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**TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS**

CANDIDATE
NAME

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CLASS

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INDEX
NUMBER

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MATHEMATICS

4052/01

Paper 1

21 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

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

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

DO NOT WRITE ON ANY BARCODES.

Answer **all** the questions.

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

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

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 90.

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

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

For π , use either your calculator value or 3.142.

For Examiner's use

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This document consists of **24** printed pages and **2** blank 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

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

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

Answer **all** the questions.

- 1 (a) Simplify $\left(\frac{\sqrt[3]{a}}{3b^2}\right)^4$ and express your answer in positive index form.

Answer [1]

- (b) Solve $10 \times 3^6 - 2 \times 9^3 = 8 \times 3^k$.

Answer $k =$ [2]

- 2 (a) Convert 2.4 radians into degrees.

Answer [1]

- (b) Area of triangle $XYZ = 63 \text{ cm}^2$, $XY = 12 \text{ cm}$, $YZ = 15 \text{ cm}$ and $\angle XYZ$ is the largest angle in the triangle.
Find angle XYZ .

Answer [2]

- 3 Mr Tan had lunch with his friends at a restaurant to celebrate his birthday. They ordered a meal from a set menu at a special price of \$ x . In addition, they ordered some dishes from the a la carte menu at \$96. All dishes from the a la carte menu would be entitled to 20% birthday discount. After adding 10% service charge and 9% goods and service tax (GST), they paid \$257.55. Find x , correct to the nearest whole number.

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

- 4 (a) $\sqrt[6]{x} = a \times b^2 \times c^3$ where a , b and c are different prime numbers.

Amy claimed that x is a perfect square and a perfect cube. Do you agree? Explain your answer.

Answer

.....

 [2]

- (b) The numbers $y = 2^7 \times 5^{11} \times 13^{21}$ and $z = 2^7 \times 5^{10}$.

- (i) The integer $w = y \div m$ is a perfect cube.

Find the smallest possible value of m . Write your answer as a product of its prime factor.

Answer $m =$ [1]

- (ii) The lowest common multiple and highest common factor of y , z and w are $2^8 \times 5^{11} \times 13^{21}$ and $2^7 \times 5^9$ respectively.

Find the smallest possible value of v as a product of its prime factors.

Answer $v =$ [1]

5 Raymond invests \$8000 at a rate of 0.5% per quarter compound interest.

(a) Explain why the first year's interest is not 2% of \$8000.

Answer

.....

.....

.....

[1]

(b) Calculate the interests of his investment at the end of 2 years.

Answer [2]

6 The expression $x^2 - 20x - a$ is equivalent to $(x + b)^2 - 125$.

Find the value of a and b .

Answer $a =$

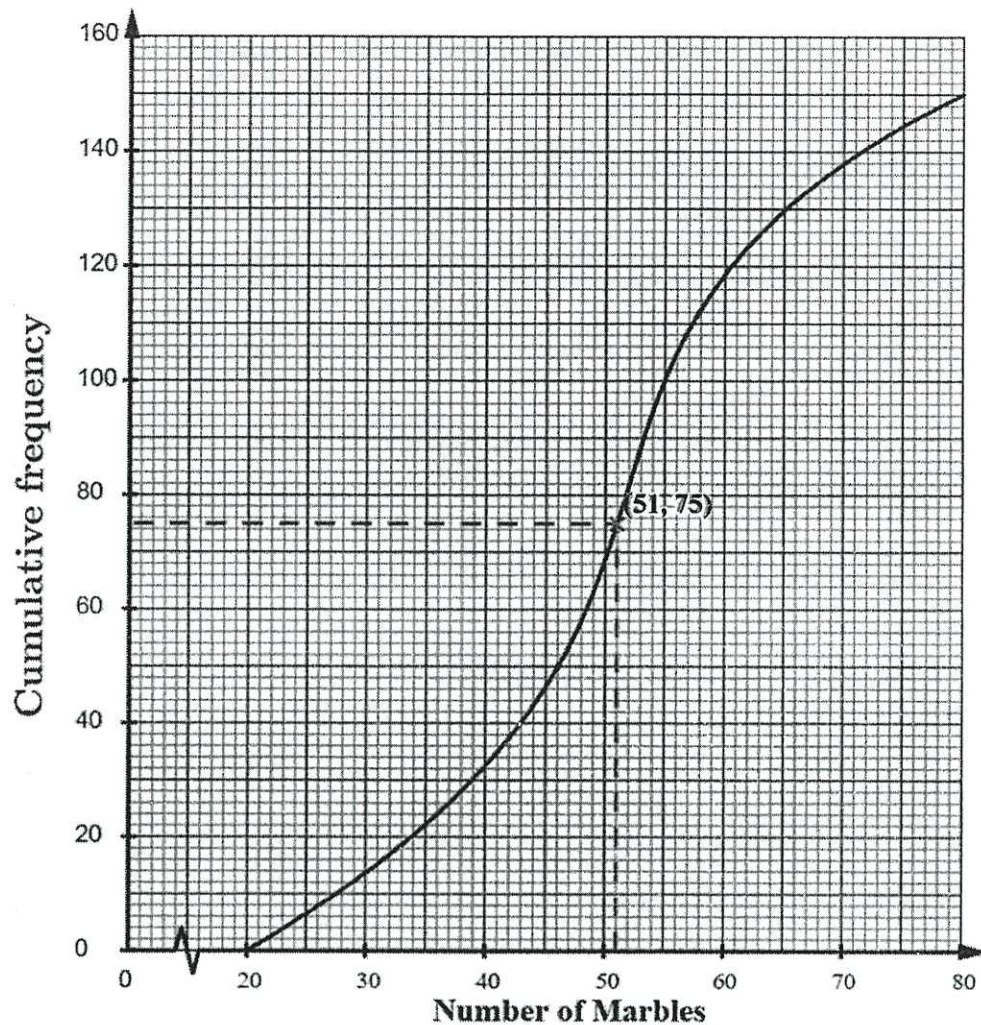
$b =$ [2]

- 7 A tank was filled with some pebbles and $x \text{ cm}^3$ of water.
Initially, the total volume of pebbles and water was 50% more than the empty space left in the tank while the volume of pebbles was 10% of the volume of water.
After 3600 cm^3 of pebbles were added, the volume of pebbles became 25% of the volume of water.
Find the value of x and, hence, find the capacity of the tank.

Answer $x = \dots\dots\dots$

Capacity of tank = $\dots\dots\dots \text{cm}^3$ [3]

- 8 A group of 150 teenagers were asked to estimate the number of marbles in a jar. The cumulative frequency diagram represents their estimates.



(a) Use the diagram to find the

- (i) number of teenagers whose estimate for the number of marbles, n , is $40 \leq n < 60$.

Answer [1]

- (ii) number of teenagers who estimated at least 60 marbles.

Answer [1]

(iii) 20th percentile.

Answer [1]

(b) Explain the meaning of the point (51, 75) in this cumulative frequency diagram.

Answer

.....

 [1]

(c) The actual number of marbles in the jar is 47. This is the p th percentile.

(i) Write down the value of p .

Answer $p =$ [1]

(ii) Find the probability that two teenagers chosen at random underestimated the number of marbles.

Answer [1]

- 9 Below are some exchange rates offered by two money changers in Singapore.

ABC Money Changer		
Currency	Sell	Buy
United States Dollar (USD)	1.29	1.26
Chinese Yuan (CNY)	0.18	0.176

XYZ Money Changer		
Currency	Sell	Buy
United States Dollar (USD)	1.285	1.27
Chinese Yuan (CNY)	0.182	0.175

- (a) Jane wants to change 200 USD to Singapore dollars (SGD).

- (i) Which money changer should she go to?

Answer

Jane should go to Money Changer because for every USD, she can get more SGD than changing her money at Money Changer.

[1]

- (ii) How much SGD will she receive?

Answer SGD..... [1]

- (b) Jane wants to change 550 Singapore dollars (SGD) to Chinese Yuan (CNY).

- (i) Which money changer should she go to?

Answer

Jane should go to Money Changer because for every 1 CNY, she will pay less SGD than changing her money at Money Changer.

[1]

- (ii) How much CNY will she receive?

Answer CNY..... [1]

- 10 (a) Write $\frac{x}{2(3-2x)} - \frac{3}{2x-5}$ as a single fraction in its simplest form.

Answer [2]

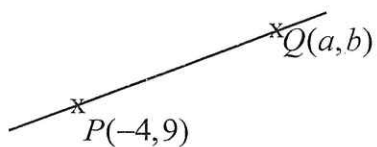
- (b) Simplify $\frac{4x-6}{16x^4-81}$.

Answer [2]

- (c) Factorise completely $15ac - 6bc + 30ad - 12bd$.

Answer [2]

- 11 P is the point $(-4, 9)$ and Q is the point (a, b) .
Line PQ is parallel to the line $2y - 3x = 10$.



Find a in terms of b .

Answer $a = \dots\dots\dots$ [2]

- 12 The mass of 20 potatoes and 25 carrots were shown below.

Potatoes	Stem	Carrots
	7	8 9
3	8	2 4 7 9 9
6 5 2 2 1	9	1 4 5 6 7 8 9 9 9
8 5 4 3 1 1 0 0	10	1 3 8
9 8 4 2 1 0	11	x 2 3 8 8 8

Key (Potatoes)
3 | 8 represents 83 grams

Key (Carrots)
9 | 1 represents 91 grams.

- (a) Write down the median mass of the potatoes.

Answer $\dots\dots\dots$ grams [1]

- (b) The interquartile range of the masses for the carrots is 20 grams. Find x .

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

- 13 Explain why $(3x-2)^2 - 6(1-x)(x+1) - 1$ is a non-negative multiple of 3 for all natural numbers x .

Answer

.....

[2]

- 14 A company that sells eggs displays this promotion poster.

Eggs at more than 50% discount. Today only!

\$2.15 for 10

\$

~~Year 2020~~
Today only!

~~\$3.20 for 10~~

\$

Year 2025

Prices of eggs have gone up by about 50% from year 2020 to 2025 but we are offering you eggs at the prices of 2020 TODAY!

Explain one aspect of the poster that is misleading.

Answer

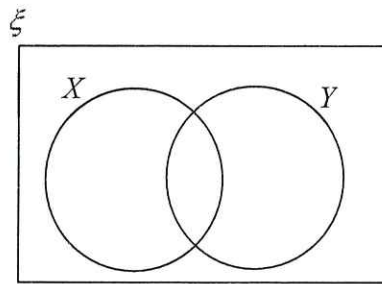
.....

