

Secondary 4C

MATH 2026

Assessment Compilation

100%

Name :

Form/ Acad Class : /

Name of Teacher:.....

A+

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Mathematics (Syllabus 4052)

SCHEME OF ASSESSMENT

Paper	Duration	Description	Marks	Weighting
Paper 1	2 hours 15 minutes	There will be about 26 short answer questions. Candidates are required to answer all questions.	90	50%
Paper 2	2 hours 15 minutes	There will be 9 to 10 questions of varying marks and lengths. The last question in this paper will focus specifically on applying mathematics to a real-world scenario. Candidates are required to answer all questions.	90	50%

SUBJECT CONTENT

Conten	Learnt In	Check List
PROBLEMS IN REAL WORLD CONTEXT (Paper 1 & 2)		
Convert money according to the exchange rate given	Sec 2	☐
Calculation of simple interest	Sec 2	☐
Calculation of compound interest	Sec 3	☐
Concept of hire purchase	Sec 2	☐
Calculation of GST and service charge	Sec 2	☐
Interpreting table and calculation of income tax	Sec 2	☐
Interpreting table and calculation of utilities bills	Sec 2	☐

Topic/Sub-topic	Content	Learnt in	Check list
NUMBER AND ALGEBRA			
N1 Numbers & their operations	Primes and prime factorisation	Sec 1	☐
	Finding highest common factor (HCF) and lowest common multiple (LCM), squares, cubes, square roots and cube roots by prime factorisation	Sec 1	☐
	Negative numbers, integers, rational numbers, real numbers, and their four operations	Sec 1	☐
	Calculations with calculator	Sec 1	☐
	Representation and ordering of numbers on the number line	Sec 1	☐
	use of the symbols $<$, $>$, $\leq$, $\geq$	Sec 1	☐
	approximation and estimation (including rounding off numbers to a required number of decimal places or significant figures and estimating the results of computation)	Sec 1	☐
	Use of standard form $A \times 10^n$, where n is an integer, and $1 \leq A < 10$	Sec 3	☐
	Positive, negative, zero and fractional indices	Sec 3	☐
	Laws of indices	Sec 3	☐
N2 Ratio and Proportion	Ratios involving rational numbers	Sec 1	☐
	Writing a ratio in its simplest form	Sec 1	☐
	Map scales (distance and area)	Sec 2	☐
	Direct and inverse proportion	Sec 2	☐
N3 Percentage	Expressing one quantity as a percentage of another	Sec 1	☐
	Comparing two quantities by percentage	Sec 1	☐
	Percentages greater than 100%	Sec 1	☐
	Increasing/decreasing a quantity by a given percentage	Sec 1	☐
	Reverse percentages	Sec 1	☐
N4 Rate and speed	Rates and average rates (including the concepts of speed and average speed)	Sec 1	☐
	Conversion of units (e.g. km/h to m/s)	Sec 1	☐

Topic/Sub-topic	Content	Learnt in	Check list
NUMBER AND ALGEBRA			
N5 Algebraic expressions and formulae	Using letters to represent numbers	Sec 1	☐
	Interpreting notations: * ab as $a \times b$ * $\frac{a}{b}$ as $a \div b$ or $a \times \frac{1}{b}$ * a^2 as $a \times a$, a^3 as $a \times a \times a$, a^2b as $a \times a \times b$, ... * $3y$ as $y + y + y$ or $3 \times y$ * $3(x + y)$ as $3 \times (x + y)$ * $\frac{3 \pm y}{5}$ as $(3 \pm y) \div 5$ or $\frac{1}{5} \times (3 \pm y)$	Sec 1	☐
	Evaluation of algebraic expressions and formulae	Sec 1	☐
	Translation of simple real-world situations into algebraic expressions	Sec 1	☐
	Recognizing and representing patterns/relationships by finding an algebraic expression for the n th term	Sec 1	☐
	Addition and subtraction of linear expressions	Sec 2	☐
	Simplification of linear expressions such as: * $-2(3x - 5) + 4x$ * $\frac{2x}{3} - \frac{3(x - 5)}{2}$	Sec 2	☐
	Use brackets and extract common factors	Sec 2	☐
	Factorisation of linear expressions of the form $ax + bx + kay + kby$	Sec 2	☐
	Expansion of the product of algebraic expressions	Sec 2	☐
	Changing the subject of a formula	Sec 2	☐
	Finding the value of an unknown quantity in a given formula	Sec 1	☐
	Use of special algebraic identities: ❖ $(a + b)^2 = a^2 + 2ab + b^2$ ❖ $(a - b)^2 = a^2 - 2ab + b^2$ ❖ $a^2 - b^2 = (a + b)(a - b)$	Sec 2	☐
	Factorisation of quadratic expressions $ax^2 + bx + c$	Sec 2	☐
	Multiplication and division of simple algebraic fractions such as : $\left(\frac{3a}{4b^2}\right)\left(\frac{5ab}{3}\right)$ $\frac{3a}{4} \div \frac{9a^2}{10}$	Sec 2	☐

Topic/Sub-topic	Content	Learnt in	Check list
	Addition and subtraction of algebraic fractions with linear or quadratic denominator such as: $\frac{1}{x-2} + \frac{2}{x-3}$ $\frac{1}{x^2-9} + \frac{2}{x-3}$ $\frac{1}{x-3} + \frac{2}{(x-3)^2}$	Sec 2	☐
N6 Functions and Graphs	Cartesian coordinates in two dimensions i.e. Plotting and reading of coordinates (x, y)	Sec 2	☐
	Linear functions ($y = ax + b$) and quadratic functions ($y = ax^2 + bx + c$) i.e. able to identify equation of linear and quadratic graphs	Sec 2	☐
	Graphs of linear functions	Sec 1	☐
	The gradient of a linear graph as the ratio of the vertical change to the horizontal change (positive and negative gradients)	Sec 1	☐
	Graphs of quadratic functions and their properties: ❖ positive or negative coefficient of x^2 ❖ maximum and minimum points ❖ symmetry	Sec 2	☐
	Sketching the graphs of quadratic functions given in the form: ❖ $y = (x - p)^2 + q$ ❖ $y = -(x - p)^2 + q$ ❖ $y = (x - a)(x - b)$ ❖ $y = -(x - a)(x - b)$	Sec 3	☐
	Graphs of power functions of the form $y = ax^n$, where $n = -2, -1, 0, 1, 2, 3$ and simple sums of not more than three of these	Sec 3	☐
	Graphs of exponential functions $y = ka^x$, where a is a positive integer	Sec 3	☐
	Estimation of the gradient of a curve by drawing a tangent	Sec 3	☐
N7 Equations and Inequalities	Solving linear equations in one variable	Sec 1	☐
	Solving simple fractional equations that can be reduced to linear equations such as: $\frac{x}{3} + \frac{x-2}{4} = 3$ $\frac{3}{x-2} = 6$	Sec 2	☐
	Solving simultaneous linear equations in two variable by ❖ Substitution and elimination methods ❖ Graphical method	Sec 2	☐

	Solving quadratic equations in one unknown by ❖ Factorisation ❖ Use of formula i.e. $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ❖ Completing the square for $y = x^2 + px + q$ ❖ Graphical method	Sec 2 Sec 3	☐
	Solving fractional equations that can be reduced to quadratic equations such as: $\frac{6}{x+4} = x+3$ $\frac{1}{x-2} + \frac{2}{x-3} = 5$	Sec 3	☐
	Formulating equations to solve problems	Sec 3	☐
	Solving linear inequalities in one variable, and representing the solution on the number line	Sec 2 Sec 3	☐
N8 Set Language and notation	Use of set language and the following notation: Union of A and B $A \cup B$ Intersection of A and B $A \cap B$ Number of elements in set A $n(A)$ '... is an element of ...' $\in$ '... is not an element of ...' $\notin$ Complement of set A A' The empty set $\emptyset$ Universal set $\mathcal{U}$ A is a subset of B $A \subseteq B$ A is not a subset of B $A \not\subseteq B$ A is a (proper) subset of B $A \subset B$ A is not a (proper) subset of B $A \not\subset B$	Sec 4	☐
	Union and intersection of two sets		☐
	Venn diagrams		☐
N9 Matrices	Display of information in the form of a matrix of any order	Sec 4	☐
	Interpreting the data in a given matrix		☐
	Product of a scalar quantity and a matrix		☐
	Problems involving the calculation of the sum and product (where appropriate) of two matrices		☐

Topic/Sub-topic	Content	Learnt in	Check list
GEOMETRY AND MEASUREMENT (Paper 1)			
G1 Angles, Triangles and Quadrilaterals	Identifying right, acute, obtuse and reflex angles	Sec 1	☐
	Identifying vertically opposite angles, angles on a straight line and angles at a point	Sec 1	☐
	Angles formed by two parallel lines and a transversal: ❖ Corresponding angles ❖ Interior angles ❖ Alternate angles	Sec 1	☐
	Knowing the properties of ❖ Triangles, special quadrilaterals and regular polygons (pentagon, hexagon, octagon and decagon etc), including symmetry properties	Sec 1	☐
	Classifying special quadrilaterals on the basis of their properties	Sec 1	☐
	Angle sum of interior and exterior angles of any convex polygon	Sec 1	☐
	Construction of (using compasses, ruler, set squares and protractors): ❖ simple geometrical figures from given data	Sec 1	☐
G2 Congruence and similarity	Congruent figures and similar figures	Sec 2	☐
	Properties of congruent figures ❖ corresponding sides and angles are equal	Sec 2	☐
	Properties of similar figures ❖ corresponding angles are equal ❖ corresponding sides are proportional	Sec 2	☐
	Enlargement and reduction of a plane figure	Sec 2	☐
	Scale drawings	Sec 3	☐
	Construction of (using compasses, ruler, set squares and protractors): ❖ perpendicular bisectors ❖ angle bisectors	Sec 3	☐
	Determining whether two triangles are congruent or similar based on their respective tests	Sec 3	☐
	Ratio of areas of similar plane figures	Sec 3	☐
	Ratio of volumes of similar solids	Sec 3	☐
	Solving simple problems involving similarity and congruence	Sec 3	☐

Topic/Sub-topic	Content	Learnt in	Check list
G3 Properties of circles	Symmetry properties of circles: ❖ equal chords are equidistant from the centre ❖ the perpendicular bisector of a chord passes through the centre ❖ tangents from an external point are equal in length ❖ the line joining an external point to the centre of the circle bisects the angle between the tangents	Sec 3	☐
	Angle properties of circles: ❖ angle in a semicircle is a right angle ❖ angle between the tangent and radius of a circle is a right angle ❖ angle at the centre is twice the angle at the circumference ❖ angles in the same segment are equal ❖ angles in opposite segments are supplementary	Sec 3	☐
G4 Pythagoras' theorem and trigonometry	Use of Pythagoras' theorem	Sec 2	☐
	Determining whether a triangle is right-angled given the lengths of three sides	Sec 2	☐
	Use of trigonometric ratios (sine, cosine and tangent) of acute angles to calculate unknown sides and angles in right-angled triangles	Sec 2	☐
	Extending sine and cosine to obtuse angles	Sec 3	☐
	Use of the formula $\frac{1}{2}ab \sin C$ for the area of a triangle	Sec 3	☐
	Use of sine rule $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ for any triangle	Sec 3	☐
	Use of sine rule $a^2 = b^2 + c^2 - 2bc \cos A$ for any triangle	Sec 3	☐
	Problems in two and three dimensions including those involving angles of elevation and depression and bearings	Sec 3	☐
G5 Mensuration	Perimeter and Area of plane figures ❖ parallelogram, trapezium	Sec 1	☐
	Volume and surface area of solid figures ❖ cube, cuboid ❖ prism, cylinder ❖ pyramid, cone and sphere	Sec 1 Sec 1 Sec 2	☐
	Conversion between cm^2 and m^2 , and between cm^3 and m^3	Sec 1	☐
	Problems involving volume and surface area of composite solids	Sec 2	☐
	Arc length, sector area and area of a segment of a circle	Sec 3	☐
	Use of radian measure of angle (including conversion between radians and degrees)	Sec 3	☐

Topic/Sub-topic	Content	Learnt in	Check list
G6 Coordinate Geometry	Finding the gradient of a straight line given the coordinates of two points on it	Sec 3	☐
	Finding the length of a line segment given the coordinates of its end points	Sec 3	☐
	Interpreting and finding the equation of a straight line graph in the form $y = mx + c$	Sec 3	☐
	Geometric problems involving the use of coordinates	Sec 3	☐
G7 Vectors in two dimensions	Use of notations: $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$, $\mathbf{a}$, $ \overrightarrow{AB} $ and $ \mathbf{a} $	Sec 4	☐
	Representing a vector as a directed line segment		☐
	Translation by a vector		☐
	Position vectors		☐
	Magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$		☐
	Use of sum and difference of two vectors to express given vectors in terms of two coplanar vectors		☐
	Multiplication of a vector by a scalar		☐
	Geometric problems involving the use of vectors		☐

Topic/Sub-topic	Content	Learnt in	Check list
STATISTICS AND PROBABILITY			
S1 Data Handling and analysis	Analysis and interpretation of: ❖ tables ❖ bar graphs ❖ pictograms ❖ line graphs ❖ pie charts ❖ dot diagrams ❖ histograms with equal class intervals ❖ stem-and-leaf diagrams ❖ cumulative frequency diagrams ❖ box-and-whisker plots	Sec 1	
		Sec 2	☐
		Sec 4	
	Purpose and use, advantages and disadvantages of the different forms of statistical representations (i.e. explanation questions)	Sec 1	☐
	Drawing simple inference from statistical diagrams	Sec 1 Sec 2	☐
	Explaining why a given statistical diagram leads to misinterpretation of data	Sec 1 Sec 2	☐
	Purposes and use of ❖ mean ❖ mode ❖ median	Sec 2	☐
	Calculation (ungrouped/grouped data) ❖ mean ❖ mode ❖ median	Sec 2	☐
	Quartiles and percentiles	Sec 4	☐
	Range, interquartile range and standard deviation as measures of spread for a set of data	Sec 4	☐
S2 Probability	Calculation of the standard deviation for a set of data (grouped and ungrouped)	Sec 4	☐
	Using the mean and standard deviation to compare two sets of data	Sec 4	☐
	Probability of single events ❖ listing all possible outcomes in a simple chance situation to calculate the probability	Sec 2	☐
	Probability of simple combined events (including using possibility diagrams and tree diagrams, where appropriate)	Sec 4	☐
	Addition and multiplication of probabilities (mutually exclusive events and independent events)	Sec 4	☐

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL

TERM 1 GRADED ASSESSMENT 2025

SUBJECT : Mathematics
4052

DATE : 3 MARCH 2025

LEVEL : Secondary 4 (EXP)
Secondary 5 (NA)

DURATION : 50 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

The total of the marks for this paper is 35.

For Examiner’s Use			
Type of Penalties		Question Number	35
Accuracy	–1		
	–2		
Presentation	–1		
	–2		

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. Given that $\xi = \{\text{polygons}\}$, $A = \{\text{polygons with all sides equal}\}$, $B = \{\text{triangles}\}$ and $C = \{\text{quadrilaterals}\}$, state the name of the polygon in the following set.

(a) $A \cap B$

Answer: _____ [1]

(b) $A \cap C$

Answer: _____ [1]

- 2 (a) Express $x^2 - 12x + 9$ in the form $(x + a)^2 + b$.

Answer: _____ [2]

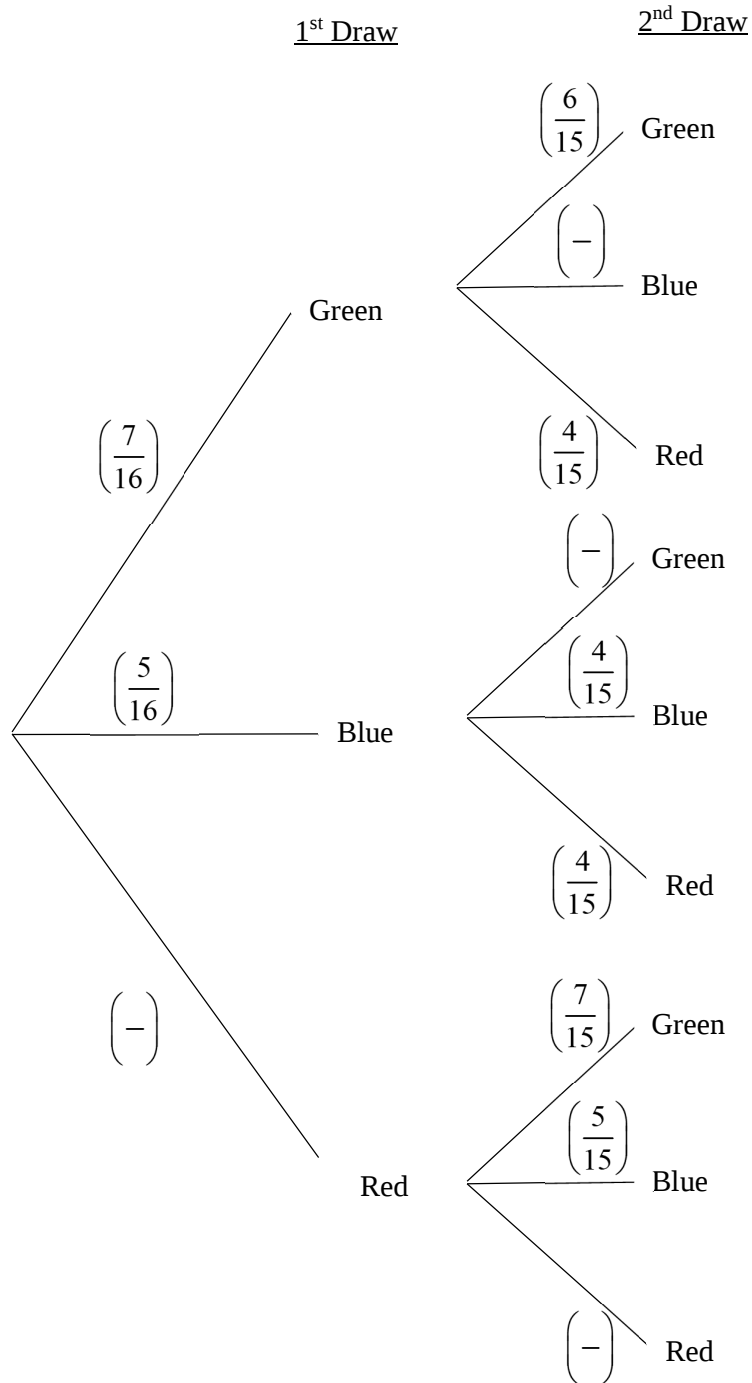
(b) **Hence**, solve $x^2 - 12x + 9 = 0$ giving your answers correct to two decimal places.

Answer: $x =$ _____ or _____ [2]

3. A box contains 16 balls, of which 7 are green, 5 are blue and 4 are red. Two balls are taken out of the box at random, one after the other, without replacement.

(a) Complete the following tree diagram.

[2]



(b) Find the probability that

(i) the balls drawn will be of different colour,

Answer: _____ [1]

(ii) exactly one of the balls drawn is blue,

Answer: _____ [1]

(iii) no red balls are drawn.

Answer: _____ [1]

4. In a group of 380 students, 235 students study Biology, 102 students study Physics and x students study both Biology and Physics.

With the help of a Venn diagram, find

- (a) the least possible number of students who studied both Biology and Physics,

Answer: _____ students [2]

- (b) the greatest possible number of students who study neither Biology nor Physics.

Answer: _____ students [2]

5. The graph of $y = (x - h)^2 + k$ has a minimum point at $\left(-\frac{1}{2}, \frac{3}{4}\right)$.

(a) State the values of h and of k .

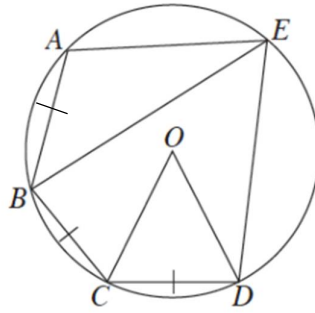
Answer: $h =$ _____

$k =$ _____ [2]

(b) **Hence**, sketch the graph of $y = (x - h)^2 + k$, indicating the minimum point and y -intercept.

Answer: _____ [2]

6. The diagram shows a pentagon $ABCDE$ inscribed in a circle with centre O .



$AB = BC = CD$ and angle $ABC = 130^\circ$.

(a) Calculate

(i) angle AEB ,

Answer: _____ $^\circ$ [2]

(ii) angle AED .

Answer: _____ $^\circ$ [2]

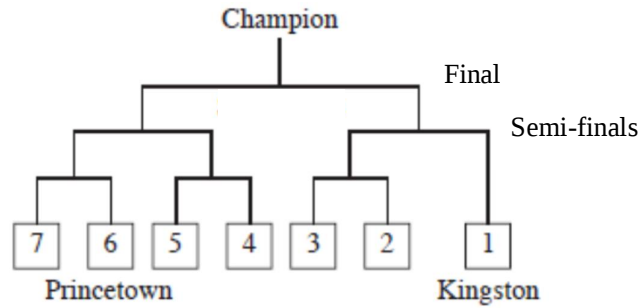
(b) Bobby claimed that line AOD is the diameter of the circle. Do you agree with him? Explain.

Answer:

[1]

7. Seven teams participated in a football competition which uses a knock-out system. The teams are randomly drawn into the positions 1, 2, 3, 4, 5, 6 and 7. It is known that Kingston and Princetown are in positions 1 and 6 respectively. The winner of each game proceeds to the next round as shown in the diagram and the losing team is eliminated from the competition.

Kingston goes straight into the semi-finals and will face the winner of the teams in positions 2 and 3. Each team has an equal probability of winning the other team.



Find the probability that

- (a) Princetown will reach the semi-finals,

Answer: _____ [1]

- (b) Kingston will be the champion,

Answer: _____ [1]

- (c) Princetown is not the champion.

Answer: _____ [1]

8. An empty water tank has a capacity of 3500 litres.

Pump A can fill the tank at a rate of x litres per minute.

Pump B can fill the tank at a rate of $(x - 10)$ litres per minute.

- (a) Write down an expression, in terms of x , for the number of minutes it would take to fill the tank using pump A.

Answer: _____ [1]

- (b) Write down an expression, in terms of x , for the number of minutes it would take to fill the tank using pump B.

Answer: _____ [1]

- (c) It takes 0.35 hours longer to fill the tank using pump B than it does using pump A.
Write down an equation to represent this information and show that it reduces to

$$3x^2 - 30x - 5000 = 0.$$

Answer: _____ [3]

- (d) Solve the equation $3x^2 - 30x - 5000 = 0$, giving your solutions correct to two decimal places.

Answer: $x =$ _____ or _____ [2]

- (e) Calculate how long it would take to fill the tank from empty using pump A and pump B together. Give your answer in minutes and seconds, correct to the nearest ten seconds.

Answer: _____ mins _____ secs [1]

End of Paper

Answer Key

1a) {equilateral triangles}

1b) {rhombus}

2a) $(x-6)^2 - 27$

2b) 0.80 or 11.20

3a) –

3bi) $\frac{83}{120}$ 3bii) $\frac{11}{24}$ 3biii) $\frac{11}{20}$

4a) 0

4b) 145

5a) $h = -\frac{1}{2}$, $k = \frac{3}{4}$

5b) sketch

6ai) 25° 6aii) 75°

6b) –

7a) $\frac{1}{2}$ 7b) $\frac{1}{4}$ 7c) $\frac{7}{8}$ 8a) $\frac{3500}{x}$ 8b) $\frac{3500}{x-10}$

8c) -

8d) 46.13 or –36.13

8e) 42 mins 40 secs

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL

TERM 1 GRADED ASSESSMENT 2024

SUBJECT : Mathematics

DATE : 16 FEBRUARY 2024

LEVEL : Secondary 4 Express

DURATION : 50 minutes

Candidates answer on the Question Paper.

READ THE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

The total of the marks for this paper is 35.

<i>For Examiner's Use</i>	
<i>Score</i>	<i>/35</i>

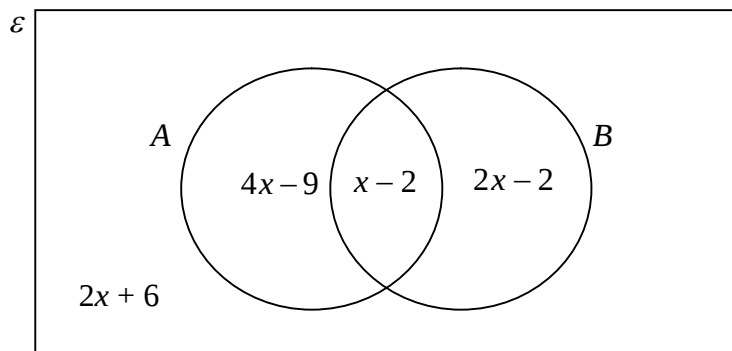
Answer all questions.

- 1 A group of people were selected at random and asked if they have watched the movie. Transformers (T) and Avengers (A).

Describe in words the meaning of $(A' \cap T) \cup (A \cap T)$.

Answer: _____ [2]

- 2 The Venn diagram below shows the two sets A and B as well as the number of elements in each subset.



- (a) On the diagram above, shade $(A' \cup B)$. [1]
- (b) Given that $n(B) = n(A \cap B')$, calculate the value of x .

Answer: $x =$ _____ [2]

- (c) Hence, find the number of elements in $(A \cup B)'$.

