q24**
4	3	3	3	3	3	4	5
Q25	**Q26**						
8	5			**Presentation Deduction**	**−1 / −2**	**Total 90**	

This document consists of **20** printed pages.

Mathematical Formulae

Compound Interest

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

Measurement

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 Calculate $\dfrac{9.26}{\sqrt{51.76}-2.02^3}$, giving your answer correct to 5 significant figures.

-8.8362	

Answer ..... [1]

---

2 **(a)** Express 252 as a product of its prime factors.

$2^2\times3^2\times7$	

Answer ..... [1]

(b) The highest common factor (HCF) of two numbers is 21.
The lowest common multiple (LCM) of the two numbers is 252.
Both numbers are less than 100.
Find the two numbers.

$A = 3^2\times7$ $B = 2^2\times3\times7$ LCM = $252 = 2^2\times3^2\times7$ HCF = $21 = 3\times7$ The two numbers are 63 and 84.	

Answer ..... [2]

---

3 Given that $27^n = 8\sqrt{9^{6n}}$, find the value of 3^n.

$(3^3)^n = 8\times(3^{12n})^{\frac{1}{2}}$ $3^{3n} = 8\times3^{6n}$ $\dfrac{1}{8} = 3^{6n-3n}$ $3^{3n} = \dfrac{1}{8}$ $3^n = \sqrt[3]{\dfrac{1}{8}}$ $= \dfrac{1}{2}$	

Answer ..... [2]

---

4 **(a)** Simplify $(4n)^2-(4n+a)(4n-a)$.

$=16n^2-[(4n)^2-a^2]$

$=a^2$

Answer ..... [1]

(b) **Hence,** without the use of a calculator, evaluate $75^2-(78)(72)$.

$=(75)^2-[(75+3)(75-3)]$ M1

$=3^2$

$=9$

Answer ..... [2]

---

5 Cindy invested \$4200 in ABN Bank for 3 years. ABN Bank pays 1.8% per year compound interest. She would have earned the same amount of interest if she had invested the same amount of money for 3 years and 6 months in HKSB Bank which pays r% per year simple interest.

Calculate the value of r.

$$\text{Interest} = 4200\left(1+\frac{1.8}{100}\right)^3-4200$$

$$=230.9068944$$

$$\frac{4200\times r\times 3.5}{100}=230.9068944$$

$$r=1.5707952$$

$$=1.57$$

Answer ..... [3]

---

6 Simplify $(4x-5)(5x^2+4x-7)$.

$=$

$20x^3+16x^2-28x-25x^2-20x+35$

$=20x^3-9x^2-48x+35$

---

7 Rearrange the formula $\frac{x}{3}=\left(\frac{y}{7z-6w}\right)^{\frac{1}{3}}$ to make z the subject.

$$\frac{x^3}{27}=\frac{y}{7z-6w}$$
$$7x^3z-6x^3w=27y$$
$$7x^3z=27y+6x^3w$$
$$z=\frac{27y+6x^3w}{7x^3}$$

Answer $z=$ ..... [3]

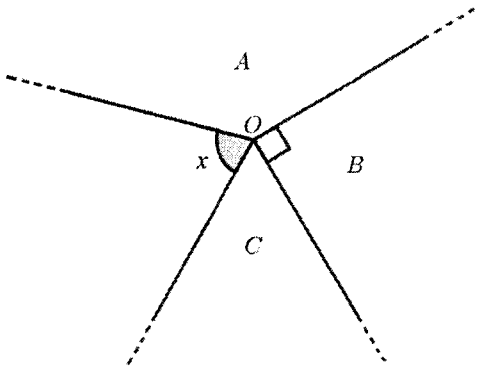
---

8 **(a)** A polygon has n sides. Two of its exterior angles are 50° and 70°, and the remaining exterior angles are each 16°. Find the value of n.

$$50+70+16(n-2)=360$$
$$16n=272$$
$$n=17$$

Answer ..... [2]

(b)



The diagram shows one interior angle of each of three regular polygons, A, B and C.
The polygons fit together at point O, leaving a space marked by angle x.
A is a regular nonagon, B is a square and C is an equilateral triangle.
Find angle x.

$$x=360-\left(\frac{(9-2)\times180}{9}+90+60\right)$$
$$=70°$$

Answer ..... [2]

---

9 An area of 1 km^2 is represented by 4 cm^2 on a map.

(a) Calculate, in km^2, the actual area of a volcanic crater which is represented by a circle of area 0.3 cm^2 on the map.

