CANBERRA SECONDARY SCHOOL

O

2024 Preliminary Examination

Secondary Four Express/Five Normal Academic

MATHEMATICS
4052/01

20 Aug 2024
2 hours 15 minutes
1130h – 1345h

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

READ THESE INSTRUCTIONS FIRST

Write your full name, class and index number on all work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, 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.
Calculators should be used 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 MARKER'S USE		
	Marks Awarded	Max Marks
Total		90

This question paper consists of 21 printed pages including the cover page.

Setter: Mr Ng Chuen Joo

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Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 Solve $9-\frac{1}{2}x=25$.

Answer $x=$ _____ [1]

---

2 Ahmad, Simon and Bala share a sum of money in the ratio 3 : 2 : 5.
If Bala has \$900 more than Simon, what is the sum of money being shared by the three of them?

Answer \$ _____ [2]

---

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

Answer _____ [2]

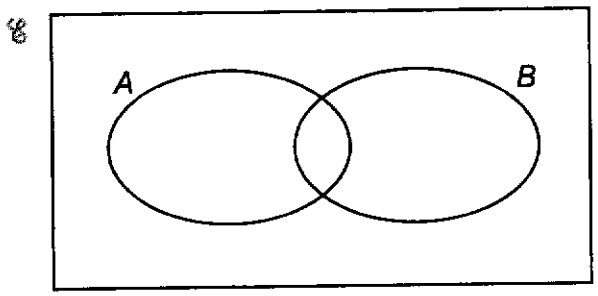
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4 Five positive integers have a mean of 5, median of 4, mode of 3 and a range of 7. Find the five numbers.

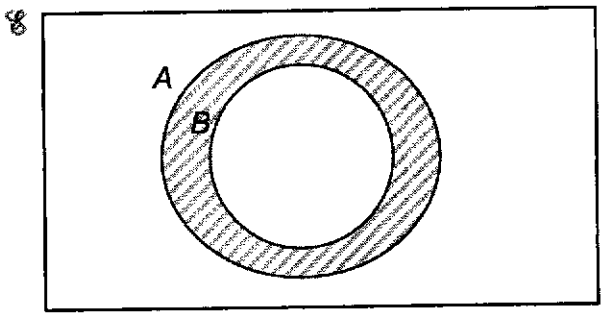
Answer _____ [2]

---

5 **(a)** On the Venn diagram, shade the region that represents $A' \cup B$. [1]



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



Answer _____ [1]

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6 The quadratic curve $y = x^2 + 4x - 21$ can be written as $y = (x - a)(x + b)$.

(a) Find the value of a and the value of b, where a and b are positive integers.

Answer $a =$ _____ [1]

$b =$ _____ [1]

(b) Explain why y will not have a value smaller than -25.

Answer

_____

_____ [1]

7 **(a)** Expand and simplify $(3x - y)(y + x)$.

Answer _____ [2]

(b) Factorise completely $3 - 12a^2$.

Answer _____ [2]

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8 **(a)** Given that $\sqrt{a} \times a^3 \div a^x = 1$, find the value of x.

Answer _____ [1]

(b) Simplify $4 \div \left(\frac{x}{2}\right)^{-2}$, giving your answer in positive index.

Answer _____ [2]

---

9 **(a)** $x^2 - 10x + 27$ can be expressed in the form $(x+p)^2 + q$.
Find the value of p and the value of q.

Answer p = _____ [1]

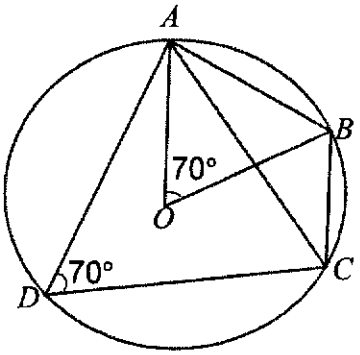
q = _____ [1]

(b) Hence write down the coordinates of the minimum point of the graph of $y = x^2 - 10x + 27$.

Answer (_____, _____) [1]

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10



In the diagram, O is the centre of the circle and $ABCD$ is a cyclic quadrilateral.
Angle AOB = angle $ADC = 70°$.
Explain why triangle ABC is an isosceles triangle.
Give reasons for each step of your working.

[3]

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11 **(a)** The angles of a quadrilateral taken in order are $3x$, $6x$, $5x$ and $4x$.
Find the value of x.

Answer x = _____ [1]

(b) Explain whether the quadrilateral is a parallelogram or a trapezium.

_____ because _____ [2]

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12 A square pyramid P has base with side x m, height y m and a volume of $300\,\text{m}^3$.

Find

(a) the volume of a similar square pyramid, which has a height double that of the pyramid P.

Answer _____ m^3 [1]

(b) the volume of another square pyramid with side $3x$ m and height $\frac{2}{3}y$ m.

Answer _____ m^3 [2]

---

13 The following stem-and-leaf diagram shows the scores of students in a math test.

Stem	**Leaf**
6	8 9
7	0 2 3 3 4 4 4 7 8
8	3 4 5 6 7 7 9
9	1 3 7

6|8 represents 68 marks

Find

(a) the median score,

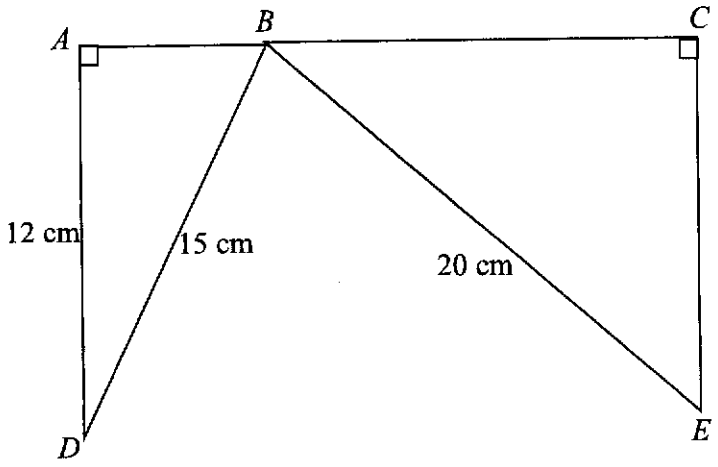
Answer _____ [1]

(b) the interquartile range.

Answer _____ [2]

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14 In the diagram, there are two right-angled triangles ΔABD and ΔCEB such that $AD = 12$ cm, $BD = 15$ cm and $BE = 20$ cm.



(a) Find $\cos \angle ABD$.

