

Name: _____ ()

Class: _____



MONTFORT SECONDARY SCHOOL

PRELIMINARY EXAMINATION

Secondary 4 Express/ 5 Normal (Academic)

MATHEMATICS
Paper 2

4052/02
28 August 2025 (Thu)

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer **all** 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 number 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.

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

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Simplify $\frac{x^2 + 4xy}{x^2 - 16y^2}$.

Answer [2]

(b) Simplify $\left(-\frac{2a}{p}\right)^4 \div \frac{8a^2}{p}$, leaving your answer in positive index notation.

Answer [2]

- (c) Solve the equation $x^2 - 6x - 17 = 0$ by completing the square.
Give your solutions correct to 2 decimal places.

Answer $x =$ or [3]

(d) Solve $\frac{2}{x-2} + \frac{3}{x+4} = 1$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

- 2 (a) Dan works in a shop.
He is paid \$12.50 for each hour he works.
He is also paid a bonus of 5% for the sales made from the goods he sells.

In a particular week, Dan worked for 38 hours and made \$1450 in sales from the goods sold.

Calculate the total amount he was paid for the week.

Answer \$ [2]

- (b) Peter spends £385 on his credit card when he is London.
He pays a credit card fee of 1.5% of this amount.
The credit card company uses an exchange rate between Singapore dollars (\$) and British pounds (£) of \$1 = £0.57.

Calculate the total cost, in Singapore dollars, that Peter must pay the credit card company.
Give your answer correct to the nearest cent.

Answer \$ [3]

- (c) The table shows the mass, in grams, of three atoms.

Atom	Carbon	Hydrogen	Oxygen
Mass (grams)	1.99×10^{-23}	1.66×10^{-24}	2.66×10^{-23}

A carbon dioxide molecule consists of one carbon atom and two oxygen atoms.

A water molecule consists of two hydrogen atoms and one oxygen atom.

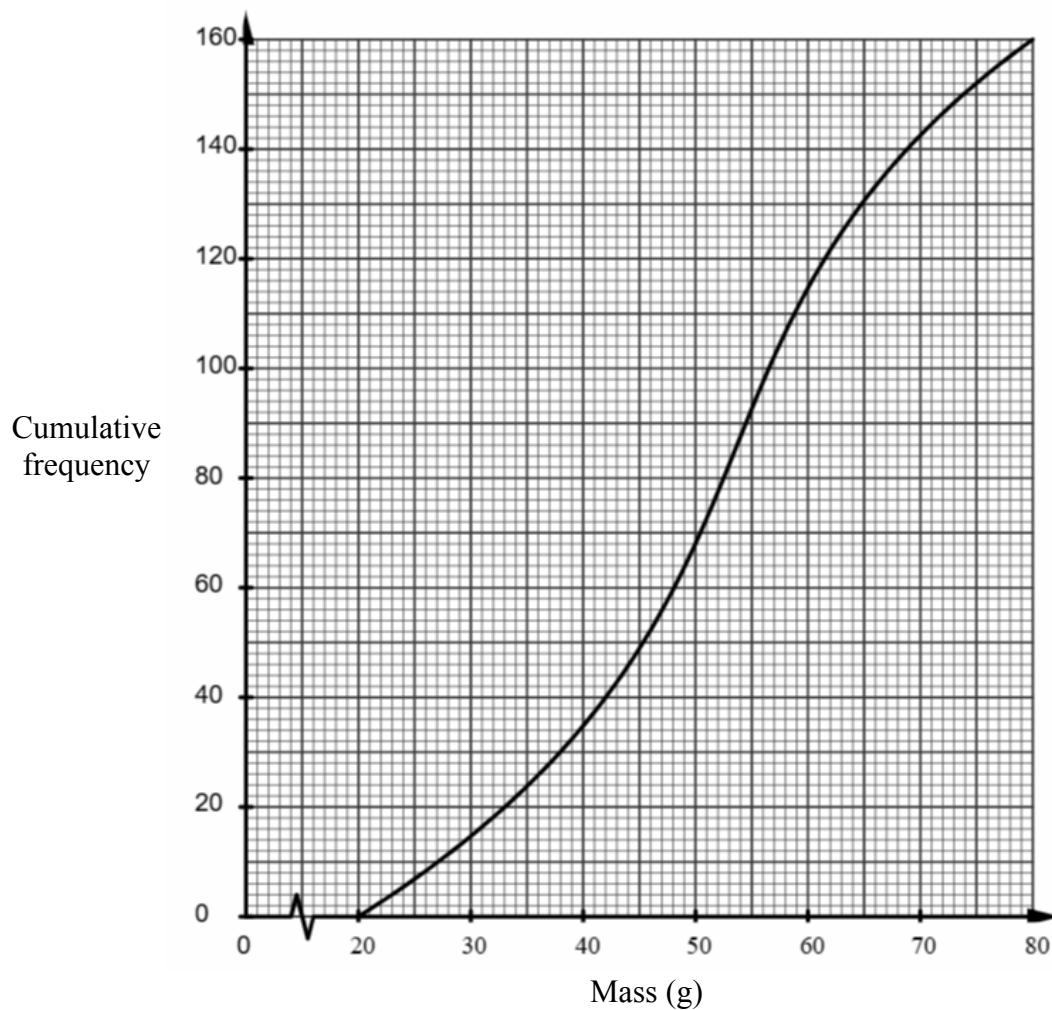
- (i) Find the mass, in grams, of one molecule of carbon dioxide.
Give your answer in standard form.

