Name:_____( ) **Class: 4 ( )**

ANGLICAN HIGH SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATION 2025

S4

4052/01

MATHEMATICS

Paper 1 **21 August 2025**

Candidates answer on the Question Paper. **2 hours 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the space at the top of this page.
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 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. 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.

For Examiners' Use

Question	1	2	3	4	5	6	7
Marks							
Question	8	9	10	11	12	13	14
Marks							
Question	15	16	17	18	19	20	21
Marks							

Clarity/ Logic	Accuracy/ Precision	Units		**90**

Parent's Name and Signature:

Date:

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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

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

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

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Answer **all** the questions.

1 Simplify $\left(\frac{27\sqrt{a^3}}{b^{-3}}\right)^{-\frac{2}{3}}$, leaving your answer in positive index form.

1	$\left(\frac{27\sqrt{a^3}}{b^{-3}}\right)^{-\frac{2}{3}}$ $= \frac{3^{-2}a^{-1}}{b^2}$ $= \frac{1}{9ab^2}$	**M1 Open Bracket** **A1**

Answer ..... [2]

---

2 Expand and simplify $(x-y)^2-(x+1)(x-2y)$.

2	$(x-y)^2-(x+1)(x-2y)$ $= x^2-2xy+y^2-(x^2-2xy+x-2y)$ $= x^2-2xy+y^2-x^2+2xy-x+2y$ $= y^2-x+2y$	**M1 – expand** **M1 – correct sign when remove bracket** **A1**

Answer ..... [3]

---

3 Factorise completely $ax-2cy-cx+2ay$.

3	$ax-2cy-cx+2ay$ $= ax-cx-2cy+2ay$	

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	$=x(a-c)+2y(-c+a)$ $=x(a-c)+2y(a-c)$ $=(x+2y)(a-c)$	**M1** – Factorise x and $2y$ **A1**

Answer ..... [2]

---

4 **(a)** Solve the equation $39-\frac{3}{4}x=3-2(4-x)$.

4(a)	$39-\frac{3}{4}x=3-2(4-x)$ $39-\frac{3}{4}x=3-8+2x$ $39+5=2x+\frac{3}{4}x$ $44=\frac{11}{4}x$ $x=16$	**M1 – expand and rearrange** **A1**

Answer x = ... [2]

(b) Solve the equation $\frac{2x}{3-2x}-\frac{7}{x-3}=2$.

4(b)	$\frac{2x}{3-2x}-\frac{7}{x-3}=2$ $\frac{2x(x-3)}{(3-2x)(x-3)}-\frac{7(3-2x)}{(3-2x)(x-3)}=2$ $\frac{2x^2-6x-21+14x}{3x-9-2x^2+6x}=2$ $2x^2+8x-21=18x-18-4x^2$ $6x^2-10x-3=0$ $x=\frac{-(-10)\pm\sqrt{(-10)^2-4(6)(-3)}}{2(6)}$ $x=1.93$ *or* -0.260 (3s.f.)	**M1 – to single fraction** **M1 – apply formula** **A1**

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Answer x = ... [3]

---

5 Mr Chan is looking at Deepavali decorations. There are two lights, one green and one red, flashing at different intervals. The green light and the red light flash at intervals of 6 seconds and 8 seconds respectively. If the two lights start flashing at the same time, how long will it take for the two lights to next flash simultaneously?

Answer

5	$6 = 2 \times 3$ $8 = 2^3$ LCM = $2^3 \times 3 = 24$ It will take 24 s for the two lights to next flash simultaneously again.	**M1 – prime factorisation** **A1 – LCM**

..... s [2]

---

6 **(a)** Express 2250 as the product of its prime factors.

6a	$2250 = 2 \times 3^2 \times 5^3$	**B1**

Answer ..... [1]

(b) The number $\dfrac{2250h}{k}$, where h and k are integers, is a perfect cube.

Find the smallest positive integer values of h and of k.

6b	$2250 = 2 \times 3^2 \times 5^3$ $h = 3$ and $k = 2$	**B1**

Answer h = ...

k = ... [1]

(c) Find two smallest possible integers, one is odd and the other is even, such that they have a lowest common multiple of 2250 and a highest common factor of 45.

6c	$2250 = 2 \times 3^2 \times 5^3$ $45 = 3^2 \times 5$	**B1 each for 90 and 1125**

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	90 and 1125	

Answer ..... and ..... [2]

---

7 A student makes a pendulum by tying a string to a small solid sphere and hanging it from a retort stand. The time, in seconds, taken by the pendulum to swing from one end to the other and back again is called the period, P seconds. The period is directly proportional to the square root of the length of the string, L cm. If the value of P increases by 25%, what is the corresponding percentage change in the value of L ?

Answer

7	$P = k\sqrt{L}$ Let $P = a$ and $L = b$ $a = k\sqrt{b}$ $k = \frac{a}{\sqrt{b}}$ $P = \left(\frac{a}{\sqrt{b}}\right)\sqrt{L}$ New $P = 1.25a$ $1.25a = \left(\frac{a}{\sqrt{b}}\right)\sqrt{L}$ $\sqrt{L} = 1.25\sqrt{b}$ $L = 1.5625b$ Percentage change $= \frac{1.5625b - b}{b} \times 100$ $= 56.25\%$ The length of the string increased by 56.25%.	**M1** – the equation for direct proportion is given. **M1 – value of *L*** **A1 – Statement must be written**

..... % [3]

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8 The Great Pyramid of Giza, located in Egypt, has a surface area of 8.30×10^4 m^2 and a volume of 2.45×10^4 m^3. A vendor is selling geometrically similar replicas of the pyramid. The replica has a volume of 9.22×10^{-6} m^3. Estimate the surface area of the replica, giving your answer in m^2 and in standard form.

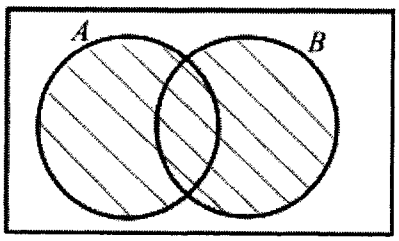
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7	Let the height of the Great Pyramid be H. Let the height of the replica be h $\left(\frac{h}{H}\right)^3 = \frac{\text{Volume of replica}}{\text{Volume of Great Pyramid}}$ $\left(\frac{h}{H}\right)^3 = \frac{9.22\times10^{-6}}{2.45\times10^{4}}$ $\frac{h}{H} = \sqrt[3]{\frac{9.22\times10^{-6}}{2.45\times10^{4}}}$ $= 7.2197\times10^{-4}$ Let S be the surface area of the Great Pyramid and s be the surface area of the replica $\frac{s}{S} = \left(\frac{h}{H}\right)^2$ $s = \left(\frac{h}{H}\right)^2 \times S$ $= \left(7.2197\times10^{-4}\right)^2 \times 8.30\times10^{4}$ $= 4.33\times10^{-2}\ \text{m}^2$	**M1 –** $\left(\frac{h}{H}\right)^3 = \frac{\text{Volume of replica}}{\text{Volume of Great Pyramid}}$ **M1 – value of** $\frac{h}{H}$ **M1 –** $\frac{s}{S} = \left(\frac{h}{H}\right)^2$ **A1**

Answer ..... m^2 [4]

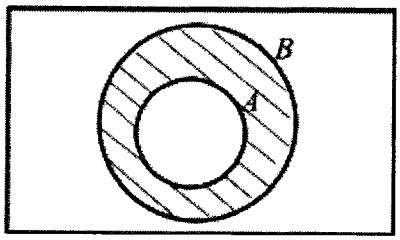
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9 **(a)** On the Venn diagram, shade the region which represents $(A' \cap B')'$.



B1 [1]

(b) Use set notation to describe the shaded region.



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9b	$A' \cap B$	**B1**

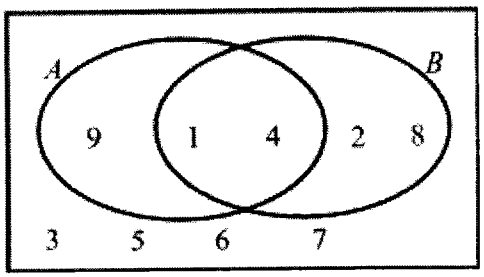
Answer ..... [1]

(c) $\xi = \{x : x \text{ is an integer such that } 0 < x < 10\}$

$A = \{1, 4, 9\}$

$B = \{1, 2, 4, 8\}$

The Venn diagram shows the universal set and the elements in each of its subsets.



(i) Describe the elements of Set A.