Answer: _____ [1]

- 3 The universal set ε and the sets A and B are given by,

$$\varepsilon = \{x : x \text{ is an integer and } 9 \leq x < 20\}$$

$$A = \{x : x \text{ is an even number}\}$$

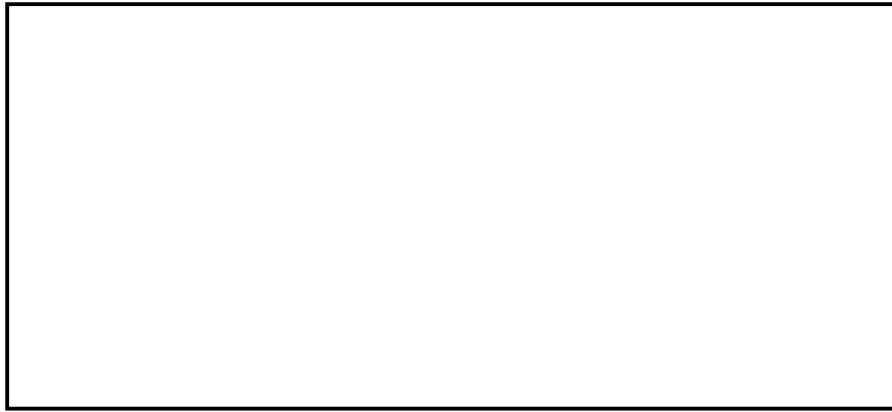
$$B = \{x : x \text{ is a multiple of } 5\}$$

- (a) Draw a Venn diagram to illustrate the sets, ε , A and B .

Indicate clearly the elements of each set.

Answer:

[3]



- (b) Find $n(A)$.

Answer: _____ [1]

- (c) List the elements of $A' \cap B$.

Answer: _____ [1]

- 4 A bag contains 16 red counters and 9 blue counters.

Two counters are taken from the bag at random without replacement.

- (a) Michael says the probability that both counters are blue is $\frac{81}{625}$.

Explain what he has done wrong.

Answer: _____

_____ [1]

- (b) Draw a tree diagram to show the probabilities of the possible outcomes.

Answer: [2]

- (c) Find, as a fraction in its simplest form, the probability that only one of the counters is red.

Answer: _____ [2]

- 5 6 cards numbered 1 to 6 are placed inside a box. Two cards are taken out of the box, one at a time, with replacement. The numbers on the two cards are noted down in a possibility diagram.

Draw 1

Draw 2

	1	2	3	4	5	6
1	1, 1		3, 1	4, 1	5, 1	6, 1
2		2, 2	3, 2	4, 2		6, 2
3	1, 3	2, 3	3, 3	4, 3	5, 3	
4	1, 4	2, 4	3, 4		5, 4	6, 4
5	1, 5		3, 5	4, 5	5, 5	6, 5
6	1, 6	2, 6		4, 6		6, 6

(a) Complete the possibility diagram above. [1]

(b) Find the probability that

(i) both numbers are even,

Answer: _____ [1]

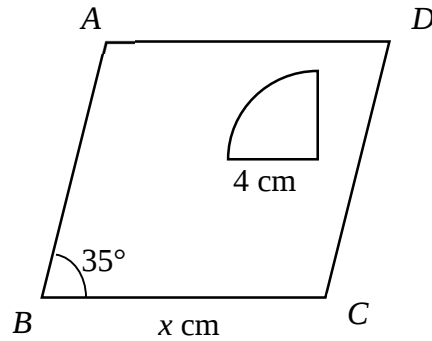
(ii) the sum of the two numbers is more than 8,

Answer: _____ [1]

(iii) the product of the two numbers is divisible by 6.

Answer: _____ [1]

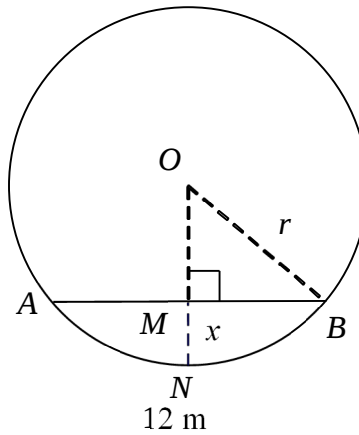
- 6 A quadrant of a circle with radius 4 cm is drawn inside a rhombus $ABCD$ in which $AB = x$ cm and angle $ABC = 35^\circ$. Show that the probability that a point selected at random in the rhombus lies within the quadrant is about $\frac{22}{x^2}$.



Answer:

[3]

- 7 The figure below shows a circle of centre O , with radius r metres. A and B are points on the circle such that $AB = 12$ m. M is the midpoint of AB and M is on ON such that $MN = x$ metres.



- (a) By considering $\triangle OMB$, show that $x^2 - 2rx + 36 = 0$.

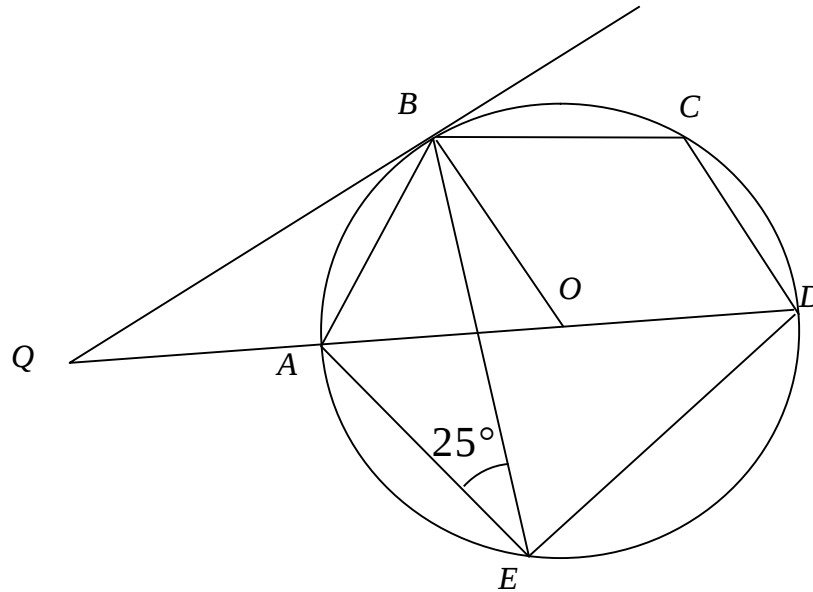
Answer:

[2]

- (b) Hence, given that $MN = 3$ m, calculate the radius of the circle.

Answer: _____ m [1]

- 8 The points A, B, C, D and E lie on a circle, centre O . AD is a diameter of the circle.
 BQ is a tangent to the circle, $\angle AEB = 25^\circ$ and QAD is a straight line.



Calculate, stating your reasons clearly,

- (a) (i) angle BAD .

Answer: _____ $^\circ$ [2]

- (ii) angle BED .

Answer: _____ $^\circ$ [1]

(iii) angle BQA .

Answer: _____ $^{\circ}$ [1]

(iv) reflex angle BOD .

Answer: _____ $^{\circ}$ [1]

(v) angle ABQ .

Answer: _____ $^{\circ}$ [1]

(b) If angle $DAE = x^{\circ}$, show that angle $QBE = (115 - x)^{\circ}$.

Answer: _____ [2]

(c) Given that angle $ABE = 42^{\circ}$, determine whether the lines BO and AE are parallel.
Give a reason for your answer.

Answer: _____

 _____ [1]

End of Paper

Answer key

1) –

2a) -

2b) 5

2c) 16

3a) -

3b) 5

3c) {15}

4a) -

4b) –

4c) $\frac{12}{25}$

5a) -

5bi) $\frac{1}{4}$ 5bii) $\frac{5}{18}$ 5biii) $\frac{5}{12}$

6) –

7a) -

7b) 7.5

8ai) 65° 8aii) 65° 8aiii) 40° 8aiv) 230° 8av) 25°

8b) –

8c) –

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL

TERM 1 GRADED ASSESSMENT 2023

SUBJECT : Mathematics **DATE : 21 FEBRUARY 2023**

LEVEL : Secondary 4 Express **DURATION : 50 minutes**
Secondary 5 Normal(A)

Candidates answer on the Question Paper.

READ THE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** the questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total number of marks for this paper is 35.

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.

<i>For Examiner's Use</i>	
<i>Score</i>	/35

This paper contains 10 printed pages including this cover page.

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.

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

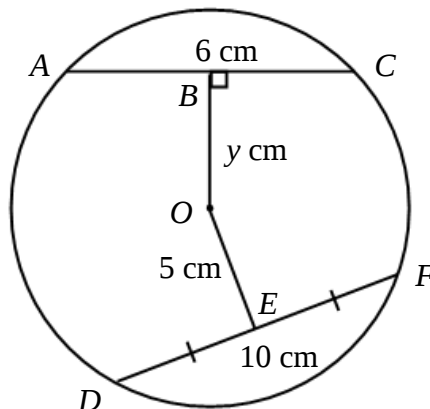
$$a^2 = b^2 + c^2 - 2bc \cos A$$

Statistics

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

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

1. In the diagram below, A , C , D and F lie on a circle with centre O . OB is perpendicular to chord AC and E is the mid-point of chord DF . Given that $AC = 6$ cm, $DF = 10$ cm, $OE = 5$ cm and $OB = y$ cm, find the value of y correct to 3 significant figures. You should state any circle properties that you use in your solutions.



Answer:..... [4]

2. It is given that $A = \{x : x \text{ is a natural number not greater than } 15\}$,
 $B = \{x : x \text{ is a factor of } 28 \text{ between } 1 \text{ and } 20\}$ and $C = \{x : x \text{ is a prime number less than } 15\}$.

(a) List the elements of

(i) $A \cap B$

Answer:..... [1]

(ii) $B \cup C$

Answer:..... [1]

(b) Given that $m \in B \cap C$

(i) write down all the possible values of m ,

Answer:..... [2]

(ii) find $n(B \cap C)$.

Answer:..... [1]

(c) If draw a Venn diagram showing sets A , B and C , listing all their elements.

Answer:

[2]

(d) Is $B \subset A$? Explain.

Answer:

.....

 [2]

3. (a) Solve the equation $\frac{9}{x-4} = 2x-1$.

Answer: [3]

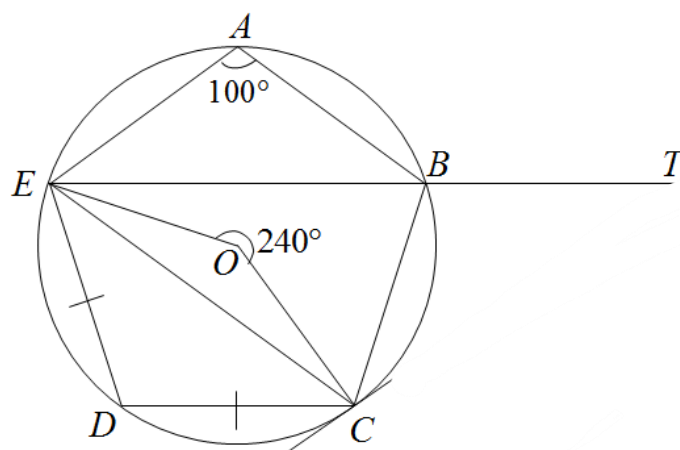
(b) (i) Express $15+4x-x^2$ in the form $b-(x+a)^2$.

Answer: [1]

(ii) Hence solve the equation $15+4x-x^2=0$ giving your answer correct to two decimal places.

Answer: [3]

4. In the diagram, O is the centre of circle $ABCDE$ where $DE = DC$. Reflex angle $EOC = 240^\circ$ and angle $EAB = 100^\circ$



Find, giving reasons for each answer,

- (a) angle BCE ,

Answer: [1]

- (b) angle DCE ,

Answer: [2]

- (c) angle CEB .

Answer: [2]

(d) angle CAB ,

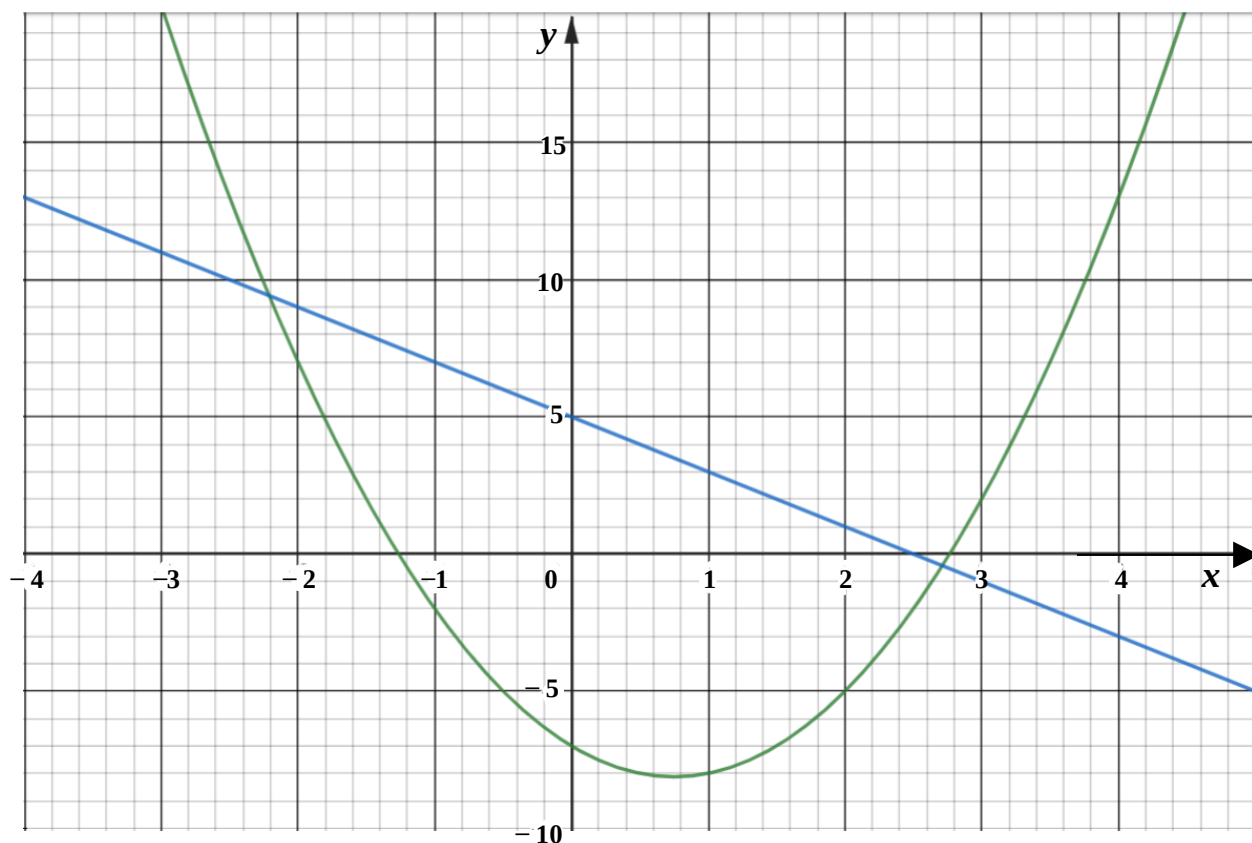
Answer: [1]

(e) T is on the line EB extended, such that angle $CTE = 20^\circ$. Show that if the line CT is drawn, it would be a tangent to the circle at C . Show your calculations clearly stating the relevant circle properties used.

Answer:

..... [3

5. The graphs of $y = 2x^2 - 3x - 7$ and $y = 5 - 2x$ are drawn on the grid.



- (a) Explain why the equation $2x^2 - 3x - 7 = k$ does not have solutions for some values of k .

Answer:

.....

[1]

- (b) The points of intersection of the curve, $y = 2x^2 - 3x - 7$ and the straight line, $y = 5 - 2x$ gives the solutions of a quadratic equation. Find the quadratic equation, giving your answer in the form $ax^2 + bx + c = 0$.

Answer: [1]

(c) The equation $2x^2 - 6x - 3 = 0$ can be solved by drawing a suitable straight line on the grid.

(i) Find the equation of the straight line.

Answer: [1]

(ii) By drawing the line, solve the equation $2x^2 - 6x - 3 = 0$.

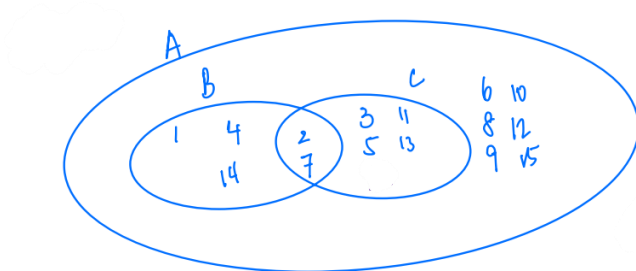
Answer: $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

END OF PAPER

Answers

1. 6.40 cm

2. $\{1, 2, 4, 7, 14\}$ $\{1, 2, 3, 4, 5, 7, 11, 13, 14\}$ 2, 7 2



This is because all of B is found within A . Also B is not equal to A .

3. -0.5 or 5 $19 - (x - 2)^2$ 6.36 or -2.36

4. 80° 30° 40° 40°

$$\angle CBT = 60^\circ - 20^\circ \text{ (ext } \angle \text{ of } \triangle \text{ sum of 2 opp. int } \angle \text{)}$$

$$= 40^\circ$$

$$\angle OCE = \frac{180^\circ - 120^\circ}{2} \text{ (base } \angle \text{ of isos } \triangle \text{)}$$

$$= 30^\circ$$

$$\therefore \angle OCB = 80^\circ - 30^\circ \text{ (sum of adj } \angle \text{ s)}$$

$$= 50^\circ$$

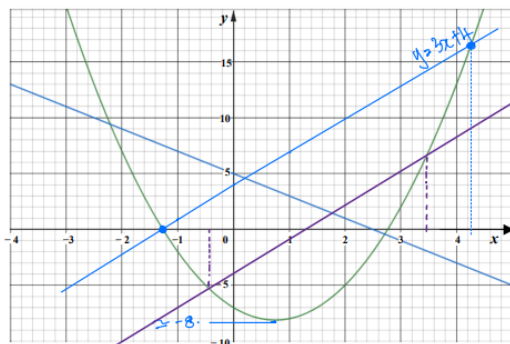
$$\therefore \angle OCT = 50^\circ + 40^\circ$$

$$= 90^\circ$$

By converse of the circle property that 'radius is perpendicular to tangent' and since radius OC is perpendicular to CT , CT must be a tangent.

5. The graphs of $y = 2x^2 - 3x - 7$ and $y = 5 - 2x$ are drawn on the grid.

5.



(a) Explain why the equation $2x^2 - 3x - 7 = k$ does not have solutions for some values of k .

Answer: $y = 2x^2 - 3x - 7 \therefore y = k$ is a line parallel to x -axis. For k values less than min. value of the curve, the line $y = k$ wmt intersect with the curve. hence no soln. [1]

(b) The points of intersection of the curve, $y = 2x^2 - 3x - 7$ and the straight line, $y = 5 - 2x$ gives the solutions of a quadratic equation. Find the quadratic equation, giving your answer in the form $ax^2 + bx + c = 0$.

$$2x^2 - 3x - 7 = 5 - 2x$$

$$2x^2 - x - 12 = 0$$

Answer: $2x^2 - x - 12 = 0$ [1]

$$y = 3x - 4$$

$$-0.4 \text{ and } 3.4$$

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL MASTERY REVIEW 2025

SUBJECT : Mathematics (4052)

DATE : 14 MAY 2025

LEVEL : Sec 4 (EXP) / 5 (NA)

DURATION : 2 hr 15 min

Candidates answer on the Question Paper.

READ THE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** the questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total number of marks for this paper is 90 marks.

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

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

For π , use either your calculator value or 3.142.

For Examiner's Use			
Type of Penalties		Question Number	90
Presentation	−1		
	−2		

This paper contains 22 printed pages including this cover page.

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

Answer **all** the questions.

Section A (45 marks)

- 1** Solve the simultaneous equations

$$3x - 2y = 14$$

$$5x + 3y = 17$$

You must show your working.

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

- 2** Simplify $\frac{2x^2 - 9x - 5}{x^2 - 25}$.

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

- 3 Amanda invested \$9000 into an account paying at $R\%$ per annum compounded half-yearly. After 6 years, she had earned a total interest of \$3104. Find R .

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

- 4 Solve the equation $x^2 + 18x + 21 = 0$ by completing the square. Give your solutions correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- 5 (a) Find all the prime numbers that satisfy the inequality $-8 < 2 + 3x \leq 20$.

Answer [3]

- (b) Simplify $\left(\frac{27h^{-9}}{k^6}\right)^{\frac{2}{3}}$. Give your answer in positive indices.

Answer [2]

- (c) Express 24.5 millimetre in metres. Give your answer in standard form.

Answer m [1]

6 A map has a scale of 1 : 1 000 000.

- (a)** The distance between Singapore and Penang is 712 km.
Calculate the distance, in centimetres, between Singapore and Penang on the map.

Answer cm [2]

- (b)** The area of Singapore on the map is 7.36 cm^2 .
Calculate the area of Singapore in square kilometres.

Answer km^2 [2]

- 7 A straight line L passes through the points $P(-2, 6)$ and $Q(10, k)$.

The line L is parallel to $-4y = x + 5$,

- (a) Show that $k = 3$. [2]

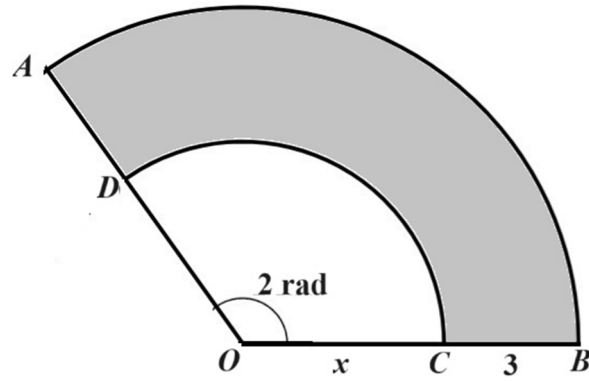
- (b) Find the length of PQ .

Answer [1]

- (c) Find the equation of line L .

Answer [2]

8



The diagram shows two concentric sectors centred at O .
 Angle AOB is 2 radian, $OC = x$ cm and $BC = 3$ cm.
 The perimeter of the shaded area $ABCD$ is 30 cm.

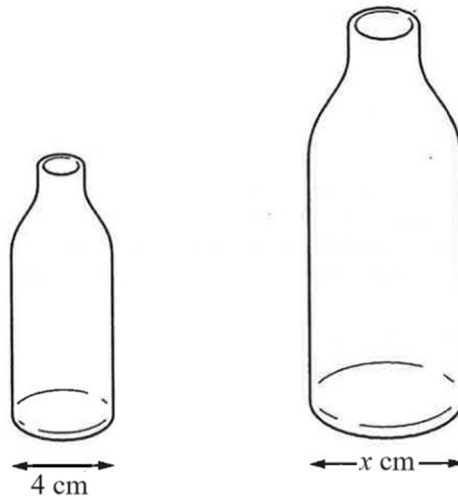
(a) Find the value of x .

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

(b) Calculate the shaded area.

Answer $\dots\dots\dots \text{cm}^2$ [2]

9



The diagram shows two geometrically similar bottles.
The diameters of the bottles are 4 cm and x cm respectively.

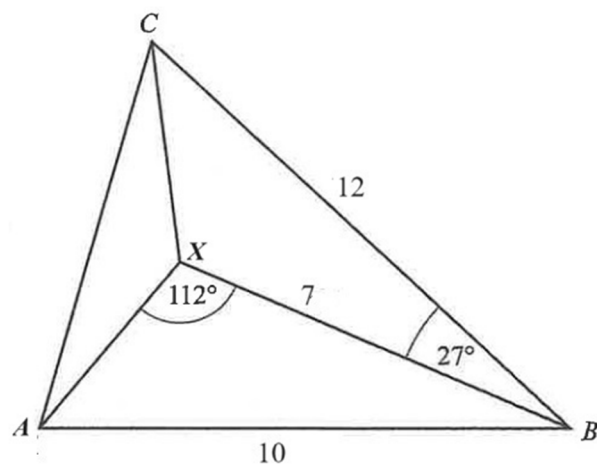
- (a) The capacity of the small and big bottles are 80 ml and 2160 ml respectively.
Find the value of x .

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

- (b) Hence, given that the outer surface area of the big bottle is 252 cm^2 , find the outer surface area of the small bottle.

Answer $\dots\dots\dots \text{ cm}^2$ [2]

10



X is a point inside triangle ABC .

$AB = 10$ cm, $BC = 12$ cm and $BX = 7$ cm.

Angle $AXB = 112^\circ$ and angle $XBC = 27^\circ$.

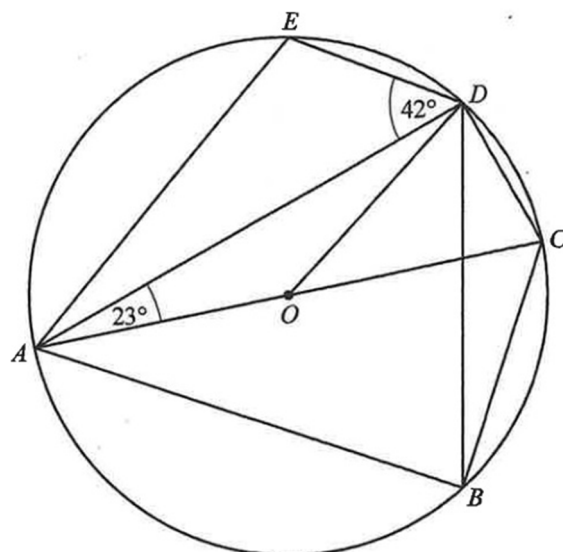
(a) Calculate CX .

Answer cm [2]

(b) Calculate the area of triangle ABC .

Answer cm^2 [4]

11



A, B, C, D and E are points on the circle, centre O .

AC is a diameter of the circle.

Angle $OAD = 23^\circ$ and angle $ADE = 42^\circ$.

Find, giving reasons for each answer,

(a) angle ABD ,

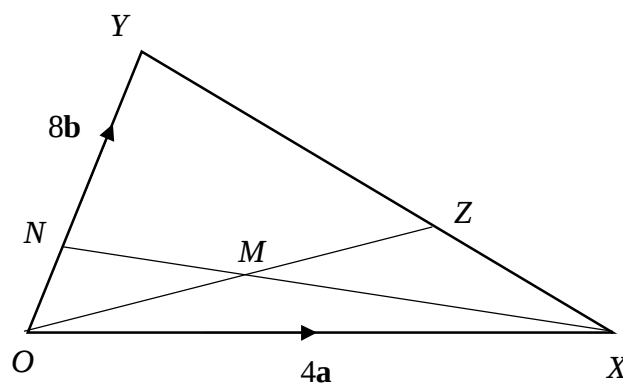
Answer $^\circ$ [2]

(b) angle EAD .