Answer grams [2]

- (ii) Find the number of water molecules in 500 g of water.
Give your answer in standard form.

Answer [3]

- 3 The cumulative frequency curve below shows the masses of 160 eggs from factory A.



- (a) Use the curve to estimate

(i) the median mass,

Answer g [1]

(ii) the interquartile range of the masses.

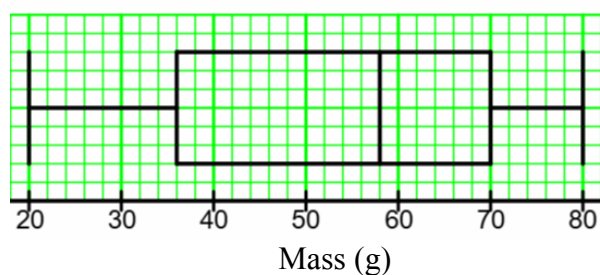
Answer g [2]

- (b) Three of the 160 eggs are selected at random without replacement.

Find the probability that two eggs each has a mass less than 48 g and one egg has a mass greater than 75 g.

Answer [3]

- (c) The box-and-whisker plot below shows the masses of 160 eggs from factory B.



Halim made the following statements.

Explain for each statement whether you agree or disagree and then provide a reason.

Statement
1. The eggs in factory A are heavier.
2. The eggs in factory B have a wider spread of masses.