9ci	Perfect square, square numbers	**B1**

Answer

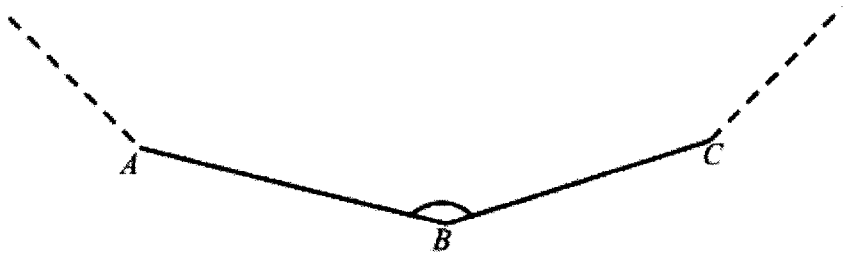
..... [1]

(ii) Find the value of $n(A \cup B')$.

9cii	7	**B1**

Answer ..... [1]

10



In the diagram above, ABC is part of a polygon. $\angle ABC$ is $148°$. The remaining interior angles are each equal to $139°$. Find the number of sides of this polygon.

10	Let n be the number of sides of the polygon.	**M1 – for forming equation** **A1**

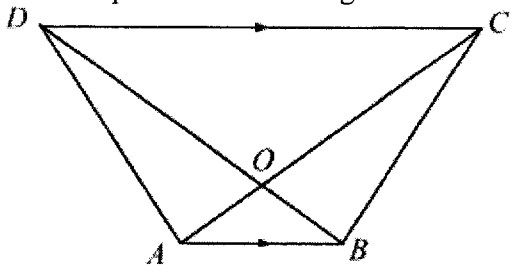
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	$180(n-2)=148+139(n-1)$ $180n-360=148+139n-139$ $180n-139n=148-139+360$ $41n=369$ $n=9$	

Answer ..... [2]

---

11 $ABCD$ is a trapezium where DC is parallel to AB. Diagonals AC and BD intersect at O. $DO = CO$.



(a) Name a pair of similar isosceles triangles.

Answer

11a	ΔAOB and ΔCOD	**B1**

..... [1]

(b) Show that triangle ABC and triangle BAD are congruent.
Give a reason for each statement you make.

11 b	AB is common length. ΔODC is an isosceles triangle since $DO = CO$, thus $\angle ODC = \angle OCD$. $\angle OBA = \angle ODC$ and $\angle OAB = \angle OCD$(alt $\angle$s, $DC // AB$), hence $\angle OBA = \angle OAB$ and $AO = BO$. $AC = AO + OC$ $= BO + OD$ $= BD$ Hence, by SAS property, triangle ABC and triangle BAD are congruent.	**B1 – state common length** **B1 – *AC = BD*** **B1 – state test**

..... [3]

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12 The test scores for a group of 24 students were recorded.

0	9	Test Scores
1		

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2	1	3					
3	1	3	4	7	7	7	8
4	2	5	7	9			
5	5	6	7	7	9	9	
6							
7	0	7	8	8			

Key 7 | 0 means 70 marks

The results are shown in the stem-and-leaf diagram.

(i) Find the interquartile range.

12i	$58 - 35.5 = 22.5$	**B1**

Answer ..... marks [2]

(ii) Find the median result.

12ii	$\frac{45+47}{2} = 46$	**B1**

Answer ..... marks [1]

(iii) Find the mode result.

12iii	37	**B1**

Answer ..... marks [1]

(iv) 15 students did not achieve a merit grade. Find the minimum score to achieve merit grade.

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12iv	56	**B1**

Answer ..... marks [1]

13 The table shows the number of books read by some students last month.

Number of books	0	1	2	3
Frequency	1	3	x	5

(a) Show that the mean value of the data is 2.

13a	$\frac{0(1)+1(3)+2x+3(5)}{1+3+x+5}=\frac{18+2x}{9+x}$ $=\frac{2(9+x)}{9+x}$ $=2$	**M1 – forming equation** **A1**

[2]

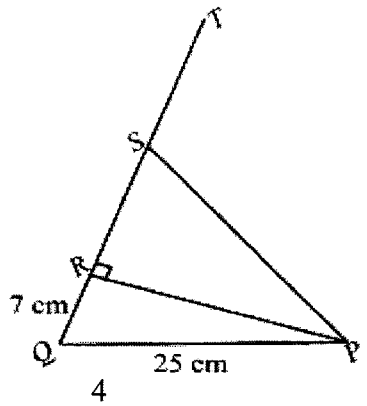
(b) The standard deviation of the data is 1. Find the value of x.

13b	$\sqrt{\frac{1(0)^2+3(1)^2+x(2)^2+5(3)^2}{9+x}-2^2}=1$ $\frac{48+4x}{9+x}-4=1$ $\frac{48+4x}{9+x}=5$ $48+4x=45+5x$ $x=3$	**M1 – forming equation** **M1 – simplifying** **A1**

Answer $x=$

..... [3]

14 In the diagram, $PQ = 25$ cm, $QR = 7$ cm and $\angle SRP = 90°$. $QRST$ is a straight line.



(a) Given that $\sin \angle TSP = \frac{4}{5}$, find the exact value of

[Turn Over

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(i) cos $\angle TSP$,

14ai	$\cos \angle TSP = -\frac{SR}{SP}$ $= -\frac{3}{5}$	**B1**

Answer cos $\angle TSP$ = ... [1]

(ii) the length of SR.

14aii	$RP = \sqrt{25^2 - 7^2}$ $= 24$ cm $\sin \angle RSP = \sin \angle TSP$ $\frac{4}{5} = \frac{RP}{SP}$ $SP = 30$ cm $\therefore SR = \sqrt{30^2 - 24^2}$ $= 18$ cm	**M1 – *RP*** **M1 – *SP*** **A1**

Answer ..... cm [3]

(b) A triangle with vertices ABC has an area of 16.9 cm^2. $AB = 8.9$ cm and $AC = 4.7$ cm.

Find the two possible values of angle BAC.

14b	Area of triangle $ABC = \frac{1}{2} \times AB \times AC \times \sin \angle BAC$ $16.9 = \frac{1}{2} \times 8.9 \times 4.7 \times \text{sn} \angle BAC$ $\sin \angle BAC = \frac{2 \times 16.9}{8.9 \times 4.7}$ $\angle BAC = 53.9°$ or $126.1°$ (1 d.p)	**M1 – for using area of triangle** **A1 – for both answers. No answer mark awarded if students only write down the acute angle**

Answer .....° and .....° [2]

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15 A new type of energy harvesting device is being developed to capture energy from small environmental vibrations. The engineers observe that the fraction of energy captured by the device during nth second of continuous operation, relative to its maximum capacity,

follows a specific pattern.

Time (second)	Fraction of energy captured relative to its maximum capacity
1st	$\frac{1}{2}\left(1-\frac{1}{2}\right)$
2nd	$\frac{1}{2}\left(\frac{1}{2}-\frac{1}{3}\right)$
3rd	$\frac{1}{2}\left(\frac{1}{3}-\frac{1}{4}\right)$
...	...
nth	...

(a) Write down the fraction of energy captured for the nth second of operation.

15a	$\frac{1}{2}\left(\frac{1}{n}-\frac{1}{n+1}\right)$	**B1**

Answer ..... [1]

(b) The team needs to find the total energy captured after K seconds of continuous operation.

Show that the total energy captured after K seconds is $\frac{1}{2}\left(1-\frac{1}{K+1}\right)$.

Answer

15b	Total energy captured after K seconds $= \frac{1}{2}\left(1-\frac{1}{2}\right) + \frac{1}{2}\left(\frac{1}{2}-\frac{1}{3}\right) + \frac{1}{2}\left(\frac{1}{3}-\frac{1}{4}\right) + \ldots +$ $\frac{1}{2}\left(\frac{1}{K-1}-\frac{1}{K}\right) + \frac{1}{2}\left(\frac{1}{K}-\frac{1}{K+1}\right)$ $= \frac{1}{2}\left(1-\frac{1}{K+1}\right)$	**M1 – Listing** **M1 – Factorise half** **A1**

[3]

(c) The energy harvesting device is considered a success if it is able to harvest at least 49.8% of its maximum capacity. Find the minimum number of seconds for which the device is considered a success.

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15c	$\frac{1}{2}\left(1-\frac{1}{K+1}\right)\geq 0.498$ $1-\frac{1}{K+1}\geq 0.996$ $0.004\geq\frac{1}{K+1}$ $K+1\geq\frac{1}{0.004}$ $K+1\geq 250$ $K\geq 249$	**M1 – form inequality** **M1 – simplify** **A1**

Answer ..... s [3]

16 Map A has a scale of 1: 200 000 and map B has a scale of 1: n.

The area of a lake on map A is 4 cm^2 while the area of the same lake on map B is 2.56 cm^2.

Find n.