1 cm^2 : 0.25 km^2 Actual area = $0.25 \times 0.3 = 0.075 km^2$	

Answer .....km^2 [1]

(b) Find the scale of the map in the form $1 : n$.

1 cm^2 : 0.25 km^2 1 cm : 0.5 km 1 : 50 000	

Answer ..... [2]

---

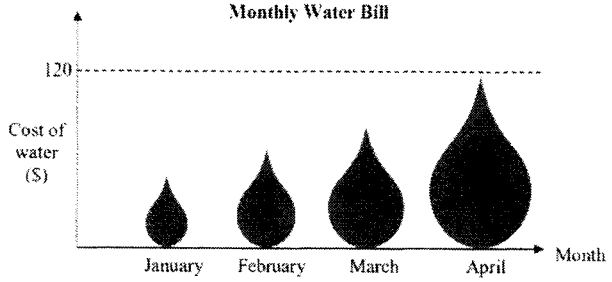
10 The base and the height of a triangle are each reduced by 40% followed by an increase by 50%. Find the percentage reduction in the area of the triangle.

Original area $= \frac{1}{2} \times b \times h = \frac{bh}{2}$ New area $= \frac{1}{2} \times (0.6)(1.5)b \times (0.6)(1.5)h$ $= \frac{0.81bh}{2}$ Percentage reduction $= \frac{1-0.81}{1} \times 100\%$ $= 19\%$	

Answer .....% [2]

---

11 Mrs Lim draws this graph to show her monthly water bill for the first four months of the year 2024.

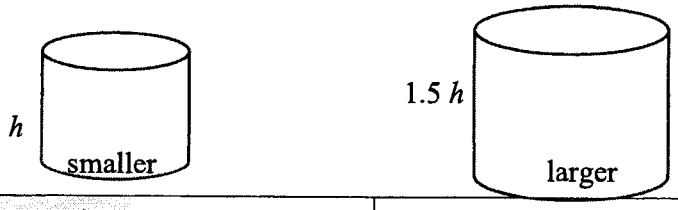


State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

No equal intervals indicated on the vertical axis and if the values start from 0. Unable to read the cost of water in the months before April. OR Not clear if the size of the water droplets, is referring to the area of the droplets or the height of the droplets. Unable to determine the annual water bill.	

---

12 Starlight Café sells latte drinks in two geometrically similar mugs.
The height of the larger mug is 1.5 times the height of the smaller mug, h.
Latte in a smaller mug and in a larger mug are sold at $3.30 and $13.20 respectively.
Mandy thinks that it is more value for money to buy latte in 4 smaller mugs than one larger mug.
Is Mandy correct? Justify your decision with calculations.



$\frac{V_1}{V_2} = \left(\frac{h}{1.5h}\right)^3 = \frac{h^3}{3.375h^3}$ Volume of 4 small mugs > Volume of 1 large mug $4 > 3.375$ Cost of 4 small mugs = $3.30 × 4 = $13.20 Cost of 1 large mug = $ 13.20 Mandy is correct. For the same amount paid for the latte, more latte is obtained from 4 small mugs of latte than from 1 large latte.	