Answer

1

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2

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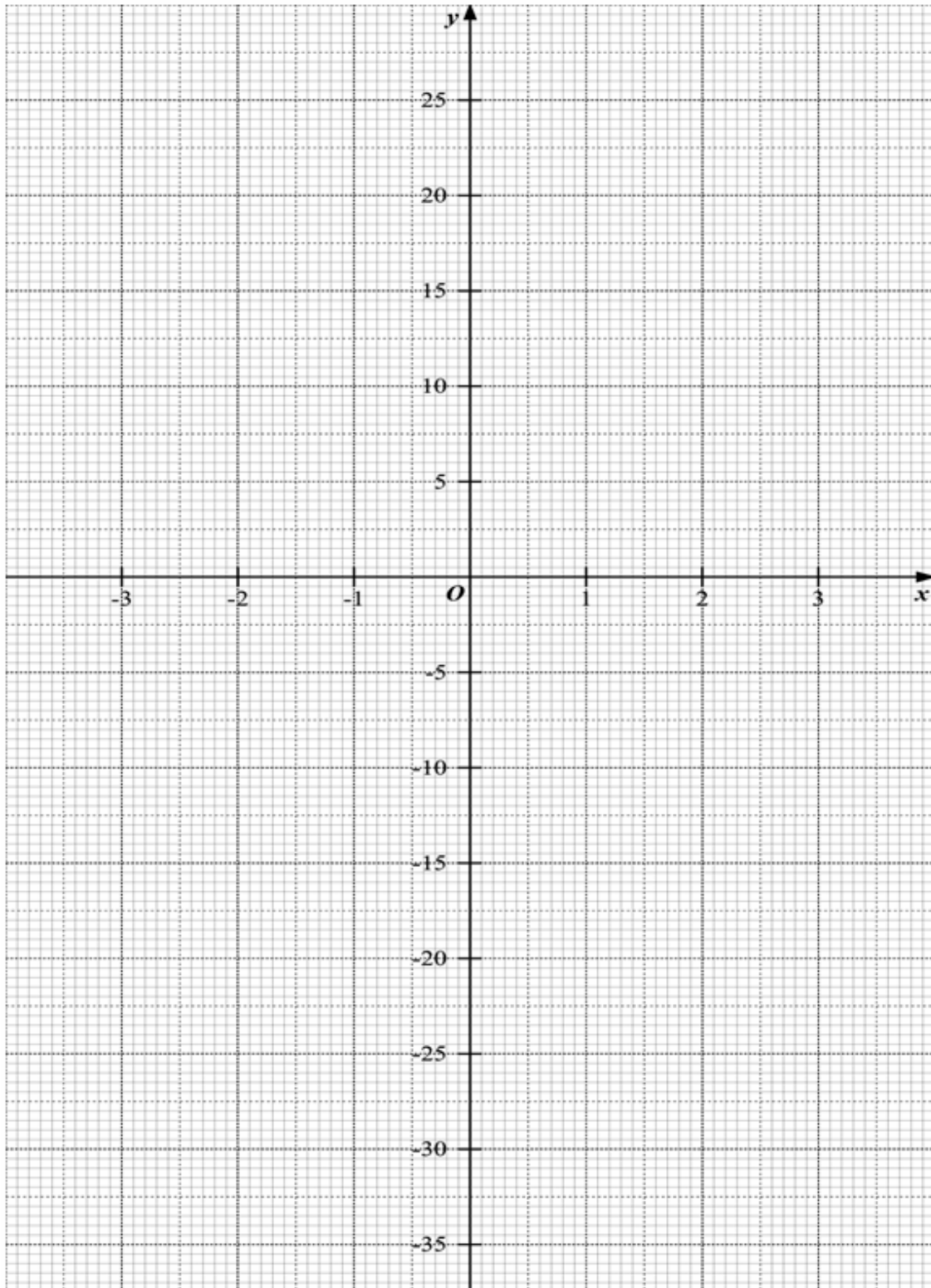
[4]

- 4 (a) Complete the table of values for $y = x^3 - 5$.

x	-3	-2	-1	0	1	2	3
y		-13	-6	-5	-4	3	22

[1]

- (b) On the grid, draw the graph of $y = x^3 - 5$ for $-3 \leq x \leq 3$.



[3]

- (c) Use your graph to estimate the value of $\sqrt[3]{5}$.

Answer [1]

- (d) (i) On the same axes, draw the graph of $y = 15 - 5x$. [2]

- (ii) Write down the x -coordinate of the point where this line intersects the curve.

Answer [1]

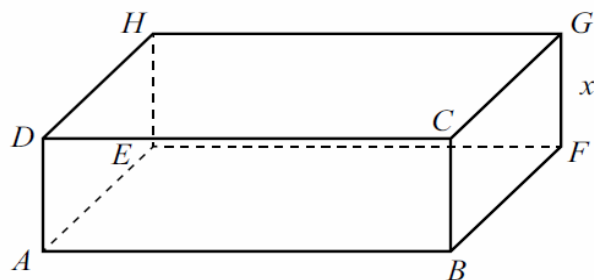
- (iii) This value of x is a solution of the equation $x^3 = a + bx$.

Find the value of a and of b .

Answer $a =$

$b =$ [2]

5



The diagram shows a cuboid with height x cm.
 The width of the cuboid is 6 cm more than its height.
 The length of the cuboid is twice its width.