Answer _____ [2]

(b) If ΔABD and ΔCEB are similar, find the length of BC.

Answer _____ cm [2]

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15 As of 2023, the population of Singapore is approximately 5.64 million and the population of Malaysia is approximately 33.57 million.

(a) Find the total population of both countries, giving your answer in standard form.

Answer _____ [2]

(b) The population of Singapore in 2023 was 5% more than its population in 2013.
Calculate the population of Singapore in 2013.

Answer _____ [2]

---

16 A box contains 15 marbles of which x are green and the rest are yellow.

(a) Write down the probability, in terms of x, that a marble chosen from the box is yellow.

Answer _____ [1]

(b) When 5 more green marbles are added to the box, the probability of choosing a yellow marble becomes $\frac{1}{2}$.
Find the initial number of green marbles in the box.

Answer _____ [2]

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17 **(a)** **(i)** Express 1500 as the product of its prime factors.
Leave your answer in index notations.

Answer _____ [1]

(ii) $p = 2^m \times 3^2 \times n$, where m and n are positive integers.
Find the values of m and n if the HCF of 1500 and p is 6,
given that $100 < p < 150$.

Answer m = _____ [1]

n = _____ [1]

(b) In a race, Car A, Car B and Car C took 3 minutes, 6 minutes and 8 minutes respectively to complete one lap around the racing track.
If the race started at 7 pm, at what time will the cars be back at the starting point together again?

Answer _____ [2]

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18 A length of 5 cm on a map represents an actual distance of 2.5 km.

Find

(a) the actual distance represented by 20 cm on the map, giving your answer in km,

Answer _____ *km* [1]

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

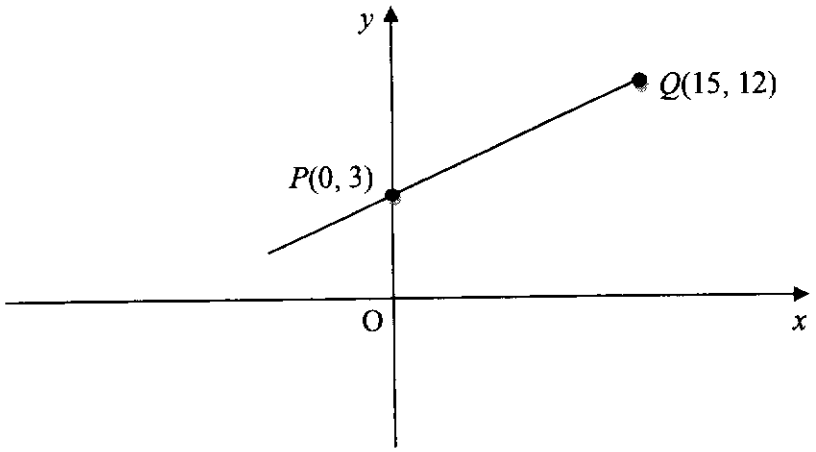
Answer _____ [2]

(c) the land area in km^2, which is represented by 30 cm^2 on the map.

Answer _____ km^2 [2]

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19 The coordinates of P and Q are (0, 3) and (15, 12) respectively.



(a) Find the equation of PQ.

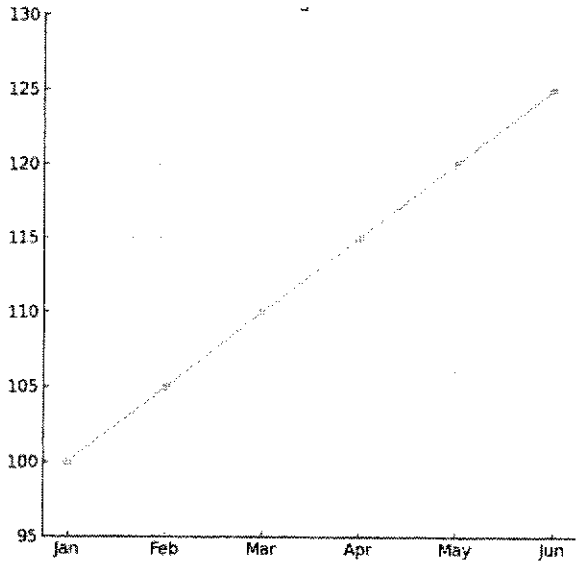
Answer _____ [2]

(b) Find the perimeter of trapezium $OPQR$, where O is the origin and R is the point of reflection of Q along the x-axis.

Answer _____ [3]

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20 The line chart below shows the sales performance of a company.



Explain what is misleading about this line chart and how it may mislead the reader.

_____

_____

_____ [2]

_____

21 12 men will take 54 days to complete a building project.

(a) Assuming that the men work at the same rate, how long will it take for 9 men to complete the project?

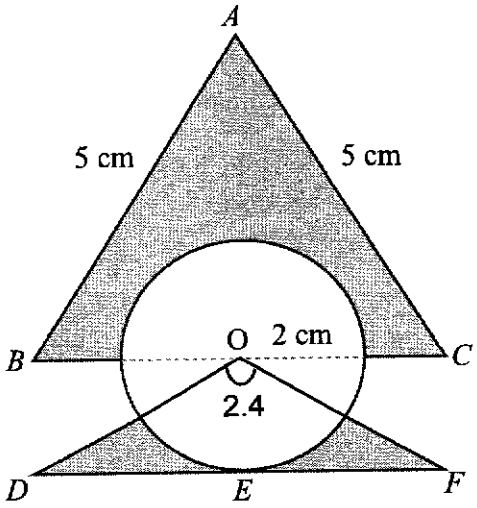
Answer _____ days [1]

(b) How many days can be saved if 6 more men are added to the team?