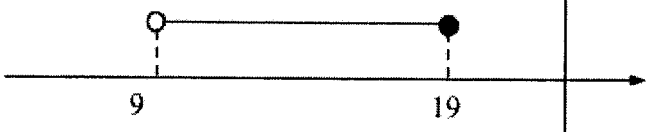
16	Map A 1 cm : 2 km 1 cm^2 : 4 km^2 4 cm^2 : 16 km^2 Actual area is 16 km^2. Map B 1 cm : $\frac{n}{100000}$ km 1 cm^2 : $\frac{n^2}{100000^2}$ 2.56 cm^2 : $\frac{2.56n^2}{100000^2}$ km^2 Actual area in terms of n is $\frac{2.56n^2}{100000^2}$. $\frac{2.56n^2}{100000^2}=16$ $\frac{1.6n}{100000}=4$ $1.6n=400000$ $n=250000$	**M1 – actual area** **M1 – in terms of n** **A1**

Answer x = ... [3]

17 Solve the inequality $\frac{3}{2}<\frac{x-3}{4}\leq\frac{9+x}{7}$, and represent your answer on a number line.

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Answer

17	$\frac{3}{2} < \frac{x-3}{4} \leq \frac{9+x}{7}$ $\frac{3}{2} < \frac{x-3}{4}$ $12 < 2x - 6$ $18 < 2x$ $9 < x$ $\frac{x-3}{4} \leq \frac{9+x}{7}$ $7x - 21 \leq 36 + 4x$ $3x \leq 57$ $x \leq 19$ $9 < x \leq 19$  	**M1 – Solve both inequalities** **A1 – Solve inqualities** **B1**

..... [3]

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18 E is the point $(2, -4)$ and F is the point $(-1, 3)$.

(a) Find the equation of the line EF in the form $y = mx + c$.'

Answer

18a	Gradient of $EF = \frac{3-(-4)}{-1-2}$ $= -\frac{7}{3}$ Equation of EF *is* $y = -\frac{7}{3}x + c$ Subst (2, -4) into equation $-4 = -\frac{7}{3} \times 2 + c$ $c = \frac{2}{3}$ Equation of EF is $y = -\frac{7}{3}x + \frac{2}{3}$	**M1 – find gradient** **A1**

..... [2]

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(b) The line PQ has equation $2y+\frac{14}{3}x-1=0$. Explain why PQ does not intersect the line EF.

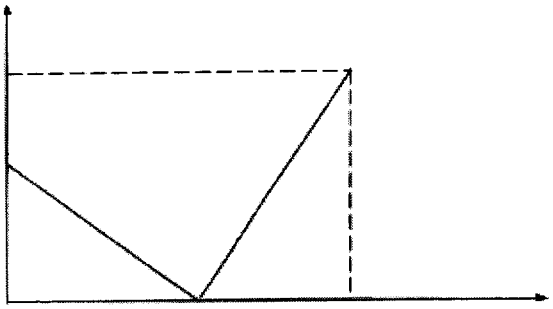
Answer

18b	Equation of PQ *is* $2y+\frac{14}{3}x-1=0$ $2y=-\frac{14}{3}x+1$ $y=-\frac{14}{3}x\div 2+\frac{1}{2}$ $y=-\frac{7}{3}x+\frac{1}{2}$ Since gradient of PQ = gradient of AB, PQ and AB are parallel and will not intersect.	**M1 – find gradient** **A1**

..... [2]

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19 The diagram shows the speed-time graph for a car's journey when it approaches a red traffic light and then drives off when the traffic light turns green. The area beneath each speed-time graph represents the distance travelled by the car.



(a) Calculate the acceleration of the car for the first 20 minutes.

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Answer

19a	Acceleration $= -36\,\text{km/hr} \div \frac{20}{60}\,\text{hr}$ $= -108\,\text{km/hr}^2$ OR Acceleration $= \frac{0-36}{\frac{20}{60}-0}$ $= -108\ \text{km/hr}^2$	**M1 – find gradient** **A1**

..... km/h^2 [2]

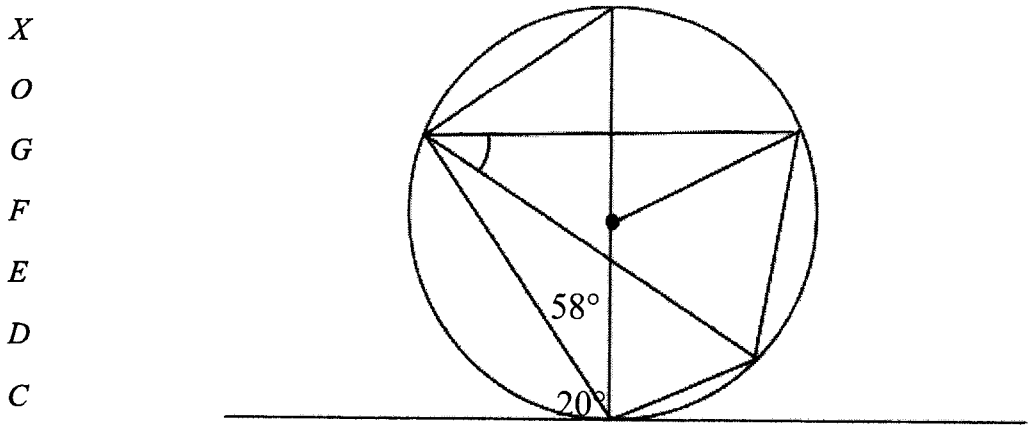
(b) Given that the distance travelled in the first 20 minutes is the same as the distance travelled between 20 minutes and 32 minutes, calculate the value of V.

19b	Same distance means the two area of triangles are the same. $\frac{1}{2} \times \frac{(32-20)}{60} \times V = \frac{1}{2} \times \frac{(20)}{60} \times 36$ $\frac{V}{10} = 6$ $V = 60$	**M1** **A1**

Answer $V =$ ..... [2]

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20 In the diagram below, the points A, E, C, G and F lie on the circle with centre O.
BCD is a tangent to the circle at C, AC is the diameter, angle $GEF = 40°$, angle $EGF = 58°$ and angle $DCG = 20°$.



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Find, stating your reasons clearly,

(i) angle ACG,

Answer

20i	$\angle ACD = 90°$(tan $\perp$ rad) $\therefore \angle ACG = 90° - 20°$ $= 70°$	**B1**

..... ° [1]

(ii) angle AEX,

20ii	$\angle AEG = \angle ACG$($\angle$ in same segment) $\angle AEX = 70° - 40°$ $= 30°$	**B1**

Answer ..... ° [1]

(iii) angle FOA,

20iii	$\angle FOA = 2 \times \angle AEX$ ($\angle$ at centre = 2 × $\angle$ at circumference) $= 60°$	**B1**

Answer ..... ° [1]

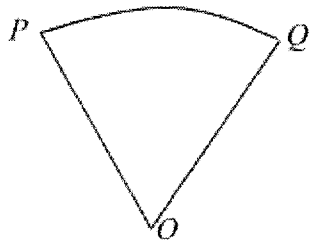
(iv) angle GCE.

20iv	$\angle GFE = 180° - 40° - 58°$($\angle$ sum of Δ) $= 82°$ $\therefore \angle GCE = 180° - 82°$($\angle$ in opposite segment) $= 98°$	**M1** **A1**

Answer ..... ° [2]

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21 The cross-section of a piece of metal in the shape of a sector of a circle with centre O and radius 20 cm is shown below. The piece of metal is 50 cm thick. The volume of the piece of metal is 2000 cm^3.



(a) Find angle POQ in radians.

21a	$\frac{1}{2}\times 20^2 \times \angle POQ \times 50 = 2000$ $\angle POQ = \frac{2000\times 2}{50\times 20^2}$ $= \frac{1}{5}$	**M1 – form equation** **A1**

Answer ..... rad [2]

(b) The piece of metal is melted and recast into a sphere. Find the radius of this sphere.

20iv	$\frac{4}{3}\pi r^3 = 2000$ $r^3 = \frac{2000\times 3}{4\pi}$ $r = \sqrt[3]{\frac{6000}{4\pi}}$ $r = 7.8159$ cm $r = 7.82$ cm (3s.f)	**M1 – form equation** **A1**

Answer $r =$ ..... cm [2]

---

22 In Bakery A, a chicken pie costs \$2.50, apple pie costs \$2.00 and a taro pie costs \$1.80. In Bakery B's a chicken pie costs \$0.30 less, \$0.20 more for apple pie and \$0.10 more for taro pie.

This information can be represented by the matrix

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(a) Peter wants to buy 5 chicken, 4 apple and 2 taro pies.
Jane wants to buy 4 chicken and 7 apple pies.