The length of the diagonal, BH , of the cuboid is 30 cm.

(a) Show that $x^2 + 10x - 120 = 0$.

Answer

[5]

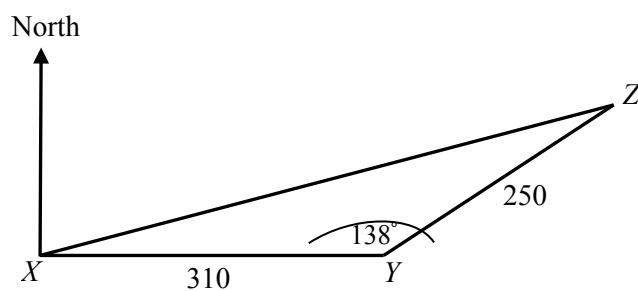
(b) Solve the equation $x^2 + 10x - 120 = 0$.

Give your solutions correct to two decimal places.

Answer $x =$ or [3]

(c) Calculate angle HBE .

Answer [2]



Points X , Y and Z are on horizontal ground.

$XY = 310\text{ m}$, $YZ = 250\text{ m}$ and angle $XYZ = 138^\circ$.

Y is due east of X .

(a) Calculate XZ .

Answer m [3]

(b) Find the bearing of Z from Y .

Answer [1]

(c) Find the shortest distance from Y to XZ .

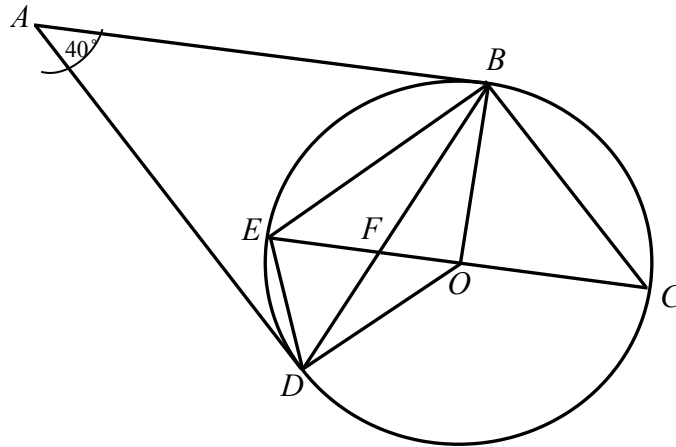
[Turn over]

Answer m [3]

- (d) An eagle hovers vertically above Y .
 The greatest angle of elevation of the eagle when viewed from the path XZ is 56° .
 Find the angle of elevation of the eagle when viewed from Z .

Answer [3]

7 (a)



The diagram shows a circle $BCDE$, centre O .
 F is the point of intersection of BD and diameter EC .
 AB and AD are tangents to the circle such that angle $BAD = 40^\circ$.

- (i) Show that triangle DEF is similar to triangle CBF .
 Give a reason for each statement you make.

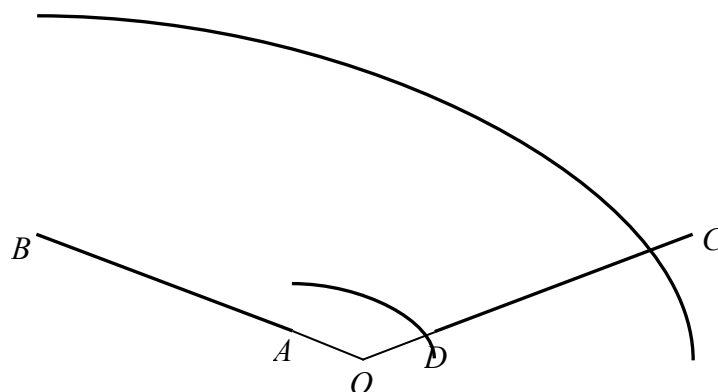
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 [2]

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

Answer angle $BED = \dots\dots\dots^\circ$ [3]

(b)



The diagram above shows a folding fan $ABCD$.