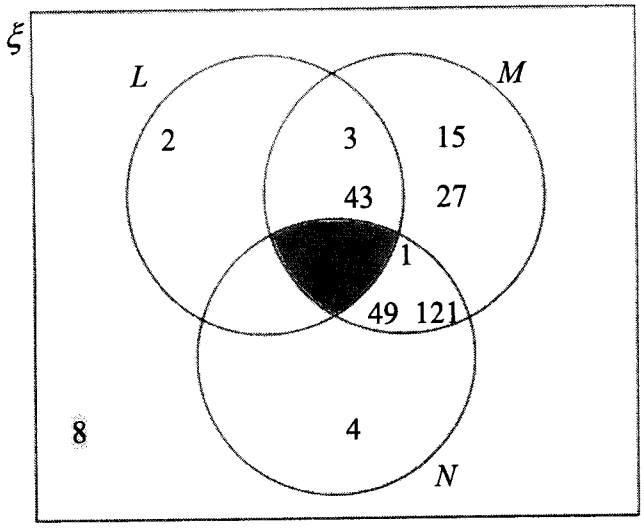
13 $\xi = \{1, 2, 3, 4, 8, 15, 27, 43, 49, 121\}$

$L = \{\text{Prime Numbers}\}$

$M = \{\text{Odd Numbers}\}$

$N = \{\text{Square Numbers}\}$

(a) Complete the Venn diagram to illustrate this information.
There are no elements in the shaded portion of the diagram.



[2]

(b) List the elements in $(M \cup L)'$

{4, 8}	

(c) Find the value of $\text{n}\big((L' \cup N) \cap (L \cup N')\big)$.

$(L' \cup N) = \{1, 4, 8, 15, 27, 49, 121\}$ $(L \cup N') = \{2, 3, 8, 15, 27, 43\}$ $\text{n}\big((L' \cup N) \cap (L \cup N')\big) = 3$	

(d) The numbers in ξ are each printed on one card.
If a card is picked at random from the ten cards, find the probability that the number printed on the card

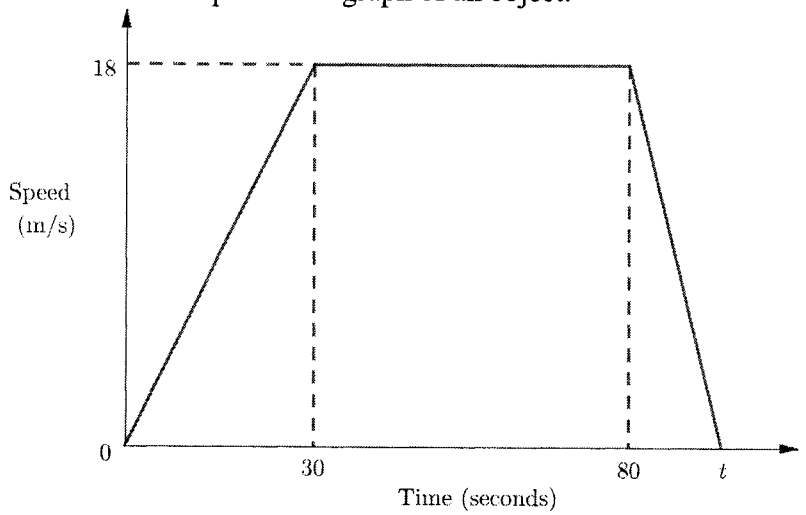
(i) is a perfect cube,

(1, 8, 27). Thus the probability is $\frac{3}{10}$.	

(ii) is a multiple of 3.

(3, 15, 27). Thus the probability is $\frac{3}{10}$.	

14 The diagram below shows the speed-time graph of an object.



(a) Calculate the speed of the object at 18 seconds. Give your answer in km/h.