Answer _____ days [2]

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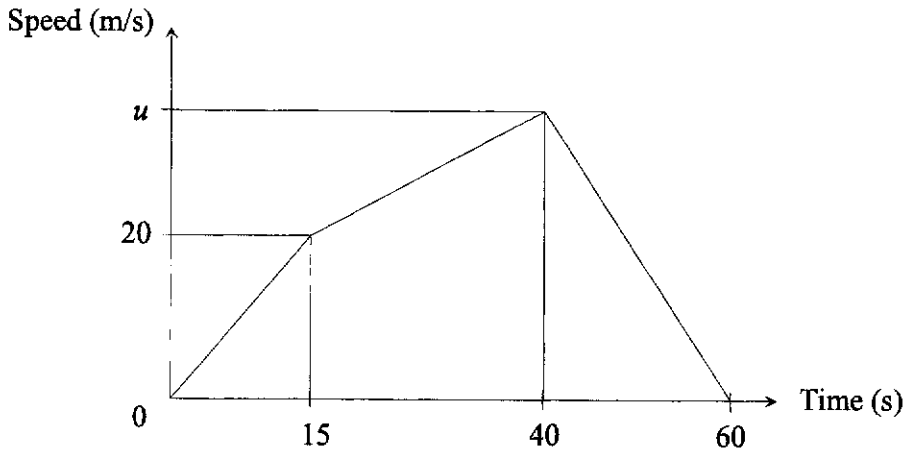
22 A logo, as shown below, has a circle with centre O and radius 2 cm, an equilateral triangle ABC of side 5 cm and an isosceles triangle ODF with $OD = OF$.
DEF is a tangent to the circle at E and angle $DOF = 2.4$ radians.
Half of the circle lies inside triangle ABC.
Calculate the area of the shaded region.



Answer _____ cm^2 [5]

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23 The diagram below shows the speed-time graph of a car which starts from rest.



(a) Calculate the speed of the car after 9 seconds.

Answer _____ m/s [2]

(b) **(i)** Find the value of u, if the total distance covered in the first 40 seconds is 900 m.

Answer _____ [2]

(ii) Hence find the deceleration of the car at the last 20s.

Answer _____ m/s^2 [1]

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24 At Café A, a latte costs \$3.50, a croissant costs \$2.70 and a sandwich costs \$5.00. At Café B, a latte costs \$0.40 more, a croissant costs \$0.20 less and a sandwich costs \$0.50 less.

This information can be represented by the matrix $\mathbf{Q} = \begin{pmatrix} 3.50 & 0.40 \\ 2.70 & -0.20 \\ 5.00 & -0.50 \end{pmatrix}$.

(a) Azza buys 2 latte, 3 croissants and 3 sandwiches.
Yu Fei buys 1 latte and 4 sandwiches.
Represent their purchases in a 2×3 matrix **P**.

Answer $\mathbf{P} =$ $\begin{pmatrix} \quad \end{pmatrix}$ [1]

(b) Evaluate $\mathbf{M} = \mathbf{PQ}$.

Answer $\mathbf{M} =$ $\begin{pmatrix} \quad \end{pmatrix}$ [2]

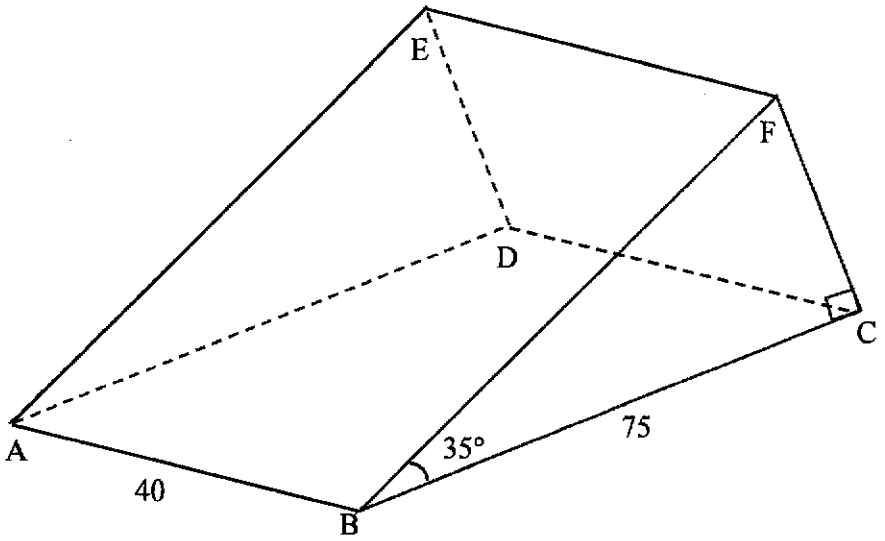
(c) Should Azza buy from Café A or Café B? Give your reasons.

_____

_____ [2]

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25

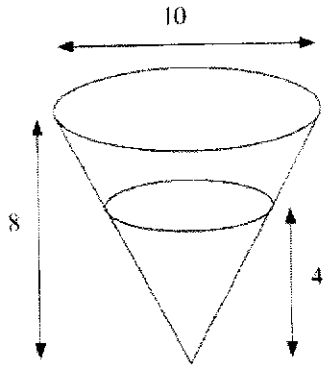


In the diagram, a wooden ramp is shown where $\angle BCF = 90^\circ$ and $\angle CBF = 35^\circ$.
$ABCD$, $CDEF$ and $ABFE$ are rectangles. $AB = 40$ cm and $BC = 75$ cm.
Find $\angle FAC$.

Answer _____ [3]

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26 A conical container with a diameter of 10 cm and a height of 8 cm is filled with water to a depth of 4 cm.



(a) Show that the volume of the water in the container is $\frac{25}{3}\pi\ cm^3$. [2]

(b) Find the surface area of the inside of the container that is in contact with the water.

Answer _____ cm^2 [2]

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(c) The water in the cone is poured into a test tube.
The test tube is made by joining together a cylinder of diameter 3 cm and a hemisphere of diameter 3 cm.
Calculate the height of the water in the test tube.



Answer _____ cm [3]

End of paper

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Errata
Q4. AED is a straight line.
Q9b. The second stage of the journey is 32 km longer than the first stage.

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Setter: Ms Sim Yi Lian

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Mathematical Formulae

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

Mensuration

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

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

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

Statistics

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

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

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Answer **all** the questions.

1 **(a)** Solve the simultaneous equations.

$$4m + 6n = 58$$
$$3m + 5n = 46$$

Answer $m =$ _____

$n =$ _____ [3]

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(b) Write as a single fraction in the simplest form $\frac{3x}{2x^2-50}-\frac{1}{x-5}$.

Answer _____ [3]

(c) $x=\sqrt[3]{\frac{25y}{7z+2}}$

(i) Find x when $y=25$ and $z=-1$.