Answer $^\circ$ [2]

Section B (45 marks)

12



OXY is a triangle.

Z is the point on XY such that $YZ : ZX = 3 : 1$.

$\overrightarrow{OX} = 4\mathbf{a}$ and $\overrightarrow{OY} = 8\mathbf{b}$.

(a) Show that the position vector of point Z is given by $\overrightarrow{OZ} = 3\mathbf{a} + 2\mathbf{b}$.

Answer

[2]

(b) M is the midpoint of OZ and N lies on OY such that XMN is straight line.

$XN = pXM$ and $ON = qOY$ where p and q are numbers.

Find the ratio $ON : NY$.

Answer : [4]

- (c) The area of triangle $OYZ = 42 \text{ cm}^2$.
Find the area of triangle OXZ .

Answer cm^2 [1]

- 13 (a)** A concert hall has three recital studios.
Each studio has standard seats and premier seats.

Studio 1 has 100 standard seats and 40 premier seats.

Studio 2 has 80 standard seats and 30 premier seats.

Studio 3 has 40 standard seats and 20 premier seats.

This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 100 & 40 \\ 80 & 30 \\ 40 & 20 \end{pmatrix}$.

The ticket price for a standard seat is \$20.

The ticket price for a premier seat is \$25.

- (i)** Represent the ticket prices in a 2×1 column matrix $\mathbf{T}$.

Answer $\mathbf{T} =$ [1]

- (ii)** Evaluate the matrix $\mathbf{M} = \mathbf{CT}$.

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

- (iii)** State what each element of $\mathbf{M}$ represents.

.....
..... [1]

- (iv)** The elements of matrix $\mathbf{N}$, where $\mathbf{N} = \mathbf{AM}$, represent the total takings, in dollars, for the concert hall. Find the total takings using matrix multiplication.

Answer \$ [1]

- (b) In the first week of the month, 4950 tickets were sold.

In the second week of the month, sales decreased by 48%.

Calculate the number of tickets sold in the second week of the month.

Answer [2]

- (c) Each recital studio has a performance in the afternoon, in the evening and at night respectively.

On a Sunday, tickets were sold in the following ratios:

afternoon tickets : evening tickets = 4 : 7

evening tickets : night tickets = 5 : 12

Find the ratio afternoon tickets : night tickets sold that Sunday.

Give your answer in its simplest form.

Answer : [2]

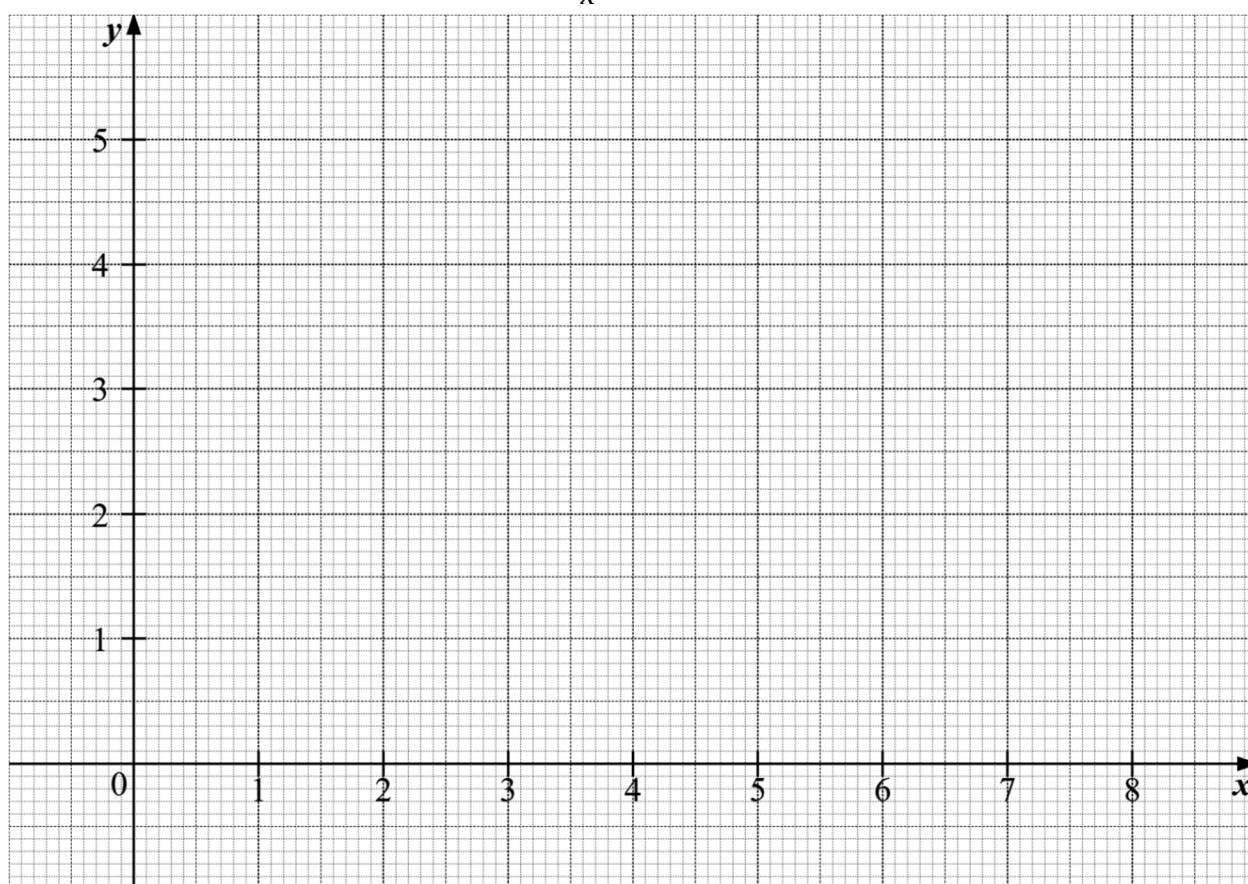
14 (a) (i) Complete the table of values for $y = x + \frac{8}{x} - 5$.

x	1	2	3	4	5	6	7	8
y	4	1	0.7	1	1.6		3.1	4

[1]

(ii) On the grid, draw the graph of $y = x + \frac{8}{x} - 5$ for $1 \leq x \leq 8$.

[3]



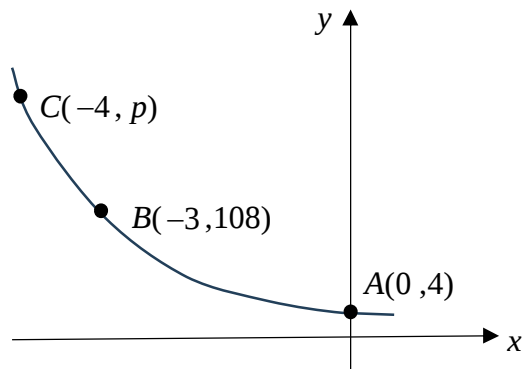
(iii) By drawing a suitable straight line on the grid, solve the equation $x^2 - 8x + 8 = 0$.

Answer [3]

- (iv) Use your graph to determine whether there is a solution for $6x + \frac{48}{x} - 30 \leq 0$. Give a reason for your answer.

.....
 [1]

(b)



The sketch shows the graph of $y = ka^{-x}$, where $a > 0$.

The graph passes through the points A (0 , 4), B (-3 , 108) and C (-4 , p).

Find the value of p .

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

15 (a) The table shows the masses, m kg, of 100 students.

Mass (m kg)	$40 < m \leq 50$	$50 < m \leq 60$	$60 < m \leq 70$	$70 < m \leq 80$	$80 < m \leq 90$
Frequency	4	17	42	32	5

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

Answer $< m \leq$ [1]

(ii) Calculate an estimate of the mean mass.

Answer kg [1]

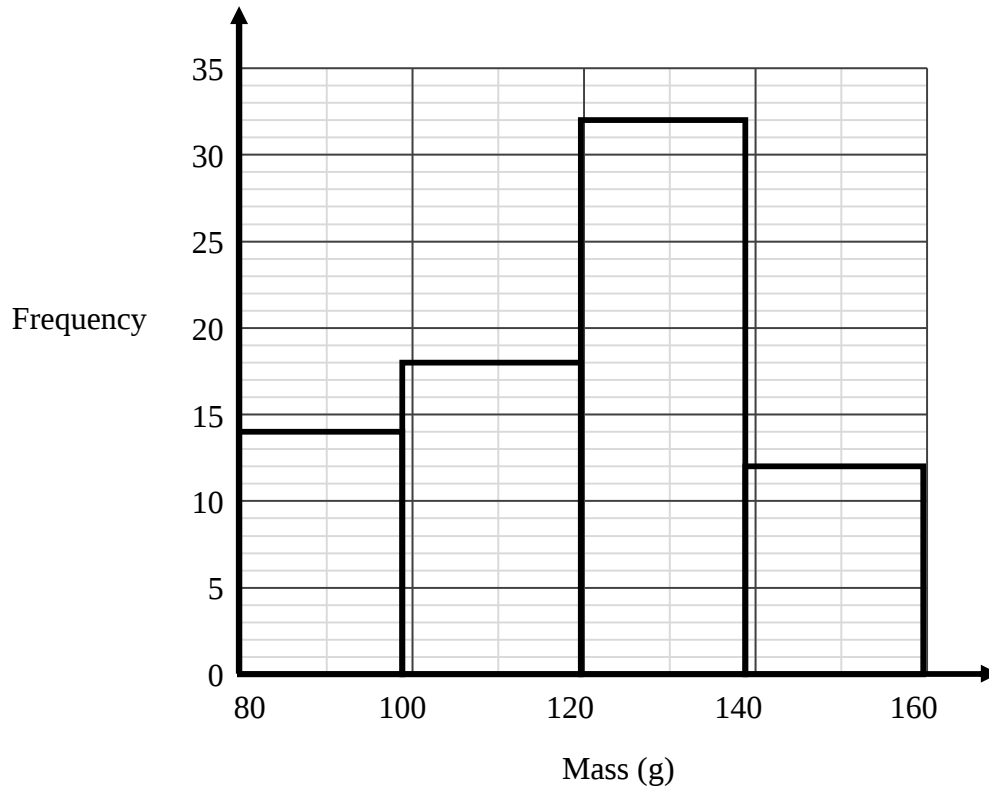
(iii) Calculate an estimate of the standard deviation of the masses.

Answer kg [1]

(iv) Pete wants to illustrate this information in a diagram. Give one advantage of illustrating this information using a histogram rather than a pie chart.

.....
 [1]

(b) The histogram shows the distribution of the masses of 76 oranges.



(i) Explain why the range of masses of oranges may not be 80g.

.....
 [1]

(ii) Three of the 76 oranges are selected at random without replacement. Find the probability that two has a mass less than 100g and one has a mass greater than 140g.

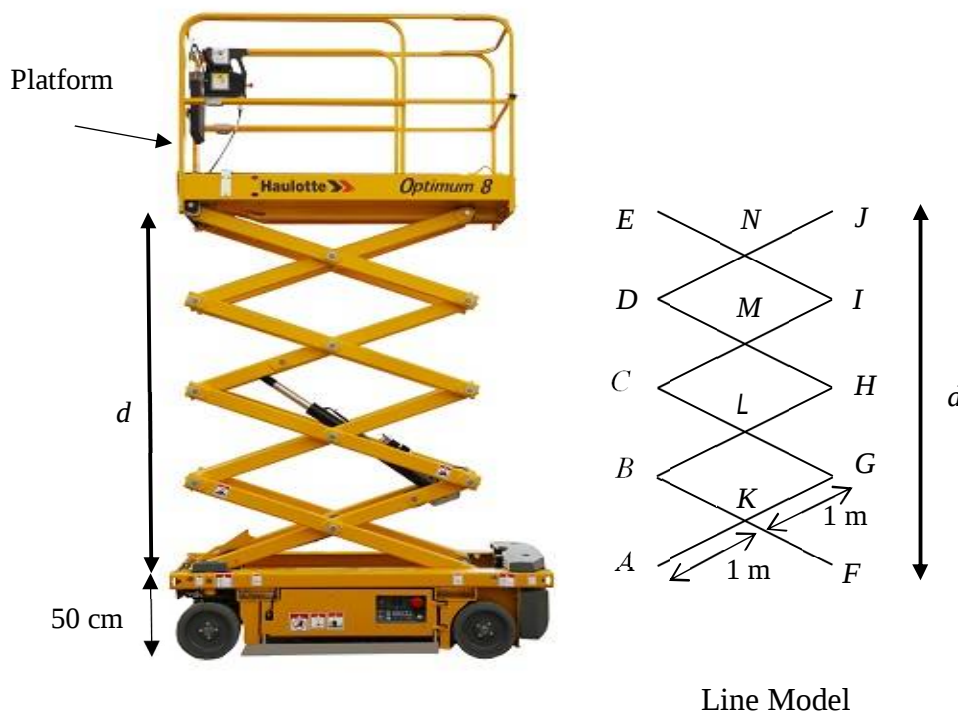
Answer [3]

- (iii) x oranges that weigh between 120g and 140g are rotten and removed. The probability of choosing an orange that weight between 80g and 100g is now $\frac{1}{5}$.

Find the value of x .

Answer [1]

- 16** The diagram below shows a scissor lift. It consists of a platform attached to a mechanism that has a criss-cross pattern which can extend and compress like multiple interconnected scissors. The mechanism can be manipulated to vertically elevate the platform to a desirable height.



- (a)** The scissor lift can be modelled into a line model shown above.

$AG = BH = CI = DJ = EI = DH = CG = BF = 2$ m and the length of each segment between two joints is 1 m. For safety reasons during operation, angle AKF must be between 60° to 170° .

- (i)** Within safety limit, find the range of the vertical distance, d , between F and J using an inequality. [3]

- (ii) David is 1.85 m tall and stands on the platform of the scissor lift. By considering the vertical distance, including the 50 cm base of the scissor lift, will David be able to save a cat at the top of a 9 m tall tree?

Explain your answer.

.....
 [2]

- (b) More information about the scissor lift is given.

- 1000 kg is equivalent to 9810 N
- Maximum lift capacity: 1650 N/m²
- Area of platform: 1.5 m²
- Weight of Platform: 90 kg
- Weight of each worker: 80 kg

A special foundation is needed on the ground if the platform and its loaded weight is above the maximum lift capacity. Given that there are 3 workers standing on the platform of the scissor lift, will the scissor lift require a special foundation?

Justify your decisions with calculations and the information given above.

.....
 [4]

End of Paper

Answer key

1) $x = 4, y = -1$	2) $\frac{2x+1}{x+5}$
3) 5.00	4) -16.75 or -1.25
5a) 2, 3 and 5	5b) $\frac{9}{k^4 h^6}$
5c) 2.45×10^{-2}	
6a) 71.2	6b) 736
7a) -	7b) 12.4
7c) $y = -\frac{1}{4}x + \frac{11}{2}$	
8a) 4.5	8b) 36
9a) 12	9b) 28
10a) 6.58	10b) 48.9
11a) 67	11b) 25
12a) -	12b) 1 : 4
12c) 14	
13ai) $\begin{pmatrix} 20 \\ 25 \end{pmatrix}$	13aii) $\begin{pmatrix} 3000 \\ 2350 \\ 1300 \end{pmatrix}$
13aiii) total takings of studio 1, 2 and 3 respectively	13aiv) 6650
13b) 2574	13c) 5 : 21
14ai) 2.3	14aii) graph
14aiii) 1.2 or 6.9	14aiv)
14b) 324	
15ai) 60, 70	15aii) 66.7
15aiii) 9.06	15aiv) -
15bi) -	15bii) $\frac{273}{17575}$
15biii) 6	
16ai) $0.697 \leq d \leq 6.93$	16aii) Yes, able to save the cat
16b) Requires special foundation	

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL MASTERY REVIEW 2024

SUBJECT : Mathematics (4052)

DATE : 8 MAY 2024

LEVEL : Sec 4 (EXP) / 5 (NA)

DURATION : 2hr 15 min

Candidates answer on the Question Paper.

READ THE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** the questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total number of marks for this paper is 90 marks.

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

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

For π , use either your calculator value or 3.142.

For Examiner's Use			
Type of Penalties		Question Number	90
Accuracy	−1		
	−2		
Presentation	−1		
	−2		

This paper contains 23 printed pages including this cover page.

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.

Section A (45 marks)

- 1** The first 4 terms of a sequence are 33, 25, 17 and 9.

(a) Find an expression, in terms of n , for the n th term of the sequence.

Answer [1]

(b) Explain whether -101 is a term in the sequence.

Answer _____

 _____ [2]

- 2** y is inversely proportional to x^n .

When x is increased by 100%, y is $\frac{1}{16}$ of its original value.

Calculate the value of n .

Answer $n =$ [3]

- 3 Given that $3\sin x = 2$, find the two possible values for angle x , where $0 \leq x \leq \pi$.

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

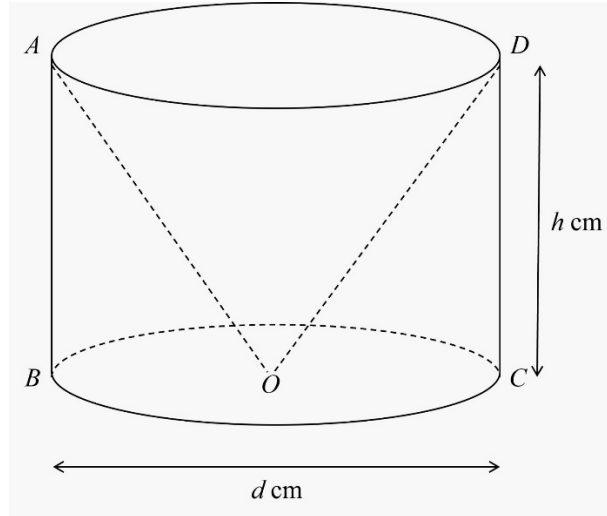
- 4 (a) Given that $\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 3 & -2 \end{pmatrix}$, find $\mathbf{A}^2$.

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

- (b) Hence, deduce $\mathbf{A}^5$.

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

5



The diagram above shows a cylindrical container with a conical shape being cut out. Both the cone and cylinder have a diameter of d cm and height h cm.

The volume of the remaining solid is $\frac{5}{36}d^3\pi \text{ cm}^3$.

Express h in terms of d .

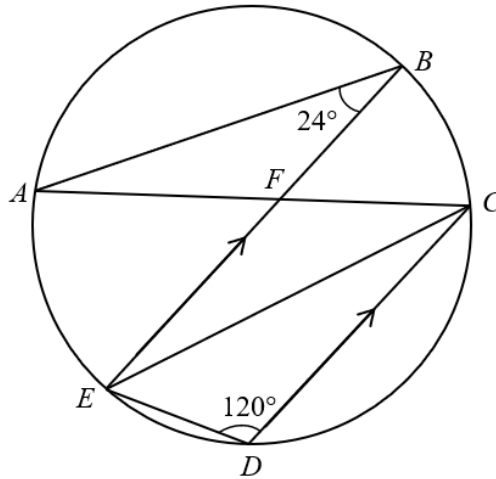
Answer $h = \dots\dots\dots$ [3]

6 The diagram shows a circle $ABCDE$.

BE is a diameter of the circle and BE is parallel to CD .

F is the point of intersection of AC and BE .

Angle $ABE = 24^\circ$ and angle $CDE = 120^\circ$.



(a) Stating your reasons clearly, find

(i) angle ACE ,

Answer $^\circ$ [1]

(ii) angle CAE .

Answer $^\circ$ [1]

(b) Explain why F is not the centre of the circle.

Answer _____

 _____ [2]

- 7 (a) Expand and simplify $(x - a)(x + a) - (x - 2a)^2$.

Answer [2]

- (b) Given that $x = 3a$, show that $(x - a)(x + a) - (x - 2a)^2$ is a multiple of 7.

Answer _____

 _____ [2]

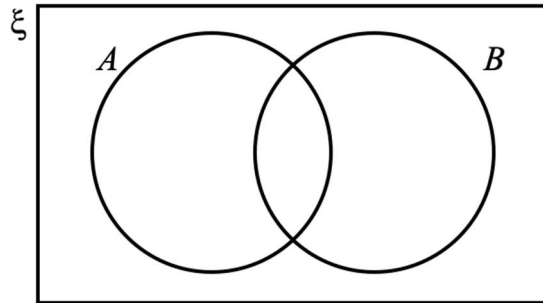
8 $\xi = \{\text{integers } x : 0 < x \leq 10\}$

$A = \{\text{prime numbers}\}$

$B = \{(x-5)(4-x) = 0\}$

(a) Complete the Venn Diagram to illustrate this information.

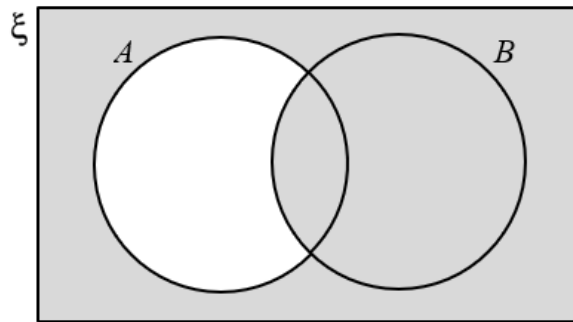
[2]



(b) List the elements in $(A \cup B)'$

Answer [1]

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



Answer [1]

9 X is the point $(6, 2)$ and Y is the point $(4, 5)$.

(a) Find $|\overrightarrow{XY}|$.

Answerunits [2]

(b) $\mathbf{p} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} 3 \\ -3.5 \end{pmatrix}$.

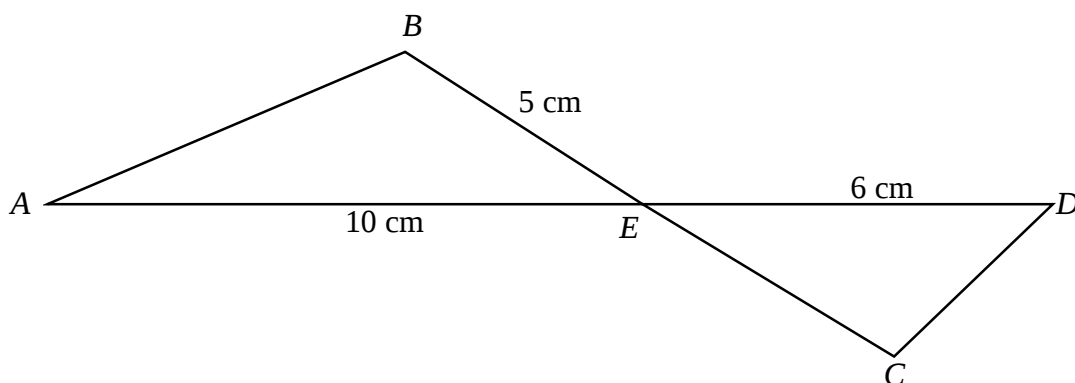
$\overrightarrow{XY} = m\mathbf{p} + 2\mathbf{q}$, where m is a constant.

Find the value of m .

Answer $m =$ [2]

10 In the diagram, AD and BC meet at E .

$AE = 10$ cm, $BE = CE = 5$ cm and $DE = 6$ cm.



(a) Explain why triangle ABE and triangle DCE are not similar.

Answer _____

 _____ [2]

(b) The perpendicular height from B to AD is the same as that from C to AD .

State the ratio of the area of triangle ABE to the area of triangle DCE .

Answer : [1]

- 11** Adam, Bernard and Carl took a multiple-choice test containing 40 questions.

Carl attempted all questions.

The matrices show the results of the test and the marks awarded.

	Correct	Incorrect	Not Attempted	Marks
Adam	30	6	4	Correct $\begin{pmatrix} 2 \\ -1 \\ 0 \end{pmatrix}$
Bernard	32	7	1	Incorrect
Carl	x	$40 - x$	0	Not Attempted

- (a)** Find $\begin{pmatrix} 30 & 6 & 4 \\ 32 & 7 & 1 \\ x & 40-x & 0 \end{pmatrix} \begin{pmatrix} 2 \\ -1 \\ 0 \end{pmatrix}$, leaving your answer in terms of x .

Answer [2]

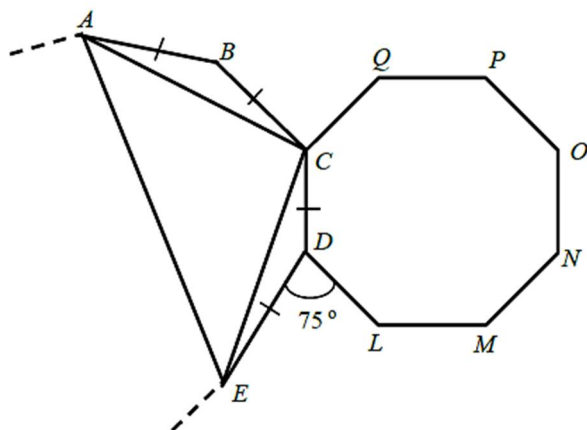
- (b)** Explain what your answer to **(a)** represents.

Answer _____
 _____ [1]

- (c)** If Carl has scored the highest marks, using your answer in part **(a)**, form an inequality to find his least number of correct answers.

Answer [2]

- 12 The diagram shows a regular octagon $CDLMNOPQ$ and part of a regular n -sided polygon $ABCDE\dots$.



Find

- (a) angle CDL .

Answer $^{\circ}$ [1]

- (b) the number of sides in the regular polygon $ABCDE$.