[2]

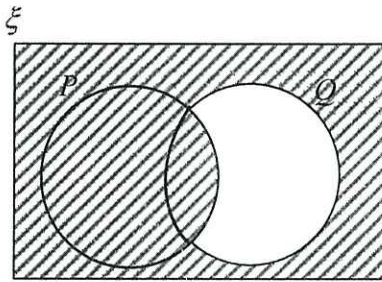
- 15 (a) On the Venn Diagram, shade the region which represents $(X \cap Y') \cup (X' \cap Y)$.

Answer

[1]



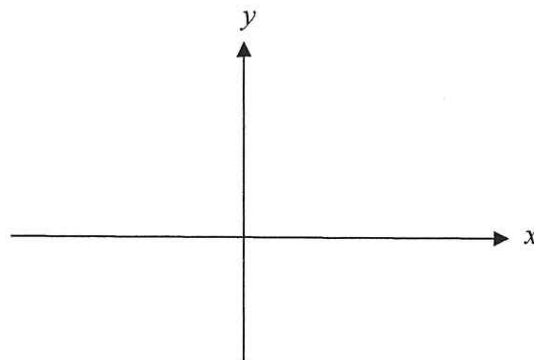
- (b) Use set notation to describe the shaded region.



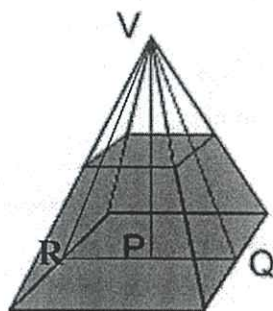
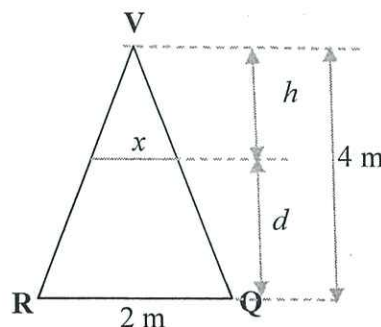
Answer [1]

- 16 Sketch the graph $y = -(x+4)(x-6)$ on the axes below. Indicate clearly the equation of the line of symmetry, the coordinates of the turning point and the points where the graph crosses the axes.

[3]



- 17 Diagram *A* shows a sealed right-pyramid with a square base containing some water. Diagram *B* shows the cross section of the pyramid and water.

Diagram *A*Diagram *B*

The square base is of length 2 m and the height of the pyramid is 4 m.

The length of the square surface area of the water is x m, the depth of the water is d m and the surface of the water is h m from the top of the pyramid.

- (a) Show that $d = 4 - 2x$.

[1]

- (b) Given that the volume of the empty space is $\frac{1}{3}$ of the volume of the water, calculate d .

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

- 18 Mr Asahi is a Japanese tutor. He offers basic and advanced Japanese lessons. The matrix **S** shows the number of students he has each week.

$$S = \begin{matrix} & \begin{matrix} \text{Basic} & \text{Advanced} \end{matrix} \\ \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} & \begin{matrix} \text{Weekdays} \\ \text{Weekends} \end{matrix} \end{matrix}$$

- (a) Mr Asahi charges \$280 and \$320 per month for basic and advanced lessons respectively. Represent this information in a column matrix **C**.

Answer **C** = ... [1]

- (b) Evaluate the matrix **P** = 12**SC** where **P** represents the annual fees collected for lessons on weekdays and weekends respectively.

Answer **P** = ... [1]

- (c) Mr Asahi wants to increase the monthly lesson fees for basic and advanced courses by 10% and 20% respectively.

Write down a matrix **N** such that **M** = **NC** where **M** is a 2 x 1 matrix that represents the new fees after the increase.

Answer **N** = ... [1]

- (d) Evaluate the matrix **Q** = (1 1)**SM**.

Answer **Q** = ... [2]

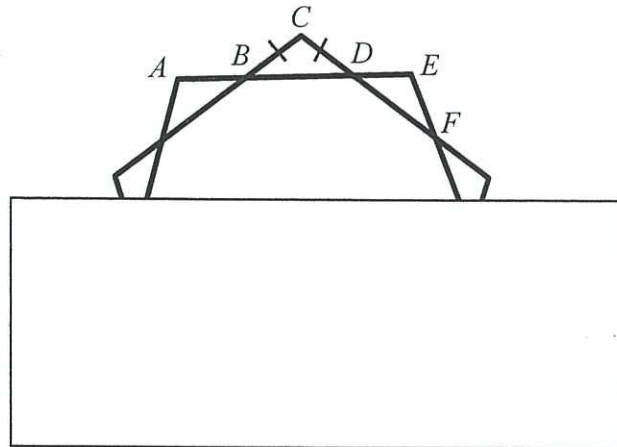
- (e) State what the element(s) of **Q** represent.

Answer

.....

 [1]

- 19 The partially covered star below is made up of an n -sided regular polygon in the centre surrounded by n isosceles congruent triangles.



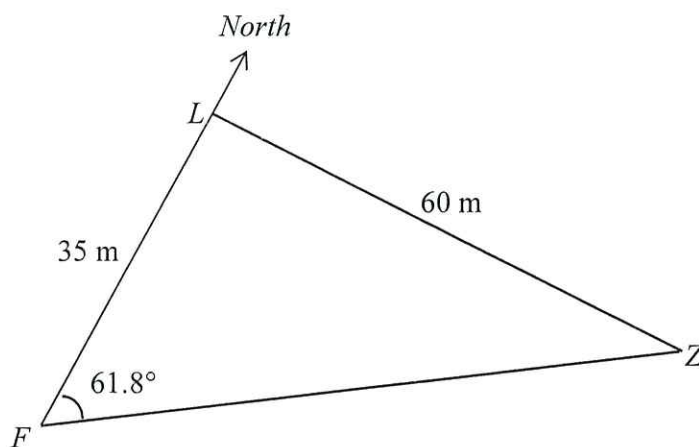
- (a) Given that $\angle BCD = 108^\circ$ and $ABDE$ forms a straight line, find the value of n .

Answer $n = \dots\dots\dots$ [2]

- (b) Find the interior angle of the regular n -sided polygon.

Answer $\dots\dots\dots$ [1]

- 20 The diagram shows the positions of a lioness L , a zebra foal F and a dazzle of zebras Z . $LF = 35$ m, $LZ = 60$ m and $\angle LFZ = 61.8^\circ$.



- (a) Find the bearing of F from Z .

Answer [1]

- (b) (i) Explain why is $\angle LZF$ an acute angle.

Answer

.....

 [1]

- 20 (b) (ii) Find the bearing of Z from L .

Answer [2]

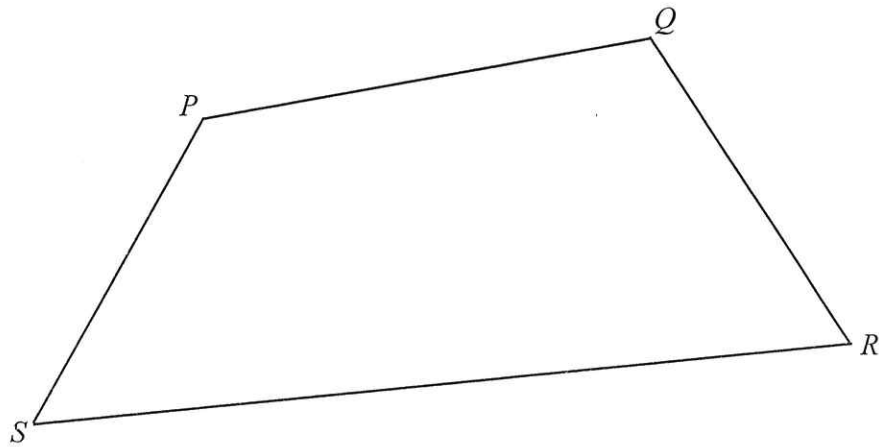
- (c) Find the length of FZ .

Answer [2]

- (d) The lioness at L spotted the foal at F .
If the foal ran from F to Z , find the shortest distance for the lioness to reach the foal from L .

Answer [2]

21 The diagram shows a garden $PQRS$.



- (a) A new tower T is to be built at a location equidistant from PS and PQ .
Mark a possible location of the tower T on the diagram. [1]
- (b) A new café C in the tower T is to be located equidistant from R and S .
Mark the final location of the café C on the diagram. [1]

- 22 (a) Given the table of values, calculate and explain why x and y^2 are inversely proportional.

x	$\frac{1}{4}$	1	4	9
y	12	6	3	2

Answer

.....

[1]

- (b) Calculate the percentage reduction in x when y is increased by 150%.

Answer% [2]

- 23 (a) The first four terms of a sequence are

8, 5, 2, -1.

- (i) Write down, in terms of n , the n th term of the sequence.

Answer [1]

- (ii) The first four terms of another sequence are

9, 9, 11, 15.

By comparing this sequence with the sequence in part (a), write down, in terms of n , the n th term of this sequence.

Answer [1]

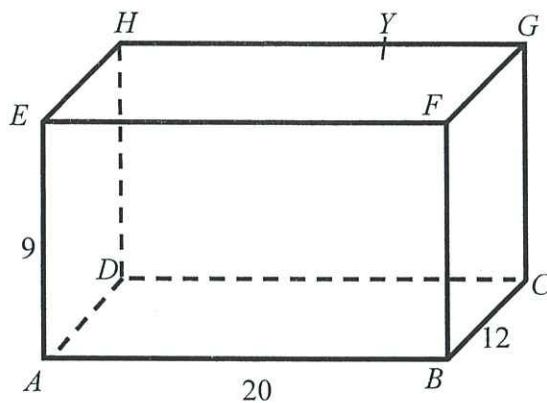
- (b) Sum of the first n terms of a new sequence with a common difference is

$$S_n = \frac{n}{2}(7n-3).$$

Find the n th term of this new sequence.

Answer [2]

- 24 The diagram shows a cuboid container $ABCDEFGH$.
 $AB = 20$ m, $BC = 12$ m, $AE = 9$ m, Y is a point on GH such that $HY : YG = 3 : 2$ and
 $AY = \sqrt{369}$ m.



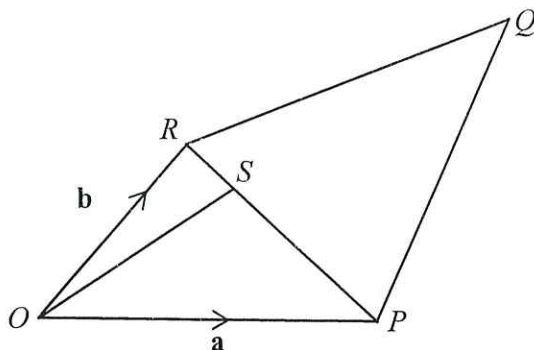
- (a) Find $\angle AYB$.