Speed $= \frac{18}{30} \times 18 = 10.8$ m/s $= 38.88$ km/h	

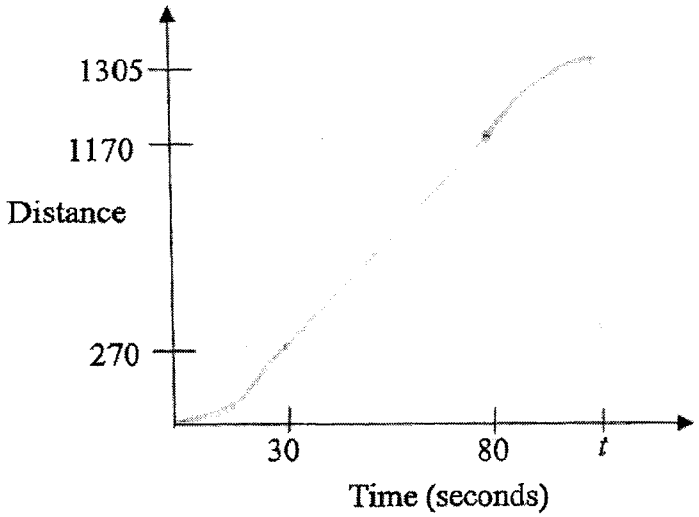
Answer .....km/h [2]

(b) At 80 seconds, the object starts decelerating at a rate that was twice its acceleration from 0 to 30 seconds, before coming to a stop at t seconds.
Calculate the total distance travelled on the journey.

Distance $= \frac{1}{2} \times 30 \times 18 + 50 \times 18 + \frac{1}{2} \times 15 \times 18$ $= 1305$ m	

(c) Draw the distance-time graph of the object on the grid given below.
You must label the values on the distance-axis clearly.

[2]



15 Tom has 46 blue and 29 red balls. He wants to use all the balls to fill a ball pit. He wants at least 70% of the balls to be blue. Find the smallest number of extra blue balls he needs to add to his ball collection.

$$\frac{46+x}{46+29+x} \geq \frac{7}{10}$$

$$460+10x \geq 525+7x$$
$$3x \geq 65$$
$$x \geq 21.666$$

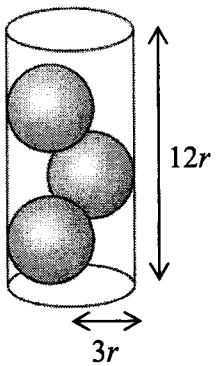
Smallest $x = 22$

Answer ..... [3]

16 Three spheres, each of radius $2r$ cm, are placed inside a cylinder. The cylinder has radius $3r$ cm and height $12r$ cm. Water is poured into the cylinder to fill it completely. The volume of water poured into the cylinder is $k\pi r^3$ cm^3. Find the value of k.

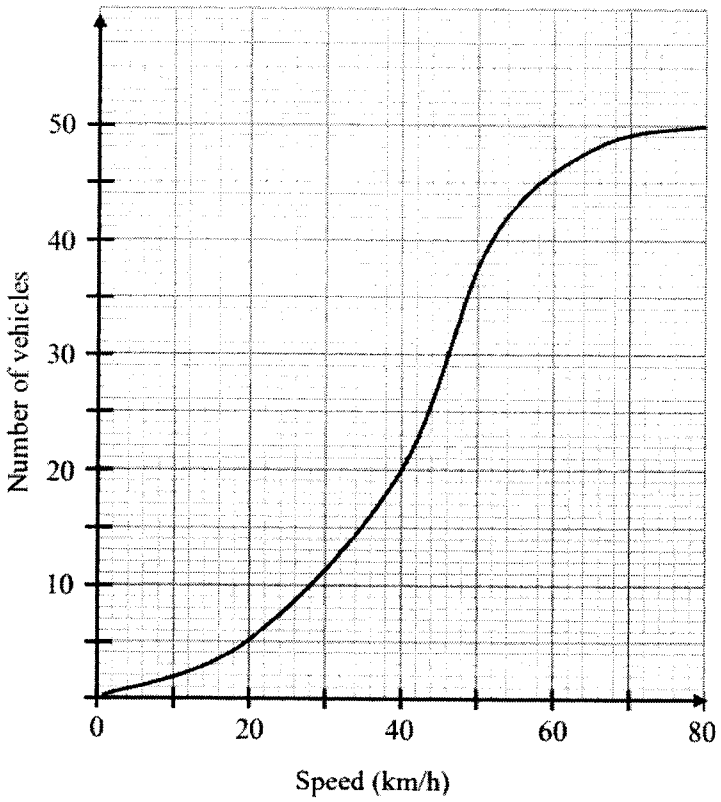
Vol of 3 spheres+Vol of water = Vol of cylinder