Answer [3]

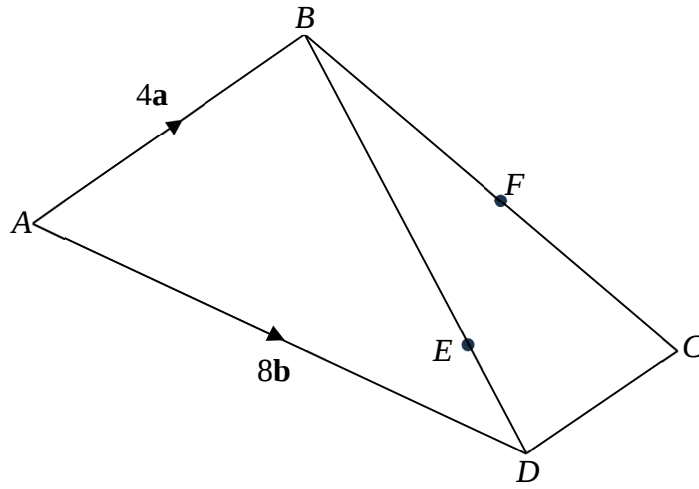
- 13** Ali wishes to buy a new car. The price of the car is \$108 000. After making the downpayment of \$21 600, he decides to take a bank loan for the rest of the money to be paid to the car dealer. Bank UCC charges an interest rate of 2.98% per annum compounded half yearly. Bank HBB charges a simple interest rate of 3.19% per annum. If Ali decides to take a 10-year loan, which bank should he loan from? Justify your answer.

Answer Ali should loan from bank _____ because _____

_____ [4]

Answer **all** the questions.
Section B (45 marks)

14



In the diagram, $\vec{AB} = 4\mathbf{a}$, $\vec{AD} = 8\mathbf{b}$ and $\vec{EF} = 2(\mathbf{a} - \mathbf{b})$.
 E is the point on BD such that $BE:BD = 3:4$.
 F is the midpoint of BC .

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

Answer [2]

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

Answer [2]

- (b) What type of quadrilateral is $ABCD$?
Justify your answer using vectors.

Answer $ABCD$ is a _____ because _____

_____ [3]

15 A housewife plans to buy \$30 worth of vegetables at x cents per kg.

(a) Write down an expression, in terms of x , for the number of kg she plans to buy.

Answer kg [1]

(b) The price of vegetables is now selling at 6 cents less per kg. Write down an expression in terms of x for the number of kg she can buy for \$30 now.

Answer kg [1]

(c) Given that she bought $5\frac{5}{9}$ kg more than she planned, form an equation in x and show that it reduces to $x^2 - 6x - 3240 = 0$. [3]

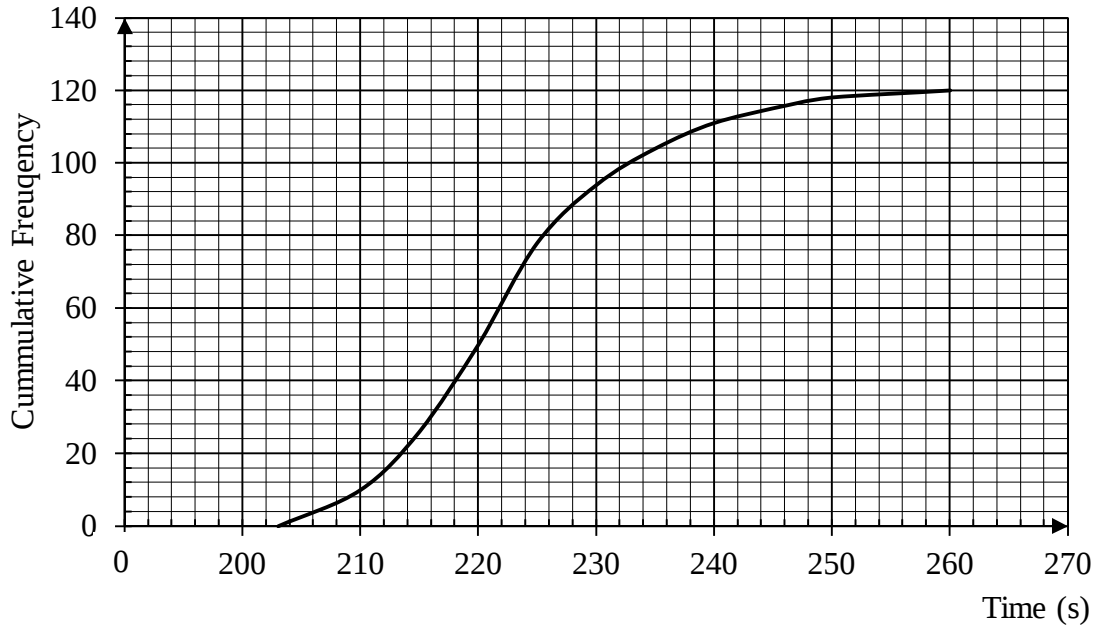
(d) Solve $x^2 - 6x - 3240 = 0$.

Answer [2]

(e) Hence, find the number of kg of vegetables she bought after the price had decreased.

Answer kg [1]

- 16** The cumulative frequency curve shows the distribution of time taken, in seconds by a lorry to travel along a certain stretch of the Expressway for 120 trips.



- (a)** Given that 10% of the trips took at most p seconds, find the value of p .

Answer s [1]

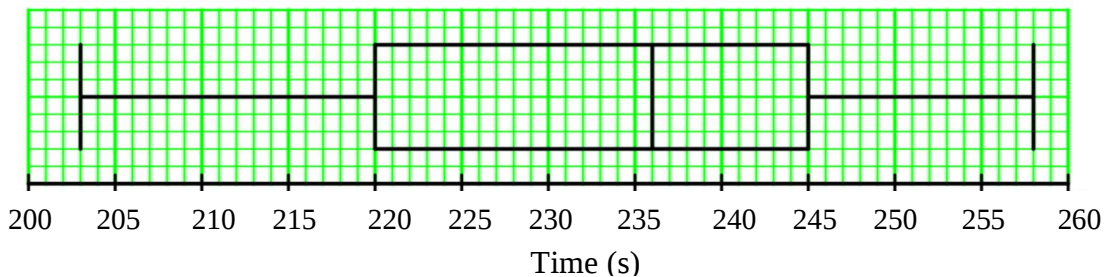
- (b)** If 15% of the trips are liable to receive a speeding ticket, find the time taken that will exceed the speeding limit.

Answer s [2]

- (c) If two particular trips were selected at random, find the probability that one will exceed the speed limit while the other will not.

Answer [2]

The time taken by a tour bus to travel along the same stretch of Expressway over 120 trips is given by the following box-and-whisker plot.



- (d) Use the two diagrams to complete this table for the lorry's and bus's travelling time.

	Lower Quartile (s)	Median (s)	Upper Quartile (s)	Interquartile Range (s)
Lorry				
Tour Bus				

[3]

- (e) Compare the travelling time taken by the bus and lorry in two different ways.

Answer 1. _____

2. _____

[2]

- 17 The variables x and y are connected by the equation $y = \frac{x^2}{5} + \frac{4}{x^2} - 3$.

Some corresponding values of x and y , correct to one decimal place, are given in the table below.

x	-2	-1	-0.5	0.5	1	2	3	4	5
y	-1.2	1.2	13.0	13.0	1.2	-1.2	-0.8	p	2.2

- (a) Find the value of p .

Answer [1]

- (b) On the graph paper, plot the points given in the table and join them with a smooth curve. [3]

- (c) By drawing a tangent, find the gradient of the curve at $x = 4$.

Answer [2]

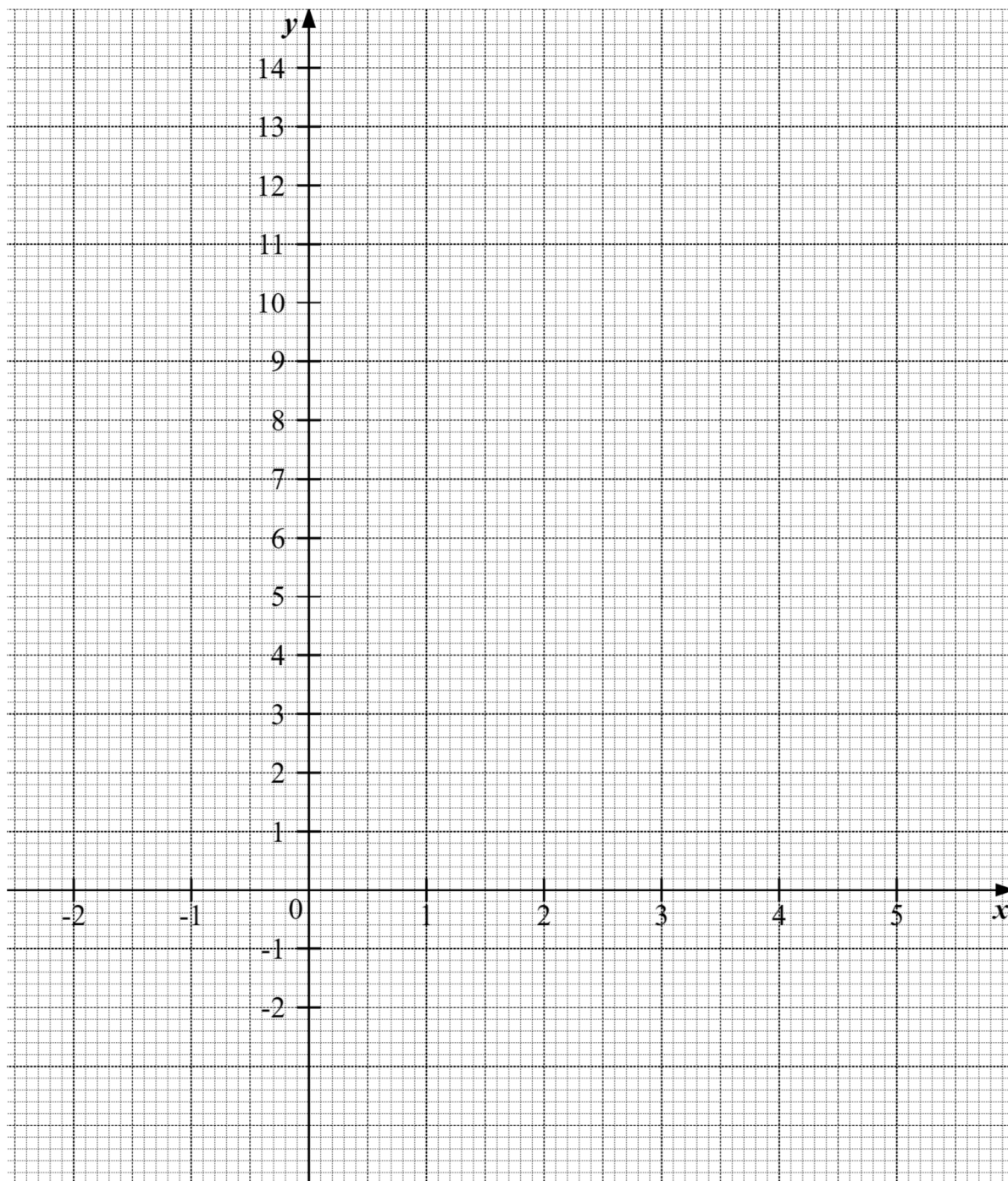
- (d) (i) On the same axes, draw the line with gradient -1.5 that passes through the point with coordinates $(2,1)$. [1]

- (ii) From the graph, state the equation of this line.

Answer [1]

- (iii) Using your graph, write down the coordinates of the points where the line intersects the curve.

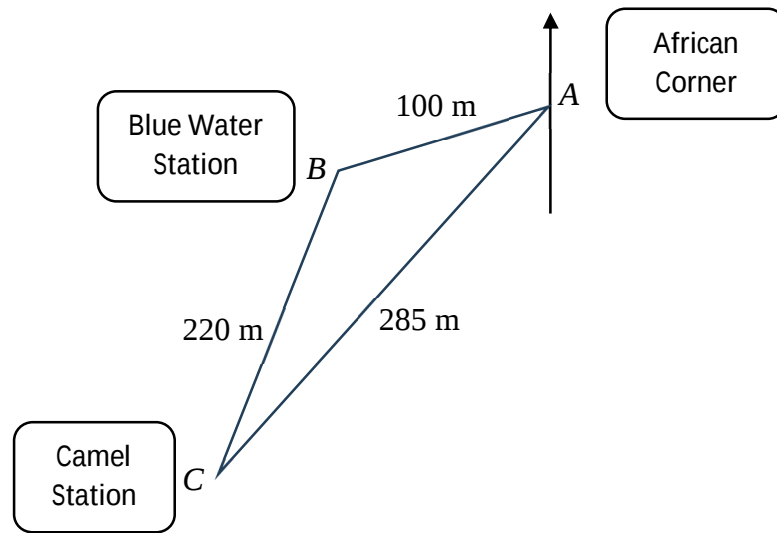
Answer (..... ,), (..... ,), and (..... ,), [2]



18 Mrs Tan brought her children to a zoo on a particular day.

- (a)** They took a tram ride and alighted at the Blue Water station. The children wanted to meet the giraffe and its family at the Africa Corner exhibit.

The diagram shows three points, A , B and C , on ground level, which represent the Africa Corner exhibit, the Blue Water station and the Camel station respectively.



$AB = 100$ m , $AC = 285$ m and $BC = 220$ m.
The bearing of B from A is 262° .

- (i)** Calculate the bearing of A from B .

Answer $^\circ$ [1]

- (ii)** Calculate angle ABC .

Answer $^\circ$ [2]

- (b) After visiting the giraffes, Mrs Tan and her children were thinking to have lunch at Bar Fancy. Bar Fancy is located along a straight tram route represented by the line CB produced, and it was nearest to point A . How far is Bar Fancy from point A ?

Answer m [3]

- (c) After lunch, Mrs Tan walked along the tram route to meet her friend at the Camel station. As Mrs Tan walked along the tram route, she saw a giraffe at the Africa Corner exhibit. Mrs Tan is 1.75 m tall and the giraffe is 6 m tall. She claimed that the range of angle of elevation from her height to the giraffe's height was approximately between 1.25° and 2.84° , as she walked towards the Camel station.

Explain, with numerical calculations, whether her claim was valid. [4]

End of Paper

Answer Key

1a) $-8n + 41$	1b) not a term in the sequence
2) 4	3) 41.8 or 138.2
4a) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	4b) $\begin{pmatrix} 2 & -1 \\ 3 & -2 \end{pmatrix}$
5) $h = \frac{5}{6}d$	
6ai) 24	6aii) 60
6b) -	
7a) $4ax - 5a^2$	7b) -
8a) -	8b) {1, 6, 8, 9, 10}
8c) $A' \cup B$	
9a) 3.61	9b) 2
10a) -	10b) 5 : 3
11a) $\begin{pmatrix} 54 \\ 57 \\ 3x - 40 \end{pmatrix}$	11b) Total marks scored by Adam, Bernard and Carl in the multiple choice test respectively.
11c) 33	
12a) 135	12b) 12
13) HBB	
14a) $6b - 3a$	14b) $8b - 2a$
14c) trapezium	
15a) $\frac{3000}{x}$	15b) $\frac{3000}{x - 6}$
15c) -	15d) 60 or 54
15e) $55\frac{5}{9}$	
16a) 211	16b) 213
16c) $\frac{9}{35}$	16d) -
16e) -	
17a) 0.5	17b) -
17c) 1.48	17di)
17dii) $y = -1.5x + 4$	17diii) (-0.7, 5) (0.75, 2.8) (3.1, -6.7)
18ai) 082°	18aii) 121.2°
18b) 85.5	18c) not valid

NAME

CLASS

INDEX No.

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ST. PATRICK'S SCHOOL MASTERY REVIEW 2023

SUBJECT : Mathematics

DATE : 11 MAY 2023

LEVEL : Sec 4G3 / 5G2

DURATION : 2hr 15 min

Candidates answer on the Question Paper.

READ THE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** the questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total number of marks for this paper is 90 marks.

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

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

For π , use either your calculator value or 3.142.

For Examiner's Use	
Score	/90

This paper contains 26 printed pages including this cover page.

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

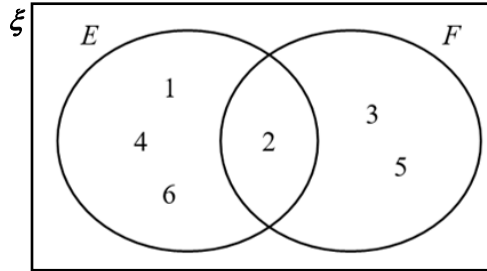
$$\text{Mean} = \frac{\sum fx}{\sum f}$$

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

Section A (45 marks).

1. $\xi = \{x : x \text{ is an integer, } 1 \leq x \leq 6\}$

The Venn Diagram shows the elements of ξ and two sets E and F .



Use one of the symbols below to complete each statement.

$\emptyset \quad \subset \quad \not\subset \quad \notin \quad \in \quad \xi$

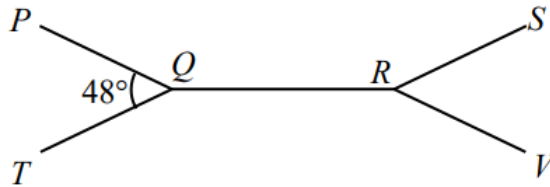
- (a) $\{1, 6\}$ _____ E .

Answer [1]

- (b) $(E \cup F)' =$ _____.

Answer [1]

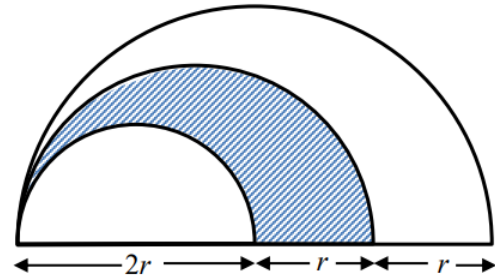
2. PQRS and TQRV are parts of two identical regular n – sided polygon.



The two polygons are joined along the edge QR and angle $PQT = 48^\circ$. Calculate the value of n .

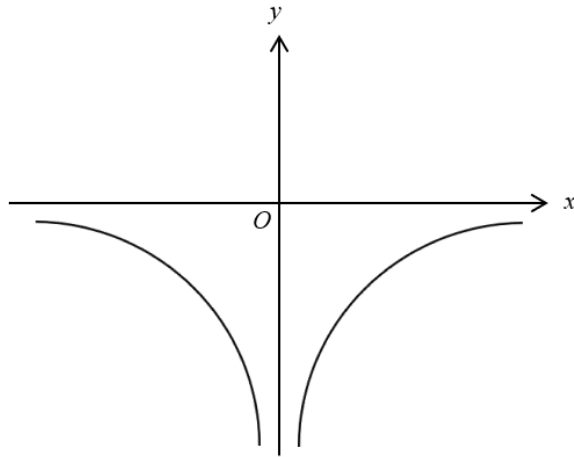
Answer $n =$ [2]

3. The figure shows three semicircles of diameter $2r$ cm, $3r$ cm and $4r$ cm. Find the ratio of the shaded part to that of the unshaded part.



Answer [3]

4. The sketch shows the graph $y = kx^n$. State a value for k and for n that would fit the graph.



Answer $k =$ [1]

$n =$ [1]

5. Express as a single fraction in its lowest form $\frac{4}{x-6} - \frac{3x}{(x-6)^2}$.

Answer [2]

6. Simplify $\frac{6x^2-10x}{5xy^6} \div \frac{6x^2-7x-5}{10x^2y}$.

Answer [3]

7. Newton's Law of universal gravitation states that the force, F newtons (N), between two particles is inversely proportional to the square of the distance, d metres, between them. When the distance between the two particles is x metres, the force is 52 N.

(a) Calculate the force when the distance between the two particles is doubled.

Answer N [2]

(b) Find, in terms of x , the distance between the two particles if the force is 208 N.

Answer m [2]

8. Mr Tan visited a car showroom one day and decided to buy a new car which was priced at \$145 000. He paid 40% as downpayment and took up a car loan for the remaining balance.

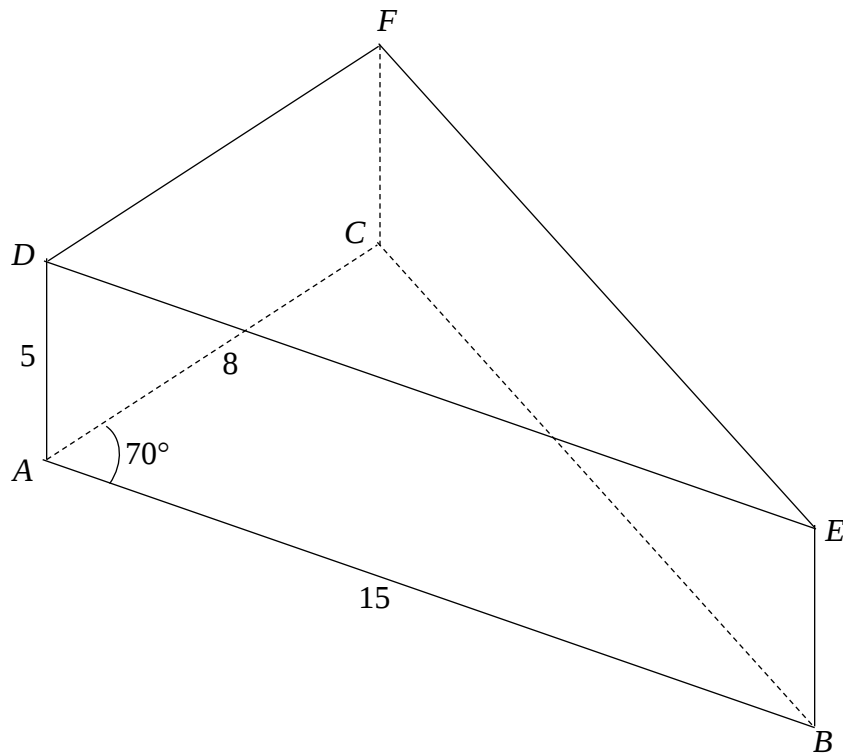
(a) Calculate the balance of his car loan.

Answer \$ [1]

- (b) Mr Tan opted for a 5-year loan and the bank charged a compound interest of r % per annum, compounded yearly. Find the interest rate per annum, r , incurred by Mr Tan if he had to pay a total amount of \$99 800 for the car loan.

Answer $r =$ [3]

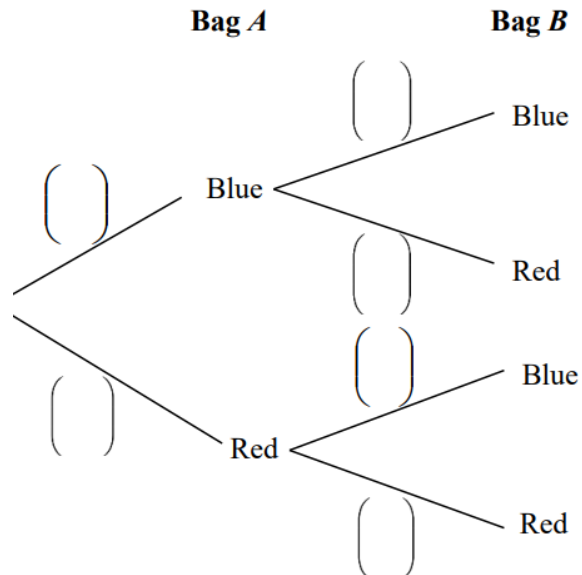
9. In the diagram, $ABCDEF$ shows a model of a room in the shape of a triangular prism. ABC is on flat ground and $ABED$, $BCFE$ and $ACFD$ are vertical walls. $AB = 15$ cm, $AC = 8$ cm, $AD = 5$ cm and angle $BAC = 70^\circ$.



X is a point on AB such that CX is perpendicular to AB .
Find the angle of elevation of D from X .

Answer $^\circ$ [3]

10. Bag A contains 4 blue and 8 red balls. Bag B contains 7 blue balls and 6 red balls. **A ball is chosen at random from bag A and placed in bag B.** A ball is then chosen at random from bag B. The Tree Diagram shows the possibilities for the colours of the balls chosen.



(a) Complete the tree diagram. [2]

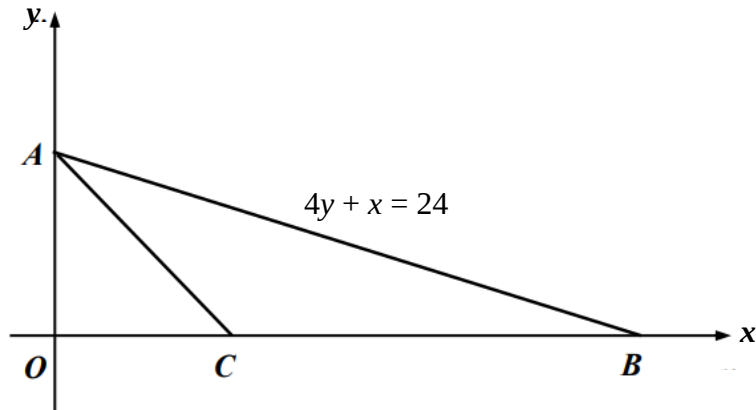
(b) Find the probability of choosing only one red ball.

Answer [1]

(c) Find the probability of choosing at least one blue ball.

Answer [1]

11. The diagram shows a sketch of a straight line AB with equation $4y + x = 24$ and a point C lying on the x -axis. The length of BC is 18 units.



Find

- (a) the length of AB ,

Answer units [2]

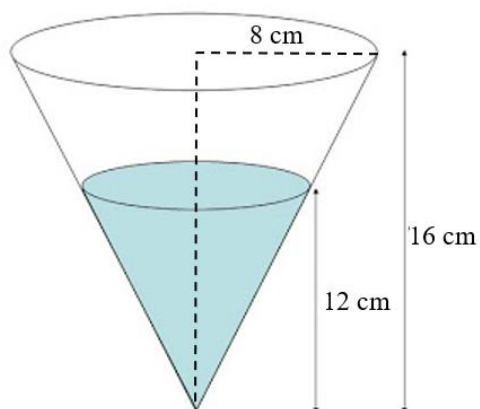
- (b) the equation of line AC ,

Answer [2]

(c) the shortest distance from C to the line AB .

Answer units [2]

12. Water is filled to a depth of 12 cm in the cone as shown in the diagram below. The cone has a radius of 8 cm and a height of 16 cm.