Answer $x=$ _____ [1]

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

Answer $y=$ _____ [2]

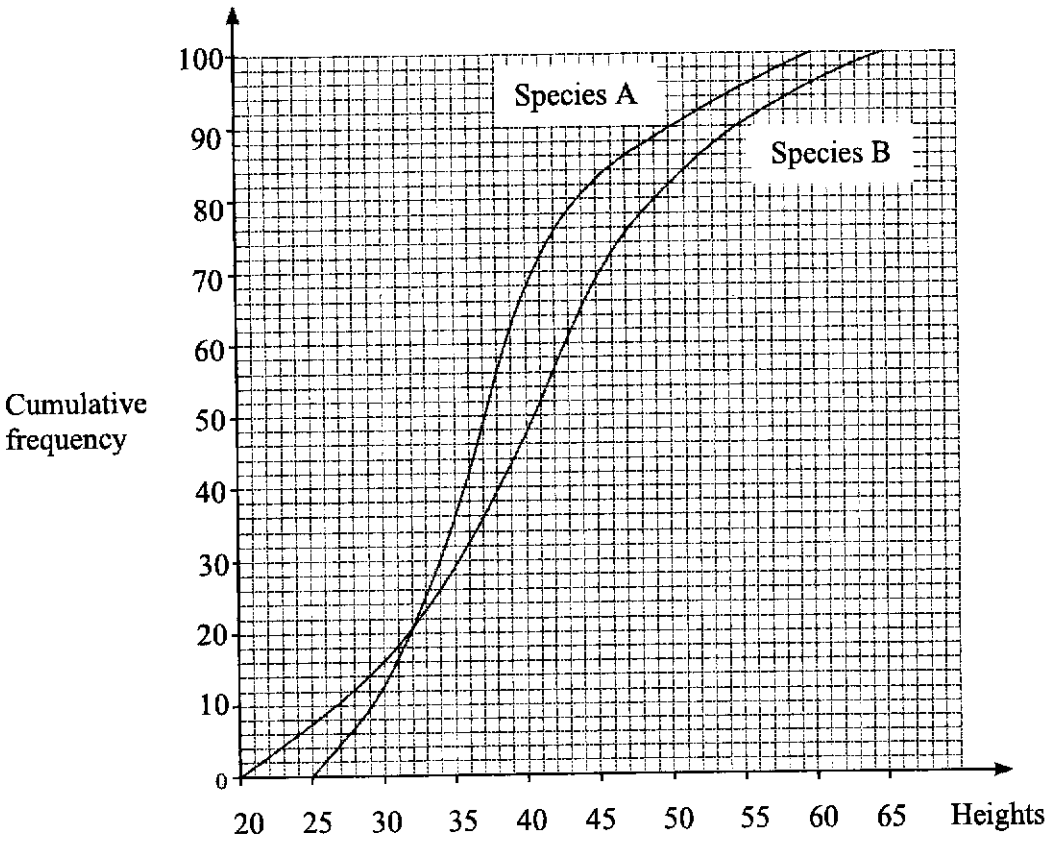
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(d) Solve the equation $\frac{2x+3}{(3x+1)(x-1)}-2=0$.

Answer $x =$ _____ or _____ [3]

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2 **(a)** The heights, in centimeters, of 100 plants of each of species A and species B are recorded.
The cumulative frequency curves show the distributions of their heights.



(i) Use the curve to estimate

(a) the median height for species B,

Answer _____ cm [1]

(b) the 40th percentile for species A,

Answer _____ cm [1]

(c) the interquartile range for species A.

Answer _____ cm [2]

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(ii) Plants from species B are used for an event.
Only plants with height within 10% of 50 cm are used.
Find the percentage of plants from species B which are used.

Answer _____ % [2]

(b) A box has 20 pots of plants.
There are 5 pink pots, 9 blue pots and the remaining pots are green.

(i) Two pots are taken from the box at random, without replacement.
Find, as a fraction in its simplest form, the probability that one pot is pink and the other is blue.

Answer _____ [2]

(ii) These two pots are returned to the box.
Three pots are taken from the box at random, without replacement.
Find, as a fraction in its simplest form, the probability that only one pot is green.

Answer _____ [2]

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3 **(a)** Wayne inherited a sum of money from his parents.

He decided to invest 60% of the money and shares $\frac{3}{4}$ of the **remaining** amount with his wife.
The other $20 000 are meant for their travelling expenses.
Calculate the sum of money he inherited.

Answer $ _____ [3]

(b) A bank offers two investment packages.

Package A	Package B
• Simple interest of 0.97% per annum. • One time payout of 10% of the amount of the investment.	• Compound interest of 3.78% per annum.

Wayne wants to invest $55 000 in one of the packages for 3 years.
Which package should he choose if he wishes to reap the most benefits from the investment?

_____

_____ [5]

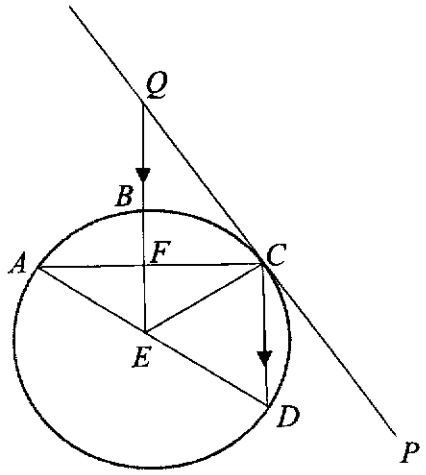
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(c) Wayne and his wife go on a seven days self-drive trip to Australia.
They pay 150 AUD per day for car hire and 380 AUD per night for hotel.
They pay using credit card and is charged with a fee of 2% for the currency conversion.
The exchange rate between Singapore dollars and Australian dollars is $1 = 0.91 AUD.
Calculate the total amount, including credit card fee, Wayne is charged for car hire and accommodation.
Give your answer in Singapore dollars, correct to the nearest dollar.

Answer $ _____ [3]

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4 A, B, C and D are points on a circle.
Line PCQ is a tangent to the circle.
Line QE bisects angle AEC and is parallel to line CD.



(a) Show that $EC = ED$.
Give a reason for each statement you make.

[2]

(b) Show that triangle AEF is similar to triangle QCF.
Give a reason for each statement you make.

[2]

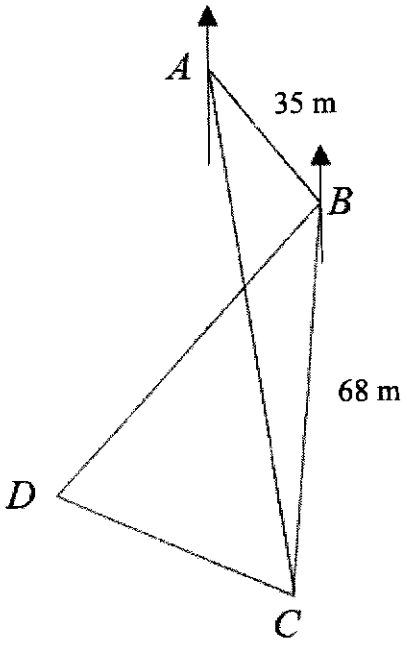
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(c) Diameter $AD = 28$ cm and angle $QCF = 61°$.
Calculate the area of segment CD.