22a	$\begin{matrix} & C & A & T \\ Y = & \begin{pmatrix} 5 & 4 & 2 \\ 4 & 7 & 0 \end{pmatrix} & \begin{matrix} Peter \\ Jane \end{matrix} \end{matrix}$	**B1**

Represent their purchases in a 2×3 matrix **Y**.

Answer **Y** = [1]

(b) Evaluate the matrix **W** = **YX**.

22b	$W = \begin{pmatrix} 5 & 4 & 2 \\ 4 & 7 & 0 \end{pmatrix} \times \begin{pmatrix} 2.5 & -0.3 \\ 2.0 & 0.2 \\ 1.8 & 0.1 \end{pmatrix}$ $= \begin{pmatrix} 24.1 & -0.5 \\ 24 & 0.2 \end{pmatrix}$	**M1 – form equation** **A1**

Answer **W** = [2]

(c) What does the last column of **W** represent?
Answer

22c	The last column represents the **savings** for Peter and **extra cost** for Jane if they buy from **Bakery B**	**B1**

[1]

(d) Find the amount that Peter and Jane would spend in Bakery B.

22d	Peter would spend \$23.60 buying from Bakery B Jane would spend \$24.20 buying from Bakery B $\begin{pmatrix} 24.1 & -0.5 \\ 24 & 0.2 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 23.6 \\ 24.2 \end{pmatrix}$	**B1**

Answer Peter would spend \$ .....

and Jane would spend \$ ..... [1]

---

23 The drawing in the answer space below shows three tents, *A*, *B* and *C* pitched at East Coast Park.

(a) Construct

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(i) the perpendicular bisector of AB, [1]

(ii) the bisector of angle ABC. [1]

(b) A fast-food restaurant, M, is located equidistant from A and B as well as equidistant from BC and AB.

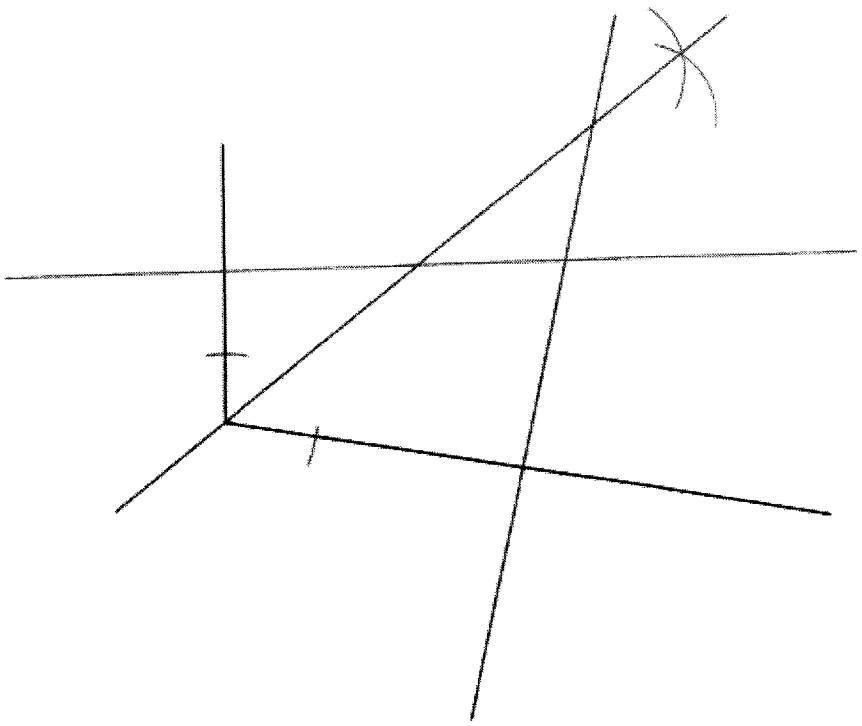
Mark and label M. [1]

(c) The toilet, T, is located equidistant from the 3 tents.

Mark and label T. [1]

Answer

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A

C

B

M

T

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NAME: _____ ( ) CLASS: 4 ( )

ANGLICAN HIGH SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATIONS 2025

S4

MATHEMATICS
Paper 2

4052/02
25 August 2025
2 hours 15 minutes

Candidates answer on the Question Paper.

MARKING SCHEME

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.
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 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.

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 Examiners' Use

Questions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Marks	**M**	**L/M/M**	**L**	**M**	**L**	**M/L**	**L/L/L**	**L/M/H/H**
Questions	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Marks	**M/H/L**	**M/M**	**M/H**	**L/L/M/M/M**	**L/L/M**	**L/M**	**L/L/M/M/ M/M**	**M/L/L/M/H**

Table of Penalties			
	Units		
	Clarity/Logic		
	Accuracy/Precision		**90**

Parent's Name and Signature:

Date:

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This document consists of 24 printed pages.

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

Sector area = $\frac{1}{2}r^2\theta$, where θ 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

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

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

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1 Rearrange the formula to make c the subject. $D=(a-c)^2-a^2$.

$D=(a-c)^2-a^2$ $(a-c)^2=D+a^2$ $a-c=\pm\sqrt{D+a^2}$ $c=a\pm\sqrt{D+a^2}$	**M1** **M1** **A1**

---

2 **(a)** A investor deposits \$18 000 with a finance company paying compound interest on a monthly basis at 6% per annum.

Calculate the interest received at the end of 5 years, correct to 2 decimal places.

$\text{Total Amount}=18000\left(1+\frac{6\div12}{100}\right)^{5\times12}$ $=24279.30$ $\text{Interest}=\text{Total Amount}-\text{Principal}$ $=24279.30-18000$ $=\$6279.30$	**M1** **A1**

(b) The price of a washing machine is \$900 before discount.
After selling the machine at a 20% discount, the seller still makes a profit of 25%.

Calculate the cost price of the washing machine.

Let x be the cost price of the washing machine $\text{Selling price of washing machine}=900\times80\%$ $=720$	**M1 for selling price of washing machine**
$\text{Percentage profit}=\frac{\text{Selling price}-x}{x}\times100\%$ $25=\left(\frac{720-x}{x}\right)\times100$ Divide both sides by 25 $1=4\left(\frac{720-x}{x}\right)$ $x=2880-4x$ $5x=2880$ $x=\$576$	**M1** **A1**

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(c) The price of a gaming laptop is \$2 999. John buys this laptop on hire purchase after putting a down payment of \$600. For the remaining amount of the laptop, John has to pay the seller a monthly instalment of \$120 over 2 years.

Calculate the interest rate charged by the seller.

P, remaining amount owed to seller $= \$2999 - \$600$ $= \$2399$ Total amount paid to seller over 2 years $= 24 \times \$120$ $= \$2880$ Interest earned by seller $= \$2880 - \$2399$ $= \$481$	**M1 for finding interest**
Using $I = \frac{PRT}{100}$ $481 = \frac{2399 \times R \times 2}{100}$ $R = 10.025$ $= 10.0\%$	**M1 apply formula** **A1**

---

3 Write as a single fraction in its simplest form $\frac{2}{9x^2-1} + \frac{1}{1-3x}$.

$\frac{2}{9x^2-1} + \frac{1}{1-3x}$ $= \frac{2}{(3x-1)(3x+1)} - \frac{1}{3x-1}$ $= \frac{2-1(3x+1)}{(3x-1)(3x+1)}$ $= \frac{-(3x-1)}{(3x-1)(3x+1)}$ $= \frac{-1}{3x+1}$	**M2 for factorising $x^2 - 1$ and switching operation sign.** **A1**

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4 **(a)** Express $-x^2+4x-3$ in the form $a(x+b)^2+c$.

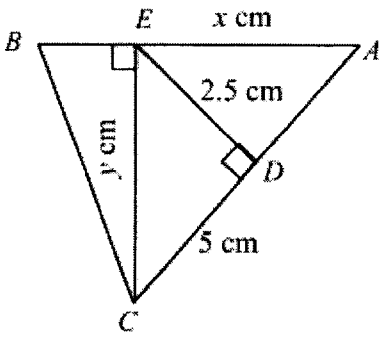
$-x^2+4x-3=-(x^2-4x+3)$ $=-((x-2)^2-4+3)$ $=-(x-2)^2+1$	**M1 for factorising** **A1**

(b) Hence, write down the coordinates of the turning point of the graph $-x^2+4x-3$.

Coordinates of turning point = (2,1)	**B1**

---

5 In triangle ABC, angle CDE and angle CEB are right angles.
$DE = 2.5$ cm, $CD = 5$ cm, $AE = x$ cm and $CE = y$ cm.



(a) **(i)** Show that ΔECD and ΔACE are similar.