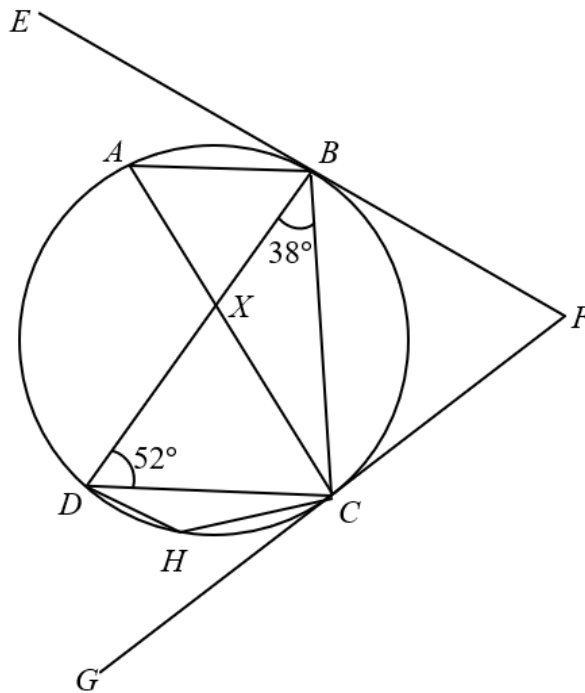
- (a) Find the volume of the water in the cone.

Answer cm^3 [2]

- (b) Calculate the surface area of the cone that is in contact with the water.

Answer cm^2 [2]

13. In the diagram, BXD and AXC are straight lines. A, B, C, D and H are points on the circumference of the circle. angle $BDC = 52^\circ$ and angle $DBC = 38^\circ$. EF and GF are tangents at B and C respectively.



- (a) Determine, with mathematical calculations, whether BD passes through the centre of the circle.

[2]

(b) Stating your reasons clearly, find

(i) angle CAB ,

Answer $^{\circ}$ [1]

(ii) angle BCF ,

Answer $^{\circ}$ [2]

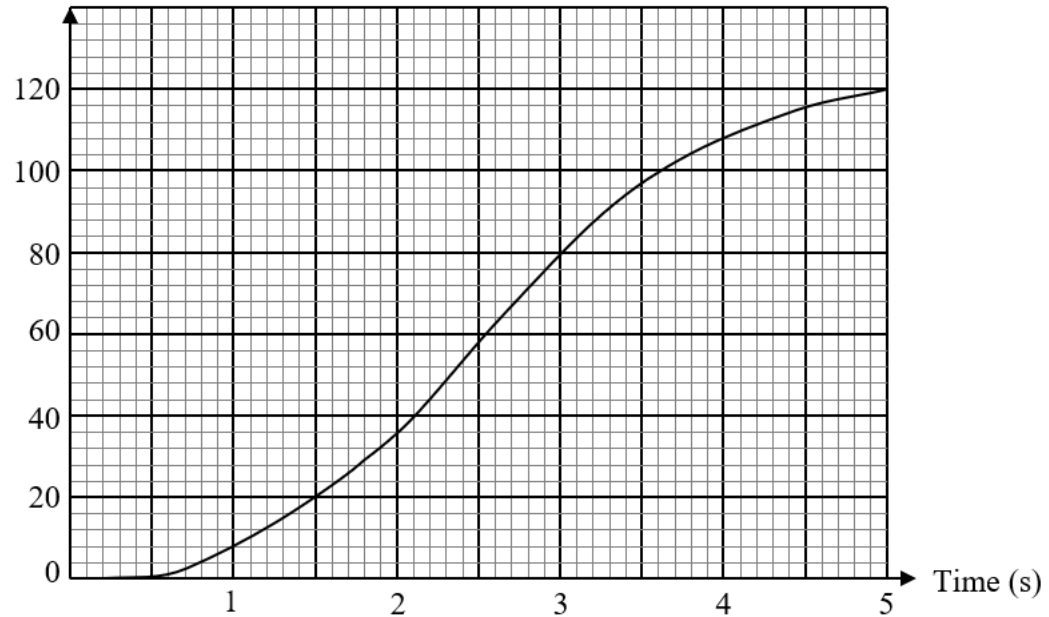
(iii) $\angle CHD$.

Answer $^{\circ}$ [1]

Section B (45 marks).

- 14 The cumulative frequency graph below shows the response time of 120 users when accessing mobile app ChessKing.

Cumulative Frequency



- (a) A user is selected at random, find the probability that the user experienced a response time of less than 2 s.

Answer [1]

- (b) Find the interquartile range of the response time of ChessKing.

Answer [2]

- (c) Below is the frequency table of the response time of ChessKing.

Response-time (t seconds)	$0 < t \leq 1$	$1 < t \leq 2$	$2 < t \leq 3$	$3 < t \leq 4$	$4 < t \leq 5$
Number of users	8	28	44	28	12

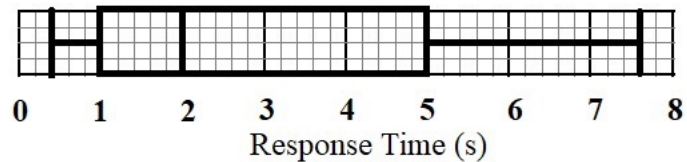
- (i) Estimate the mean response time.

Answer [1]

- (ii) Estimate the standard deviation of the response time.

Answer s [2]

- (d) The box-and-whisker diagram below represents the response time when accessing another mobile app ChessQueen.

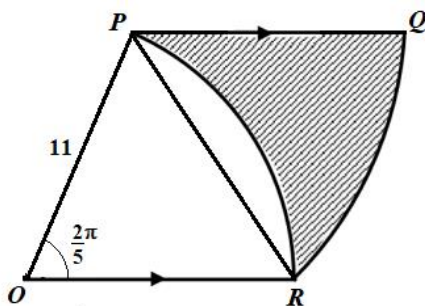


John says, “ChessQueen app provides a more consistent response time compared to ChessKing.”

Do you agree? Justify your answer.

[2]

- 15 In the diagram, OPR is a sector with centre O , $OP = 11$ cm and $\angle POR = \frac{2}{5}\pi$.
 QR is an arc of a circle with centre P . PQ is parallel to OR .



- (a) Find the length of PR .

Answer cm [2]

- (b) Find the area of the shaded region.

Answer cm² [4]

16 (a) The coordinates of P and Q are $(5, 8)$ and $(13, 14)$ respectively.

(i) Write down the column vector $\overrightarrow{PQ}$.

Answer [2]

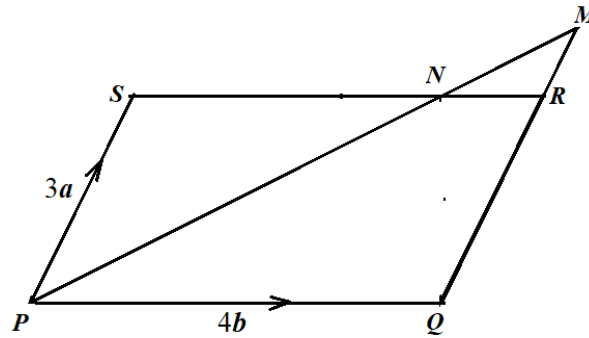
(ii) Find $|\overrightarrow{PQ}|$.

Answer [1]

(iii) Given that $\overrightarrow{RS}$ is 5 units in length, parallel but in opposite direction to $\overrightarrow{PQ}$, find $\overrightarrow{RS}$.

Answer [2]

(b)



$PQRS$ is a parallelogram.

N is a point on SR such that $SN:NR = 3:1$.

$\overrightarrow{PS} = 3a$ and $\overrightarrow{PQ} = 4b$.

- (i) Express $\overrightarrow{PN}$ as simply as possible, in terms of a and b .

Answer [1]

- (ii) M is a point on PN such that $4\overrightarrow{PM} = 3\overrightarrow{PN}$.
Find $\overrightarrow{RM}$.
Hence, make two comments about the points Q , R and M .

[3]

- 17 A florist sells only 2 types of bouquets : *A* and *B*.
 Each bouquet contains 4 kinds of flowers.
 The matrix ***P*** below shows the number of stalks of each kind of flower used in each bouquet.

	Rose	Lily	Daisy	Tulip	
Matrix <i>P</i> =	10	8	2	12	<i>Bouquet A</i>
	12	7	5	10	<i>Bouquet B</i>

- (a) On any normal week, 15 *Bouquet A* and 20 *Bouquet B* are sold.
 Representing this in a 1x2 matrix ***Q***, evaluate ***T = QP***.

Answer ***T*** = [2]

- (b) State what matrix ***T*** represents.

[1]

- (c) During the Christmas Week, the demand for all types of flowers is expected to be k times the demand on a normal week
- (i) By using multiplication of matrix by a scalar, express in terms of k , the matrix M , which represents the total number of stalks for each type of flower sold during Christmas Week.

Answer $M =$ [1]

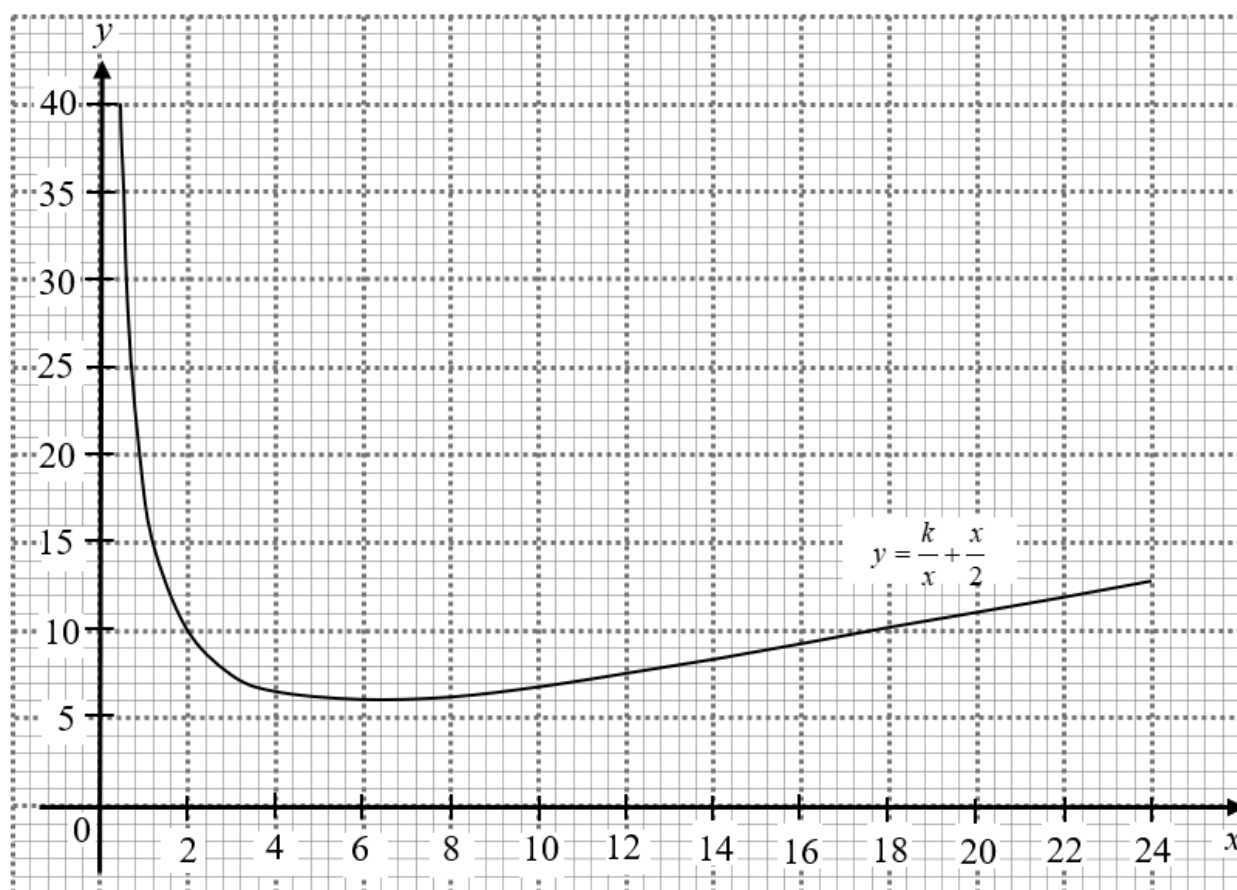
- (ii) The selling price of each stalk of the different type of flowers is shown below.

	Rose	Lily	Daisy	Tulip
Selling Price per stalk (\$)	6	5	4	10

Find by matrix multiplication, the value of k , given that the total amount from the sales of all the flowers during the Christmas Week is \$47760.

Answer $k =$ [3]

- 18 The graph below represents $y = \frac{k}{x} + \frac{x}{2}$.



- (a) Given that the coordinates of the lowest point on the graph is (6, 6), show that $k = 18$.

[1]

- (b) By drawing a tangent to the curve, find the gradient of the graph when $x = 4$.

Answer [2]

- (c) By drawing a suitable straight line on the same axes, solve

$$\frac{18}{x} + \frac{3x}{2} = 15.$$

Answer $x =$ or [4]

- 19 Decor is a company that imports carpet grass in rolls, as shown in Figure 1. It also provides a service to cut the carpet grass according to the design specified by its customers.

In an interior design project, a customer requires Decor to provide wavy carpet grass that has the outline of 8 sectors placed side by side (Figure 3). Each sector has a radius of 2 m and a subtended angle of 30° as shown in Figure 2. The wavy design is to be cut out from an imported roll of carpet grass with fixed width of 2.2 m as shown in Figure 3.



Figure 1

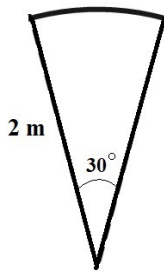


Figure 2.

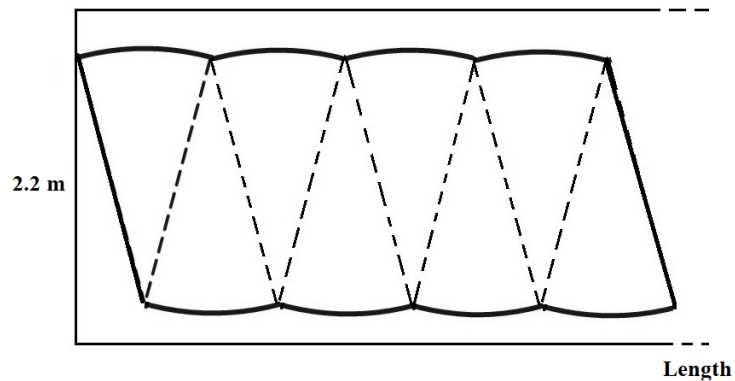


Figure 3.

- (a) Determine, with clear justification, the length of carpet grass needed to make the wavy design (Figure 3).

[4]

- (b) Decor sells the carpet grass according to the customer's required length and in multiples of 10 cm. It is priced at \$20 per metre. To cut the carpet grass to the specified design, there is an additional service charge of \$6 per metre.

Calculate the total amount Decor will charge its customer for the wavy design.

[4]

Answer \$

End of Paper

Answers

1	(a) $\subset$ (b) $\emptyset$	2	15
3	5 : 11	4	$k = -2, \quad n = -2$
5	$\frac{x-24}{(x-6)^2}$	6	$\frac{4x^2}{y^5(2x+1)}$
7	(a) 13 (b) $\frac{1}{2}x$	8	(a) \$87000 (b) 2.78
9	61.3°	10	(b) $\frac{10}{21}$ (c) $\frac{2}{3}$
11	(a) 24.7 (b) $y = -x + 6$ (c) 4.37	12	(a) 452 cm^3 (b) 253 cm^2
13	(a) BD passes through the centre of the circle. (b) (i) 52° (ii) 52° (iii) 142°	14	(a) $\frac{3}{10}$ (b) 1.4s (c) (i) $2\frac{17}{30}s$ (ii) 1.06s (d) $IQR \text{ for ChessQueen} = 5 - 1 = 4s$. <i>No, ChessQueen has less consistent response time.</i>
15	(a) 12.9 cm (b) 60.3 cm^2	16	(a) (i) $\begin{pmatrix} 8 \\ 6 \end{pmatrix}$ (ii) 10 (iii) $-\begin{pmatrix} 4 \\ 3 \end{pmatrix}$ (b) (i) $3a + 3b$ (ii) $\overrightarrow{QR} = 3\overrightarrow{RM}$ Q, R and M are collinear.
17	(a) (390 260 130 380) (b) T represents the quantities of each kind of flowers sold per week. (c) (i) $M = k(390 \ 260 \ 130 \ 380)$ (ii) $k = 6$	18	(b) -0.61 (c) 1.4 or 8.6

19	(a) 4.66 m (b) \$ 168.27		
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NAME	FORM CLASS	ACAD CLASS	INDEX NO.



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2025

SUBJECT : Mathematics **DATE : 14 August 2025**
(4052/01)

LEVEL : Secondary 4Exp/5NA **DURATION : 2 hours 15 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Form Class, Acad Class and Index No. in the spaces at the top of the page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 3.142, unless the equation 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 of the marks for this paper is 90.

For Examiner's Use			
Type of Penalties		Question Number	
Presentation	−1		
	−2		
			90

This paper consists of 21 printed pages including this cover page.

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 Rearrange the numbers in descending order.

$$\frac{43}{28} \quad \sqrt[3]{4.4} \quad 3.4^{\frac{2}{5}} \quad 1.63$$

Answer , , , [2]

- 2 A number has exactly 12 factors. Three of its factors are 10, 12, and 15.
List all the factors of this number.

Answer [2]

- 3 George can paint 18 rooms in 6 days. Liam can paint 10 rooms in 5 days. If they continue to paint at the same rate, how long will it take them to paint 28 rooms together?

Answer days [3]

- 4 The number of reported influenza cases in a town increased from 5000 in 31st January 2020 to 12000 in 31st July 2020.

If the number of cases increased by $r\%$ each month, find the value of r .

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

- 5 P is directly proportional to Q^3 .

(a) When $Q = \frac{1}{6}$, $P = \frac{1}{4}$.

Find P when $Q = \frac{1}{3}$.

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

- (b) A change in Q produces a change in P .

When the value of Q is multiplied by $\frac{1}{4}$, the value of P changes by a factor of m .

Find m .

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

6 Solve the inequalities $-8 \leq \frac{1}{5}x - 3 < 2$.

Answer [3]

7 The High Speed Rail travels at 217 miles per hour (mph).

(a) Given that 1 mile = 1 609 m, convert 217 mph to m/s.

Answer m/s [2]

(b) The speed of light is 3×10^8 m/s. Find how many times is the speed of light compared to the speed of High Speed Rail, leaving your answer in standard form.

Answer times [2]

8 $2^{4m} = 2^{54} + 2^{54} + 2^{54} + 2^{54}$

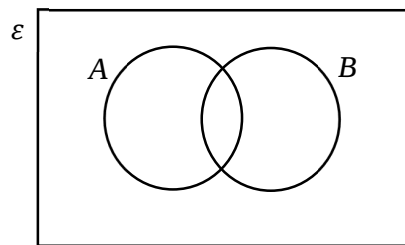
Find the value of m .

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

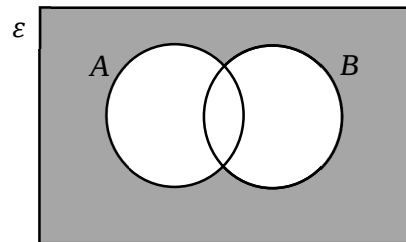
9 (a) On the Venn diagram, shade the region that represents $A \cap B'$.

Answer

[1]



(b) Write down the set represented by the shaded region.



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

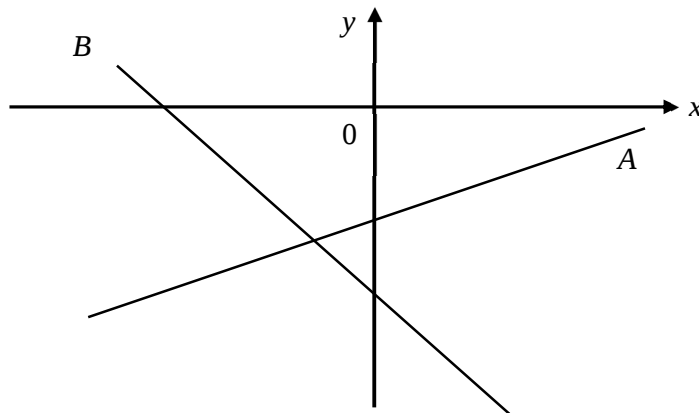
10 (a) Line P has an equation $4y - 3x = 12$.

Line Q passes through the point $(-14, 0)$ and has the same gradient as line P .

Find the equation of line Q .

Answer [2]

(b)



The equation of the line A is $y = x - 1$.

Peter says that the equation for the line B is $2y + 4x + 1 = 0$.

Is he correct? Explain your answer.

Answer

 [2]

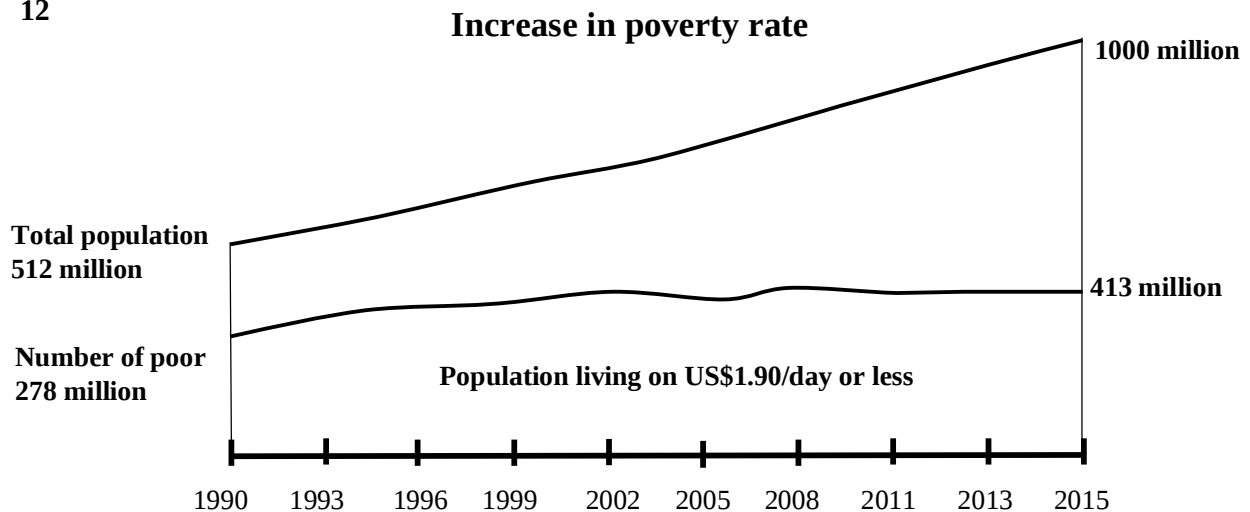
11 (a) Factorise completely $p^2 + 5p + 6$.

Answer [1]

(b) Hence, factorise completely $(y+1)^2 + 5(y+1) + 6$.

Answer [2]

12



Poverty Rate is calculated as $\frac{\text{Number of Poor}}{\text{Total Population}}$.

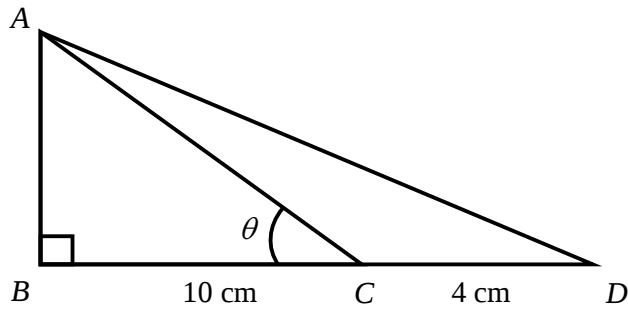
Explain how the chart above may be misleading.

Justify your answer with calculation.

Answer

 [2]

- 13 In the diagram, not drawn to scale, BCD is a straight line. Given that $BC = 10$ cm, $CD = 4$ cm, and $\cos \theta = \frac{4}{5}$.



Find

- (a) the length of AC ,

Answer cm [1]

- (b) the value of $\sin \angle ACD$, giving your answer as a fraction in its simplest form,

Answer [2]

- (c) the length of AD ,

Answer cm [1]

- (d) the area of triangle ACD ,

Answer cm^2 [1]

(e) the shortest distance of C to AD .

Answer cm [2]

14 Solve the pair of simultaneous equations.

$$5x + 4y = 40$$

$$3x - y = 7$$

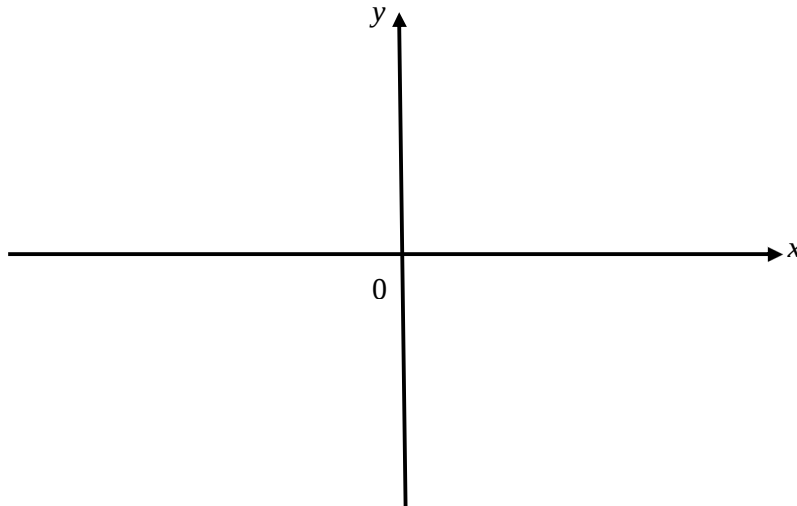
Answer $x = \dots\dots\dots$ $y = \dots\dots\dots$ [3]

15 (a) Express $-x^2 + 4x - 5$ in the form of $-(x+h)^2 + k$.