Answer [3]

- (b) Find the largest angle of depression of AB from Y .

Answer [2]

- 25 $OPQR$ is a quadrilateral. $\overrightarrow{OP} = \mathbf{a}$, $\overrightarrow{OR} = \mathbf{b}$ and $RS = \frac{1}{4}RP$.



- (a) Given that $\overrightarrow{RQ} = \frac{2}{3}\mathbf{a} + \mathbf{b}$, show that O , S and Q form a straight line.

Answer

.....
 [2]

- (b) X is a point on OP such that XS is parallel to QP .
 Find $\overrightarrow{XS}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer $\overrightarrow{XS} = \dots\dots\dots$ [3]



**TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
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INDEX
NUMBER

--	--

MATHEMATICS

4052/02

Paper 2

14 August 2025

2 hour 15 minutes

Candidates answer on the Question Paper

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For π , use either your calculator value or 3.142.

For Examiner's use

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This document consists of **23** printed pages and **1** blank page.

Mathematical Formulae

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

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

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

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

TURN OVER FOR QUESTION 1

- 1 (a) The table shows the total electricity consumption in Singapore over three years.

Year	2022	2023	2024
Total electricity consumption in Gigawatt hour (GWh)	50818	53715	55143

- (i) Express the 2022 electricity consumption in Gigawatt hours (GWh) in standard form correct to two significant figures.
[1 GWh = 10^9 Wh]

Answer GWh [1]

- (ii) In 2023, the electricity consumed by households took up 16.5% of the total electricity consumption. Calculate the amount of electricity consumed by households in 2023, correct to two significant figures.

Answer GWh [2]

- (iii) Calculate the percentage increase in the total electricity consumption from 2022 to 2024.

Answer% [2]

- (b) The speed of light is 3×10^8 m/s. Find the distance, in kilometres, travelled by light in 70 nanoseconds, giving your answer in standard form.
[1 nanosecond = 10^{-9} seconds]

Answer km [2]

- (c) (i) The actual length of a transistor is 0.25 mm.
In a scale drawing, the length of the same transistor is x mm.
Given that the scale used is 20 : 1, find the value of x .

Answer $x =$ mm [1]

- (ii) Made to the same scale as the transistor, the actual surface area of a microprocessor is 120 mm^2 , find the surface area of the microprocessor in a scale drawing in square centimetres.

Answer cm^2 [2]

-
- 2 (a) Solve $2(5-4x) = 3x-1$.

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

- (b) Solve the inequalities $\frac{x+12}{3} \geq -3(x-3)$ and $5x-3 < 7$.

Answer $\dots\dots\dots$ [3]

- (c) Given the formula, $d = \frac{1}{2}(b^2c - 7b^2)$

- (i) Find the value of d when $b = -2$ and $c = 5$,

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

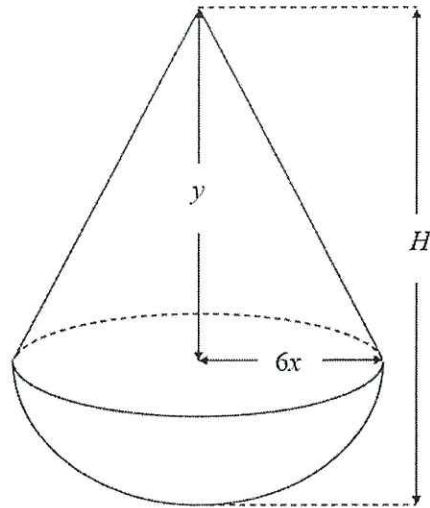
- (ii) Rearrange the given formula to make b the subject.

Answer $b = \dots\dots\dots$ [2]

- (d) Solve the equation $\frac{x}{2x-1} - 3 = \frac{4}{x}$.
Give your solutions correct to two decimal places.

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

- 3 The diagram shows a solid formed from a cone and a hemisphere.
 The cone has base radius $6x$ cm and height y cm.
 The hemisphere has radius $6x$ cm.



- (a) The volume of the cone is twice the volume of the hemisphere.
 Find y in terms of x .

Answer $y = \dots\dots\dots$ [4]

- (b) The total surface area of the solid is 600 cm^2 . Find the value of H .

Answer $H = \dots\dots\dots$ [5]

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

Values are given to one decimal place where appropriate.

x	-3	-2	-1	-0.5	0.3	0.5	1	2	3
y	-8.9	-5.8	-2	2.5	12.0	5.5	4	6.3	

[1]

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

- (c) (i) On the same grid, draw the graph of $y - 2x = 5$ for $-3 \leq x \leq 3$. [2]

- (ii) Write down the x -coordinates of the points where the line intersects the curve.

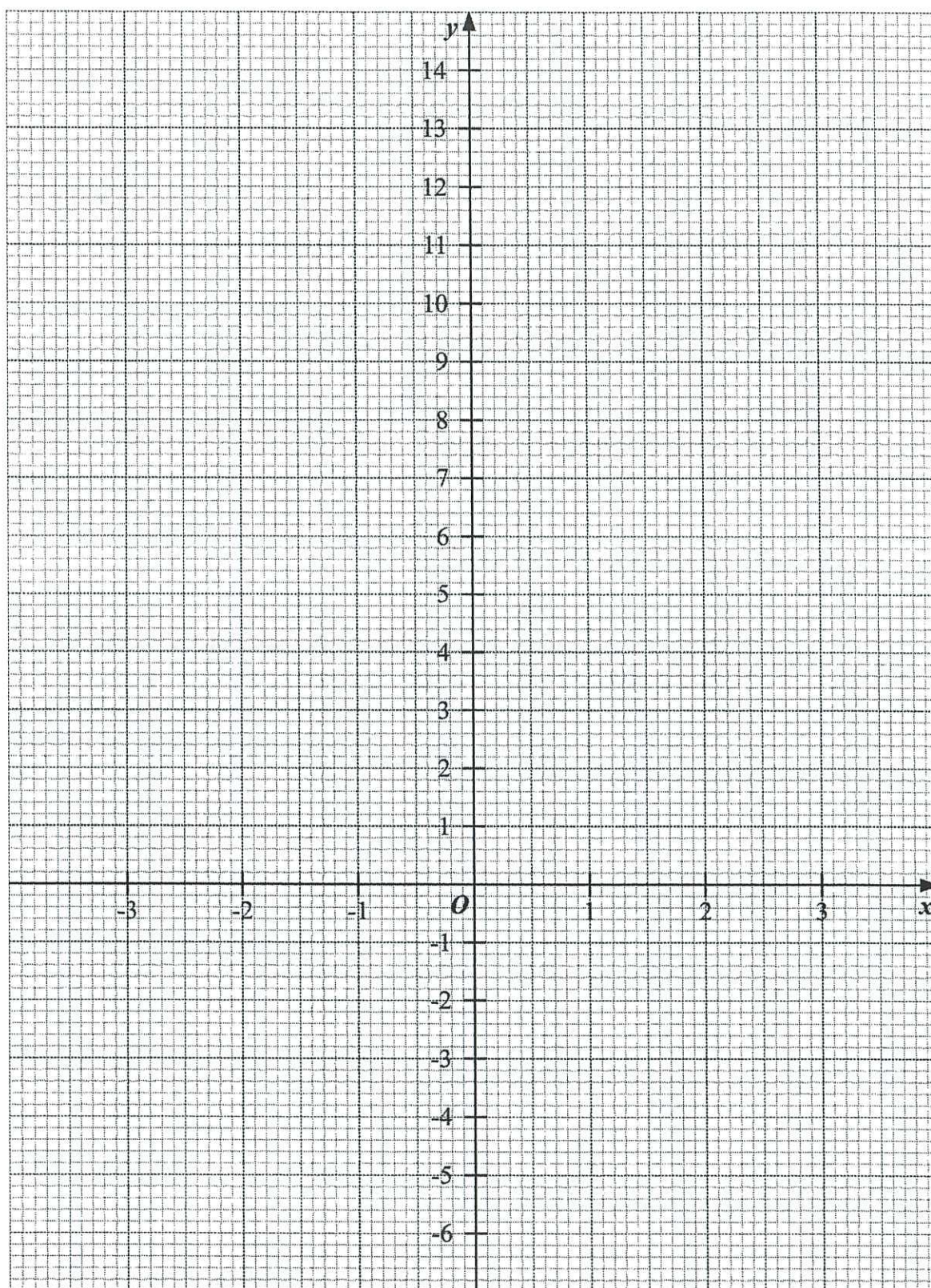
Answer $x = \dots\dots\dots$ and $\dots\dots\dots$ [2]

- (iii) These values of x are the solutions of the equations $Ax^3 + Bx^2 + 1 = 0$.

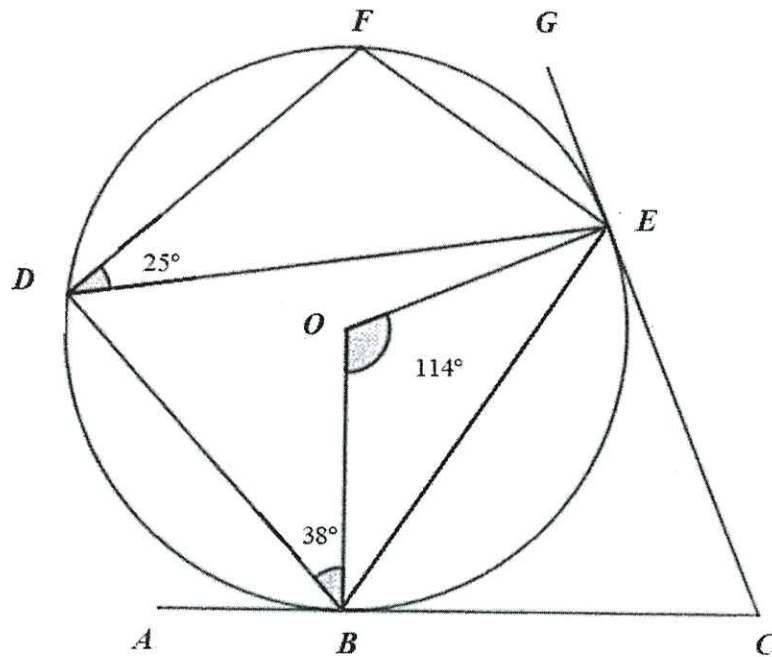
Find the value of A and the value of B .