AD and BC are arcs of circles centre O with radii 10 cm and 40 cm respectively.

The perimeter of the fan is 190 cm.

Calculate

(i) the angle AOD in radians,

Answer radians [2]

(ii) the area of the fan.

Answer cm^2 [2]

- 8 (a) P is the point $(-2, 5)$ and Q is the point $(4, 11)$.

$$\vec{PS} = \begin{pmatrix} 3 \\ -6 \end{pmatrix}.$$

- (i) Calculate the length of the line PQ .

Answer [2]

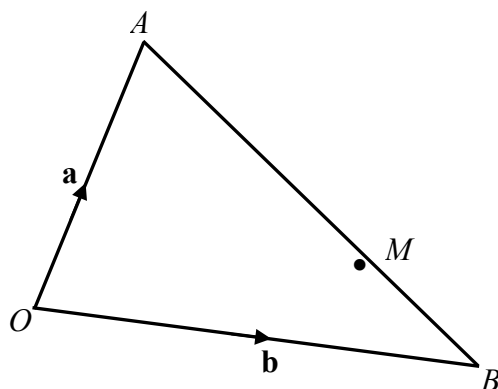
- (ii) Find the coordinates of point S .

Answer (.....,) [1]

- (iii) Find the equation of the line QS .

Answer [2]

(b)



OAB is a triangle.

M is a point on AB .

$\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$.

$AM = \frac{2}{3} AB$.

(i) Express $\vec{AM}$, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$.

Answer $\vec{AM} = \dots\dots\dots$ [2]

Q is a point on OB such that OA is parallel to QM .

(ii) Express $\vec{QB}$, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$.

Answer $\vec{QB} = \dots\dots\dots$ [2]

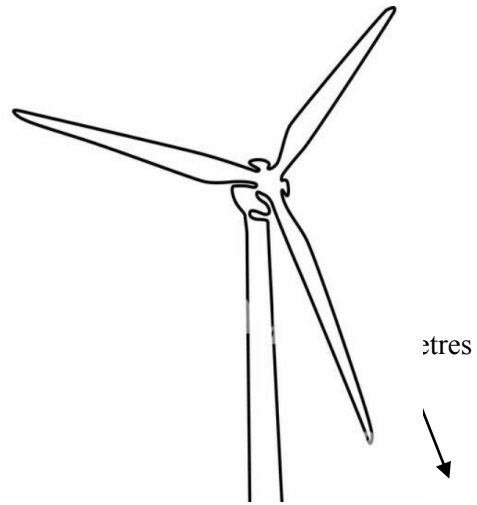
(iii) Find the ratio area of triangle OAB : area of trapezium $OAMQ$.

Answer $\dots\dots\dots : \dots\dots\dots$ [2]

- 9 Wind energy is a clean and renewable source of power.

A city wants to build some wind power plants to generate electricity.

A wind turbine model shown below was found to be suitable, and some information about the model is given in the table.



Number of rotor blades of each wind turbine	: 3
Length of each rotor blade	: 56 metres
Maximum speed of rotation of each wind turbine	: 12 rotations per minute
Construction and installation costs	: \$4.3 million
Maintenance cost	: 1.8 cents per kilowatt hour (kWh) of electricity generated
Average amount of electricity generated per rotation	: 0.9 kilowatt hour (kWh)

- (a) Calculate the distance, in metres, covered by the tip of a rotor blade of the wind turbine in one complete rotation.

Answer metres [1]

- (b) Hence, find the maximum speed, in metres per minute, that can be achieved by the tip of a rotor blade of the wind turbine.

Answer metres/minute [2]

- (c) The first wind turbine aims to start operation in November 2025.
The electricity generated will be sold at 25.28 cents per kilowatt hour (kWh).

Assuming there are 365 days in a year, suggest an earliest possible year in which the city first recover the costs of construction, installation and maintenance.