Answer [2]

(b) Hence, sketch the graph of $y = -x^2 + 4x - 5$ on the axes below. Indicate clearly the turning point, the values where the graph crosses the x and y axes (if any).

Answer [2]

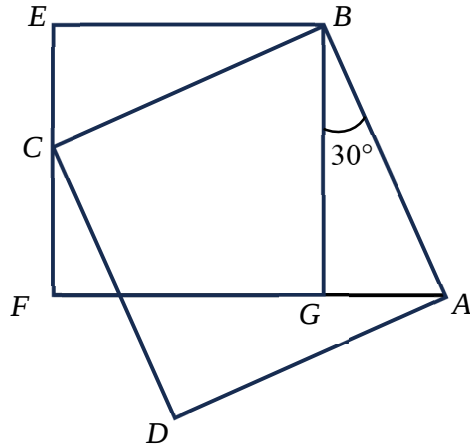


(c) Explain why the equation $-x^2 + 4x - 5 = -1$ has only one solution.

Answer

 [1]

- 16 In the diagram below, $ABCD$ is a square, $BEFG$ is a rectangle and angle ABG is 30° .



- (a) Show that triangle ABG is congruent to triangle CBE .

Answer

.....

.....

.....

.....

.....

..... [3]

- (b) Russell commented that $BEFG$ is a square. Do you agree with him? Give your reasons.

Answer

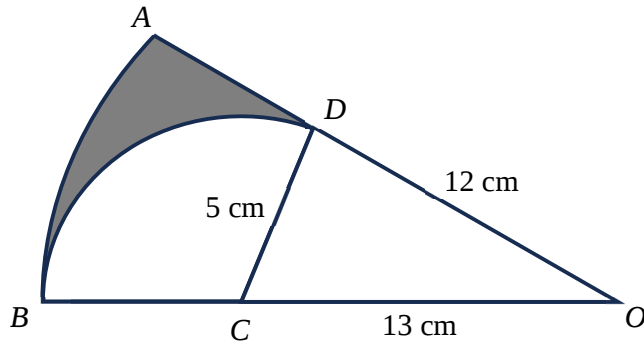
.....

.....

..... [1]

17 The figure shows a sector OAB with centre O , and an arc BD of another circle with centre C .

It is given that $OC = 13$ cm, $OD = 12$ cm and $CD = 5$ cm.



(a) Prove that triangle ODC is a right-angled triangle.

Answer

 [2]

(b) Find

(i) angle AOB , in radian,

Answer radian [1]

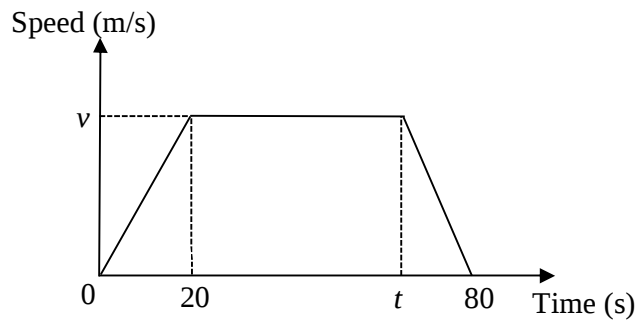
(ii) the perimeter of the shaded region,

Answer cm [3]

(iii) the area of the shaded region.

Answer cm^2 [3]

18 The diagram below shows the speed-time graph of a bus journey.



The bus accelerated at 1.5 m/s^2 for the first 20 seconds.

(a) Find the value of v .

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

It then travelled at a constant speed until t seconds before it came to a stop at $t = 80$ seconds.

The total distance travelled for the whole journey was 2 km.

(b) Find the value of t .

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

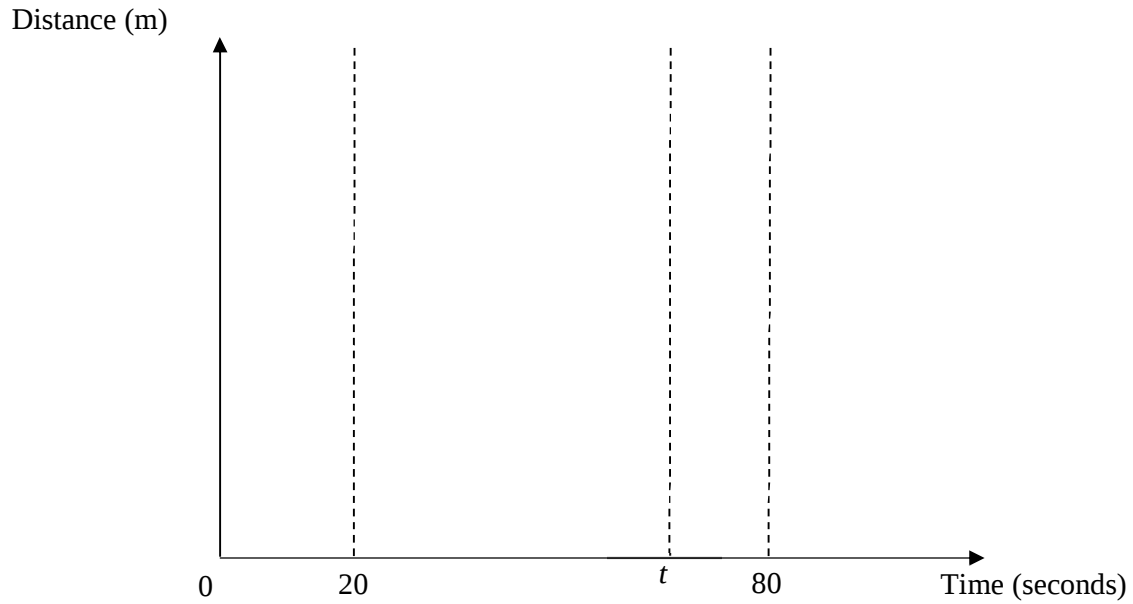
(c) Calculate the average speed, in km/h, of the bus for the whole journey.

Answer $\dots\dots\dots$ km/h [2]

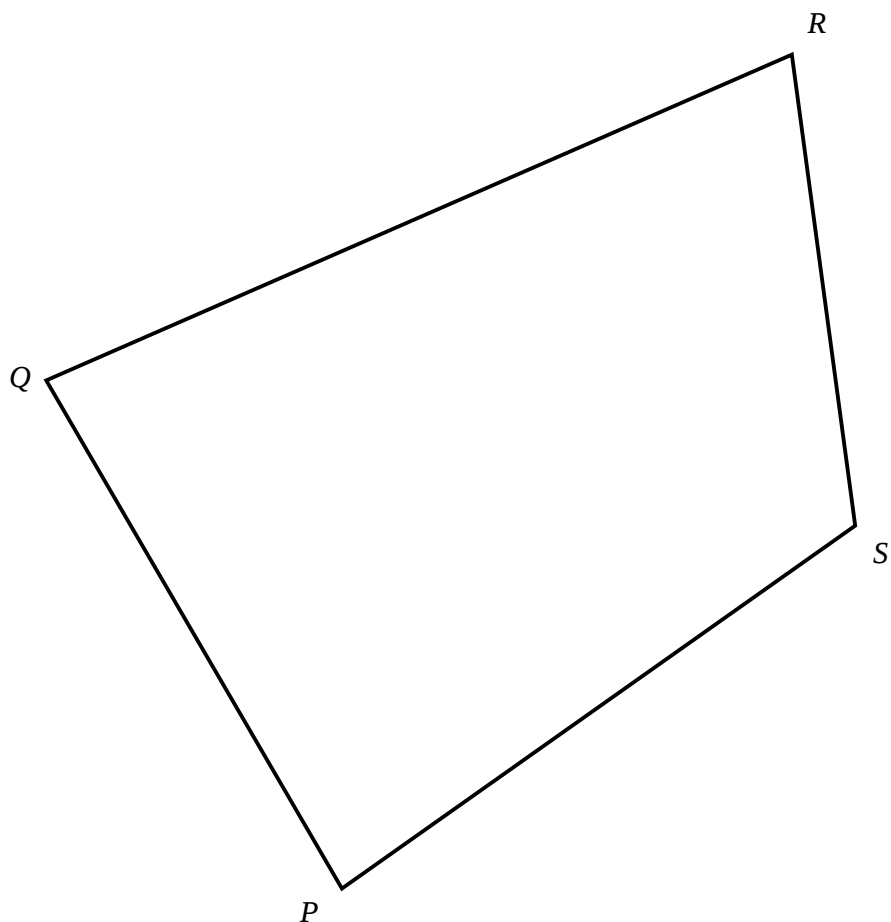
- (d) On the axes below, draw the distance-time graph of the bus journey, marking and stating the distance travelled for each time duration clearly on the vertical axis.

Answer

[3]



19 The diagram shows a park, $PQRS$.



(a) Construct the bisector of angle PSR . [1]

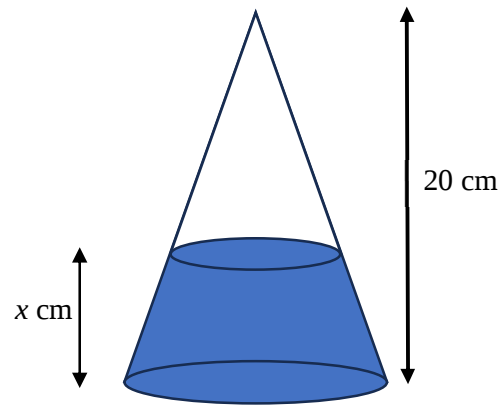
(b) Construct the perpendicular bisector of QR . [1]

(c) A pavilion X is to build in the park, equidistant from Q and R **and** equidistant from RS and PS .

Mark the pavilion X on your diagram and measure the length of QX .

Answer $QX = \dots\dots\dots$ cm [1]

20 The diagram shows a cone of height 20 cm.



The volume of the liquid in the cone is half the volume of the cone.
Calculate the depth, x cm, of the liquid.

Answer cm [3]

21 (a) These are the first four terms in the sequence.

13, 17, 21, 25

(i) Find an expression, in terms of n , for the n th term of the sequence.

Answer [2]

(ii) Explain why the terms in this sequence are always odd.

Answer

 [1]

(b) The sum of the first n terms of another sequence is given by $2n^2 + 5n$.

Find the 12th term in this sequence.

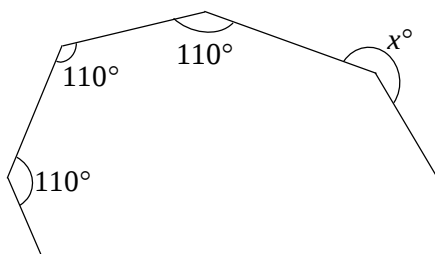
Answer [2]

- 22 (a) In a regular polygon, the ratio interior angle : exterior angle = 5 : 1

Calculate the number of sides of the polygon.

Answer sides [2]

- (b) The diagram shows part of a heptagon (7-sided polygon). Three interior angles are each 110° . The remaining interior angles are equal. Find the value of x .



Answer $x =$ [3]

- 23** A ball is dropped at random into one of these six holes, numbered as shown in the diagram. The number under each hole gives the score obtained when the ball drops into that hole.

					
2	3	1	2	1	1

- (a)** State the probability of scoring 2.

Answer [1]

- (b)** If the same ball is dropped for a second time, find the probability of scoring

- (i)** a total of 6,

Answer [2]

- (ii)** a total of 4.

Answer [2]

End of Paper

Answer Key

1	$\sqrt[3]{4.4}$, $3.4^{\frac{2}{5}}$, 1.63 , $\frac{43}{28}$	2	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
3	5.6 days	4	15.7
5a	2	5b	$\frac{1}{64}$
6	$-25 \leq x < 25$		
7a	97.0	7b	3.09×10^6
8	14		
9a	-	9b	$(A \cup B)'$
10a	$y = \frac{3}{4}x + \frac{21}{2}$	10b	incorrect
11a	$(p+2)(p+3)$	11b	$(y+3)(y+4)$
12	-		
13a	$\frac{25}{2}$	13b	$\frac{3}{5}$
13c	15.9	13d	15
13e	1.89		
14	$x = 4, y = 5$		
15a	$-(x-2)^2 - 1$	15b	-
15c	-		
16a	AAS congruency test	16b	Agree
17a	-	17bi	0.395
17bii	22.9	17biii	9.39
18a	30	18b	$73\frac{1}{3}$
18c	90	18d	-
19	-		
20	4.13		
21ai	$4n + 9$	21aii	-
21b	51		
22a	12 sides	22b	217.5
23a	$\frac{1}{3}$	23bi	$\frac{1}{36}$
23bii	$\frac{5}{18}$		

NAME	FORM CLASS	ACAD CLASS	INDEX NO.



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2025

SUBJECT : Mathematics
(4052/02)

DATE : 19 August 2025

LEVEL : Secondary 4EXP/5NA

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Form Class, Acad Class and Index No. in the spaces at the top of the page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 3.142, unless the equation 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 of the marks for this paper is 90.

For Examiner's Use			
Type of Penalties		Question Number	
Presentation	−1		
	−2		
			90

This paper consists of 22 printed pages and 1 blank page.

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)** Solve $\frac{3(7-a)}{4} = 2a + 1$.

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

(b) It is given that $y = \sqrt{m - 3x^3}$.

(i) Find the value of y when $m = 105$ and $x = 2$.

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

(ii) Express x in terms of y and m .

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

(c) Simplify $\frac{1}{x-3} + \frac{10}{10x - x^2 - 21}$.

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

2 Machine A can pack 60 packs of chips in x minutes.

Machine B can pack 135 packs of chips in $(2x-1)$ minutes.

The two machines together can pack 27 packs of chips in 1 minute.

(a) Express in term of x , the number of packs of chips packed by

(i) Machine A in 1 minute,

Answer [1]

(ii) Machine B in 1 minute.

Answer [1]

(b) Form an equation in x and show that it reduces to $9x^2 - 47x + 10 = 0$.

Answer

[3]

- (c) Solve the equation $9x^2 - 47x + 10 = 0$.

Answer $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

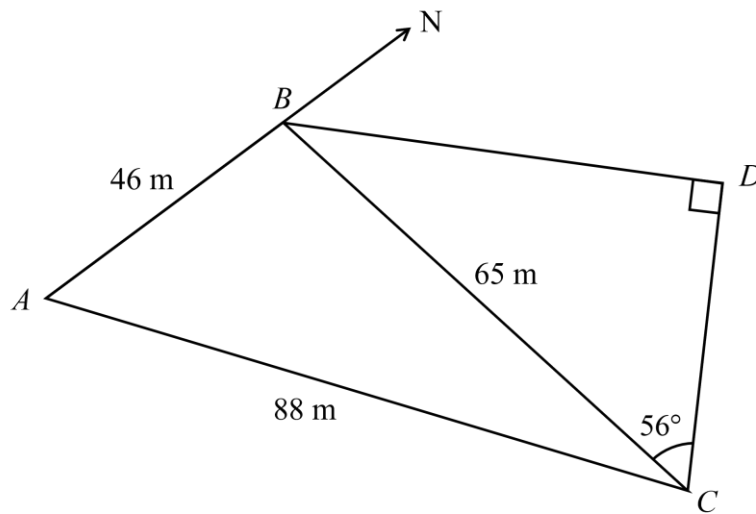
- (d) Explain why one of the solutions in **part (c)** must be rejected.

Answer

$\dots\dots\dots$ [1]

- 3 The diagram shows two triangular fields ABC and BCD .

$AB = 46$ m, $AC = 88$ m, $BC = 65$ m, angle $BCD = 56^\circ$ and angle $BCD = 90^\circ$.



- (a) Find

(i) angle BCA ,

Answer angle BCA $^\circ$ [3]

(ii) angle BAC ,

Answer angle BAC $^\circ$ [2]

- (b)** B is due north of A .

Calculate the bearing of A from C .

Answer $^{\circ}$ [1]

- (c)** A tree is planted at point D and a watering system, S , is installed along BC where it is the shortest distance to the tree at D .

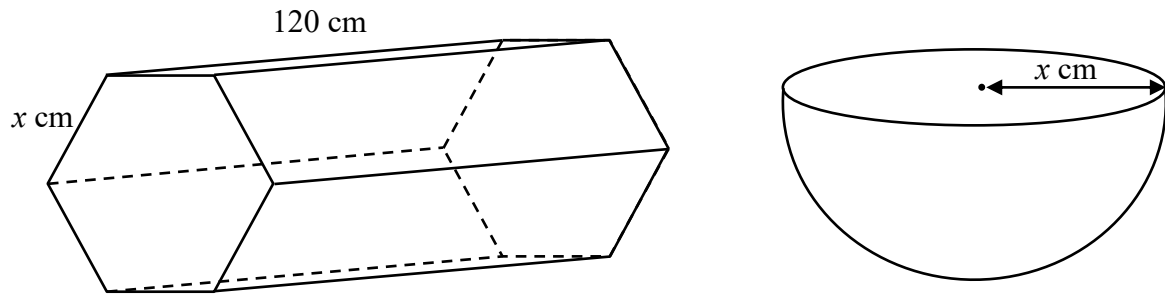
Calculate the shortest distance of S from D .

Answerm [2]

- (d)** The angle of elevation of the top of the tree from the watering system is 7° .
Assuming the height of the watering system is negligible, find the height of the tree.

Answerm [2]

4

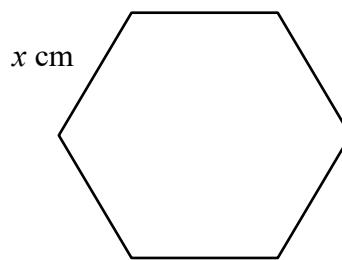


The diagram shows a solid hexagonal prism and a solid hemisphere.

The solid hemisphere has a radius of $x \text{ cm}$ and the solid hexagonal prism has a regular hexagonal cross-section with sides $x \text{ cm}$ and length 120 cm .

- (a) The cross section of the solid hexagonal prism is shown below.

Show that the area of the cross-section is $2.598x^2 \text{ cm}^2$.



Answer

[2]

- (b) Given that the volume of the solid hexagonal prism is 5000 cm^3 , find the value of x .

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

- (c) **Hence**, find the total surface area of the solid hemisphere.

Answer $\dots\dots\dots \text{cm}^2$ [2]

- 5 The variables x and y are connected by the equation

$$y = -\frac{x^3}{2} + 4x + 1.$$

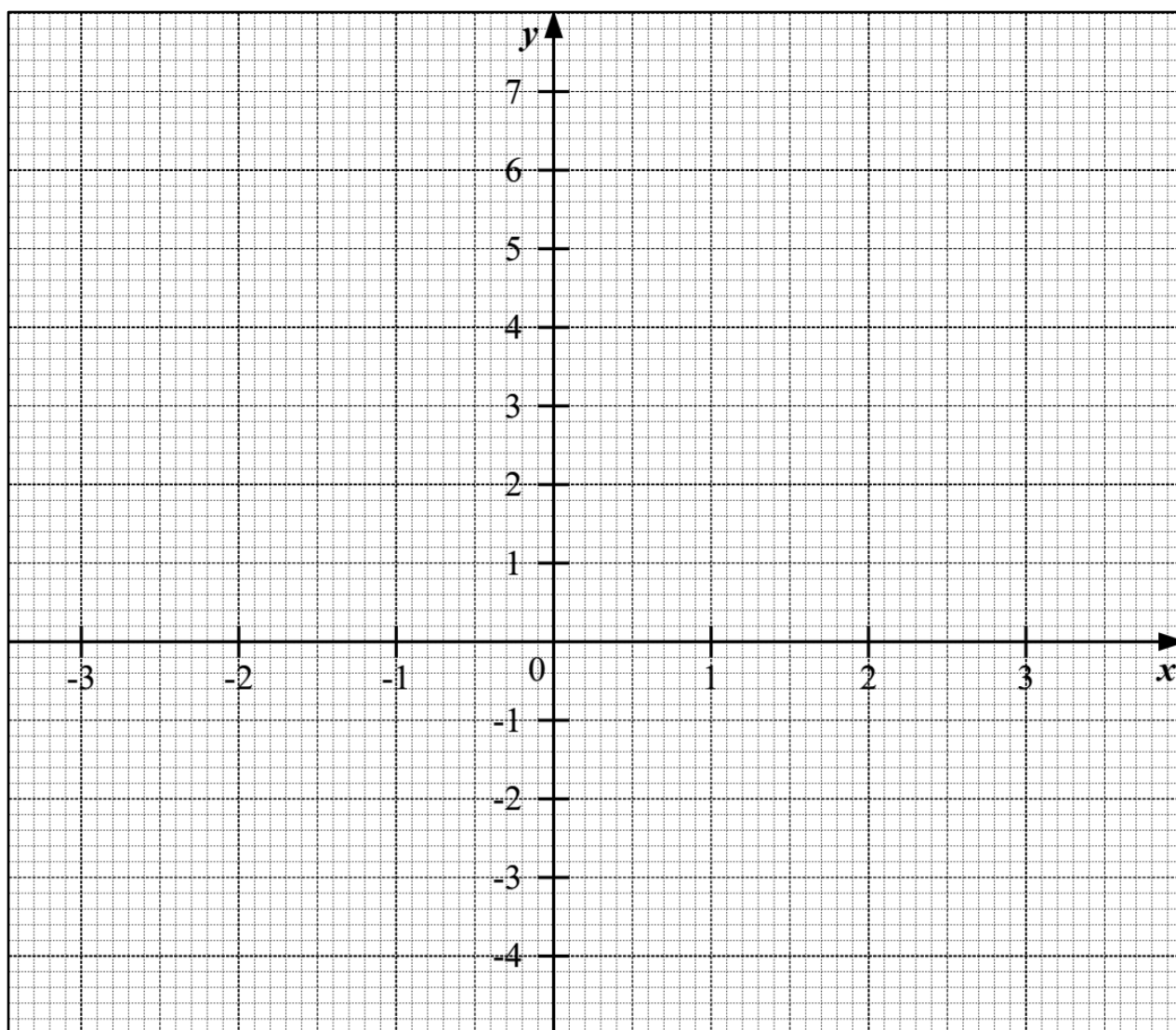
Some corresponding values of x and y are given in the table below.

x	-3	-2	-1.5	-1	0	0.5	1	2	3
y	p	-3	-3.3	-2.5	1	2.9	4.5	5	-0.5

- (a) Find the value of p .

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

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



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

Answer [2]

- (d) (i) On the same grid, draw the line $y = x + 2$ for $-3 \leq x \leq 3$. [1]

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

Answer $x =$ and and [2]

- (iii) These values of x are solutions of the equation $Ax^3 + Bx + C = 0$, where A , B , and C are integers. Find the values of A , B and C .

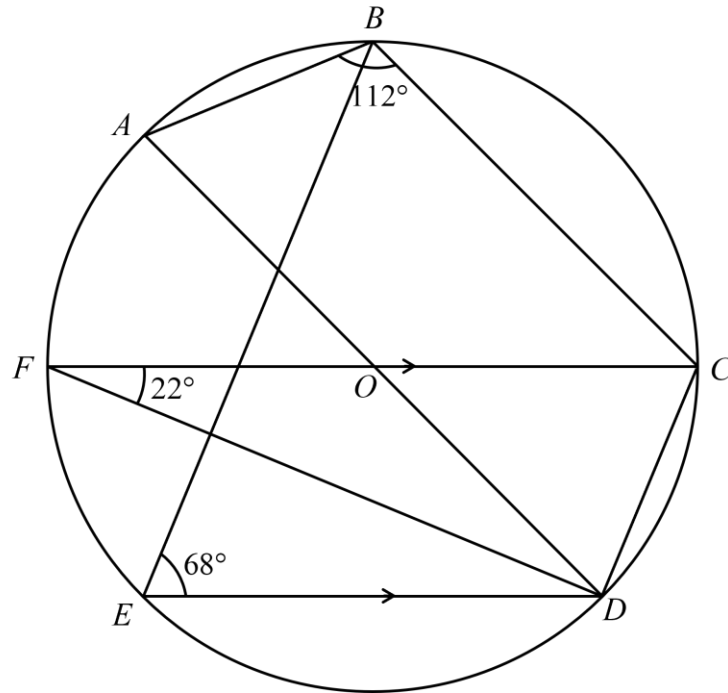
Answer $A =$

$B =$

$C =$ [2]

- 6 In the diagram, $ABCDEF$ is a circle with centre O .
 AD and FC are diameters and FC is parallel to ED .

Angle $ABC = 112^\circ$, angle $OFD = 22^\circ$ and angle $BED = 68^\circ$.



- (a) Stating your reasons clearly, find
 (i) angle COD ,

Answer angle $COD = \dots\dots\dots^\circ$ [1]

- (ii) angle BAD ,

Answer angle $BAD = \dots\dots\dots^\circ$ [1]

(iii) angle CBE ,

Answer angle $CBE = \dots\dots\dots^\circ$ [2]

(iv) angle FBD .

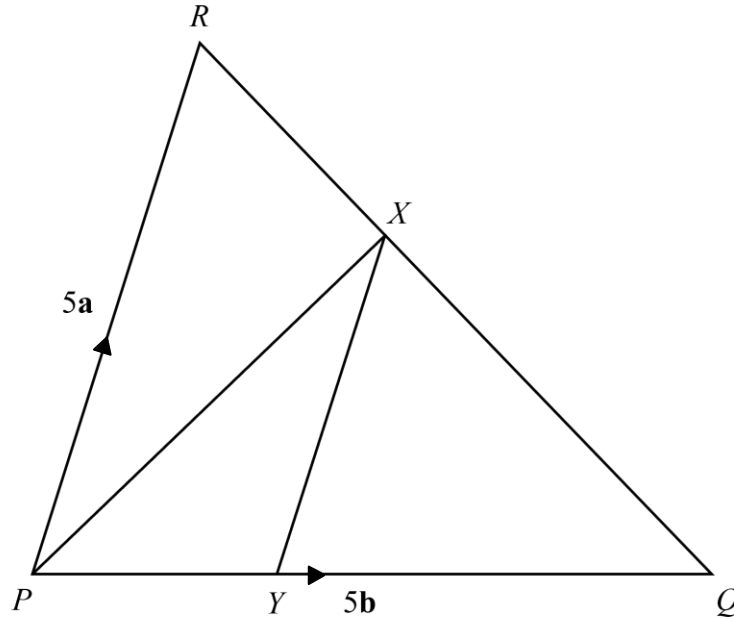
Answer angle $FBD = \dots\dots\dots^\circ$ [2]

(b) Write the relationship between lines BC and AD , stating your reasons clearly.