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

$B = \dots\dots\dots$



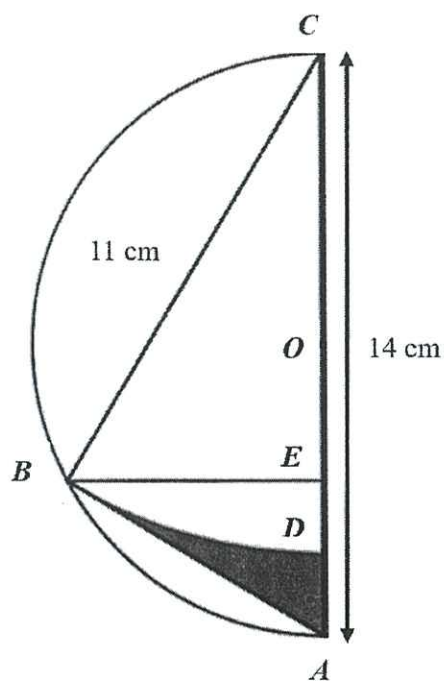
- 5 In the diagram, B, D, E and F lie on the circle with centre O . AC and CG are tangents to circles at B and E respectively. It is given that angle $EDF = 25^\circ$, angle $OBD = 38^\circ$ and angle $BOE = 114^\circ$



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

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

- (b) The diagram shows a semicircle, centre O , with a diameter AC of 14 cm. CD is perpendicular to AB . BD is an arc of a circle with C as the centre and radius 11 cm.



- (i) Show that angle $BCE = 0.667$ radian when corrected to 3 significant figures. [1]

- (ii) Calculate the area of the shaded region.

Answer cm² [3]

-
- 6 (a) A is the point $(1, -4)$ and B is the point $(-7, -2)$. The point C is the result of the translation of point B by $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$.

(i) Find the coordinates of point C .

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

(ii) Find the equation of the line AC .

Answer [3]

- (b) J is a point $(-2, m)$ and K is a point $(10, 1)$
 The equation of the line JK is $y = -\frac{1}{2}x + 6$.

- (i) Find the value of m .

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

- (ii) Hence, find the length of the line JK .

Answer $JK = \dots\dots\dots$ units [2]

- (iii) The line with equation $6y + px = 16$ intersects the line JK at the point $(q, 5)$,
 where p and q are constants.
 Find the value of p and the value of q .

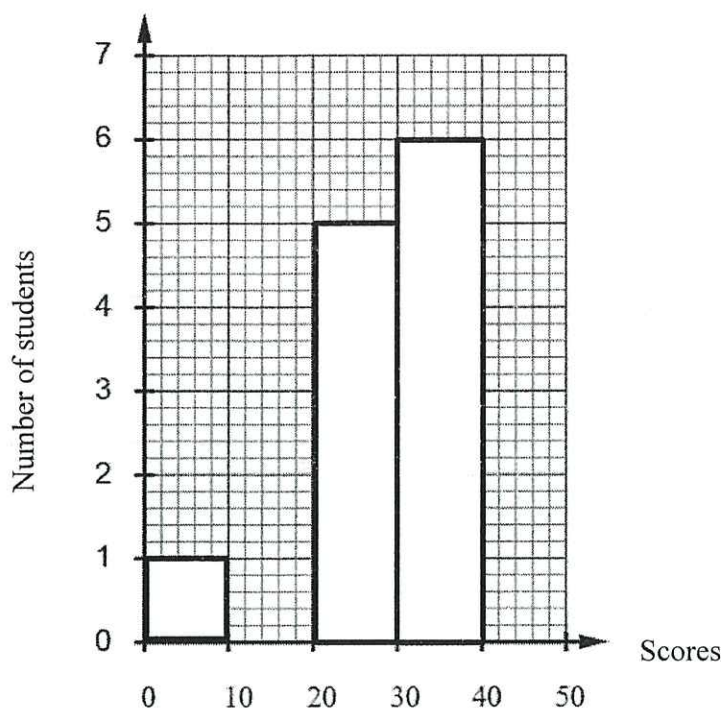
Answer $p = \dots\dots\dots$
 $q = \dots\dots\dots$ [4]

- 7 (a) The stem-and-leaf diagram shows the scores of a group of students in an English test.

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

Key: 1 | 8 represents 18 marks

- (i) The values in the stem-and-leaf diagram are used to construct the histogram below. Complete the histogram. [1]



Using the histogram,

- (ii) calculate the estimated mean of the scores.

Answer marks [1]

- (iii) calculate the estimated standard deviation of the scores.

Answer marks [1]

- (b) The mean and standard deviation values of the stem-and-leaf diagram are in the table below.

Mean	33.3 marks
Standard deviation	11.4 marks

Give a reason for the difference in values between the table above and the values found in **a(ii)** and **a(iii)**.

.....

.....

.....

.....

[1]

(c) There are 30 coloured balls in a bag. 5 balls are red, 9 are blue and the rest are green.

- (i) A ball is selected from the bag at random.
Find the probability that the selected ball is green.

Answer [1]

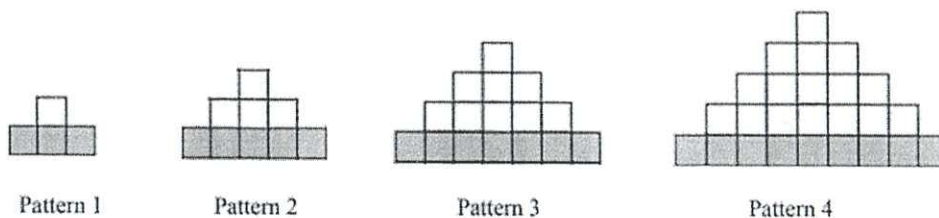
- (ii) Two balls are selected from the bag at random without replacement.
Find the probability that both the selected balls are of the same colour.

Answer [2]

- (iii) Two balls are selected from the bag at random with replacement.
Find the probability that both the selected balls are of different colour.

Answer [2]

- 8 (a) The diagram shows a sequence made by using grey and white squares.



- (i) Complete the table below. [2]

Pattern Number	n
Number of grey squares	
Number of white squares	

- (ii) Determine if any sequence can be formed with 1381 white squares. Justify your answers with clear working. [2]

- (iii) Show that $n^2 - (2n + 1) = (n - 1)^2 - 2$ [1]

- (iv) Hence or otherwise, show that the number of white squares will be greater than the number of grey squares when $n \geq 3$. Justify your answers with clear working. [2]

-
- (b) Jonathan buys a car on hire purchase.
He made a 25% downpayment and takes up a 7-year loan which charges simple interest at 3.78% per annum.
Given that he pays \$1850 monthly instalment for the car, calculate the cash price of the car.
Give your answer correct to the nearest dollar.

Answer \$..... [4]

- 9 Mr Goh would like to replace all 60 units of air conditioners in his office building. He is considering between two brands of air conditioners.

Information about the two brands of air conditioners is shown in the table below.

Brand	A	B
Price of each air conditioner unit (after GST)	S\$1288	S\$840
Power consumption per air conditioner unit per hour	3 kW	3.2 kW
Frequency of repair, maintenance and servicing of air conditioner units	Twice a year	Four times a year
Total cost for repair, maintenance and servicing of 60 units	S\$2100 per visit	S\$1000 per visit
Warranty* (activated upon purchase)	Three years	Two years
*Warranty covers free of charge repair, maintenance and servicing of air conditioner units with free replacement of parts for the stated duration. (non-extendable)		

The latest Electricity Tariff* is shown in the table below.

*An electricity Tariff is the pricing structure used to determine how much you pay for electricity consumption

	Tariff (without GST)	Tariff (with GST)
kWh* charge (¢ per kWh)	28.12	30.65
* kWh (kilowatt-hour) is a unit of energy equal to one kilowatt (kW) of power sustained for one hour		

The usage of air conditioner units in Mr Chen's office building is shown in the table below.

Days	Usage time per unit	Number of units used
Monday	8 hours	45
Tuesday to Friday	7 hours each day	60
Saturday and Sunday	No usage	

-
- (a) Work out the amount of energy used, in kWh, when a Brand A air conditioner is operates for 6 hours.

Answer kWh [1]

- (b) Mr Goh's office building operates for 50 weeks per year. (excluding public holidays).
Find the total hours of usage of the air conditioner units in the office building for a year.

Answer h [2]

- (c) Based on the usage of his office building, which air conditioner model will have a lower cost after first 4 years of use?
Justify your decision with clear working and state one assumption that you took into consideration.

Answer

.....
..... [7]

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**TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS**

CANDIDATE
NAME

SOLUTION

CLASS

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INDEX
NUMBER

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MATHEMATICS

4052/01

Paper 1

21 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

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

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

DO NOT WRITE ON ANY BARCODES.

Answer **all** the questions.

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

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

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 90.

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

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

For π , use either your calculator value or 3.142.

For Examiner's use

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Qn		Solution
1	(a)	$\left(\frac{\sqrt[3]{a}}{3b^2}\right)^4 = \frac{a^{\frac{4}{3}}}{3^4(b^2)^4} = \frac{a^{\frac{4}{3}}}{81b^8}$
	(b)	$10 \times 3^6 - 2 \times 9^3 = 8 \times 3^k$ $10 \times 3^6 - 2 \times 3^6 = 8 \times 3^k$ $8 \times 3^6 = 8 \times 3^k$ $3^6 = 3^k$ $k = 6$

Qn		Solution
2	(a)	2.4 radians $= 2.4 \times \frac{180^\circ}{\pi}$ $= 137.5^\circ \text{ (1 d.p.)}$
	(b)	Area of $\triangle XYZ = \frac{1}{2} \times YX \times YZ \times \sin \angle XYZ$ $63 = \frac{1}{2} \times 12 \times 15 \times \sin \angle XYZ$ $\sin \angle XYZ = 0.7$ $\angle XYZ = 44.427^\circ \text{ or } 180^\circ - 44.427^\circ$ $= 44.4^\circ \text{ or } 135.6^\circ \text{ (1 d.p.)}$ If $\angle XYZ = 44.4^\circ$ and $\angle XYZ$ is the largest angle, then sum of $\angle$s in $\triangle XYZ < 44.4^\circ \times 3 = 133.2^\circ < 180^\circ$. This contradicts $\angle$ sum of $\triangle = 180^\circ$. $\therefore \angle XYZ \neq 44.4^\circ$. Answer: 135.6°

Qn	Solution
3	$(x + 96 \times 0.8) \times 1.1 \times 1.09 = 257.55$
	$x = 138$ (nearest whole number)

Qn	Solution
4 (a)	$\sqrt[6]{x} = a \times b^2 \times c^3$ where a, b and c are different prime numbers.
	$\sqrt[6]{x} = a \times b^2 \times c^3$ where a, b and c are different prime numbers. $x = (a \times b^2 \times c^3)^6$ $= [(a \times b^2 \times c^3)^3]^2$ $= [(a \times b^2 \times c^3)^2]^3$ Or $\sqrt{x} = (a \times b^2 \times c^3)^3$ and $\sqrt[3]{x} = (a \times b^2 \times c^3)^2$
	Yes, I agree. Since $x = [(a \times b^2 \times c^3)^3]^2 = [(a \times b^2 \times c^3)^2]^3$ or $\sqrt{x} = (a \times b^2 \times c^3)^3$ and $\sqrt[3]{x} = (a \times b^2 \times c^3)^2$ where $(a \times b^2 \times c^3)^3$ and $(a \times b^2 \times c^3)^2$ are integers, x is a perfect square of $(a \times b^2 \times c^3)^3$ and a perfect cube of $(a \times b^2 \times c^3)^2$. Alternatively: Yes, I agree. Since $x = a^6 \times b^{12} \times c^{18}$, all the indices (powers) of the prime factors of x are multiples of 2 and 3 (or multiples of 6), x is both a perfect square and a perfect cube.