Answer _____ cm^2 [4]

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5 A, B, C and D are points on horizontal ground.
$AB = 35$ m and $BC = 68$ m.
The bearing of B from A is 137° and the bearing of C from B is 192°.
Angle $ABD = 85°$ and angle $BCD = 70°$.



(a) Show that angle $ABC = 125°$.

[2]

(b) Calculate AC.

Answer _____ m [3]

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(c) Calculate DC.

Answer _____ m [2]

A man travels in a straight line from D to C.
X, is the position of the man where it is the shortest distance from B during this journey.

(d) Show that $BX = 63.9$ m.

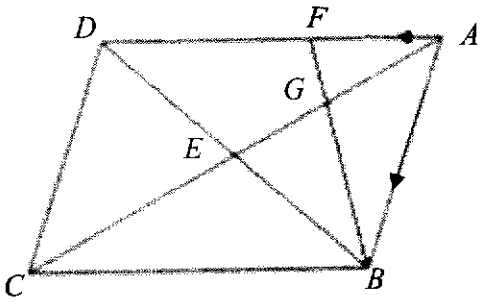
[2]

(e) A drone is hovering vertically above B.
The angle of elevation of the drone from C is $40.5°$.
Calculate the greatest angle of elevation of the drone from a point on DC.

Answer _____ [3]

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6 In the diagram $ABCD$ is a parallelogram.
The diagonal AC and BD intersect at E.
$\overrightarrow{AF} = \mathbf{2p}$ and $\overrightarrow{AB} = \mathbf{6p} + \mathbf{4q}$.
F is a point on AD such that $\frac{AF}{AD} = \frac{1}{3}$.
G is the mid-point of AE.



(a) Express $\overrightarrow{DE}$ in terms of **p** and **q**, as simply as possible.

Answer _____ [2]

(b) Express $\overrightarrow{AG}$ in terms of **p** and **q**, as simply as possible.

Answer _____ [2]

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(c) Show that $\overrightarrow{BG} = \mathbf{-3p - 3q}$.

[2]

(d) Explain why B, G and F lie on a straight line.

_____

_____

_____

_____ [2]

(e) Calculate $\dfrac{\text{the area of triangle } ABF}{\text{the area of parellogram } ABCD}$.

Answer _____ [2]

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7 **(a)** Complete the table of values for $y = \frac{x^3}{4} - 2x + 1$.

x	−3	−2	−1	0	1	2	3
y	0.25	3	2.75	1	−0.75		1.75

[1]

(b) On the grid opposite, draw the graph of $y = \frac{x^3}{4} - 2x + 1$ for $-3 \le x \le 3$. [3]

(c) Explain how your graph shows that there is only one solution of the equation $\frac{x^3}{4} - 2x + 1 = k$ for some values of k.

_____

_____ [1]

(d) The equation $x^3 - 9x - 4 = 0$ can be solved by drawing a suitable straight line on the grid.

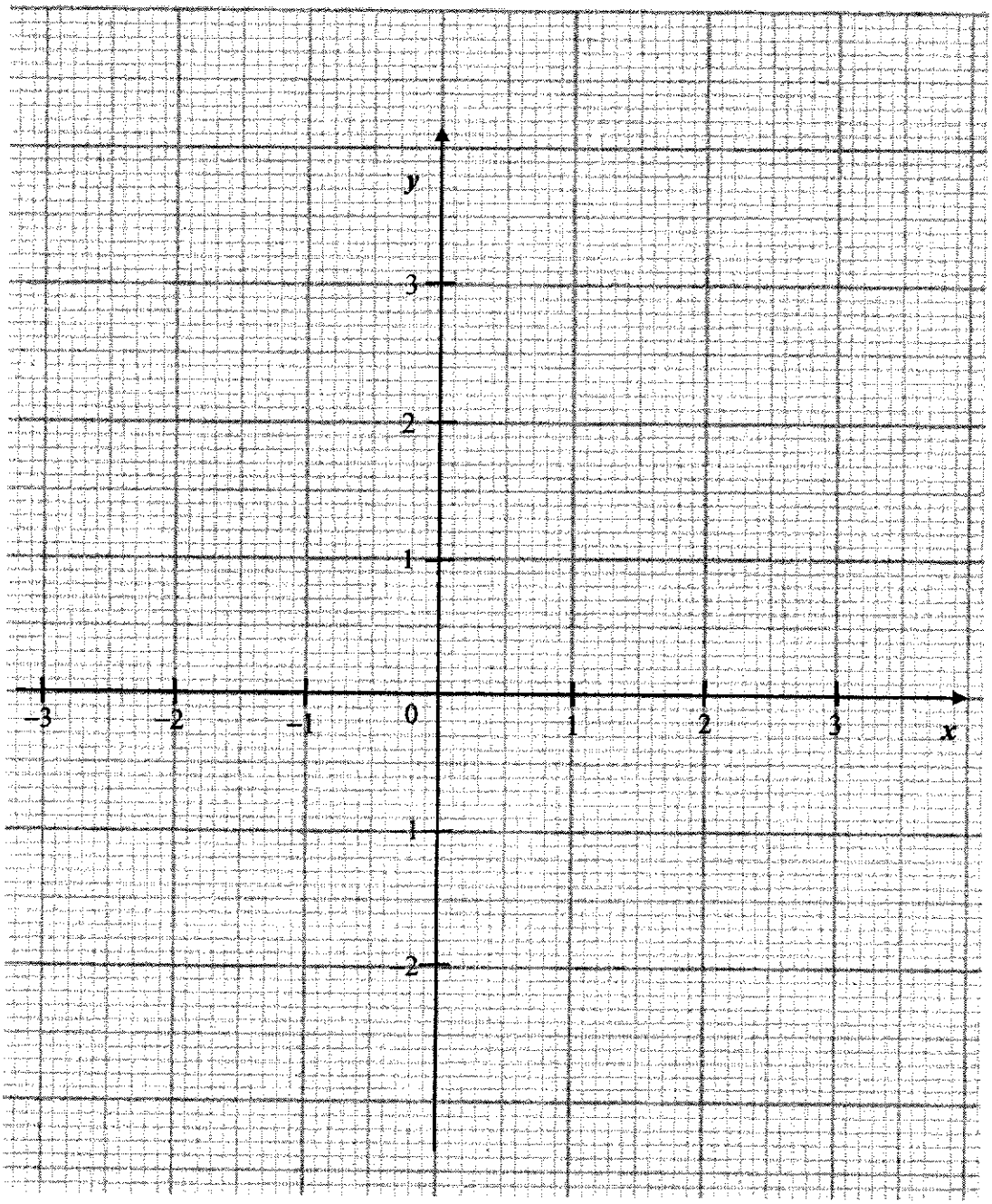
(i) Find the equation of the straight line.