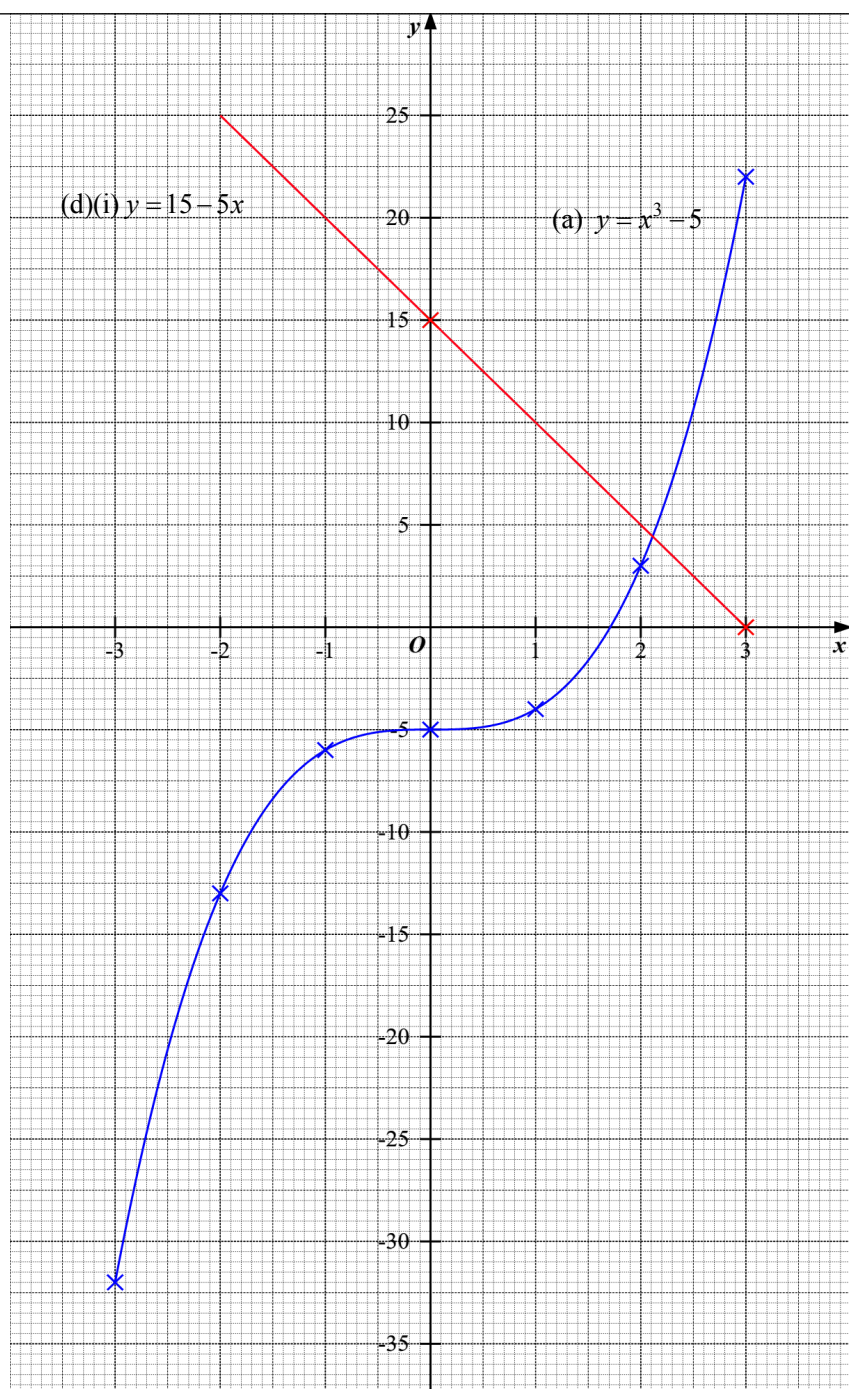
Justify the decision you make and show your calculations clearly.