4 (b)	(i)	Given $y = 2^7 \times 5^{11} \times 13^{21}$, $w = y \div m$ and w is a perfect cube Biggest $w = \frac{2^7 \times 5^{11} \times 13^{21}}{\text{smallest } m} = 2^6 \times 5^9 \times 13^{21}$ Smallest $m = 2 \times 5^2$
	(ii)	LCM = $2^8 \times 5^{11} \times 13^{21}$ HCF = $2^7 \times 5^9$ $y = 2^7 \times 5^{11} \times 13^{21}$ $z = 2^7 \times 5^{10}$ Smallest $v = 2^8 \times 5^9$

Qn		Solution
5	(a)	The first year's interest is more than 2% of \$8000 because interest calculated every quarter is based on the new principal which includes interest accumulated so the principal increases every quarter.
	(b)	Interest = $8000\left(1 + \frac{0.5}{100}\right)^8 - 8000$
		= \$325.66 (2 d.p.)

Qn		Solution
6		$x^2 - 20x - a$ $= (x - 10)^2 - 10^2 - a$ $= (x + b)^2 - 125$
		$\therefore b = -10, -10^2 - a = -125$ $a = 25$

Qn		Solution
7		Let the initial amount of water be $x \text{ cm}^3$. Then the initial amount of pebbles will be $0.1x \text{ cm}^3$. $\frac{0.1x + 3600}{x} = \frac{1}{4} \quad \text{or } 15\% \times x = 3600$ $0.4x + 14400 = x \quad x = \frac{3600}{0.15}$ $x = 24000 \quad = 24000$
		Capacity of tank $= \frac{2.5}{1.5} (24000 + 0.1 \times 24000) \quad \text{or } 24000 \times 1.1 + \frac{24000 \times 1.1}{1.5}$
		= 44000
		Alternatively:

		Pebbles	Water	Tank	
		$0.1x$	x	$\frac{250\%}{150\%} \times 1.1x = \frac{11}{6}x$	
+3600		$0.25x$	x		
$\therefore 0.25x - 0.1x = 3600$ $x = 24000$ $\frac{11}{6}x = \frac{11}{6} \times 24000$ $= 44000$					

8	(a)	(i)	$118 - 32 = 86$ teenagers
		(ii)	$150 - 118 = 32$ teenagers
		(iii)	39 marbles
	(b)	75 teenagers' estimate is < 51 marbles Do not accept median is 51 or 50 th percentile is 51 or half the number of teens estimate 51 marbles.	
	(c)	(i)	54 students' estimate < 47 marbles. $\frac{54}{150} \times 100\% = 36\%$ 36 th percentile = 47, $p = 36$
		(ii)	$\frac{54}{150} \times \frac{53}{149} = \frac{477}{3725}$ or 0.128 (3 s.f.)

Qn		Solution	
9	(a)	(i)	Jane should go to <u>XYZ</u> Money Changer because for every USD, she can get <u>0.01</u> more SGD than changing her money at <u>ABC</u> Money Changer.
		(ii)	USD 1 = SGD 1.27 Jane will receive $200 \times \text{SGD } 1.27 = \text{SGD } 254.00$
	(b)	(i)	Jane should go to <u>ABC</u> Money Changer because for every 1 CNY will pay <u>0.002</u> less SGD than changing her money at <u>XYZ</u> Money Changer.
		(ii)	CNY 1 = SGD 0.18 $\Rightarrow$ SGD 1 = CNY $\frac{1}{0.18}$ Jane will receive CNY $\frac{550}{0.18} = \text{CNY } 3055.56$

Qn		Solution	
10	(a)		$\frac{x}{2(3-2x)} - \frac{3}{2x-5}$ $= \frac{x(2x-5) - 3 \times 2(3-2x)}{2(3-2x)(2x-5)}$ $= \frac{2x^2 - 5x - 18 + 12x}{2(3-2x)(2x-5)}$ $= \frac{2x^2 + 7x - 18}{2(3-2x)(2x-5)}$
		(b)	$\frac{4x-6}{16x^4-81}$ $= \frac{4x-6}{(4x^2-9)(4x^2+9)}$ $= \frac{2(2x-3)}{(2x-3)(2x+3)(4x^2+9)}$ $= \frac{2}{(2x+3)(4x^2+9)}$

	(c)	$15ac - 6bc + 30ad - 12bd$ $= 3c(5a - 2b) + 6d(5a - 2b)$ $= (3c + 6d)(5a - 2b)$ $= 3(c + 2d)(5a - 2b)$

Qn	Solution
11	$2y - 3x = 10$ $y = \frac{3}{2}x + 5$ Gradient = $\frac{3}{2}$ $\frac{9-b}{-4-a} = \frac{3}{2}$ $18 - 2b = -12 - 3a$ $3a = -12 - 18 + 2b$ $a = \frac{2}{3}b - 10$

Qn	Solution
12	(a) median mass of potatoes $= \frac{(101+103)}{2} = 102 \text{ grams}$
	(b) $20 = Q_3 - Q_1$ $Q_3 = 20 + Q_1$ $Q_3 = 20 + 89$ $= 109$ $109 = \frac{108 + y}{2}$ $y = 110$ $x = 0$

Qn	Solution
13	$(3x-2)^2 - 6(1-x)(x+1) - 1$ $= 9x^2 - 12x + 4 - 6(1-x^2) - 1$ $= 15x^2 - 12x - 3$ $= 3(5x^2 - 4x - 1)$ $= 3(5x+1)(x-1)$ For all natural numbers x, $5x+1 > 0$ and $x-1 \geq 0$. $\therefore (5x+1)(x-1)$ are non-negative integers. This implies $(3x-2)^2 - 6(1-x)(x+1) - 1 = 3(5x+1)(x-1)$ is a non-negative multiple of 3.

Qn	Solution
14	The title that eggs are sold at more than 50% discount is misleading. The discount today is actually $= \frac{3.20 - 2.15}{3.20} \times 100\%$ $= 32.8\% \text{ (3 s.f.)}$ which is $< 50\%$. Alternatively, Price after 50% discount of \$3.20 should be \$1.60 but \$2.15 $>$ \$1.60. The discount is less than 50%. A possible mistake made by students is that students may think that the picture of Year 2025 is misleading. However, since the picture only increases in length but not in breadth compare to Year 2020, the size of the picture is proportional to the price and there is nothing misleading about the pictures.

Take note:

If the picture of Year 2025 shows an increase in both length and breadth as shown below, then there will be an alternative answer as shown below.

Eggs at more than 50% discount. Today only!

\$2.15 for 10 ← \$3.20 for 10

\$

Year 2020
Today only!

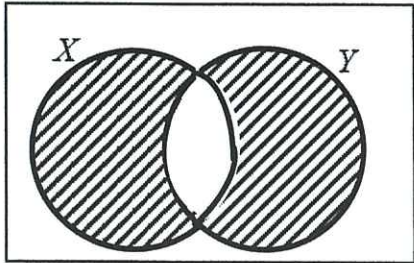
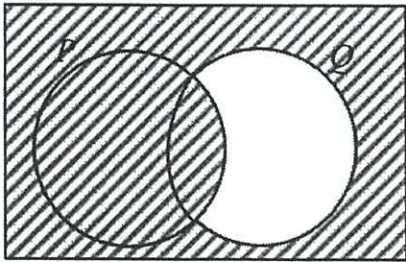
\$

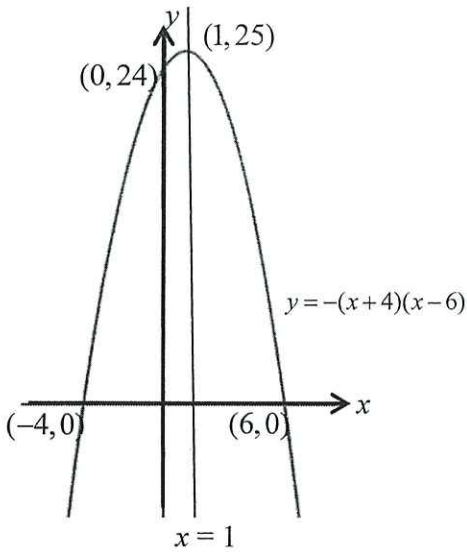
Year 2025

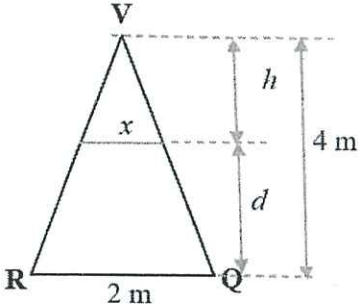
Prices of eggs have gone up by about 50% from year 2020 to 2025 but we are offering you eggs at the prices of 2020 TODAY!

Comparing the pictures representing the prices in 2020 and 2025, the picture of 2025 increases in both length and breadth which is an exaggeration of the price increase.

The price in 2025 is $\frac{3.20}{2.15} \approx 1.5$ times of 2020 but the area/size of the picture is $1.5^2 = 2.25 > 2$ times of 2020.

Qn	Solution
15 (a)	$(X \cap Y)' \cup (X' \cap Y)$ 
(b)	 $P \cup Q'$ Accept: $P \cup (P \cup Q)'$

Qn	Solution
16	 Eqn of line of symmetry $x = 1$. Coordinates of the turning point $(1, 25)$, x-intercepts $(-4, 0)$, $(6, 0)$ and y-intercept $(0, 24)$.