Angle ECD = Angle ACE (common angle) Angle EDC = Angle AEC = 90° (given) By AA test, the 2 triangles are similar.	**B1**

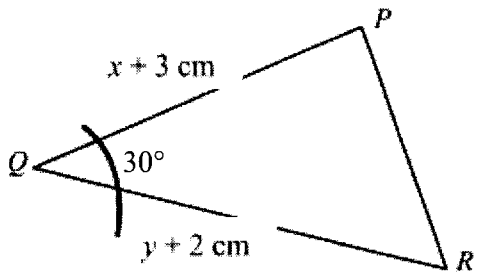
(ii) Express y in terms of x.

$\frac{ED}{AE}=\frac{CD}{CE}$ $\frac{2.5}{x}=\frac{5}{y}$ $y=2x$	**B1**

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(b) **(i)** In triangle PQR, angle $PQR = 30°$, $PQ = x + 3$ cm and $QR = y + 2$ cm.

Express the area of triangle PQR in terms of x and y.



Area of $\Delta PQR = \frac{1}{2}(y+2)(x+3)\sin 30°$ $= \frac{1}{4}(y+2)(x+3)$ cm^2	**B1**

(ii) The area of triangle PQR is $17\frac{1}{2}$ cm^2.

Using your answer in **a(ii)** and **b(i)**, find the value of x and of y.

$\frac{1}{4}(x+3)(y+2) = 17\frac{1}{2}$ $\frac{1}{4}(x+3)(2x+2) = \frac{35}{2}$ $2x^2 + 8x + 6 = 70$ $2x^2 + 8x - 64 = 0$ $x^2 + 4x - 32 = 0$ $(x-4)(x+8) = 0$ $x - 4 = 0$ or $x + 8 = 0$ $x = 4$ or $x = -8$ (NA)	**M1 for students to form the quadratic equation.** **M1 for solving the quadratic equation**

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When $x = 4$, $y = 2(4)$ $= 8$	**A1**

---

6 In the Singapore F1 Grand Prix, the drivers must complete 62 laps around a circuit that is 4.940 km long.
One F1 driver completed 32 laps in 65 minutes.

What must be the minimum average speed for the remaining laps if he wants to complete the race in at most two hours?

Distance travelled in the first 32 laps $= 32 \times 4.940$ $= 158.08$ km	
Time taken $= \frac{65}{60}$ hours	**M1 for calculating the distance and times for the first 32 laps.**
Distance to travel in the next 30 laps $= 30 \times 4.940$ $= 148.2$ km	
$\frac{\text{Distance}}{\text{Speed}} \leq \frac{55}{60}$	**M1 for setting up the inequality or equation to calculate the minimum speed in the next 30 laps.**
$\frac{148.2}{\text{Speed}} \leq \frac{55}{60}$	
$148.2 \leq \text{Speed} \times \frac{55}{60}$	
$\text{Speed} \geq 148.2 \div \frac{55}{60}$	
Speed ≥ 161.67 km per hour	**A1**

---

7 The position vector of point C is $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$. The position vector of point D is $\begin{pmatrix} 4 \\ h \end{pmatrix}$. $|\overrightarrow{CD}| = \sqrt{20}$.

Find the two possible values of h.

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$\overrightarrow{CD}=\overrightarrow{CO}+\overrightarrow{OD}$ $=\begin{pmatrix}-2\\3\end{pmatrix}+\begin{pmatrix}4\\h\end{pmatrix}$ $=\begin{pmatrix}2\\3+h\end{pmatrix}$	**M1 for** $\overrightarrow{CD}$
$\sqrt{2^2+(3+h)^2}=\lvert\overrightarrow{CD}\rvert$ $\sqrt{4+9+6h+h^2}=\sqrt{20}$ $h^2+6h+13=20$ $h^2+6h-7=0$ $(h+7)(h-1)=0$ $h=-7 \text{ or } 1$	**M1 to form quadratic equation** **A1**

8 There are 180 oranges in a box.
The table shows the distribution of the masses of these oranges.

Mass (m g)	$90 < m \leq 100$	$100 < m \leq 110$	$110 < m \leq 120$	$120 < m \leq 130$	$130 < m \leq 140$
Frequency	10	28	51	45	48

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

11.9 g	**B1**

(b) The weighing machine was faulty and overestimated each of the oranges by 5g.

Explain, with a reason, what will happen to the standard deviation.

Standard deviation remains the same. Every value is an overestimate, hence, the spread will not change the standard deviation.	**B1** **B1 for reason**

(c) Explain why the range of the masses of oranges may not be 50g.

The data is **grouped**, the smallest data is greater than 90g and the largest data is at most 140g. therefore, the actual range could be less than 50g.	**B1**

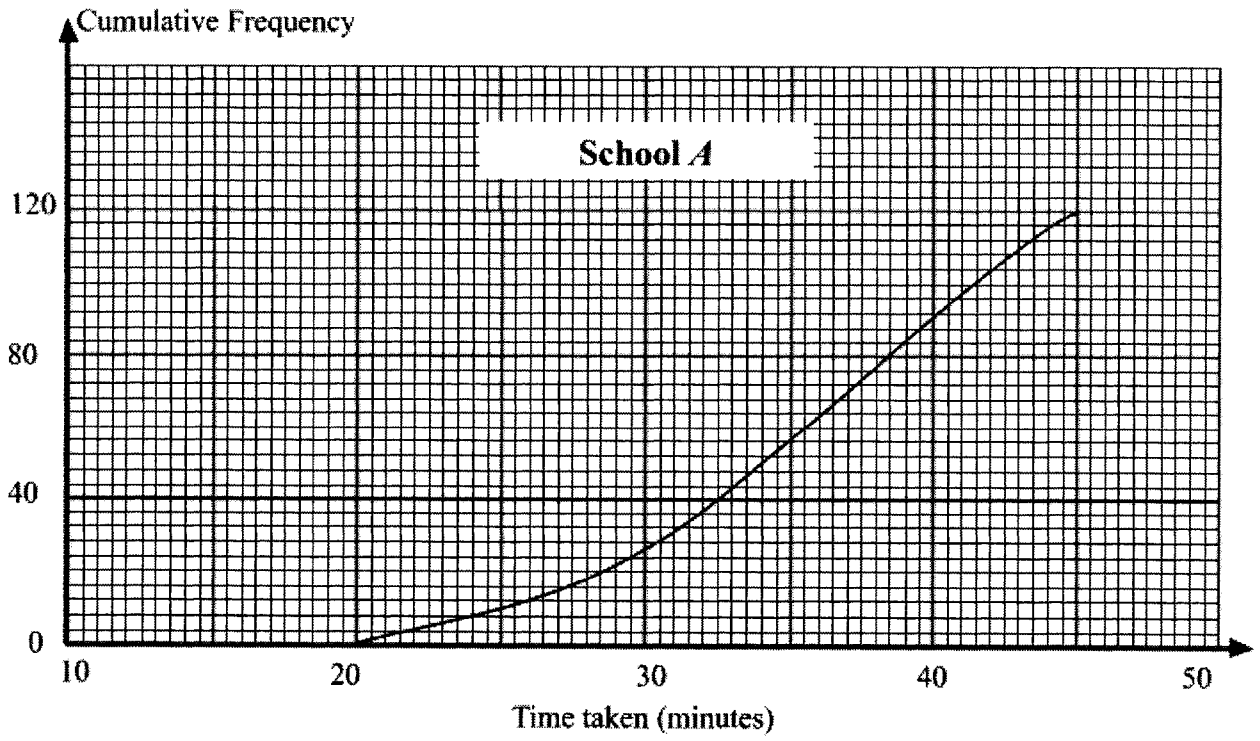
(d) Roy says, "The modal class is the interval $110 < m \leq 120$ but the modal mass may not be in the interval $110 < m \leq 120$." Is he correct? Give a reason for your answer.

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He is correct. Difference between modal mass and modal class. Or show evidence that the students know is it about. The mode mass refers to the mass with the highest frequency. However, the frequency of each mass is not known. The modal class may be in the interval $110 < m \leq 120$.	**B1** **B1**

---

9 The time taken by 120 students to travel to school A was recorded.
The cumulative frequency curve below shows the distribution of their commute times.