Answer _____ [2]

(ii) By drawing this straight line, solve the equation $x^3 - 9x - 4 = 0$.

Answer $x =$ _____ or _____ [2]

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8 The first four terms in a sequence of numbers are given below.

$$T_1 = (1\times 3)+8 = 11$$
$$T_2 = (2\times 4)+12 = 20$$
$$T_3 = (3\times 5)+16 = 31$$
$$T_4 = (4\times 6)+20 = 44$$

(a) Find T_5.

Answer _____ [1]

(b) Show that the n^{th} term of the sequence, T_n is given by n^2+6n+4.

[2]

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(c) T_{p-1} and T_p are consecutive terms in the sequence.
Find and simplify an expression, in terms of p, for the sum of T_{p-1} and T_p.

Answer _____ [3]

(d) Find the value of p when the sum of T_{p-1} and T_p is 303.

Answer $p=$ _____ [2]

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9 Jim, his wife and their child visited Hokkaido, Japan.

The tables below give information that can be used to work out some of their expenses.

	Prices of flight tickets for a return trip			
Payment mode	Cash (Includes tax)		Redemption with miles (Excludes tax of $115 per pax)	
Class	Economy	Business	Economy	Business
Adult	$1920	$5500	90 000 miles	140 000 miles
Child	$1350	$4000		

	Amount of fuel used (litres/100 km)		
	Type of car		
Type of driving	Sedan car	Sport Utility Vehicle (SUV)	Mini van
City	7.8	9.3	10.8
Out of city	5.7	7.5	8.9
Combined	6.2	8.8	9.5

	Daily rates of driver	
Day(s) of hire	8 hours	Additional time
1	$350	$45 per hour
2 or more	$300	$40 per hour

(a) They travelled in business class and Jim had 150 000 miles to offset some of the cost of their flight tickets.
Calculate the amount of money he paid for the tickets.

Answer $ _____ [2]

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(b) Jim engaged a driver for 10 hours and his family travelled in a SUV for one day during their trip.
The driver picked them from their accommodation in the city to attractions outside the city.

The driver drove the first stage of the journey at an average speed of 70 km/h.
The second stage of the journey is 32 km longer than the second stage.
The driver drove at an average speed of 80 km/h.
The journey takes a total of 4 hours and 9 minutes.

Fuel price for the vehicle was $1.70 per litre.
Jim paid $550 to the driver.
He thinks that he included a 20% tips in the amount paid to the driver.

Is he correct?
Justify your decision with calculations.

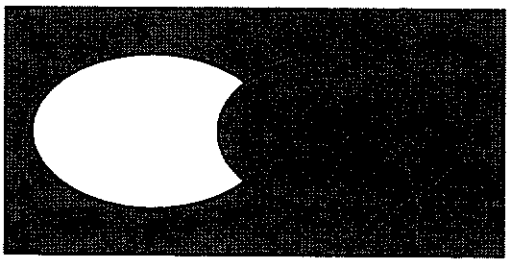
[8]

End of paper

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4E5N Prelim Exam 2024 Maths P1- Marking Scheme

1	$9-\frac{1}{2}x=25$ $-\frac{1}{2}x=16$ $x=-32$
2	Total sum of money $=\frac{\$900}{3}\times 10$ $=\$3000$
3	$\frac{3}{2a-1}-\frac{2}{1-2a}$ $=\frac{3}{2a-1}+\frac{2}{2a-1}$ $=\frac{5}{2a-1}$
4	3, 3, 4, 5, 10
5a	
5b	$A\cap B'$
6a	a = 3, b = 7
6b	Since the minimum point of y is at (-2, -25), y will not have a value smaller than -25.
7a	$(3x-y)(y+x)$ $=3xy+3x^2-y^2-xy$ $=3x^2+2xy-y^2$
7b	$3-12a^2$ $=3(1-4a^2)$ $=3(1-2a)(1+2a)$
8a	3.5

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8b	$4 \div \left(\frac{x}{2}\right)^{-2}$ $= 4 \div \left(\frac{2}{x}\right)^{2}$ $= 4 \times \left(\frac{x^2}{4}\right)$ $= x^2$
9a	$x^2 - 10x + 27$ $= x^2 - 10x + 5^2 - 5^2 + 27$ $= (x-5)^2 + 2$ p = -5, q = 2
9b	(5, 2)
10	$\angle ACB = \frac{70^\circ}{2}$ (angle at centre = twice the angle at circumference) $= 35^\circ$ $\angle ABC = 180^\circ - 70^\circ$ (angles in opposite segments) $= 110^\circ$ $\therefore \angle BAC = 180^\circ - 110^\circ - 35^\circ$ (angles sum of triangle) $= 35^\circ$ Since angle ACB = angle BAC, triangle ABC is an isosceles triangle.
11a	$18x = 360^\circ$ $x = 20^\circ$
11b	$3x + 6x = 9x$ $= 180^\circ$ $\therefore$ the angles are interior angles. $6x + 5x = 11x$ $\neq 180^\circ$ The quadrilateral is a trapezium and not a parallelogram as it has 2 parallel sides and 2 non-parallel sides.
12a	$\frac{V_L}{300} = \left(\frac{2}{1}\right)^3$ $V_L = 2400m^3$

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12b	$\frac{1}{3}x^2y = 300$ $x^2y = 900$ Volume of pyramid $= \frac{1}{3}(3x)^2 \times \frac{2}{3}y$ $= 2x^2y$ $= 2 \times 900\text{m}^3$ $= 1800\text{m}^3$
13a	78
13b	The interquartile range $= 87 - 73$ $= 14$
14a	$AB = \sqrt{15^2 - 12^2}$ $= \sqrt{81}$ $= 9$ $\therefore \cos \angle ABD = \frac{9}{15}$ $= \frac{3}{5}$
14b	$\frac{BC}{DA} = \frac{BE}{DB}$ $\frac{BC}{12} = \frac{20}{15}$ BC = 16 cm
15a	Total population = (33.57 + 5.64) million = 39.21 million $= 39.21 \times 10^6$ $= 3.921 \times 10^7$
15b	Population of Singapore in 2013 $= \frac{5.64}{105} \times 100$ million =5.37 million (or 5370000 or 5.37×10^6)
16a	$\frac{15-x}{15}$
16b	P(green marbles) = P(yellow marbles)