Qn	Solution
17 (a)	 Diagram B Show that $d = 4 - 2x$. $\frac{h}{x} = \frac{4}{2}$ $\frac{4-d}{x} = \frac{4}{2}$ $4-d = 2x$ $d = 4 - 2x \text{ (shown)}$
(b)	$\frac{V_{\text{empty}}}{V_{\text{container}}} = \left(\frac{h}{4}\right)^3$ $\frac{1}{4} = \left(\frac{h}{4}\right)^3$ $h = 4 \times \sqrt[3]{\frac{1}{4}}$ $d = 4 - h$ $= 4 - 4 \times \sqrt[3]{\frac{1}{4}}$ $= 1.48 \text{ (3 s.f.)}$

17	(b)	Alternative: Vol. of big pyramid $= \frac{1}{3} \times 2^2 \times 4$ $= \frac{16}{3}$ Vol. of empty space = $\frac{1}{3} \times x^2 \times h$ $= \frac{1}{3} \times x^2 \times (4 - d)$ $= \frac{1}{3} \times x^2 \times [4 - (4 - 2x)]$ $= \frac{2}{3} x^3$ Vol. of empty space = $\frac{1}{4} \times$ Vol. of big pyramid $\frac{2}{3} x^3 = \frac{1}{4} \times \frac{16}{3}$ $x^3 = 2$ $x = \sqrt[3]{2}$ $d = 4 - 2 \times \sqrt[3]{2}$ $= 1.48 \text{ (3 s.f.)}$
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Qn		Solution
18	(a)	$C = \begin{pmatrix} 280 \\ 320 \end{pmatrix}$
	(b)	$P = 12SC$ $= 12 \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 280 \\ 320 \end{pmatrix}$ $= 12 \begin{pmatrix} 3280 \\ 1760 \end{pmatrix}$ $= \begin{pmatrix} 39360 \\ 21120 \end{pmatrix}$
	(c)	$N = \begin{pmatrix} 1.1 & 0 \\ 0 & 1.2 \end{pmatrix}$
	(d)	$Q = (1 \ 1)SM$ $= (1 \ 1) \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 1.1 & 0 \\ 0 & 1.2 \end{pmatrix} \begin{pmatrix} 280 \\ 320 \end{pmatrix}$ $= (1 \ 1) \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 308 \\ 384 \end{pmatrix}$ $= (1 \ 1) \begin{pmatrix} 3768 \\ 2000 \end{pmatrix}$ $= (5768)$
	(e)	The elements of Q represent the <u>total monthly lesson fees collected</u> by Mr Asahi <u>after the fee increase</u> .

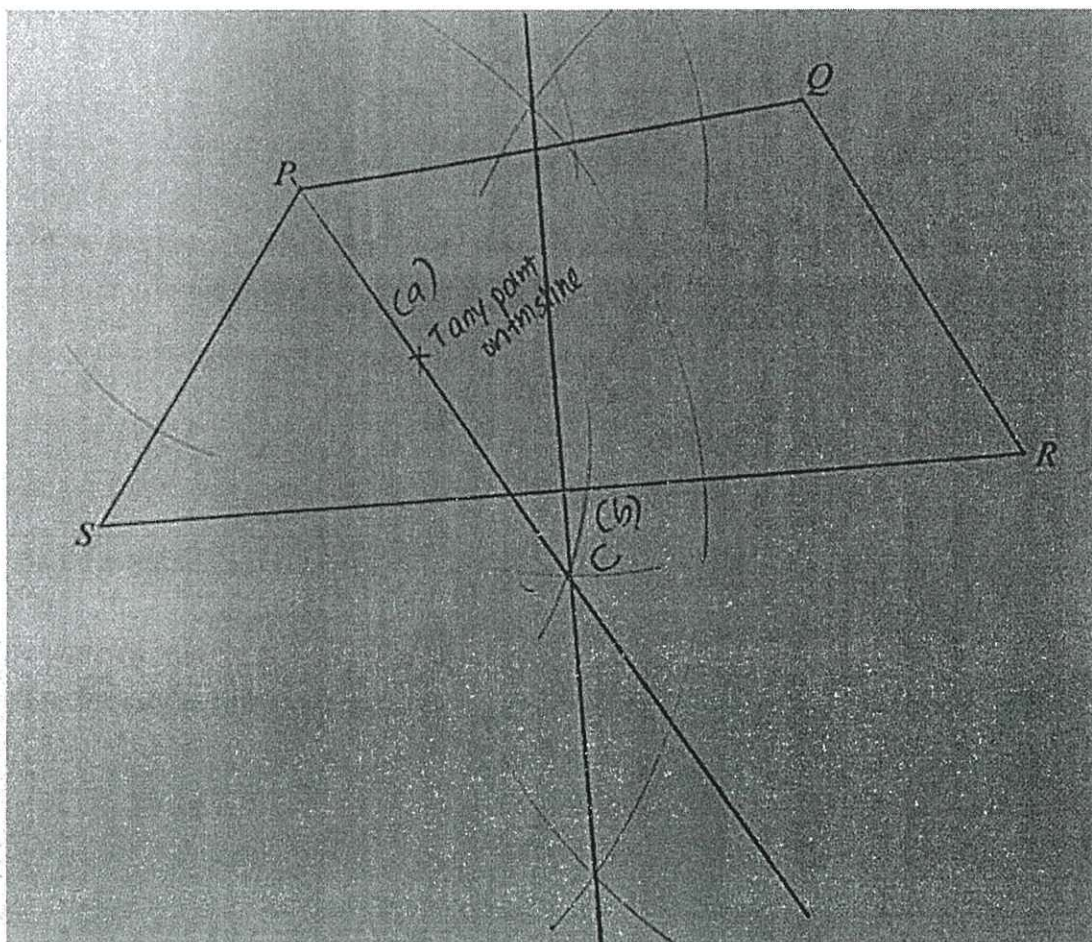
Qn		Solution
19	(a)	$\angle CBD = \angle CDB$ $= \frac{180^\circ - 108^\circ}{2} \text{ (base } \angle\text{s of isosceles } \Delta)$ $= 36^\circ$ $\text{ext. } \angle = \frac{360^\circ}{n} = 36^\circ$ $n = 10$
	(b)	Interior $\angle = 180^\circ - 36^\circ$ (adj. $\angle$s on a straight line) $= 144^\circ$ Alternative method: $\text{Interior } \angle = \frac{(10 - 2) \times 180^\circ}{10}$ $= 144^\circ$

Qn		Solution
20	(a)	Bearing of F from Z $= 180^\circ + 061.8^\circ \text{ (alternate angles)}$ $= 241.8^\circ$
	(b)(i)	$LF < LZ$ $\Rightarrow \angle LZF < \angle LFZ$ $\Rightarrow \angle LZF < 61.8^\circ < 90^\circ$ $\therefore \angle LZF$ is an acute angle
	(b)(ii)	$\frac{\sin \angle LZF}{35} = \frac{\sin 61.8^\circ}{60}$ $\sin \angle LZF = \frac{\sin 61.8^\circ}{60} \times 35 = 0.51409 \text{ (5 s.f.)}$ $\angle LZF = 30.937^\circ$ $\angle NLZ = 30.937^\circ + 61.8^\circ \text{ (exterior } \angle)$ $= 92.737^\circ$ Bearing of Z from $L = 092.7^\circ$ (1 d.p.) Alternative presentation: Bearing of Z from $L = 030.937^\circ + 061.8^\circ$ (alternate $\angle$s) $= 092.737^\circ$ $= 092.7^\circ \text{ (1 d.p.)}$

(c)	$\angle FLZ = 180^\circ - 61.8^\circ - 30.937^\circ \text{ (}\angle \text{ sum of } \Delta\text{)}$ $= 87.263^\circ$ $FZ = \sqrt{35^2 + 60^2 - 2(35)(60)\cos 87.263^\circ}$ $= 68.003$ $= 68.0 \text{ m (3 s.f.)}$ Alternative, $\frac{FZ}{\sin 87.263^\circ} = \frac{60}{\sin 61.8^\circ}$ $FZ = \frac{60}{\sin 61.8^\circ} \times \sin 87.263^\circ$ $= 68.003$ $= 68.0 \text{ m (3 s.f.)}$
(d)	Let the shortest distance from L to FZ be x. $\sin 61.8^\circ = \frac{x}{35}$ $x = 35 \sin 61.8^\circ$ $= 30.8456\dots$ $= 30.8 \text{ m (3 s.f.)}$ (d) Alternative, $\frac{1}{2} \times 68.003 \times x = \frac{1}{2} \times 35 \times 60 \sin 87.263^\circ$ $x = 30.846$ $= 30.8 \text{ m (3 s.f.)}$

Qn
21

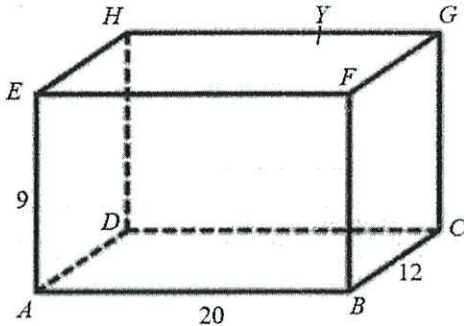
Solution



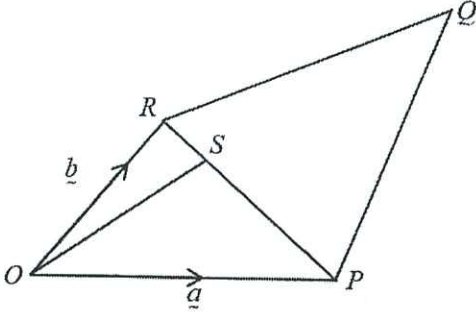
Qn		Solution				
22	(a)	x	$\frac{1}{4}$	1	4	9
		y	12	6	3	2
		xy^2	$\frac{1}{4} \times 12^2$ $= 36$	1×6^2 $= 36$	4×3^2 $= 36$	9×2^2 $= 36$
	Since $xy^2 = 36$ for all pairs of values of x and y , x and y^2 are inversely proportional.					
	(b)	$xy^2 = 36$				
	Let the original x and y be x_0 and y_0 . Let the new x and y be x_1 and y_1 .					
	When y is increased by 150%, $y_1 = 2.5y_0$.					
	$x_1(2.5y_0)^2 = x_0y_0^2$ $x_1 = 0.16x_0$					
		Percentage reduction in x				
		$= \frac{x_0 - 0.16x_0}{x_0} \times 100\%$ $= 84\%$				