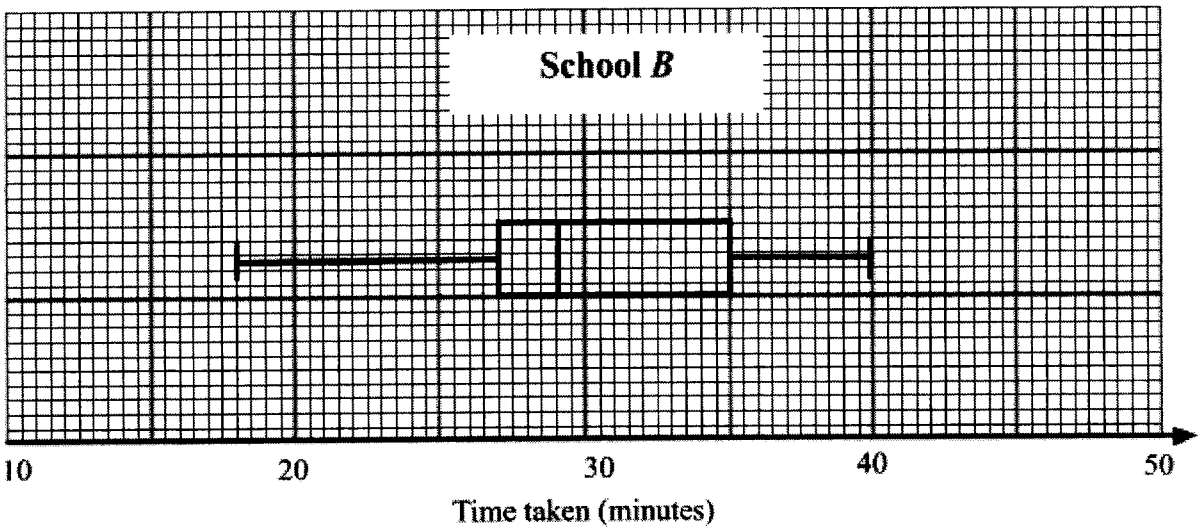


(a) Calculate the percentage of students who took at least 35 minutes to reach school.

$53\frac{1}{3}\%$ or 53.3%	**B1**

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The commute times of another group of 120 students from school *B* were recorded.
The box-and -whisker plot below shows the distribution of their travel times.



(b) Mr Chan claims that in school B, there are twice as many students who take less than 27 minutes, than those who take more than 35 minutes.

Comment, with reasons on whether the data supports the claim.

False. There are equal numbers of students who took less than 27 mins and students who took more than 35 mins.	**B1** **B1**

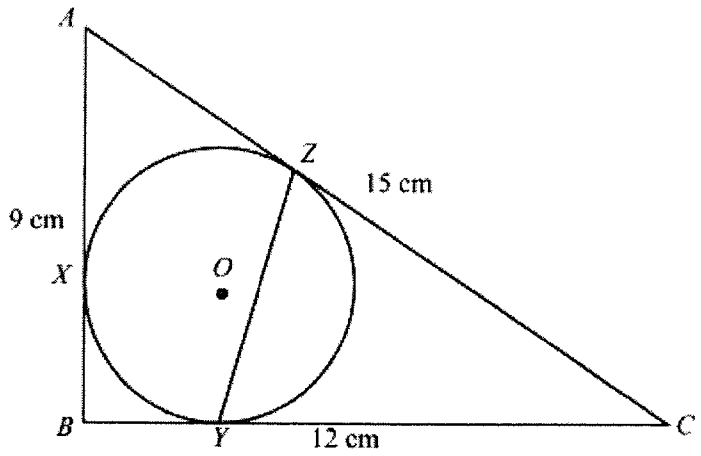
(c) Give two comments comparing the commute times of the two groups of students.

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Median for 1st group = 35.5 minutes. Median for 2nd group = 29 minutes. The commute time for the 2nd group is shorter as it has a lower median.	**B1**
The interquartile range for the first group is 9minutes while the interquartile range for the second group is 8 minutes. The 2nd group has more consistent commute times as its interquartile range is smaller.	**B1**

---

10 In the diagram, triangle ABC is a right-angled triangle.
$AB = 9$ cm, $BC = 12$ cm and $AC = 15$ cm.
A circle with centre O and radius 3 cm is inscribed inside triangle ABC.
The circle touches the sides of the circle at X, Y and Z respectively.



(a) Show that the obtuse angle $YOZ = 2.50$ radians, correct to 3 significant figures.

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$\tan \angle YOC = \frac{9}{3}$ $\angle YOC = \tan^{-1}(3)$ $= 1.2490$ rad $\therefore \quad \angle YOZ = 2 \times 1.2490$ rad $= 2.50$ rad(3s.f) (shown)	**M1 for finding angle *YOC* and angle *YOZ*.** **A1**

(b) Find the perimeter of the major segment *YXZ*.

Length of major arc $YXZ = 3(2\pi - 2.50)$ cm $= 11.34956$ cm Length of chord $YZ = \sqrt{3^2 + 3^2 - 2 \times 3 \times 3 \cos 2.50}$ cm $= 5.69391$ cm Perimeter of major segment $YXZ = 11.34956 + 5.69391$cm $= 17.04347$ cm $= 17.0$ cm (3s.f)	**M1 for finding length of major arc.** **M2 for find length of chord *YZ* using cosine rule.** **A1**

---

11 A group of N children are at school celebrating National Day.
The children come in either red or white T-shirts.
Three girls from the group wore white T-shirts.

(a) Two children are selected at random from the group.

The probability that both are girls wearing white T-shirts is $\frac{1}{70}$.

Find N.

$\frac{3}{N} \times \frac{2}{N-1} = \frac{1}{70}$ $420 = N(N-1)$ $N^2 - N - 420 = 0$ $(N-21)(N+20) = 0$	**M1 for forming the quadratic equation** **A1**

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$N-21=0$ $N+20=0$ $N=21$ $N=-20$ (NA)	

(b) One child is selected at random.

The probability that it is a girl wearing a red T-shirt is $\frac{3}{7}$.
Three children are chosen at random.
The probability that one is a boy wearing a white T-shirt and two are girls wearing red T-shirts is $\frac{108}{665}$.

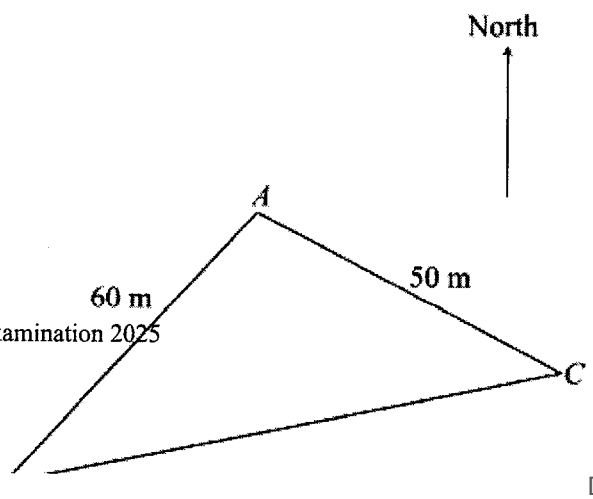
Find the value of a, of b and of c as shown in the table of information about the group of children.

	White T-shirts	Red T-shirts
Boys	a	b
Girls	3	c

$\frac{c}{21}=\frac{3}{7}$ $c=9$	**B1**
$\frac{a}{21}\times\frac{9}{20}\times\frac{8}{19}\times 3=\frac{108}{665}$ $a=\frac{108}{665}\div\left(\frac{9\times8\times3}{21\times20\times19}\right)$ $=6$	**B1**
$b=21-9-3-6$ $=3$	**B1**

---

12 The diagram shows three points A, B and C on horizontal ground.
A is at a bearing of 040° from B and C is at a bearing of 125° from A.
$AB = 60$ m and $AC = 50$ m.



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(a) Find

(i) the bearing of B from A,

Bearing of B from $A = 360° - 140°$ (sum of interior angles, //North lines) $= 220°$	**B1**

(ii) the area of triangle ABC,

Angle $BAC = 220° - 125°$ $= 95°$	**M1 for angle *BAC***
Area of triangle $ABC = \frac{1}{2} \times 60 \times 50 \times \sin 95^\circ$ $= 1494.29 \text{ m}^2$ $= 1490 \text{ m}^2$ (3 s.f)	**A1**

(iii) the distance BC,

$BC = \sqrt{60^2 + 50^2 - 2(60)(50)\cos 95^\circ}$ $= 81.3814$ m $= 81.4$ m (3 s.f)	**M1 for cosine rule** **A1**

(iv) angle ACB,

$\frac{60}{\sin \angle ACB} = \frac{81.3814}{\sin 95^\circ}$ $\sin \angle ACB = \frac{60 \sin 95^\circ}{81.3814}$ $\angle ACB = 47.262°$ $= 47.3°$ (1d.p)	**M1 for using sine rule** **A1**

(v) the shortest distance AX, where X is a point along BC.