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	$=\frac{1}{2}$ $\frac{x+5}{20}=\frac{1}{2}$ $x=5$
17a(i)	$2^2\times3\times5^3$
17a(ii)	$1500=2^2\times3\times5^3$ $p=2^m\times3^2\times n$ $HCF=2\times3$ $\therefore m=1$ and $n=7$
17b	$LCM=2^3\times3$ $=24$
18a	10 km
18b	5 cm: 2.5 km 1 cm: 0.5 km 1 cm: 50000 cm 1 : 50000
18c	$1cm^2:0.25km^2$ $30cm^2:7.5km^2$
19a	Gradient $=\frac{12-3}{15-0}$ $=\frac{3}{5}$ $\therefore$ equation of PQ: $y=\frac{3}{5}x+3$
19b	Gradient of R $=(15,-12)$ Perimeter of OPQR $=3+\sqrt{(15-0)^2+(12-3)^2}+(12\times2)+\sqrt{15^2+12^2}$ $=63.70223$ $=63.7$
20	The y-axis of the line chart does not start from zero and the reader may be misled to think that the sales performance has increased greatly from Jan to Jun.
21a	72 days
21b	12 men will take 54 days. 18 men will take $\frac{54\times12}{18}=36$ days. No. of days saved = (54 – 36) days = 18 days
22	Area of shaded region in triangle ABC

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	$=\left[\frac{1}{2}(5)^2\sin 60^\circ-\frac{1}{2}\pi(2)^2\right]cm^2$ $=\left(\frac{25\sqrt{3}}{4}-2\pi\right)cm^2$ $\tan 1.2=\frac{EF}{OE}$ $EF=2\tan 1.2$ $DF=4\tan 1.2$ Area of shaded region in triangle ODF $=\left[\left(\frac{1}{2}\times 2\times 4\tan 1.2\right)-\frac{1}{2}(2)^2 2.4\right]cm^2$ $=(4\tan 1.2-4.8)cm^2$ $\therefore$ area of shaded region of the logo $=\left(\frac{25\sqrt{3}}{4}-2\pi+4\tan 1.2-4.8\right)cm^2$ $=10.030739\ cm^2$ $\simeq 10.0\ cm^2$
23a	Let the speed of the car after 9s be v m/s. $\frac{v}{20}=\frac{9}{15}$ $v=12$
23b(i)	$\left(\frac{1}{2}\times 15\times 20\right)+\frac{1}{2}(20+u)\times 25=900$ $\frac{1}{2}(20+u)\times 25=750$ $u=40$
23b(ii)	$2\ m/s^2$
24a	$\begin{pmatrix}2 & 3 & 3\\ 1 & 0 & 4\end{pmatrix}$
24b	$\text{M}=\begin{pmatrix}2 & 3 & 3\\ 1 & 0 & 4\end{pmatrix}\begin{pmatrix}3.50 & 0.40\\ 2.70 & -0.20\\ 5.00 & -0.50\end{pmatrix}$

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	$= \begin{pmatrix} 30.10 & -1.30 \\ 23.50 & -1.60 \end{pmatrix}$
24c	Azza should buy from Café B as she would save \$1.30.
25	$\tan 35^\circ = \frac{FC}{75}$ $FC = 75\tan 35^\circ$ $AC = \sqrt{40^2 + 75^2}$ $= \sqrt{7225}$ $\tan \angle FAC = \frac{FC}{AC}$ $= \frac{75\tan 35^\circ}{\sqrt{7225}}$ $\therefore \angle FAC = \tan^{-1}\left(\frac{75\tan 35^\circ}{\sqrt{7225}}\right)$ $= 31.70902^\circ$ $\simeq 31.7^\circ$
26a	Let the radius of the water surface be r cm. $\frac{r}{5} = \frac{4}{8}$ $r = \frac{5}{2}$ $\therefore$ volume of water $= \frac{1}{3}\pi\left(\frac{5}{2}\right)^2 \times 4$ $= \frac{25}{3}\pi$ (Shown)
26b	Surface area $= \pi rl$ $= \pi\left(\frac{5}{2}\right)\sqrt{4^2 + \left(\frac{5}{2}\right)^2}$ $= 37.04716\ cm^2$ $\simeq 37.0\ cm^2$
26c	Let the height of the water above the hemisphere be h cm.

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$$\pi\left(\frac{3}{2}\right)^2 h+\frac{2}{3}\pi\left(\frac{3}{2}\right)^3=\frac{25}{3}\pi$$

$$\frac{9}{4}h=\frac{73}{12}$$

$$h=2\frac{19}{27}\text{ cm}$$

$\therefore$ height of water in the test-tube

$$=\left(2\frac{19}{27}+\frac{3}{2}\right)\text{ cm}$$

$$=4\frac{11}{54}\text{ cm (or 4.20 cm)}$$

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2024 Sec 4/5 Prelims EM Marking Scheme

1a	$4m+6n=58-----(1)$ $3m+5n=46-----(2)$ $12m+18n=174---(3)$ $12m+20n=184---(4)$ $(3)-(4)$ $-2n=-10$ $n=5$ $m=7$
b	$\frac{3x}{2x^2-50}-\frac{1}{x-5}$ $=\frac{3x}{2(x-5)(x+5)}-\frac{1}{x-5}$ $=\frac{3x-2(x+5)}{2(x-5)(x+5)}$ $=\frac{x-10}{2(x-5)(x+5)}$
ci	-5
ii	$x=\sqrt[3]{\frac{25y}{7z+2}}$ $x^3=\frac{25y}{7z+2}$ $x^3(7z+2)=25y$ $y=\frac{x^3(7z+2)}{25}$
d	$\frac{2x+3}{(3x+1)(x-1)}-2=0$ $\frac{2x+3}{(3x+1)(x-1)}=2$ $2x+3=2(3x+1)(x-1)$ $2x+3=6x^2-4x-2$ $6x^2-6x-5=0$ $x=1.54$ or -0.541
2ai	(a) 40.5
	(b) 35.5
	(c) $42-33$ $=9$