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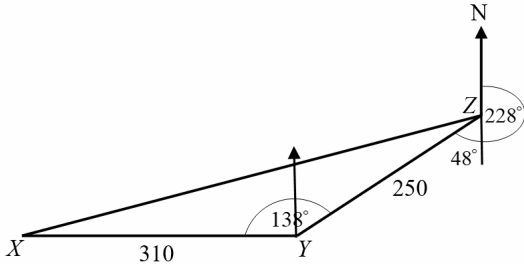
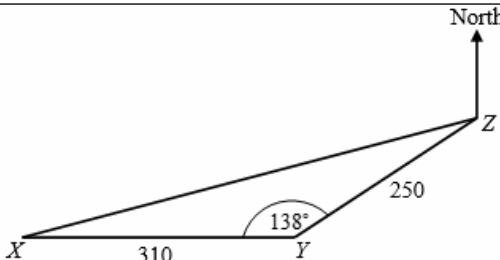
[6]

END OF PAPER

Qn		Answer Key
1	(a)	$\frac{x}{x-4y}$
	(b)	$\frac{2a^2}{p^3}$
	(c)	$x = 8.10$ or $x = -2.10$ (2 d.p.)
	(d)	$x = 5$ or $x = -2$
2	(a)	Total amount paid for the week = \$547.50
	(b)	Total cost in Singapore dollars = \$685.57
	(c)	(i) 7.31×10^{-23}
		(ii) 1.67×10^{25}
3	(a)	(i) 52.5 g
		(ii) 19.5 g
	(b)	$\frac{177}{8374}$
	(c)	Statement 1: Disagree The median mass of eggs in factory A (52.5 g) is lower than the median mass of eggs in factory B (58 g). [This suggests that the eggs in factory B are heavier.] Statement 2: Agree The interquartile range (IQR) for eggs in factory A (19.5 g) is smaller than the IQR for eggs in factory B (34 g). [This suggests that the eggs in factory B have a wider spread of masses.]
4	(b)	



	(a)	-32
	(c)	From the graph, $\sqrt[3]{5} = 1.70$
	(d)	(i) Graph of $y = 15 - 5x$
		(ii) 2.1 (2.05 to 2.15)
		$a = 20$
		(iii) $b = -5$
5	(a)	To show
	(b)	$x = 7.04$ or -17.04

	(c)	$\angle HBE = 13.6^\circ$ (1 d.p.)
6	(a)	$XZ = 523.247 \text{ m} \approx 523 \text{ m}$ (3 s.f.)
	(b)	 Bearing = 048°
	(c)	 shortest distance = 99.1 m (3 s.f.)
	(d)	Let the required angle be θ $\tan \theta^\circ = \frac{146.9321}{250}$ $\theta^\circ = 30.4^\circ$ (1 d.p)
7	(a)	(i) $\angle EDF = \angle BCF$ ($\angle$ s in the same segment) $\angle DEF = \angle CBF$ ($\angle$ s in the same segment) $\angle DFE = \angle CFB$ (vert. opp $\angle$ s) $\triangle DEF$ is similar to $\triangle CBF$ (AAA)
		(ii) $\angle BED = 110^\circ$
	(b)	(i) $\theta = 2.6 \text{ rad}$
		(ii) 1950 cm^2
8	(a)	(i) $PQ = 8.49 \text{ units}$ (3s.f.) (ii) $S(1, -1)$ (iii) Equation of QS is $y = 4x - 5$
	(b)	(i) $AM = \frac{2}{3}(\vec{-a} + \vec{b})$ (ii) $\frac{BM}{BA} = \frac{1}{3}$ so $\frac{BQ}{BO} = \frac{1}{3}$ Therefore $QB = \frac{1}{3}\vec{OB} = \frac{1}{3}\vec{b}$
		(iii) $\frac{\text{Area of } \triangle MBQ}{\text{Area of } \triangle ABO} = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$

		$\frac{\text{Area of } \triangle OAB}{\text{Area of trapezium } OAMQ} = \frac{9}{9-1} = \frac{9}{8}$ The ratio is 9 : 8
9	(a)	Distance covered = $2\pi(56)$ = 112π = 352 m
	(b)	Distance covered for a maximum speed of 12 rotations in 1 minute = $12(112\pi)$ m Maximum speed in m/min = $4222.30 \approx 4200$ m/min (3 s.f.)
	(c)	3.226 years $\approx$ 3.23 years In the year 2029