AX is the perpendicular distance from A to BC. **Method 1:**	**M1 for equating area of triangle**

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$\frac{1}{2} \times BC \times AX = \frac{1}{2} \times 60 \times 50 \times \sin 95^\circ$ $AX = \frac{60 \times 50 \times \sin 95°}{81.3814}$ $= 36.723$ m $= 36.7$ m (3 s.f) **Method 2:** $\sin 47.262° = \frac{AX}{50}$ $AX = 50 \sin 47.262°$ $= 36.723$ m $= 36.7$ m(3s.f)	**A1** **M1 for using sine rule** **A1**

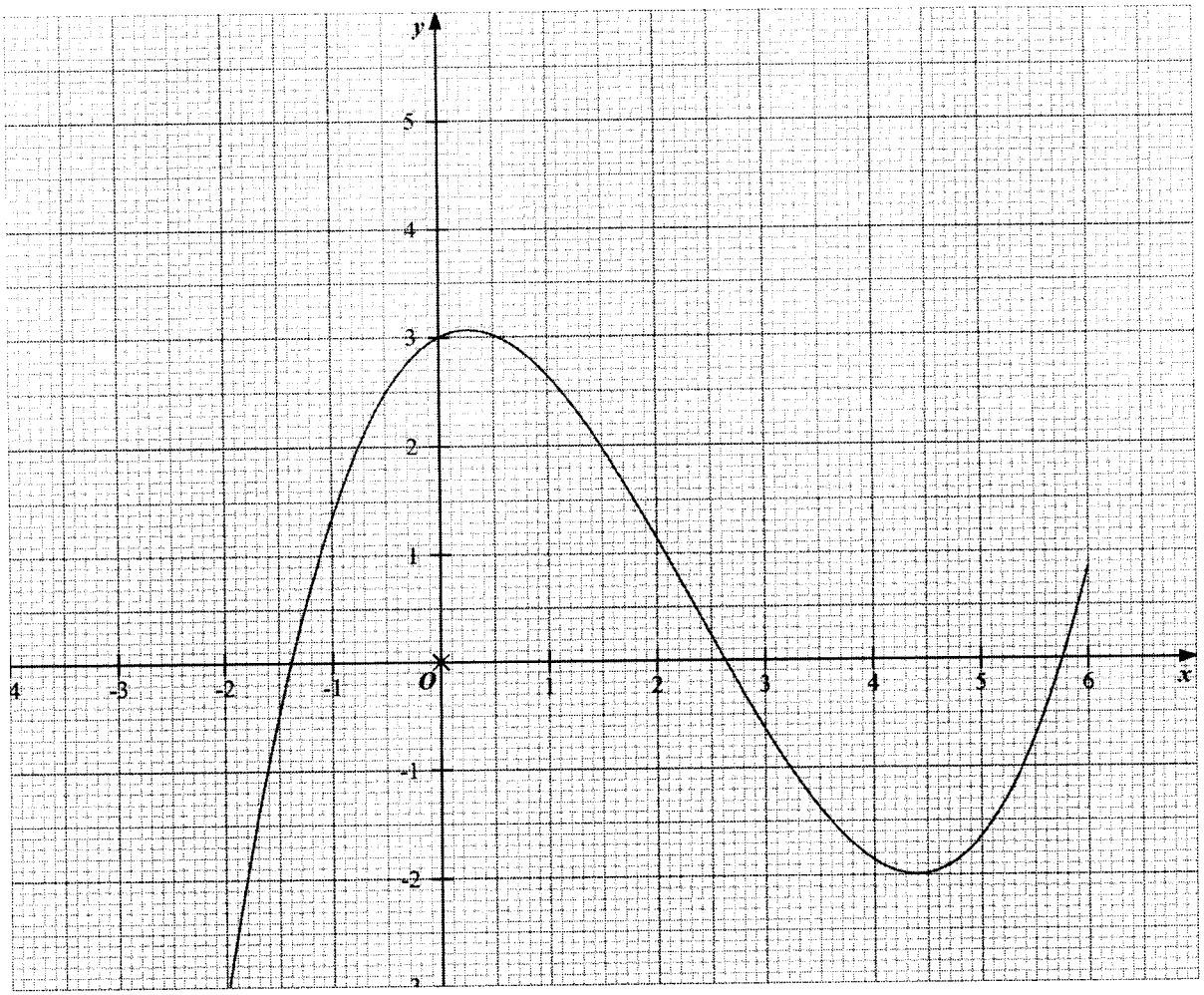
(b) Point A is the base of a vertical mast AT. The angle of depression of C from the T is 33°. Find the greatest angle of elevation of T from a point along BC.

Let height of vertical mast be p m. $\tan 33° = \frac{p}{50}$ $p = 50 \tan 33°$ $= 32.470$ m	**M1 for finding height of mast**
Greatest angle of depression is at perpendicular distance of A from BC, which is AX. $\tan \angle AXT = \frac{AT}{AX}$ $\angle AXT = \tan^{-1}\left(\frac{32.470}{36.723}\right)$ $= 41.483°$ $= 41.5°$(1d.p)	**M1 for TOA** **A1**

---

13 The graph of $y = \frac{1}{7}x^3 - x^2 + \frac{1}{2}x + 3$ is drawn on the grid.

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Using your graph,

(a) write down the range of values of x such that $y \geq 2$.

$-0.75 \leq x \leq 1.50$ Accept answers ± 0.1 from the limits.	**B1**

(b) find the gradient of the tangent to the curve where $x = -0.5$.

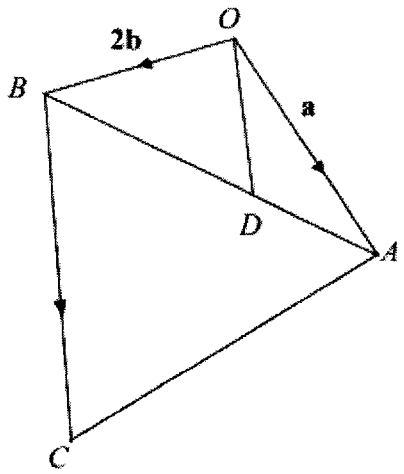
Gradient $= 1.6$ Accept ± 0.2	**M1 – the tangent is drawn.** **A1**

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(c) by drawing a suitable straight line on the grid, solve the equation $6x^3 - 42x^2 + 126 = 21x$.

$6x^3 - 42x^2 + 126 = 21x$ $x^3 - 7x^2 + 21 = \frac{7}{2}x$ $\frac{1}{7}x^3 - x^2 + 3 = \frac{1}{2}x$ $\frac{1}{7}x^3 - x^2 + \frac{1}{2}x + 3 = \frac{1}{2}x + \frac{1}{2}x$ $= x$ Consider the intersection of $y = \frac{1}{7}x^3 - x^2 + \frac{1}{2}x + 3$ and the line $y = x$ $x = 1.7$ or $x = -1.7$ Accept ± 0.1	**M1 for obtain the straight line** **M1 for drawing the straight line** **A1**

14



OACB is a quadrilateral.

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = 2\mathbf{b}$ and $\overrightarrow{BC} = 2\mathbf{a} + 2\mathbf{b}$. $BD : DA = 2 : 1$.

(a) Write each of the following in terms of **a** and **b**,

(i) $\overrightarrow{AB}$,

(i) $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ $= -\mathbf{a} + 2\mathbf{b}$	**B1**

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(ii) $\overrightarrow{CA}$,

(ii) $\overrightarrow{CA} = \overrightarrow{CB} + \overrightarrow{BO} + \overrightarrow{OA}$ $= -2\mathbf{a} - 2\mathbf{b} - 2\mathbf{b} + \mathbf{a}$ $= -\mathbf{a} - 4\mathbf{b}$	**B1**

(iii) $\overrightarrow{DO}$.

(iii) $\overrightarrow{DO} = \overrightarrow{DB} + \overrightarrow{BO}$ *o.e.* $= \frac{2}{3}\overrightarrow{AB} - 2\mathbf{b}$ $= \frac{2}{3}(-\mathbf{a} + 2\mathbf{b}) - 2\mathbf{b}$ $= -\frac{2}{3}\mathbf{a} - \frac{2}{3}\mathbf{b}$ $= -\frac{2}{3}(\mathbf{a} + \mathbf{b})$	**B1**

(b) Explain why $\overrightarrow{DO}$ is parallel to $\overrightarrow{BC}$.

$\overrightarrow{BC} = 2\mathbf{a} + 2\mathbf{b}$ $= 2(\mathbf{a} + \mathbf{b})$ $\overrightarrow{DO} = -\frac{2}{3}(\mathbf{a} + \mathbf{b})$ Therefore BC is parallel to DO.	**B1** $\overrightarrow{BC}$ and $\overrightarrow{DO}$ are shown in $(\mathbf{a} + \mathbf{b})$ form. Accept $\overrightarrow{DO} = -\frac{1}{3}\overrightarrow{BC}$ Accept $\overrightarrow{BC} = -3\overrightarrow{DO}$

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(c) Show that the area of $\dfrac{\text{Area of triangle } OBD}{\text{Area of triangle } BCD} = \dfrac{1}{3}$.