Qn		Solution	
23	(a)(i)	8, 5, 2, -1 nth term = $8 + (n-1)(-3) = 11 - 3n$	
	(a)(ii)	Comparing the two sequences: 8, 5, 2, -1 +1 +4 +9 +16 9, 9, 11, 15 nth term = $11 - 3n + n^2$	
	(b)	$S_n = \frac{n}{2}(7n-3)$ $T_1 = S_1 = \frac{1}{2}(7-3) = 2$ $T_1 + T_2 = S_2 = \frac{2}{2}(7 \times 2 - 3) = 11$	
		$T_2 = S_2 - S_1 = 11 - 2 = 9$ Common difference = $T_2 - T_1 = 9 - 2 = 7$ $T_n = 2 + (n-1)7$ $= 7n - 5$	

	Alternatively, $S_n = \frac{n}{2}(7n-3) = \frac{1}{2}(7n^2 - 3n)$ $S_{n-1} = \frac{n-1}{2}[7(n-1)-3]$ $= \frac{n-1}{2}(7n-10)$ $= \frac{1}{2}(7n^2 - 17n + 10)$ $T_n = S_n - S_{n-1}$ $= \frac{1}{2}(7n^2 - 3n) - \frac{1}{2}(7n^2 - 17n + 10)$ $= \frac{1}{2}(14n - 10)$ $= 7n - 5$
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Qn	Solution
24 (a)	 $GY = \frac{2}{5} \times 20 = 8 \text{ m}$ By Pythagoras Theorem, $AH = BG = \sqrt{BC^2 + GC^2} = \sqrt{12^2 + 9^2} = 15 \text{ m}$ $BY = \sqrt{GY^2 + BG^2} = \sqrt{8^2 + 15^2} = 17 \text{ m}$ $\cos \angle AYB = \frac{AY^2 + BY^2 - AB^2}{2(AY)(BY)}$ Given $AY = \sqrt{369} \text{ m}$, $= \frac{(\sqrt{369})^2 + 17^2 - 20^2}{2(\sqrt{369})(17)}$ $\cos \angle AYB = 0.39503 \text{ (5 s.f.)}$ $\angle AYB = 66.732^\circ$ $= 66.7^\circ \text{ (1 d.p.)}$

	(b) Let X be the point directly below Y. Let Z be the point on AB where $AZ:ZB = 3:2$. Let the largest angle of depression of AB from Y be θ. $\theta = \angle YZX$ (alternate angles) $\tan \angle YZX = \frac{9}{12}$ $\angle YZX = 36.9^\circ$ (1 d.p.) $\therefore$ largest angle of depression of AB from $Y = 36.9^\circ$.
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Qn	Solution
25 (a)	 $\begin{aligned}\overrightarrow{RP} &= \overrightarrow{OP} - \overrightarrow{OR} \\ &= \underline{a} - \underline{b} \\ \overrightarrow{OS} &= \overrightarrow{OR} + \overrightarrow{RS} \\ &= \underline{b} + \frac{1}{4}(\underline{a} - \underline{b}) \\ &= \frac{1}{4}\underline{a} + \frac{3}{4}\underline{b} \\ &= \frac{1}{4}(\underline{a} + 3\underline{b})\end{aligned}$

	$\begin{aligned}\overrightarrow{OQ} &= \overrightarrow{OR} + \overrightarrow{RQ} \\ &= \underline{b} + \frac{2}{3}\underline{a} + \underline{b} \quad \because \text{given } \overrightarrow{RQ} = \frac{2}{3}\underline{a} + \underline{b} \\ &= \frac{2}{3}\underline{a} + 2\underline{b} \\ &= \frac{2}{3}(\underline{a} + 3\underline{b}) \\ &= \frac{2}{3} \times 4 \times \frac{1}{4}(\underline{a} + 3\underline{b}) \\ &= \frac{8}{3}\overrightarrow{OS}\end{aligned}$ Since $\overrightarrow{OQ} = \frac{8}{3}\overrightarrow{OS}$, OQ is parallel to OS and O is a common point. Thus, O, S and Q form a straight line.
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(b)	Since XS is parallel to QP, let $\overrightarrow{XS} = m\overrightarrow{QP}$, $\overrightarrow{OX} = n\underline{a}$. $\begin{aligned}\overrightarrow{XS} &= m\overrightarrow{QP} \\ \overrightarrow{XO} + \overrightarrow{OS} &= m(\overrightarrow{QO} + \overrightarrow{OP}) \\ -n\underline{a} + \frac{1}{4}\underline{a} + \frac{3}{4}\underline{b} &= m\left(-\frac{2}{3}\underline{a} - 2\underline{b} + \underline{a}\right) \\ \left(-n + \frac{1}{4}\right)\underline{a} + \frac{3}{4}\underline{b} &= m\left(\frac{1}{3}\underline{a} - 2\underline{b}\right) \\ \left(-n + \frac{1}{4}\right)\underline{a} + \frac{3}{4}\underline{b} &= \frac{m}{3}\underline{a} - 2m\underline{b}\end{aligned}$ Since $\underline{a}$ and $\underline{b}$ are not parallel, $\begin{aligned}-n + \frac{1}{4} &= \frac{m}{3} \quad \text{and} \quad \frac{3}{4} = -2m \\ \therefore m &= -\frac{3}{8} \quad \text{and} \quad n = \frac{1}{4} - \frac{m}{3} = \frac{1}{4} - \left(-\frac{3}{8}\right) \div 3 = \frac{3}{8}\end{aligned}$ $\begin{aligned}\overrightarrow{XS} &= -\frac{3}{8}\left(\frac{1}{3}\underline{a} - 2\underline{b}\right) \\ &= -\frac{1}{8}\underline{a} + \frac{3}{4}\underline{b}\end{aligned}$
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	Method 2: Since triangle OSX is similar to triangle OQP, ratio of OS : OQ = 3 : 8 Ratio of XS : PQ = 3 : 8 $\overrightarrow{XS} = \frac{3}{8}(2\vec{b} - \frac{1}{3}\vec{a})$ $= \frac{3}{4}\vec{b} - \frac{1}{8}\vec{a}$
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2025 TKGS PRELIM MATH P2 Solution

Qn		Solution	
1	(ai)	$50818 \times 10^9 Wh = 5.0818 \times 10^4$ $= 5.0818 \times 10^4 GWh$ $= 5.1 \times 10^4 GWh$	
	(a)	(ii)	$\frac{16.5}{100} \times 53715 = 8862.975$ $= 8900 GWh (2 s.f.)$
		(iii)	$\frac{55143 - 50818}{50818} \times 100\% = 8.5108\%$ $= 8.51\%$

Qn			Solution
	(b)		$3 \times 10^8 \times 70 \times 10^{-9}$ $= 21m$ $= 0.021km$ $= 2.1 \times 10^{-2} km$
	(c)	(i)	$x = 0.25 \times 20 mm$ $= 5 mm$
	(c)	(ii)	Area scale : $20^2 : 1^2$ $400 : 1$ $120 mm^2 = 1.2 cm^2$ Area of model = $400 \times 1.2 = 480 cm^2$

Qn		Solution
2	(a)	$2(5-4x) = 3x-1$ $10-8x = 3x-1$ $-8x-3x = -1-10$ $-11x = -11$ $x = 1$
Qn		Solution
2	(b)	$\frac{x+12}{3} \geq -3(x-3) \text{ and } 5x-3 < 7$ $\frac{x+12}{3} \geq -3(x-3) \qquad 5x-3 < 7$ $x+12 \geq -3x+9 \qquad 5x < 10$ $4x \geq -3 \qquad x < 2$ $x \geq -\frac{3}{4}$ $-\frac{3}{4} \leq x < 2$
	(c)	(i)
		$d = \frac{1}{2}[(-2)^2(5) - 7(-2)^2]$ $= \frac{1}{2}[20 - 28]$ $= -4$
	(ii)	$2d = b^2c - 7b^2$ $2d = b^2(c - 7)$

		$b^2 = \frac{2d}{c-7}$ $b = +\sqrt{\frac{2d}{c-7}} \quad \text{or} \quad b = -\sqrt{\frac{-2d}{7-c}}$
	(d)	$\frac{x}{2x-1} - 3 = \frac{4}{x}$ $\frac{x-3(2x-1)}{2x-1} = \frac{4}{x}$ $\frac{x-6x+3}{2x-1} = \frac{4}{x}$ $\frac{-5x+3}{2x-1} = \frac{4}{x}$ $x(-5x+3) = 4(2x-1)$ $-5x^2 + 3x = 8x - 4$ $5x^2 + 5x - 4 = 0$ $x = \frac{-5 \pm \sqrt{5^2 - 4(5)(-4)}}{2(5)}$ $x = 0.52 \quad \text{or} \quad -1.52$

Qn		Solution
3	(a)	Volume of cone $= \frac{1}{3} \pi (6x)^2 y$ $= \frac{1}{3} \pi (36x^2) y$ $= 12\pi x^2 y$ Volume of hemisphere $= \frac{1}{2} \times \frac{4}{3} \pi (6x)^3$ $= \frac{2}{3} \pi (216x^3)$ $= 144\pi x^3$ $V_{\text{cone}} = 2 \times V_{\text{hemisphere}}$ $12\pi x^2 y = 2 \times 144\pi x^3$ $12\pi x^2 y = 288\pi x^3$ $y = \frac{288\pi x^3}{12\pi x^2}$ $y = 24x$

(b)