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ii	$\frac{90-69}{100}\times 100\%$ $=21\%$
bi	$\left(\frac{5}{20}\times\frac{9}{19}\right)+\left(\frac{9}{20}\times\frac{5}{19}\right)$ $=\frac{9}{38}$
ii	$\left(\frac{6}{20}\times\frac{14}{19}\times\frac{13}{18}\right)+\left(\frac{14}{20}\times\frac{6}{19}\times\frac{13}{18}\right)+\left(\frac{14}{20}\times\frac{13}{19}\times\frac{6}{18}\right)$ $=\frac{91}{190}$
3a	$20000\times 4=80000$ $\frac{80000}{40}\times 100$ $=\$200000$
b	$I=\frac{(55000)(0.97)(3)}{100}$ $=\$1600.50$ $1600.50+\left(\frac{10}{100}\times 55000\right)$ $=\$7100.50$ $A=55000\left(1+\frac{3.78}{100}\right)^3$ $=\$61475.72916$ $I=61475.72916-55000$ $=\$6475.73$ Wayne should choose package A as it will generate a higher interest.
c	$(150\times 7)+(380\times 6)$ $=3330\text{AUD}$ $\left(\frac{3330}{0.91}\times 1.02\right)$ $=3732.527$ $\approx\$3733$

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4a	Let $\angle QEC = \theta$ $\angle QEC = \angle ECD = \theta$ (Alternate angles are equal) $\angle AEF = \angle QEC = \theta$ (Angle bisector) $\angle CED = 180 - 2\theta$ (Sum of angles on a straight line) $\angle EDC = 180 - (180 - 2\theta) - \theta = \theta$ (Sum of angles in a triangle) Since $\angle ECD = \angle EDC$, $EC = ED$
b	$\angle AFE = \angle QFC$ (Vertically opposite angles are equal) $\angle ECF = 90 - \theta$ (Angle in a semi-circle) $\angle FCQ = 90 - (90 - \theta) = \theta$ (Tangent perpendicular to radius) $\angle AEF = \angle FCQ = \theta$ Triangle AEF and QCF are similar. (AA)
c	$\angle CED = 360 - 2(61) - 180 = 58$ Area of sector $ECD = \frac{58}{360} \times \pi(14)^2$ $= 99.20451468$ Area of triangle $ECD = \frac{1}{2}(14)^2 \sin 58$ $= 83.10871342$ Area of segment $CD = 99.20451468 - 83.10871342$ $= 16.0958$ ≈ 16.1
5a	$192 - 180 = 12$ $\angle ABC = 137 - 12$ $= 125$ (shown)
b	$AC^2 = 35^2 + 68^2 - 2(35)(68)\cos 125$ $AC^2 = 8579.223037$ $AC = 92.62409966$ ≈ 92.6
c	$\angle DBC = 125 - 85 = 40$ $\angle BDC = 180 - 40 - 70 = 70$ $\frac{DC}{\sin 40} = \frac{68}{\sin 70}$ $DC = 46.5147$ ≈ 46.5

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d	Area of triangle $= \frac{1}{2}(68)^2 \sin 40$ $= 1486.124954$ $1486.124954 = \frac{1}{2} \times 46.5147 \times h$ $h = 63.89915247$ ≈ 63.9
e	$\tan 40.5 = \frac{h}{68}$ $h = 58.07748661$ $\tan\theta = \frac{58.07748661}{63.89915247}$ $\theta = 42.3$
6a	$\overrightarrow{AD} = \mathbf{6p}$ $\overrightarrow{DB} = \overrightarrow{DA} + \overrightarrow{AB}$ $= \mathbf{-6p + 6p + 4q}$ $= \mathbf{4q}$ $\overrightarrow{DE} = \mathbf{2q}$
b	$\overrightarrow{AE} = \overrightarrow{AD} + \overrightarrow{DE}$ $= \mathbf{6p + 2q}$ $\overrightarrow{AG} = \mathbf{3p + q}$
c	$\overrightarrow{BG} = \overrightarrow{BA} + \overrightarrow{AG}$ $= \mathbf{-6p - 4q + 3p + q}$ $= \mathbf{-3p - 3q}$
d	$\overrightarrow{GF} = \overrightarrow{GA} + \overrightarrow{AF}$ $= \mathbf{-3p - q + 2p}$ $= \mathbf{-p - q}$ $\overrightarrow{BG} = 3\overrightarrow{GF}$ $\overrightarrow{BG}$ is parallel to $\overrightarrow{GF}$ and there is a common point G; therefore B, G and F lie on a straight line.

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e	$\frac{\text{the area of triangle } ABF}{\text{the area of triangle } ABD} = \frac{1}{3}$ $\frac{\text{the area of triangle } ABD}{\text{the area of parellogram } ABCD} = \frac{1}{2} = \frac{3}{6}$ $\frac{\text{the area of triangle } ABF}{\text{the area of parellogram } ABCD} = \frac{1}{6}$
7a	-1
c	From the graph, there is only one intersection point between the line $y = k$ and the curve for some values of k hence there is only one solution for some values of k.
di	$x^3 - 9x - 4 = 0$ $\frac{x^3}{4} - \frac{9x}{4} - 1 = 0$ $\frac{x^3}{4} - 2x + 1 = \frac{1}{4}x + 2$ $y = \frac{1}{4}x + 2$
ii	$x = -0.45$ or -2.75
8a	$T_5 = (5 \times 7) + 24 = 59$
b	$n(n+2) + 4n + 4$ $= n^2 + 2n + 4n + 4$ $= n^2 + 6n + 4$
c	$T_{p-1} = (p-1)^2 + 6(p-1) + 4$ $= p^2 - 2p + 1 + 6p - 6 + 4$ $= p^2 + 4p - 1$ $(p^2 + 4p - 1) + (p^2 + 6p + 4)$ $= 2p^2 + 10p + 3$
d	$2p^2 + 10p + 3 = 303$ $2p^2 + 10p - 300 = 0$ $p = 10$ or -15 (NA)
9a	$115 + 5500 + 4000$ $= \$9615$

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b

$$\frac{x}{70}+\frac{x+32}{80}=4\frac{3}{20}$$

$$\frac{80x+70(x+32)}{5600}=\frac{83}{20}$$

$$\frac{150x+2240}{5600}=\frac{83}{20}$$

$$150x+2240=23240$$

$$x=140$$

Total distance $=140+140+32=312$

Amount of fuel used $=\frac{312}{100}\times 8.8=27.456$

Cost $=(27.456\times 1.70)+350+90=486.6752$

$$\frac{486.6752}{100}\times 1.20=\$584.01024$$

Jim is incorrect as the tips included is less than 20% of the amount he should be paying.

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