$$3\times\left(\frac{4}{3}\pi(2r)^3\right)+k\pi r^3 = \pi(3r)^3(12r)$$
$$32\pi r^3 + k\pi r^3 = 108\pi r^3$$
$$k\pi r^3 = 76\pi r^3$$
$$\Rightarrow k = 76$$



Answer ..... [3]

17 The cumulative frequency graph shows the speed of 50 vehicles passing by a narrow road within 5 minutes.



(a) If 8% of the 50 vehicles received a speeding ticket, find the speed limit on this road.

60 km/h	

Answer .....km/h [1]

(b) Find the interquartile range of the speed of the vehicles.

50 – 32 *or* 50 – 31 =18 =19	

Answer .....km/h [2]

(c) It was said that more than 50% of the vehicles are travelling at 45 km/h when passing through the narrow road. Explain, with reason, whether you agree with the statement.

Disagree. 50% of the vehicles are travelling at a speed less than 44km/h.	

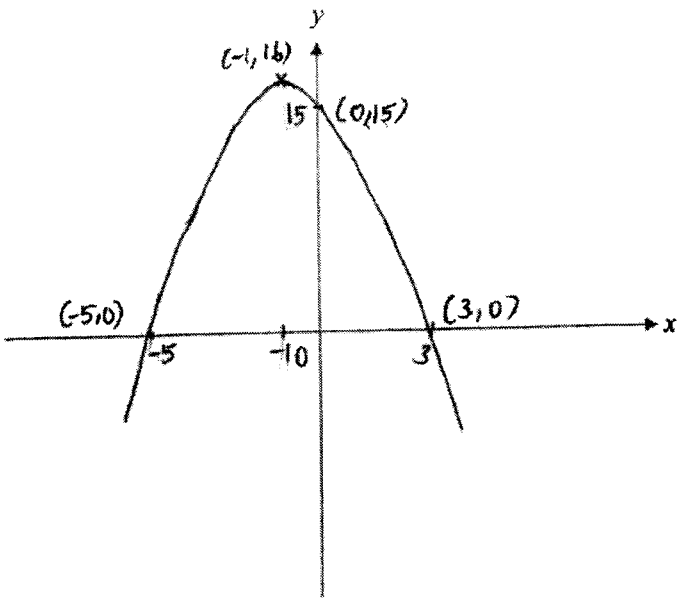
Answer .....

.....

..... [1]

18 Sketch the graph of $y = (x+5)(3-x)$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point of the curve.

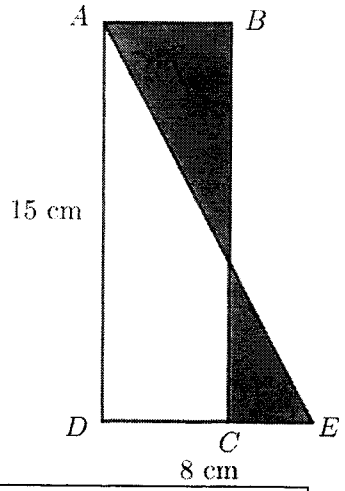
[3]



19 Given that n is an integer and $n > 1$, decide whether each statement in the table is **true** or **false**.
For each statement write **true** or **false** in the table
If you write **false**, give an example to justify your decision. [3]

Statement	True or False	Example (if false)
$n^3 > 1$	True	
$\frac{1}{n} > \frac{1}{n^2}$	True	
$(n-1)(n+3)$ is always odd	False	When $n = 3$, $(3-1)(3+3) = 12$, which is even

20 The figure shows a rectangle $ABCD$ with $AD = 15$ cm.
E is on DC produced such that $DE = 8$ cm.
The area of the shaded part X is 12 cm^2 more than the area of the shaded part Y.
Find the length of AB.