$$l_{\text{cone}} = \sqrt{(6x)^2 + y^2}$$

$$= \sqrt{(6x)^2 + (24x)^2}$$

$$= 6x\sqrt{17}$$

Curved surface area of cone

$$= \pi r l$$

$$= \pi (6x) 6x\sqrt{17}$$

$$= 36\pi\sqrt{17}x^2$$

Curved surface area of hemisphere

$$= \frac{1}{2} \times 4\pi r^2$$

$$= 2\pi (6x)^2$$

$$= 72\pi x^2$$

$$\text{Total surface area} = 36\pi\sqrt{17}x^2 + 72\pi x^2$$

$$36\pi\sqrt{17}x^2 + 72\pi x^2 = 600$$

$$x^2 = \frac{600}{\pi(36\sqrt{17} + 72)} = 0.86642$$

$$x = 0.93082 \quad (x > 0)$$

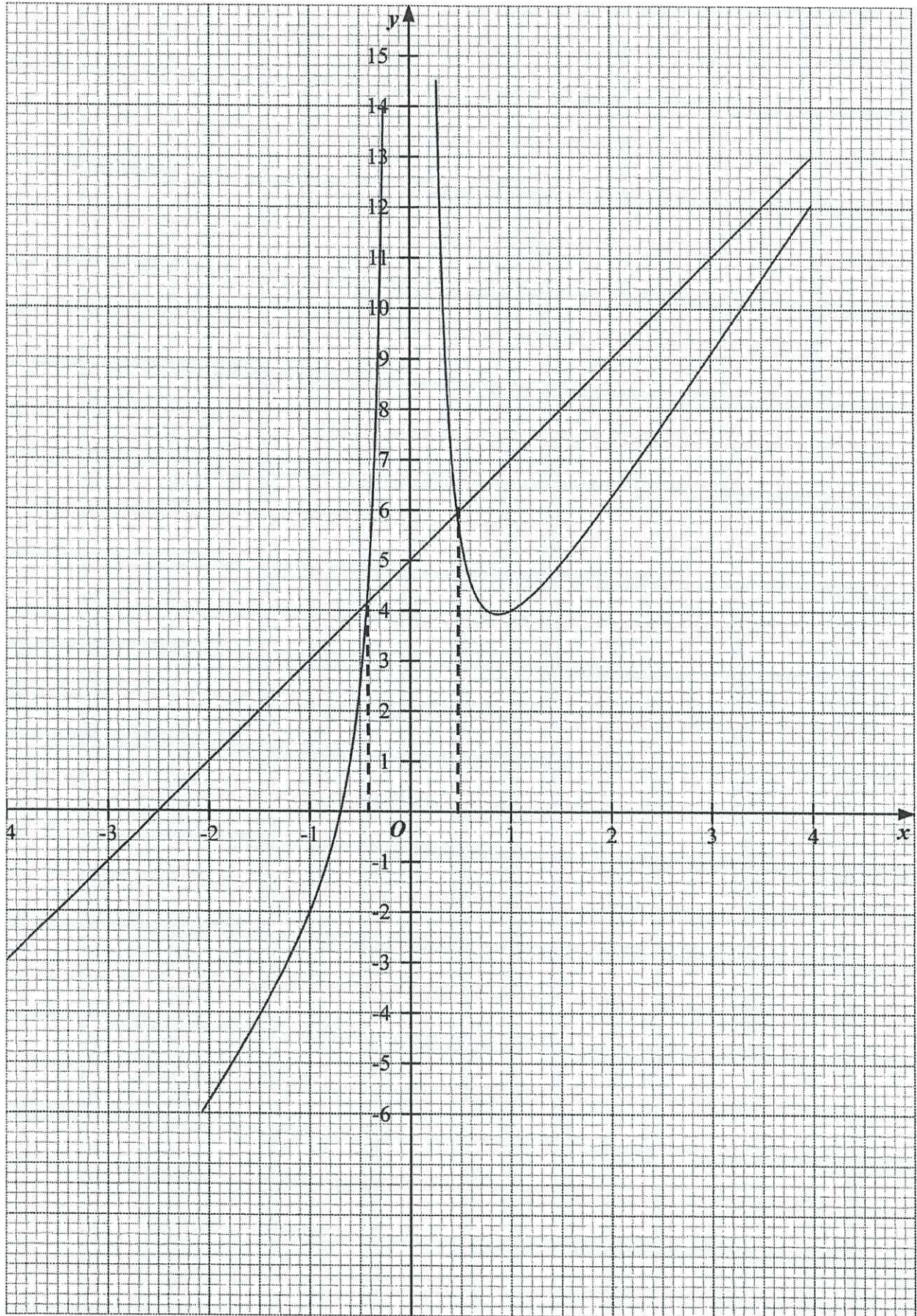
$$H = 24x + 6x = 30x$$

when $x = 0.93082$

$$H = 30(0.93082) = 27.9 \text{ cm (3 s.f)}$$

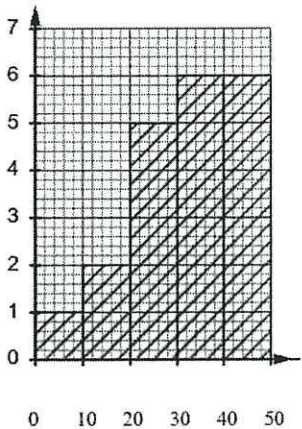
Qn		Solution				
4	(a)	<table><tr><td>x</td><td>3</td></tr><tr><td>y</td><td>9.1</td></tr></table>	x	3	y	9.1
x	3					
y	9.1					
	(b)	Graph plotting (refer to next page)				
	(ci)	Straight line plot (refer to next page)				

	(cii)	$x = -0.4 \pm 0.05 \text{ or } 0.5 \pm 0.05$
	(ciii)	$\frac{1}{x^2} + 3x = 5 + 2x$ $1 + 3x^3 = 5x^2 + 2x^3$ $x^3 - 5x^2 + 1 = 0$ $A = 1 \quad B = -5$



Qn			Solution
5	(a)		$\angle OBE = \frac{180^\circ - 114^\circ}{2} \text{ (base angle of isos triangle)}$ $= 33^\circ$ $\angle DBE = 38^\circ + 33^\circ$ $= 71^\circ$ $\angle DFE = 180^\circ - 71^\circ \text{ (angles in opp seg)}$ $= 109^\circ$ $\angle FED = 180^\circ - 109^\circ - 25^\circ \text{ (angle sum of triangle)}$ $= 46^\circ$
	(b)	(i)	$\cos \angle BCE = \frac{11}{14} \text{ (}\angle CBA = 90^\circ \text{, right angle in semicircle)}$ $\angle CBD = \cos^{-1}\left(\frac{11}{14}\right)$ $= 0.66695$ $= 0.667 \text{ rad}$
	(b)	(ii)	Area of shaded region $ABD =$ $\frac{1}{2}(11)(14)\sin(0.66695) - \frac{1}{2}11^2(0.66695)$ $= 7.2811$ $= 7.28$

Qn			Solution
6	(a)	(i)	$(-7+5, -2+4) = (-2, 2)$
		(ii)	$\text{Grad of AC} = \frac{-4-2}{1-(-2)} = -2$ $y = -2x + c$ $x = 1, y = -4$ $-4 = -2 + c$ $c = -2$ $y = -2x - 2$
	(b)	(i)	$m = -\frac{1}{2}(-2) + 6 = 7$
		(ii)	$\text{Length: } \sqrt{(-2-10)^2 + (7-1)^2} = 13.416$ ≈ 13.4
		(iii)	At $(q, 5)$, $30 + pq = 16$ ----- (1) $5 = -\frac{1}{2}q + 6$ ----- (2) $q = 2$ $p = \frac{-14}{2}$ $= -7$

Qn			Solution
7	(a)	(i)	
		(ii)	Estimated mean $= \frac{1 \times 5 + 2 \times 15 + 5 \times 25 + 6 \times 35 + 6 \times 45}{20}$ $= 32$
		(iii)	Using calculator , S.D ≈ 11.446 $= 11.4$
	(b)	In the histogram, the mean and standard deviations are calculated based on the mid-value of each interval. The mid-value is an estimate of the actual value. Hence, there is a difference in value from the table.	

(c)	(i)	$P(\text{Green}) = \frac{30-5-9}{30}$ $= \frac{8}{15}$
	(ii)	$P(\text{same color}) = P(R, R) + P(G, G) + P(B, B)$ $= \frac{5}{30} \times \frac{4}{29} + \frac{16}{30} \times \frac{15}{29} + \frac{9}{30} \times \frac{8}{29}$ $= \frac{166}{435}$
	(iii)	$P(\text{different}) = 1 - P(\text{both same color})$ $= 1 - \left(\frac{5}{30} \times \frac{5}{30} + \frac{9}{30} \times \frac{9}{30} + \frac{16}{30} \times \frac{16}{30} \right)$ $= 1 - \frac{181}{450}$ $= \frac{269}{450}$

Qn		Solution		
8	(a)	(i)	Pattern Number	n
			Number of grey squares	$2n+1$
			Number of white squares	n^2
		(ii)	$n^2 = 1381$ $n = 37.2$ There is no sequence with 1381 white squares as $n = 37.2$ is not an integer or 1381 is not a perfect square number.	
		(iii)	$n^2 - (2n+1) = n^2 - 2n + \left(\frac{2}{2}\right)^2 - \left(\frac{2}{2}\right)^2 - 1$ $= (n-1)^2 - 2$	
		(iv)	$n \geq 3$ $n-1 \geq 2$ $(n-1)^2 \geq 4$ $(n-1)^2 - 2 \geq 2$ $\therefore (n-1)^2 - 2 > 0$ Since $(n-1)^2 - 2 = n^2 - (2n+1)$, $n^2 - (2n+1) > 0$ $n^2 > 2n+1$ Therefore, the number of white tiles is greater than the number of grey tiles for $n \geq 3$	

Qn	Solution
(b)	Let x be the cash price of the car $\text{Interest} = \frac{\left(\frac{3}{4}x\right)(3.78)(7)}{100}$ $\frac{3}{4}x + \frac{\left(\frac{3}{4}x\right)(3.78)(7)}{100} = 1850 \times 7 \times 12$ $0.94845x = 155400$ $x = \frac{155400}{0.94845}$ $= \$163846.2755$ $\approx \$163846 \text{ (nearest dollar)}$

Qn		Solution														
9	(a)	$6 \times 3 = 18 kWh$														
	(b)	$Total\ hours = (8 \times 45 + 7 \times 60 \times 4) \times 50$ $= 102000\ hours$														
	(c)	<table border="1"> <thead> <tr> <th></th><th>A</th><th>B</th></tr> </thead> <tbody> <tr> <td>Cost of air con</td><td>60×1288 $= \\$77280$</td><td>$60 \times 840$ $= \\$50400$</td></tr> <tr> <td>Cost of electricity</td><td>$\frac{30.65}{100} \times 102000 \times 3 \times 4$ $= \\$375156$</td><td>$\frac{30.65}{100} \times 102000 \times 3.2 \times 4$ $= \\$400166.40$</td></tr> <tr> <td>Cost of maintenance in first 4 years</td><td>2×2100 $= \\$4200$</td><td>$2 \times 4 \times 1000$ $= \\$8000$</td></tr> <tr> <td>Total cost for 4 years</td><td>$77280 + 375156 + 4200$ $= \\$456636$</td><td>$50400 + 400166.40 + 8000$ $= \\$458566.40$</td></tr> </tbody> </table> Assumption: Tax tariff rate remains unchanged in the first 4 years. The air conditioners do not require additional repairs in the first 4 years Model A will have a lower cost after the first 4 years of usage by \$1930.40 compared to model B		A	B	Cost of air con	60×1288 $= \$77280$	60×840 $= \$50400$	Cost of electricity	$\frac{30.65}{100} \times 102000 \times 3 \times 4$ $= \$375156$	$\frac{30.65}{100} \times 102000 \times 3.2 \times 4$ $= \$400166.40$	Cost of maintenance in first 4 years	2×2100 $= \$4200$	$2 \times 4 \times 1000$ $= \$8000$	Total cost for 4 years	$77280 + 375156 + 4200$ $= \$456636$
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