Answer

.....
 [2]

- 7 In the diagram, PR , PQ and RQ are straight lines. $\overrightarrow{PR} = 5\mathbf{a}$ and $\overrightarrow{PQ} = 5\mathbf{b}$.
 Y is a point on line PQ such that $PY : YQ = 2 : 3$ and line PR is parallel to XY .



- (a) State a pair of similar triangles.

Answer

Triangle is similar to triangle [1]

- (b) Express in terms of $\mathbf{a}$ and $\mathbf{b}$,

- (i) $\overrightarrow{YX}$,

Answer [1]

- (ii) $\overrightarrow{PX}$,

Answer[2]

(c) S is the midpoint of PX .

(i) Find $\overrightarrow{RS}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer[2]

(ii) Determine with clear working, if R , S and Y lie on a straight line.

Answer

.....

[3]

(c) Find the ratio of

(i) area of triangle PQR : area of triangle YQX .

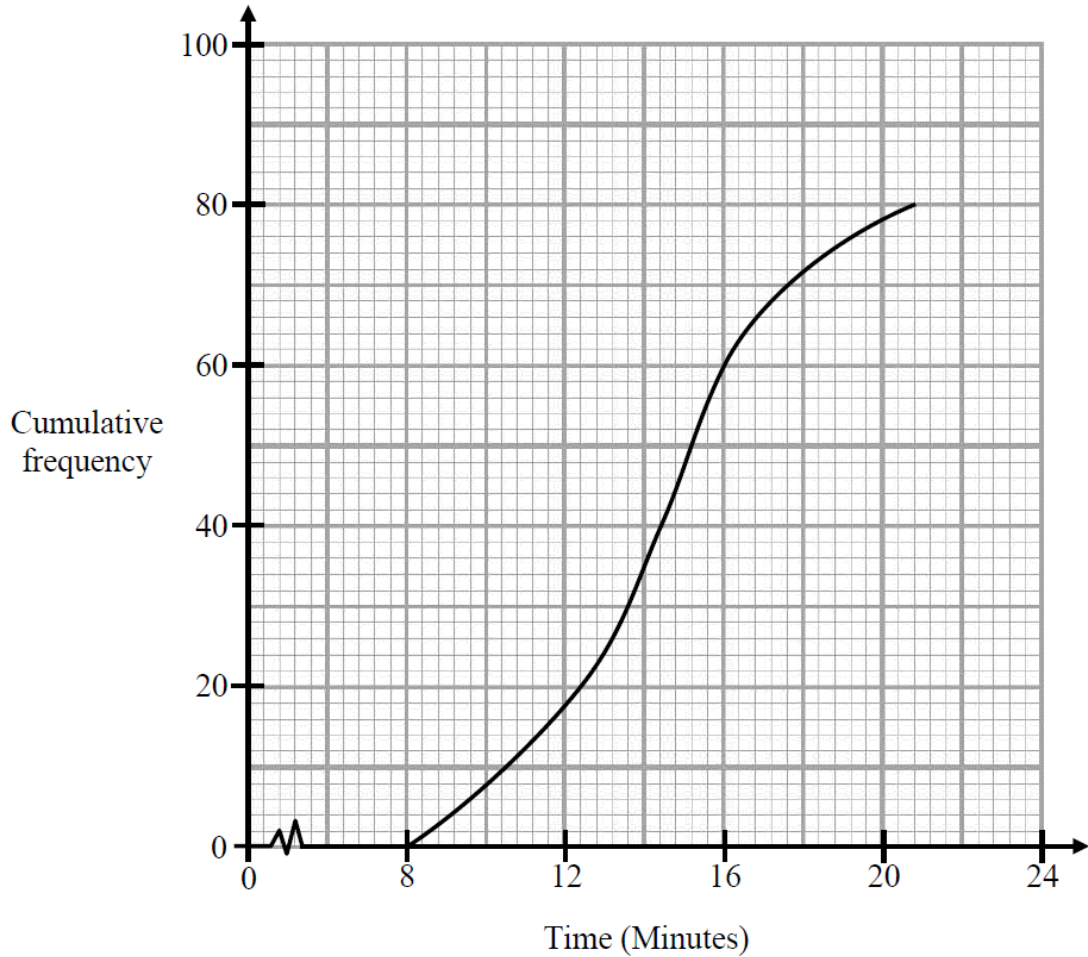
Answer :[1]

(ii) area of triangle PQR : area of triangle PYX .

Answer :[2]

- 8 A group of 80 students participated in a 3 km race.

The cumulative frequency curve below shows the distribution of their times (in minutes) taken to complete the 3 km race.



- (a) Use the curve to estimate the
(i) median,

Answer minutes [1]

- (ii) interquartile range.

Answer minutes [2]

- (b) Find the probability that a randomly chosen student completed the 3 km race in less than 15 minutes.

Answer[2]

- (c) It is announced that 30% of students did not receive a medal as they did not meet the qualifying time.

Find the qualifying time for them to receive a medal.

Answerminutes [2]

- 9 Three football teams, MenUnited, ShellC and Liverpond is participating in a football Competition with other football teams.

The table below shows the current number of matches won, drawn and lost for each team.

Football Team	Won	Drawn	Lost
MenUnited	18	6	13
ShellC	18	9	12
Liverpond	24	10	4

- (a) Write a 3×3 Matrix **A** such that it represents the number of matches each team won, drawn and lost respectively.

Answer **A** =[1]

- (b) The points awarded for matches won, drawn and lost are 3 points, 1 point and 0 points respectively. Form a 3×1 matrix **B** to represent this information.

Answer **B** =[1]

- (c) (i) Evaluate **AB**.

Answer **AB** =[2]

- (ii) Explain what matrix $\mathbf{AB}$ represents.

Answer
[1]

- (d) By using **two** matrix multiplications, find the total number of matches played from this table.

Answer[3]

- 10 Before June 2016, United Kingdom (UK) was part of the European Union. In June 2016, there was a national poll conducted in the United Kingdom to decide whether the country would 'Leave' the European Union or 'Remain' within. The results below show the polling results of 'Leave' or 'Remain', from each of the four countries that made up United Kingdom: England, Northern Ireland, Scotland and Wales.

England	15.2 million votes	13.3 million votes	<u>Total Voted</u>
	Leave (%)	Remain (%)	28.5 million
	53.4%	46.6%	Turnout: 73.0%
Northern Ireland	x million votes	0.44 million votes	<u>Total Voted</u>
	Leave (%)	Remain (%)	$(x + 0.44)$ million
	44.2%	55.8%	Turnout: 62.7%
Scotland	1.02 million votes	1.66 million votes	<u>Total Voted</u>
	Leave (%)	Remain (%)	2.68 million
	38.1%	y %	Turnout: 67.2%
Wales	0.85 million votes	0.77 million votes	<u>Total Voted</u>
	Leave (%)	Remain (%)	1.62 million
	52.5%	47.5%	Turnout: 71.7%

Table 1: Polling results from England, Northern Ireland, Scotland and Wales

- (a) The number of votes for Northern Ireland that voted 'Leave' is x .
Find the value of x .

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

- (b) The percentage of people that voted 'Remain' in Scotland is $y\%$.
Find the value of y .

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

- (c) Given that the final percentage of the national poll was computed across the four countries, find the overall percentage that chose to 'Remain' in the European Union, and hence determine the final decision for United Kingdom to 'Leave' or 'Remain' as part of the European Union.

Answer $\dots\dots\dots\%$

Decision: $\dots\dots\dots$ [4]

- (d) The ‘turnout’ is the percentage of eligible voters who casted a vote during the poll. Find the total number of eligible voters in England.

Answer[1]

- (e) Many UK citizens commented:

“If England’s turnout was higher, the number of votes to ‘Remain’ in the European Union might exceed the number of votes to ‘Leave’, when computing the National Poll for United Kingdom.”

Assuming a 75% turnout with the same percentage of 53.4% to ‘Leave’ in England, justify if the above comment is correct and show your calculations clearly.

.....
 [4]

End of Paper

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Answer Key

1a	$a = \frac{17}{11} \text{ or } 1\frac{6}{11}$	1bi	9
1bii	$x = \sqrt[3]{\frac{m-y^2}{3}}$	1c	$\frac{-x+17}{(-x+7)(x-3)} \quad \text{OR} \quad = \frac{x-17}{(x-7)(x-3)}$
2ai	$\frac{60}{x}$	2aii	$\frac{135}{2x-1}$
2b	-	2c	$\frac{2}{9} \text{ or } 5$
2d	-		
3ai	30.5°	3aii	45.9°
3b	225.9°	3c	30.1 m
3d	3.70 m		
4a	-	4b	4.00
4c	151 cm ²		
5a	2.5	5b	-
5c	-2	5di	-
5dii	$x = -2.6 \text{ and } x = 0.35 \text{ and } x = 2.25$	5diii	$A = -1, B = 6 \text{ and } C = -2$
6ai	44°	6aii	68°
6aiii	68°	6aiv	68°
6b	-		
7a	triangle <i>PQR</i> is similar to triangle <i>YQX</i>	7bi	$3a$
7bii	$2b + 3a$	7ci	$b - \frac{7}{2}a$
7cii	-	7di	25 : 9
7dii	25 : 6		
8ai	14.4 min	8aii	3.6 min
8b	$\frac{3}{5}$	8c	15.6 min
9a	$A = \begin{pmatrix} 18 & 6 & 13 \\ 18 & 9 & 12 \\ 24 & 10 & 4 \end{pmatrix}$	9b	$B = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$
9ci	$\begin{pmatrix} 60 \\ 63 \\ 82 \end{pmatrix}$	9cii	The current scores for MenUnited, ShellC and Liverpond respectively.
9d	(114)		
10a	0.349	10b	61.9%
10c	final decision is for United Kingdom to 'Leave'.	10d	39.0 million
10e	Comment is incorrect.		

NAME	CLASS	INDEX No.



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2024

SUBJECT : Mathematics (Revised)
4052/01

DATE : 6 August 2024

LEVEL : Secondary 4G3

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 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 of the marks for this paper is 90.

For Examiner’s Use			
Type of Penalties		Question Number	90
Accuracy	–1		
	–2		
Presentation	–1		
	–2		

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

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

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

1. Given that $6x + 2y = 13x - 3y$ find the ratio $x : y$.

Answer..... : [2]

2. (a) $\sin x = 0.431$

Find two possible values of x in the range $0 \leq x \leq \pi$.

Answer..... or [2]

- (b) Convert 2.7 radians into degrees.

Answer..... ° [1]

3. (a) Simplify $a^2 \div (3a^3)^2$.

Answer [1]

- (b) $77 \times 11^4 + 4 \times 121^2 = 33^x$

Use the laws of indices to find the value of x .

Show your working clearly.

Answer $x =$ [2]

4. (a) $M = p^6 \times q^{24}$, where p and q are prime numbers.

Explain why M is a perfect square.

Answer.....

.....[1]

- (b) The number $W = 2^2 \times 11^3 \times 13$.

- (i) The number $N = W \times k$ is a perfect cube.

Find the smallest possible integer value of k .

Give your answer as a product of its prime factors.

Answer $k =$ [1]

- (ii) The number $Z = 2^2 \times 7^5 \times 11^4$.

Find the highest common factor (HCF) of W and Z as a product of its prime factors.

Answer [1]

5. A train 190 m long passes through a tunnel 5.2 km long.

The average speed of the train is 28 km/h.

- (a) Change 28 km/h into m/s.

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

- (b) Calculate the time taken for the train to pass completely through the tunnel.

Give your answer in minutes and seconds to the nearest second.

Answer min..... sec [2]

6. The expression $x^2 - ax - 27$ is equivalent to $(x+3)^2 - b$.

(a) Find the value of a and the value of b .

Answer $a = \dots\dots\dots$

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

(b) The curve $y = x^2 - ax - 27$ is drawn.

Write down the equation of the line of symmetry of the curve.

Answer..... [1]

7. (a) The selling price of a machine is $x\%$ higher than the cost price.

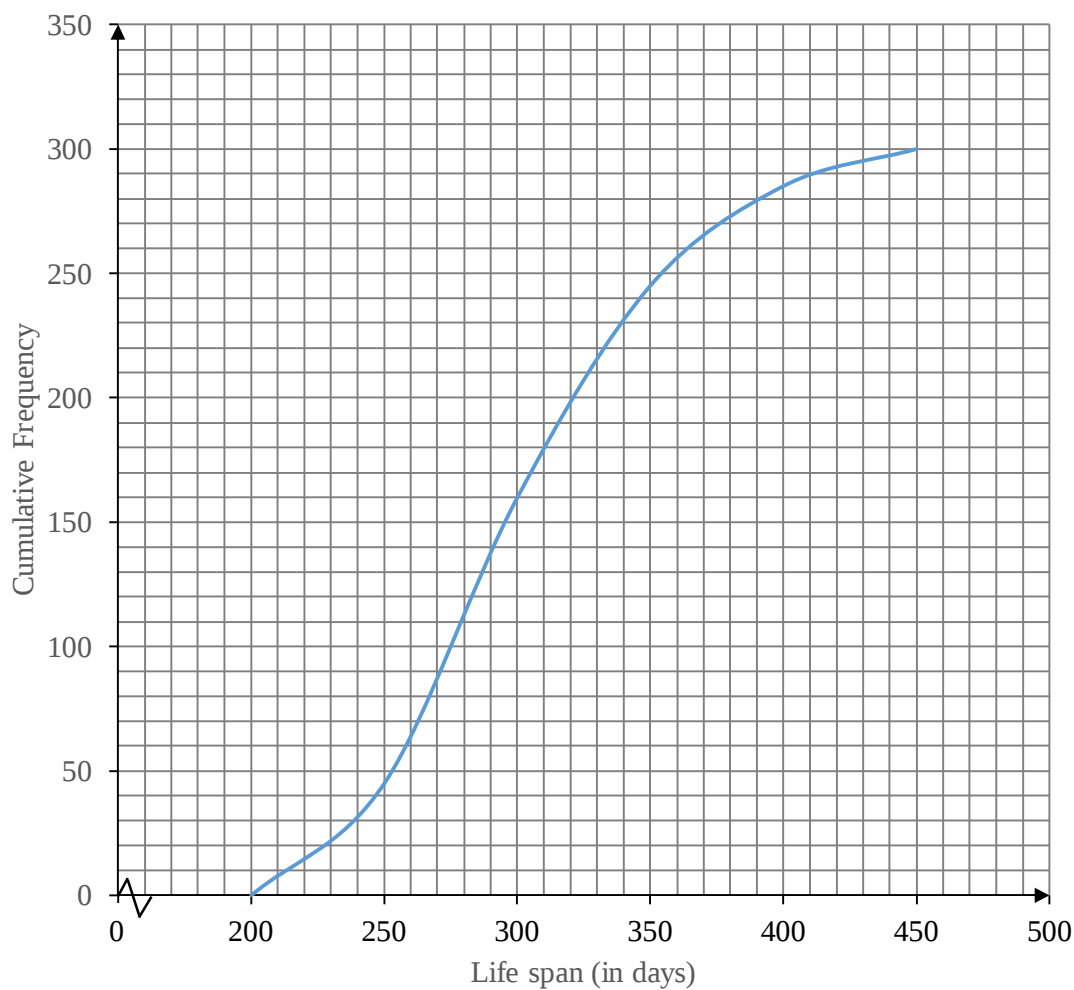
If the cost price and the selling price are \$200 and \$225 respectively, find the value of x .

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

(b) 2.4 kg of salt is dissolved in a certain amount of water, resulting in a solution that is 40% of salt by weight. Find the amount of salt to be added to obtain a solution containing 60% of salt by weight.

Answer kg [3]

8. The life span, in days, of 300 computer mice of brand X are given in the following cumulative frequency curve.



(a) Use the graph to estimate

(i) the median life span,

Answer..... days [1]

(ii) the interquartile range.

Answer..... days [2]

(b) Given that 40% of the computer mice have a life span of at least x days, find the value of x .

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

(c) The life span of another group of 300 computer mice of brand Y have the same median but a smaller interquartile range. Describe how the shape of the cumulative frequency curve differs from the given curve on the same axes.

Answer.....
.....[1]

9. Jeremy bought a watch in France. The watch costs 7880 Singapore dollars (S\$) in France. He would pay €3 more if he bought the watch in Singapore. The exchange rate in France is €1 = S\$1.5443. Calculate the exchange rate in Singapore if the same watch is priced at S\$7880 in Singapore. Give your answer in euros per Singapore dollar.

Answer S\$ 1 = € [2]

10. X is the point $(-5, 4)$ and Y is the point (a, b) .

The gradient of the line XY is $\frac{2}{5}$.

Find a in terms of b .

Give your answer in its simplest form.

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

11. Write $\frac{x^2 + 3x - 7}{x - 4} + \frac{9 + 3x}{4 - x}$ as a single fraction in its simplest form.

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

12. (a) Factorise $9x - 15 + 12xy - 20y$ completely.

Answer [2]

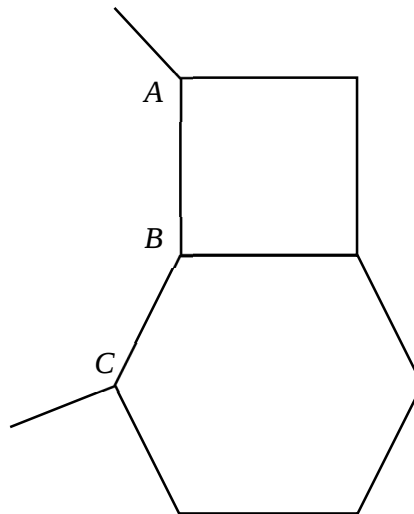
(b) Expand and simplify $(4x - 1)^2 - (8x + 1)(2x - 1)$.

Answer [2]

13. There are 12 girls and x boys in a group. The probability of selecting a boy from the group is $\frac{3}{7}$.
Find the extra number of boys who have to join the group so that the probability of selecting a boy from the group will be $\frac{4}{5}$.

Answer boys [2]

14. The figure is made up of a square, a regular hexagon and an n -sided polygon.
 AB and BC are two sides of the n -sided polygon. Find the number of sides of the polygon.



Answer sides [3]

15. Explain why $(n+5)(3n-1)-3(n-3)^2$ is a multiple of 2 for all integer values of n .

Answer

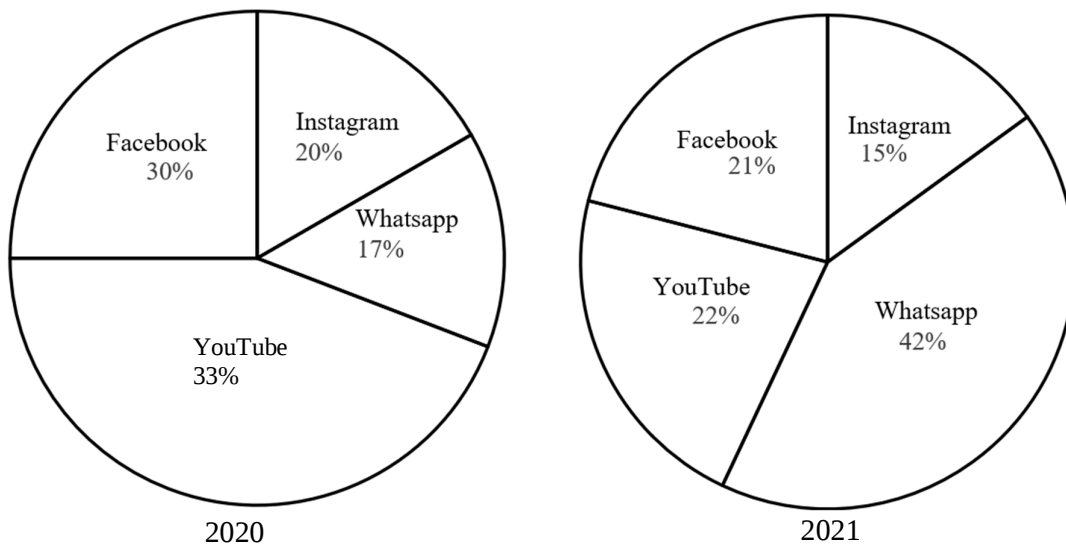
.....

.....

..... [2]

16.

Most Popular Social Media Platforms in Singapore



From the given charts, Peter said that there is a decrease in the number of Instagram users over the two years.

Do you agree with him? Explain your answer.

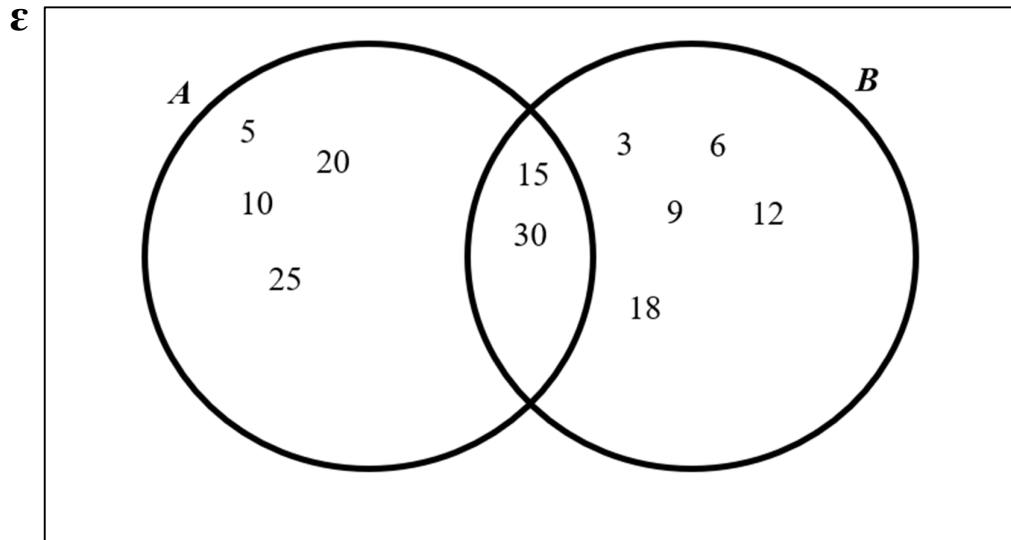
Answer

..... [1]

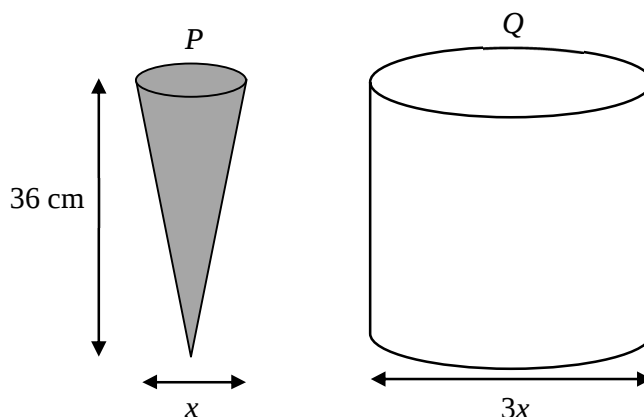
17. The Venn diagram shows two sets A and B , with some elements of the sets. Place the following numbers: 35, 36, 45 and 47 into appropriate regions.

Answer

[2]



18. The diagram shows an inverted cone P and cylinder Q . The diameter of P is x cm and Q is $3x$ cm. P contains water to a depth of 36 cm. The water in P is then poured into Q .



Calculate

- (a) the depth of water in Q ,

Answer cm [2]

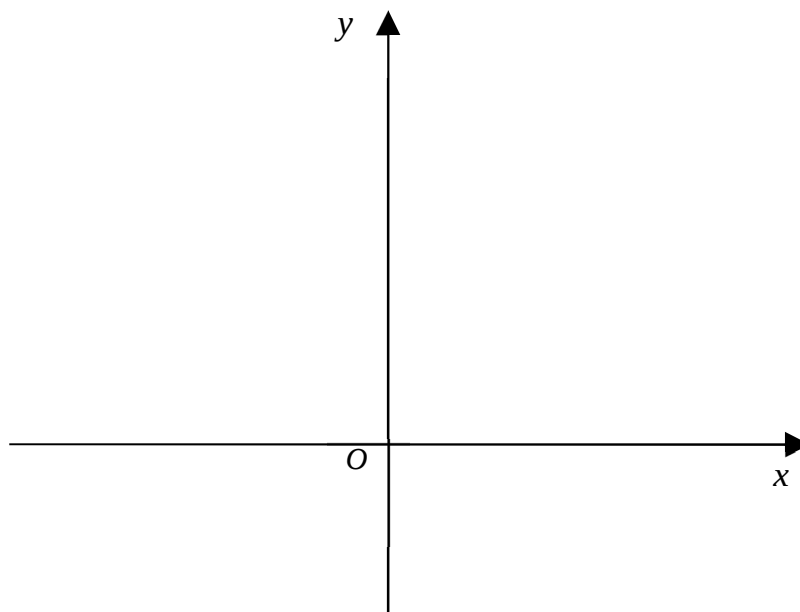
- (b) the total surface area of cylinder Q that is in contact with water, giving your answer in terms of x and π .

Answer cm^2 [2]

19. Sketch the graph of $y = -(2x + 3)(x - 5)$ on the axes below.

Indicate clearly the points where the graph crosses the axes.

[2]



20. The mass of one atom of nitrogen is 2.33×10^{-11} picograms.

(a) Express this mass in grams, giving your answer in standard form.

1 picogram = 10^{-12} grams

Answer g [1]

(b) A molecule of nitrogen dioxide (NO_2) contains one atom of nitrogen and two atoms of oxygen. Given that the mass of one atom of oxygen is 2.66×10^{-23} grams, find the mass of two molecules of nitrogen dioxide.

Give your answer in grams in standard form.