Let the unshaded region be Z. Area of X = 12 + Area of Y Area of X + Area of Z = 12 + Area of Y +Area of Z Area of $ABCD$ = Area of ΔADE + 12 $AB \times 15 = \frac{1}{2} \times 15 \times 8 + 12$ $AB = \frac{72}{15} = 4.8$ cm	

Answer .....cm [3]

21 The table shows the quiz scores for a group of 30 students.

Quiz score, m	Frequency
$0 < m \leq 5$	2
$5 < m \leq 10$	5
$10 < m \leq 15$	15
$15 < m \leq 20$	8

(a) Calculate an estimate for

(i) the mean scores of the students.

$$\text{mean} = \frac{2.5\times 2+7.5\times 5+12.5\times 15+17.5\times 8}{30}$$

$$= 12\frac{1}{3}$$

Answer ..... [1]

(ii) The standard deviation of the quiz scores.

$$\text{s.d.} = \sqrt{\frac{2.5^2\times 2+7.5^2\times 5+12.5^2\times 15+17.5^2\times 8}{30} - \left(12\frac{1}{3}\right)^2}$$

$$= 4.18$$

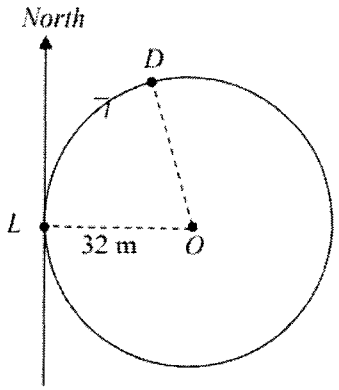
Answer ..... [1]

(b) A student who was sick did a make-up for the quiz.
The new mean mark was 13.
Given that the original median was 12, what can be deduced about the new median?

Answer The new median can be either 12 or larger than 12.
OR the new median cannot be lower than 12.

..... [1]

22 Alex flew an aerial drone from a landing site L. It flew in a circle of radius 32 metres in a clockwise direction shown in the diagram below. The centre of the circle is due east of L.



Find the bearing of the drone D from L after it travelled 43 metres along the circumference of the circle.

$$\frac{\theta}{360°} \times 2\pi(32) = 43$$

$$\theta = \frac{43 \times 360°}{2\pi(32)}$$

$$= 76.991°$$

$$\angle OLD = \frac{180° - 76.991°}{2}$$

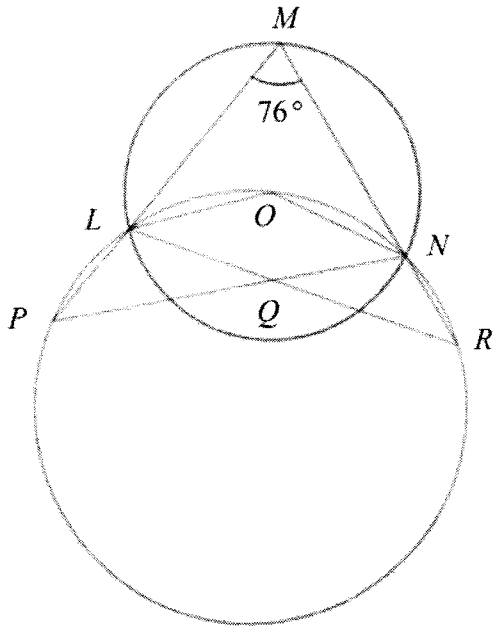
$$= 51.5045°$$

$$\text{Bearing} = 090° - 051.5045°$$

$$= 038.5°$$

Answer ..... [3]

23



The diagram shows two circles with the bigger circle passing through the centre, O, of the smaller circle. The circles intersect at L and N. PLM and MNR are straight lines.
PN and LR intersect at Q. Angle $LMN = 76°$.
Find, giving reason for each answer,