Method 1: using $Area = \frac{1}{2}ab\sin C$ to prove. $\angle OBD = \angle DBC$ (alterante angle $CB//DO$) $\dfrac{\text{Area of triangle } OBD}{\text{Area of triangle } BCD}$ $= \dfrac{\frac{1}{2}AB \times OD \sin \angle OBD}{\frac{1}{2}AB \times BC \sin \angle DBC}$ $= \dfrac{OD}{BC}$ $= \dfrac{1}{3}$ because $BC:OD = 3:1$	**B1**
Method 2: Using same height (ht) between $CB//DO$ to prove. $\dfrac{\text{Area of triangle } OBD}{\text{Area of triangle } BCD}$ $= \dfrac{\frac{1}{2}OD_{base} \times ht}{\frac{1}{2}BC_{base} \times ht}$ $= \dfrac{OD}{BC}$ $= \dfrac{1}{3}$ because $BC:OD = 3:1$	

(d) Find

(i) $\dfrac{\text{Area of triangle } BCD}{\text{Area of triangle } CAD}$,

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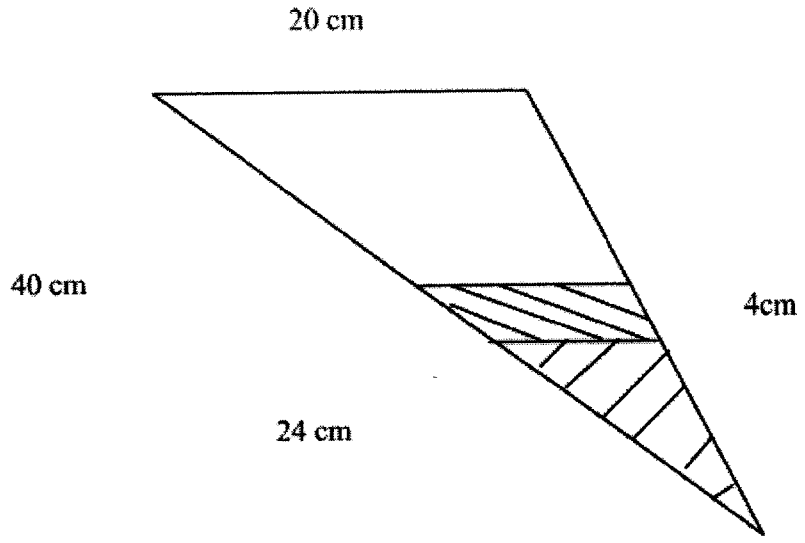
$\frac{\text{Area of triangle } BCD}{\text{Area of triangle } CAD}$ $= \frac{\frac{1}{2} BD_{base} \times ht}{\frac{1}{2} AD_{base} \times ht}$ $= \frac{2}{1}$	**B1**

(ii) $\frac{\text{Area of triangle } OBD}{\text{Area of triangle } CAD}$.

$\frac{\text{Area of triangle } OBD}{\text{Area of triangle } CAD}$ $= \frac{\text{Area of triangle } OBD}{\text{Area of triangle } BCD} \times \frac{\text{Area of triangle } BCD}{\text{Area of triangle } CAD}$ $= \frac{1}{3} \times \frac{2}{1}$ $= \frac{2}{3}$	**B1**

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15 The diagram shows a container with diameter 20 cm and height 40 cm.
It contains water to a height of 24 cm from the vertex of the container.
A layer of oil of height 4 cm floats on the water surface.



(a) Calculate the diameter of the water in the container.

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$\frac{\text{Diameter of water}}{\text{Diameter of container}} = \frac{\text{Height of water}}{\text{Height of container}}$ $\therefore \text{Diameter of water} = \frac{20 \times 24}{40}$ $= 12 \text{ cm}$	**B1**

(b) The curved surface area of the container is 150 cm^2.

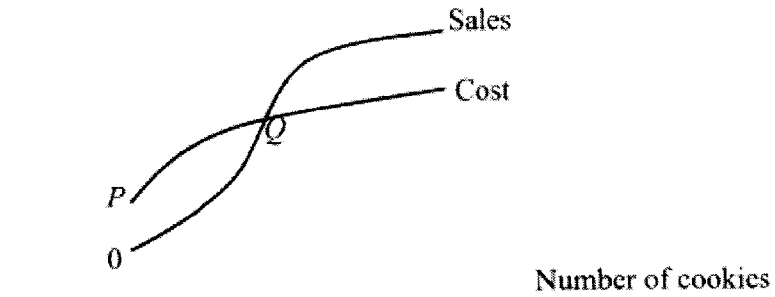
Calculate the curved surface of the container in contact with the oil.

$\frac{\text{Curved surface area of container}}{\text{Curved surface area of water}} = \left(\frac{10}{6}\right)^2$ $\text{Curved surface area of water} = \frac{150 \times 36}{100}$ $= 54 \text{ cm}^2$	**M1 for finding the curved surface areas of water**
$\frac{\text{Curved surface area of container}}{\text{Curved surface area of water and oil}} = \left(\frac{10}{7}\right)^2$ $\text{Curved surface area of water and oil} = \frac{150 \times 49}{100}$ $= 73.5 \text{ cm}^2$	**M1 for finding curved surface area of water and oil**
Hence, curved surface area of the container in contact with the oil = 73.5 cm^2 – 54 cm^2 = 19.5 cm^2	**A1**

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16 The graph below shows the monthly cost and total sales of cookies by Mrs Tan.

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(a) Explain what does point *P* represent.

P represents the depreciation cost of the oven or *P* is the cost incurred without making any cookies	**B1**

(b) Explain what does point *Q* represent.

Q represents the break even cost. Alternatively, when cost is equal to sales received o.e.	**B1**

Mrs Tan bought 3 ovens costing $10 950 that will be fully depreciated (means reduced to $0) in 2 years.

Each oven is to be used to bake large, medium and small cookies respectively.
Each large, medium and small circular cookie has a thickness of 0.4 cm and measures 6 cm, 4 cm and 3 cm in diameter respectively.

Selling price for each large cookie is $1, medium cookie is $0.80 and small cookie is $0.50.
Order for each type of cookies must be in multiples of 20.

On a particular day, she receives orders from 18 locations amounting to a total of 160 large, 100 medium and 140 small pieces of cookies. The cost of delivery fee to each location is $3.50.

The table below shows the cost of producing and packing the cookies on a particular day.

- Electricity and water usage : $6.
- Depreciation of oven : $15.
- Cost of delivery.
- Cost of materials.

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• Cost of packaging.

The cost of materials are shown in the table below.

Each piece of	Cost of material
Large cookie	20 cents
Medium cookie	15 cents
Small cookie	11 cents

Mrs Tan wants to pack exactly 20 cookies in each container. The table below shows the dimensions and cost of the different types of containers from a supplier for her to select.

Dimensions of circular containers available		Cost of each circular container
Diameter (cm)	Height (cm)	
7	10	\$0.60
6	7	\$0.50
5	10	\$0.40
4	7	\$0.30

(c) By taking 1 year to be 365 days, show that the depreciation cost of the 3 ovens per day is \$15.

Depreciation per day $= \frac{10950}{2 \times 365}$ $= \$15$	**B1**

(d) Calculate Mrs Tan's profit from the sales of cookies on this particular day.

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From the orders of 160 large, 100 medium and 140 small, 140 cookies Total sales $= 160\times\$1+100\times\$0.80+140\times\$0.50$ $=\$310$	**B1**
Cost of raw materials $= 0.2\times160+0.15\times100+0.11\times140$ $=\$62.4.$	**B1**
Based on 6,4,3 and thickness of 0.4, \$0.60 and \$0.20 packaging should be chosen. Cost of packaging $=0.60\times\left(\frac{160}{20}\right)+0.4\times\left(\frac{100}{20}\right)+0.4\left(\frac{140}{20}\right)$	**M1**
or $=0.60\left[\left(\frac{160}{20}\right)+\left(\frac{100}{20}\right)+\left(\frac{140}{20}\right)\right]$ $=\$9.60$ *or* $=\$12$	**B1**
Cost of delivery to 18 locations $= 18\times3.5$ $=\$63$	**B1**
Cost of electricity $=\$6$ Depreciation cost $=\$15$	
Total cost $= 62.40+\$9.60+63+6+15$ *or* $= 62.40+\$12+63+6+15$ $=\$156$ *or* $=\$158.40$	
Profit $=\$310-\$156$ *or* $=\$310-158.4$ $=\$154$ *or* $=\$151.60$	**B1**

(e) Without raising the price of the large, medium and small cookies, suggest a way to help Mrs Tan increase the profit margin.

Possible suggestions a) Reduce cost such as cost of material, packaging or delivery.[accept either one of the three] b) Sell only the large cookies. It is the most profitable cookies.	**B1**

End of Paper

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