(a) angle QPL,

$\angle LON = 76° \times 2 = 152°$ (angle at center =2 x angles at circumference) $\angle QPL = 180° - 152°$ (angles in opposite segment) $= 28°$	

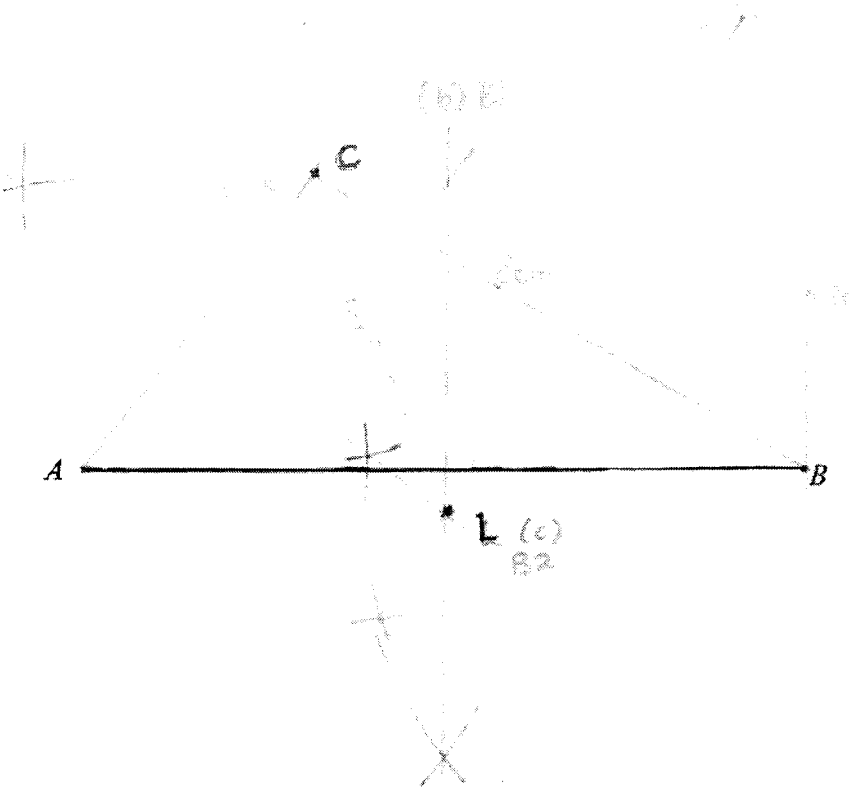
Answer ..... [2]

(b) angle NQR.

$\angle PNR = 76° + 28°$ (exterior angle of triangle) $= 104°$ $\angle NRL = 28°$ (angles in same segment) $\angle NQR = 180° - 104° - 28°$ ($\angle$ sum of Δ) $= 48°$	

Answer ..... [2]

24 The diagram shown below is part of a model drawing of the neighborhood.
Block B is due east of Block A. Block C has a bearing of 300° from B.
The distance between Block B and Block C is 8 cm.



(a) Mark and label the position of Block C on the model drawing. [1]

(b) On the same diagram, construct the perpendicular bisector of the line AB. [1]

(c) A letterbox is to be positioned such that it is equidistant from the three blocks.

(i) On the same diagram, mark L to represent the position of the letterbox. [2]

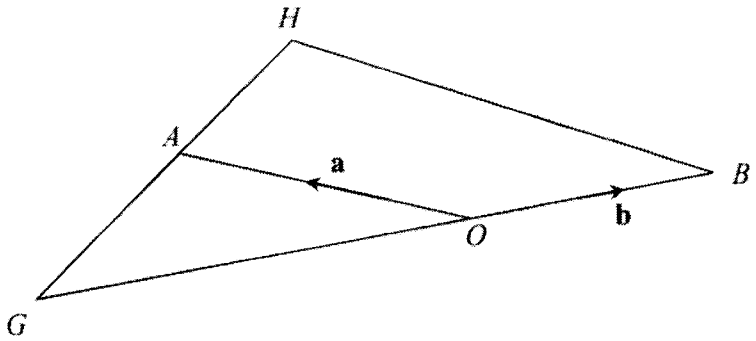
(ii) Given that the actual distance of $AB = 4$ km, calculate the actual distance between Block C and the letterbox, in kilometres.

2 km

Answer ..... [1]

25 The position vectors of A and B, relative to O, are **a** and **b** respectively.

$GB = 3OB$ and $GA = \frac{1}{2}GH$.



(a) Express each of the following in terms of **a** and **b**.

(i) $\overrightarrow{GA}$

$= \overrightarrow{GO} + \overrightarrow{OA} = 2\mathbf{b} + \mathbf{a}$	

Answer ..... [1]

(ii) $\overrightarrow{HB}$

$\overrightarrow{GH} = 2(2\mathbf{b} + \mathbf{a})$ $\overrightarrow{HB} = \overrightarrow{HG} + \overrightarrow{GB}$ $= -4\mathbf{b} - 2\mathbf{a} + 3\mathbf{b}$ $= -\mathbf{b} - 2\mathbf{a}$	

Answer ..... [2]

(b) Use your answer to **(a)(ii)** to explain why $OAHB$ is not a trapezium.

Answer $\overrightarrow{OA}$ is not a scalar multiple of $\overrightarrow{HB}$, hence, OA is not parallel to HB and since AH is also not parallel to OB, thus, $OAHB$ is not a trapezium as it has no parallel sides.

..... [1]

(c) Find the ratio of

(i) $\dfrac{\text{area of triangle } OHB}{\text{area of triangle } GHO}$,

$=\dfrac{\frac{1}{2}\times OB\times h}{\frac{1}{2}\times GO\times h}=\dfrac{1}{2}$	

Answer ..... [1]

(ii) $\dfrac{\text{area of triangle } OHA}{\text{area of } OAHB}$.

$\dfrac{\text{Area of}\Delta\text{OHB}}{\text{Area of}\Delta\text{GHO}}=\dfrac{1}{2}$ $\dfrac{\text{Area of }\Delta OHA}{\text{Area of }\Delta OHB}=\dfrac{1}{1}$ $\dfrac{\text{Area of }\Delta OHA}{\text{Area of }\Delta GHO}=\dfrac{1}{2}$ $\dfrac{\text{Area of }\Delta OHA}{\text{Area of } OAHB}=\dfrac{1}{2}$	

Answer ..... [2]

26 In sequence A, the first 3 terms are

$$a \quad ar \quad ar^2,$$

where a and r are constants.

In sequence B, the first term is a and the same non-zero number is added each time to obtain the next term.

The first 3 terms of sequence A are equal to the first, third and sixth term of Sequence B respectively.

(a) Show that $2r^2 - 5r + 3 = 0$.
Answer

Let the same non-zero number be d. Then we have

$ar = a + 2d$ $\qquad$ $ar^2 = a + 5d$

$d = \dfrac{ar - a}{2}$ $\qquad$ $d = \dfrac{ar^2 - a}{5}$

Equating the two equations

$$\frac{ar - a}{2} = \frac{ar^2 - a}{5}$$

$$\frac{r - 1}{2} = \frac{r^2 - 1}{5}$$

$$5r - 5 = 2r^2 - 2$$

$$2r^2 - 5r + 5 - 2 = 0$$

$$2r^2 - 5r + 3 = 0$$

[3]

(b) Find the value of r, justifying your answer.

$$2r^2 - 5r + 3 = 0$$

$$(2r - 3)(r - 1) = 0$$

$$r = \frac{3}{2} \quad \text{or} \quad r = 1$$

r cannot be 1 because the difference between consecutive terms in sequence B is non-zero.

Thus, $r = \dfrac{3}{2}$.

.....

.....

..... [2]