Answer g [2]

21. A coffee outlet sells three different types of coffee, espresso, latte and mocha.

The table shows the number of cups of each type of coffee sold in the morning and afternoon on a particular day.

	Espresso	Latte	Mocha
Morning	25	30	32
Afternoon	22	36	42

The number of cups of each type of coffee sold in the morning and afternoon is represented by the

matrix $\mathbf{P} = \begin{bmatrix} 25 & 30 & 32 \\ 22 & 36 & 42 \end{bmatrix}$.

A cup of espresso, latte and mocha is sold at \$1.50, \$1.80 and \$2 respectively.

(a) Write down a 3×1 matrix, $\mathbf{S}$, to represent the selling price per cup of each type of coffee.

Answer..... [1]

(b) Evaluate $\mathbf{PS}$.

Answer..... [1]

(c) Describe what is represented by the elements of $\mathbf{PS}$.

Answer

 [1]

(d) To increase profits, two proposals were examined. Assuming that the number of cups each type of coffee sold remains unchanged despite the increase in prices.

Proposal 1: Increase the prices by 15%.

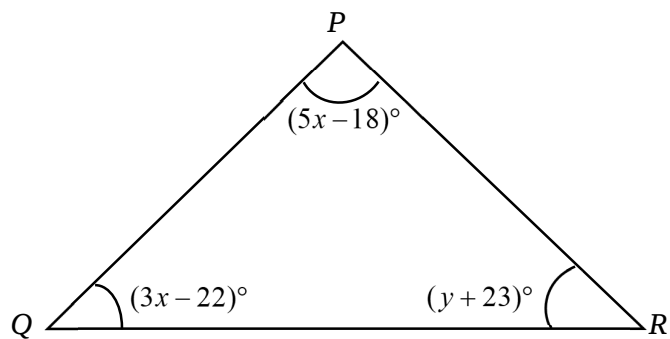
Proposal 2: Increase the price of Latte and Mocha by \$1 and \$0.50 respectively.

Using matrix multiplication, calculate the income under Proposal 1 and Proposal 2.

Which proposal will bring more profits? Show your working clearly.

Answer..... [3]

22. The diagram shows an isosceles triangle PQR with $PQ = PR$ and angles as shown.



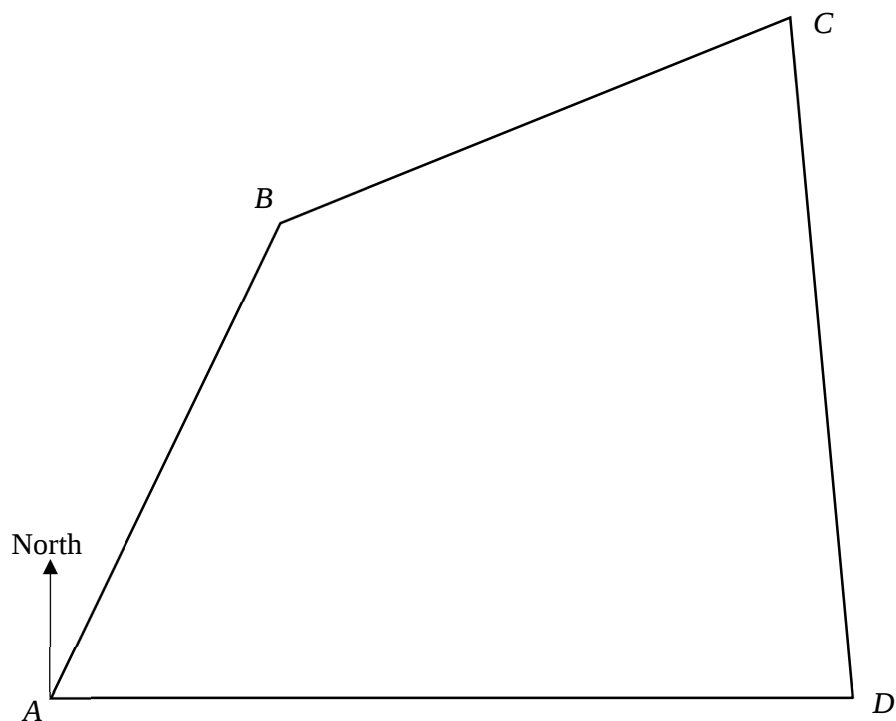
Form a pair of simultaneous equations and find the values of x and y .

Answer: $x = \dots\dots\dots$

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

23. The scale drawing represents a plot of land, $ABCD$, which is to be used for a park.

Scale: 1 cm to 100 m



- (a) Construct the perpendicular bisector of AD . [1]
- (b) Construct the bisector of angle ABC . [1]
- (c) A playground is to be built in the park, nearer to A than to D and nearer to AB than to BC .
Shade the region where the playground is to be built. [1]
- (d) Measure the bearing of B from A .

Answer ° [1]

24. The time of oscillation T , of a simple pendulum is directly proportional to the square root of its length l .

- (a) If one complete oscillation of a simple pendulum of length 8 cm takes 3 seconds, find the time taken for a pendulum 10 cm long to complete one oscillation.

Answer s [2]

- (b) Explain what happens to the time of oscillation when the length of pendulum is reduced by 75%.

Answer
 [1]

25. P_n is the n^{th} term of a sequence.

$$P_n = n^2 + 2.$$

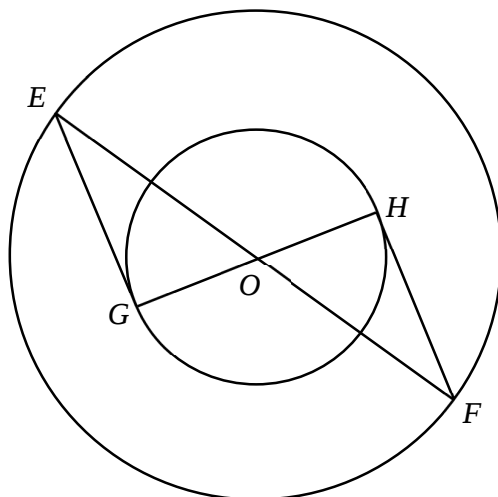
- (a) Find the first three terms in the sequence.

Answer , , [1]

- (b) P_n and P_{n+1} are consecutive terms in this sequence. Find and simplify an expression, in terms of n for $P_{n+1} - P_n$.

Answer [2]

26. EF is the diameter of the large circle, centre O .
 GH is the diameter of the small circle, centre O .
 EG and HF are tangents to the small circle.



Show that triangle OEG is congruent to triangle OFH .
 Give a reason for each statement you make.

Answer

.....

.....

..... [3]

27. A map is drawn to a scale of 1 : 600 000.

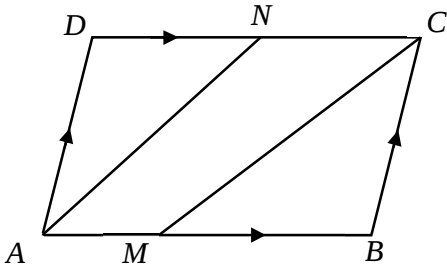
(a) Calculate the distance, in cm, between two towns P and Q which are 288 km apart on the actual ground.

Answer cm [1]

(b) A lake is represented on the map with an area of 24 cm^2 . Calculate the actual area of the lake in km^2 .

Answer km^2 [2]

28. $ABCD$ is a parallelogram. N is the midpoint of DC and M is a point on AB such that $2AM = MB$.



Given that $\overrightarrow{AB}=6\mathbf{a}$ and $\overrightarrow{AD}=4\mathbf{b}$,

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

(i) $\overrightarrow{AM}$,

Answer [1]

(ii) $\overrightarrow{MC}$.

Answer [1]

(b) Explain why $\overrightarrow{AN}$ and $\overrightarrow{MC}$ are not parallel.

Answer

[2]

(c) Find the numerical value of

(i) $\frac{\text{area of } \triangle ADN}{\text{area of parallelogram } ABCD}$,

Answer [1]

(ii) $\frac{\text{area of } \triangle ADN}{\text{area of } \triangle AMN}$.

Answer [2]

End of Paper

Answer Key

1	5 : 7		
2a	0.446 or 2.70	2b	154.7°
3a	$\frac{1}{9a^4}$	3b	4
4a	-	4bi	2×13^2
4bii	$2^2 \times 11^3$		
5a	$7\frac{7}{9}$	5b	11 min 33 sec
6a	$a = -6, b = 36$	6b	$x = -3$
7a	12.5	7b	3
8ai	295	8aii	70
8b	310	8c	-
9	0.6479		
10	$a = \frac{5b - 30}{2}$		
11	$x + 4$		
12a	$(3 + 4y)(3x - 5)$	12b	$-2x + 2$
13	39		
14	12 sides		
15	-	16	-
17	-		
18a	$\frac{4}{3}$	18b	$\frac{9\pi x^2}{4} + 4\pi x$
19	-		
20a	2.33×10^{-23}	20b	1.53×10^{-22}
21a	$\begin{pmatrix} 1.5 \\ 1.8 \\ 2 \end{pmatrix}$	21b	$\begin{pmatrix} 155.5 \\ 181.8 \end{pmatrix}$
21c	-	21d	Proposal 2
22	$x = 22, y = 21$	23	-
24a	3.35	24b	-
25a	3, 6, 11	25b	$2n + 1$
26a	SAS test		
27a	48	27b	864
28ai	2a	28aii	4a + 4b
28b	-	28ci	$\frac{1}{4}$
28cii	$\frac{3}{2}$		

NAME	CLASS	INDEX NO.



ST. PATRICK'S SCHOOL

PRELIMINARY EXAMINATION 2024

SUBJECT : Mathematics (Revised)
4052/02

DATE : 14 August 2024

LEVEL : Secondary 4G3 & 5G2

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class, and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 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 of the marks for this paper is 90.

For Examiner's Use			
Type of Penalties		Question Number	90
Accuracy	−1		
	−2		
Presentation	−1		
	−2		

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

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

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

1. (a) Solve the inequality $\frac{3-2x}{5} > \frac{1+x}{4}$.

Answer [2]

- (b) It is given that $F = \frac{m(V-k)^2}{r}$.

- (i) Find the value of F when $m = 2023$, $V = 0.14$, $k = -1.08$, $r = 0.348$.

.

Answer $F =$ [1]

- (ii) Express V in terms of F , m , k and r .

Answer $V =$[3]

- (c) Simplify $\frac{4x^2-6x}{4x^2-9}$.

Answer[2]

- 1 **(d)** Solve the equation $\frac{3}{x+1} = 5 - \frac{1}{x-2}$.
Give your solutions correct to 2 decimal places.

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

- 2 **(a)** The selling price of a desktop computer is \$2388.

The hire purchase price is a deposit of \$295 and 18 equal monthly instalments of \$125 per month. Calculate the simple interest rate per annum.

Answer% [3]

- (b)** Peter took a loan of \$5000 at a rate of 0.5% per quarter compound interest.

- (i)** He calculated that he will incur an interest of \$100 in the first year. Did he do his calculation correctly? Explain.

Answer.....
.....
.....[1]

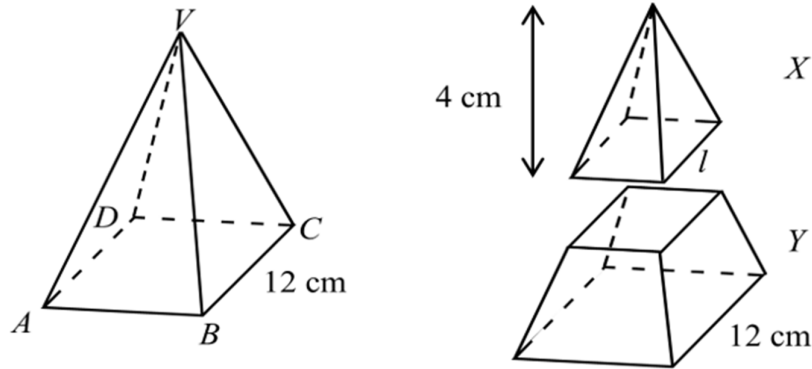
- (ii)** Calculate the interest rate that he will be charged in the first year.

Answer % [2]

- 3 Solid $VABCD$ is a right pyramid with a square base $ABCD$, where $AB = BC = 12$ cm.

The wooden pyramid is cut into two parts, pyramid X and frustum Y , along a plane parallel to its base.

The ratio of the volume of X to volume of Y is $1 : 7$ while the height of pyramid X is 4 cm.



- (a) Show that l , the side of the square base of X is 6 cm long.

Answer:

.....

[2]

- (b) Find the volume of frustum Y .

Answer cm^3 [2]

- (c) Frustum Y is to be painted on all its sides, at \$0.07 for every square centimetre. Calculate the total cost of painting this frustum.

Answer \$ [3]

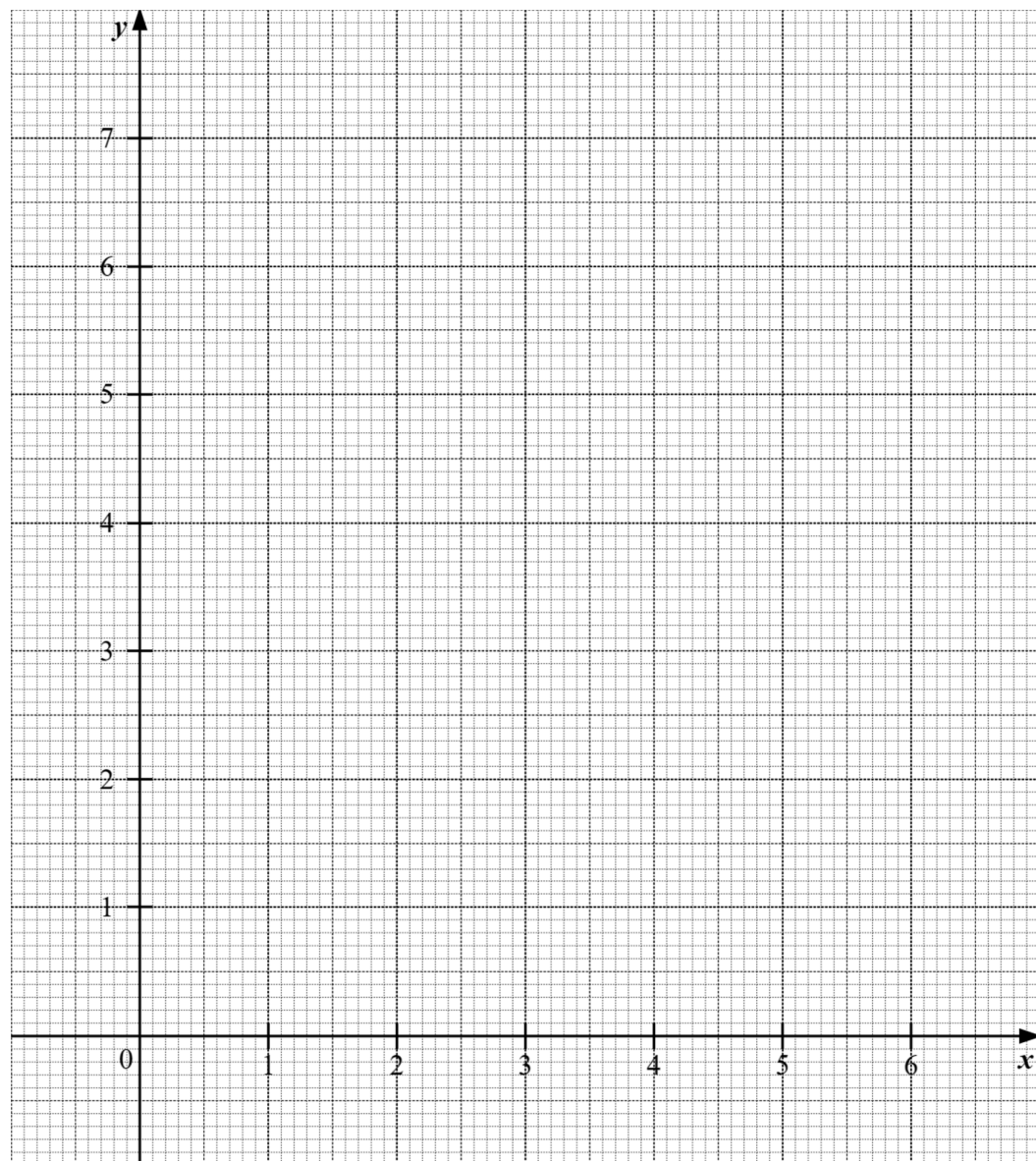
- 4 The variables x and y are connected by the equation $y = 2x + \frac{16}{x} - 11$.
Some corresponding values of x and y are given in the table below.

x	1	1.5	2	2.5	3	4	5	6
y	7	2.67	1	0.4	p	1	2.2	3.67

- (a) Find the value of p , correct to 2 decimal places.

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

- (b) On your axes, plot the points given in the table and join them with a smooth curve. [3]



- (c) The line $y = -2x + c$ is a tangent to the curve at T .

Use your graph to estimate the x -coordinate of T and the value of c .

Answer $x = \dots\dots\dots$

$c = \dots\dots\dots$ [2]

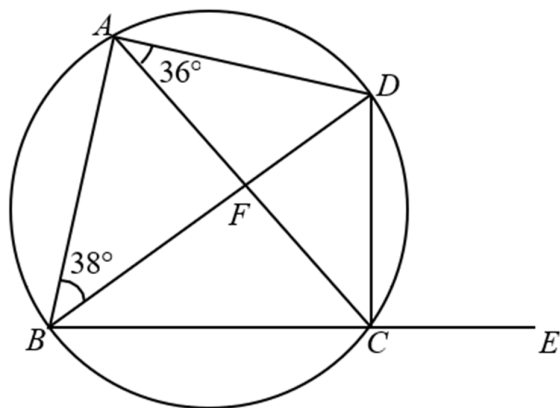
- (d) (i) On the same axes, draw the graph of $y = 4 - 0.5x$ for $0 \leq x \leq 6$. [1]

- (ii) The x -coordinates of the points of intersection of the curve $y = 2x + \frac{16}{x} - 11$ and the line $y = 4 - 0.5x$ are the solutions of the equation $5x^2 + Ax + 32 = 0$. Find the value of A .

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

- (iii) Hence, use your graph to solve the equation $5x^2 + Ax + 32 = 0$.

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



- (a) A, B, C and D are points on the circle. BC produced to E and BFD is a straight line. Angle $ABD = 38^\circ$ and angle $CAD = 36^\circ$.

- (i) Justify with reasons why AC is not a diameter of the circle, $ABCD$.

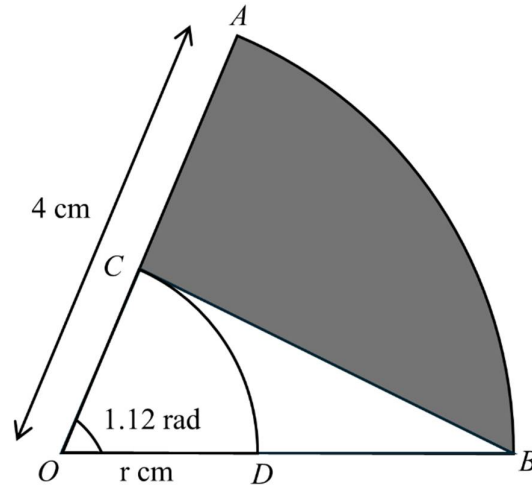
Answer

[2]

- (ii) Given that angle $BAC = 59^\circ$, find angle DCB .

Answer Angle $DCB = \dots\dots\dots^\circ$ [1]

- (b) The diagram shows two arcs AB and CD of two circles with centre O . Arc CD has radius r cm and arc AB has radius 4 cm. C and D lie on OA and OB respectively. BC is tangent to the arc CD at C and angle AOB is 1.12 radians.



- (i) Show that the value of r is 1.743 cm, correct to 4 significant figures.

Answer

[2]

- (ii) Find the perimeter of the shaded region, ABC .

Answer cm [3]

- 1 (b) (iii) Find the area of the shaded region, ABC .

Answer cm^2 [3]

6. (a) A is the point $(3, -7)$ and B is the point $(5, 3)$.

Find

- (i) the length of AB ,

Answerunits [1]

- (ii) the equation of line AB ,

Answer [2]

- (iii) the equation of the line l which passes through B and is parallel to the x -axis.

Answer [1]

- 6** **(b)** The area bounded by a line and the axes has an area of 10 square units.
The line passes through the point $P(0,4)$.
Max claims that there are 2 possible equations of the lines, and their gradients
are the negatives of each other.
Do you agree with Max's claim?
Justify your answer showing your calculations.

Answer

.....
..... [3]

- (c) The position vector of point R is $\begin{pmatrix} -5 \\ -1 \end{pmatrix}$ and the coordinates of point S are $(7, 2)$.
- (i) Find the magnitude of $\overline{RS}$.

Answerunits [2]

- (ii) T is the point on RS produced with coordinate $(k, 5)$.
Find the value of k .

Answer $k =$ [2]

- 7 (a) The height, in centimetres, of 20 boys and 15 girls from Class 2A were recorded. The results are shown in the stem-and-leaf diagram.

Boys						Girls			
					11	8			
			4	2	12	3	5	9	
	9	5	3	3	13	5	6	8	
9	7	6	2	1	14	2	3	6	
	8	5	4	0	15	4	4	5	
x	8	5	5	3	16	2	4		

Key (Boys)					Key (Girls)			
2		12	means 122 cm		11		8	means 118 cm

- (i) Write down the median mass of the girls.

Answercm [1]

- (ii) The range of the heights for the boys is 47 cm. Find x.

Answer $x =$ [1]

- (b) (i) Summarise the heights of the 15 girls from Class 2A in the frequency table below.

Height (h cm)	$110 \leq h < 130$	$130 \leq h < 150$	$150 \leq h < 170$
Frequency			

[1]

- (ii) Calculate an estimate of the mean height and the standard deviation of the heights.

Answer mean = cm

Standard deviation = cm [2]

- (c) The mean height for girls from Class 2B is 135 cm and the standard deviation was 13.5 cm.

Make two comparisons between the heights for the girls in Class A and Class B.

1.

.....

.....

2.

.....

.....[2]

- 8** A bag contains 17 red marbles and 8 green marbles.
Two marbles are taken from the bag without replacement.

- (a)** Sally says the probability that both marbles are green is $\frac{64}{625}$.
Explain what she has done wrong.

Answer:

.....

.....

.....

.....

..... [2]

- (b)** Draw a tree diagram to show the probabilities of the possible outcomes.

Answer:

[2]

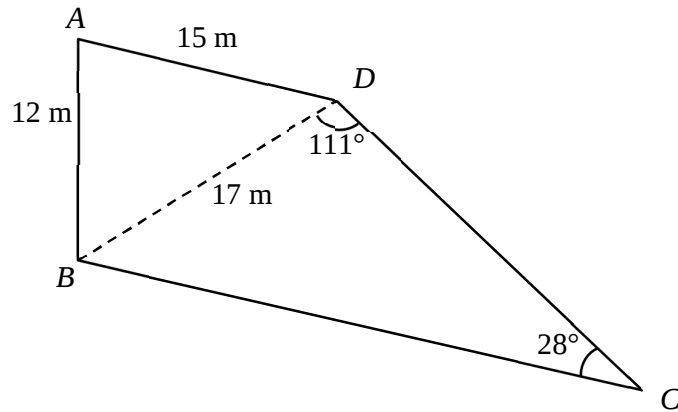
- (c) Find, as a fraction in its simplest form, the probability that only one of the marbles is red.

Answer [1]

- 9 The diagram shows a plot of land $ABCD$ on horizontal ground, consisting of two triangles ABD and BDC .

$AB = 12$ m, $BD = 17$ m and $AD = 15$ m.

Angle $BDC = 111^\circ$ and angle $BCD = 28^\circ$.



- (a) Calculate
(i) the length of CD ,

Answer m [3]

- (ii) the angle ABD .

Answer $^\circ$ [2]

- 9 (b) The land is used to plant some trees.
If each tree needs 36 square metres of space to grow, what is the greatest number of trees that can be planted in the plot of land $ABCD$?

Answer [2]

- (c) A drone is hovering vertically above B .
The angle of elevation of the drone from A is 70° .
Find the angle of elevation of the drone from D .

Answer $^\circ$ [3]

- 10** Electronic Road Pricing System (ERP) is used in managing road congestion. Based on a pay-as-you-use principle, motorists are charged when they use priced roads during peak hours.

The tables show the time periods and respective ERP rates of some roads for passenger cars, taxis and light goods vehicles in Singapore in a certain year.

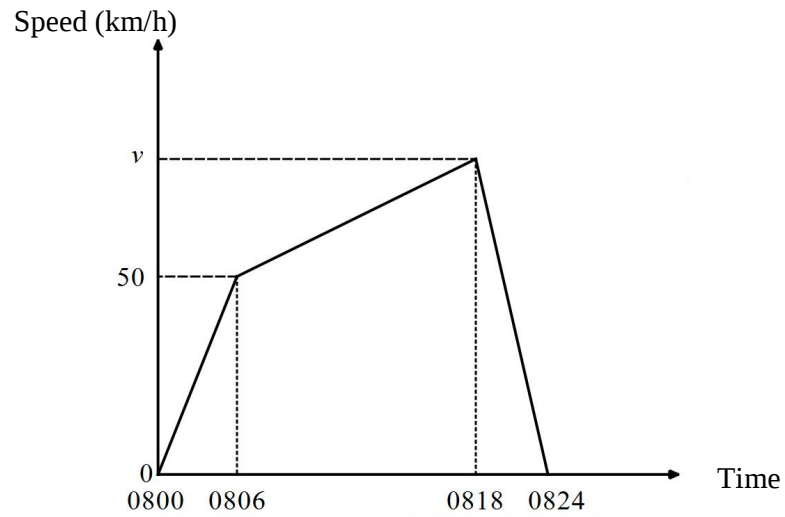
ERP Rates		
Time period	KPE Southbound after Defu Flyover	PIE slip to Bendemeer Road
7:30 – 7:35	\$2.00	-
7:35 – 8:30	\$3.00	-
8:30 – 8:35	\$4.50	\$1.00
8:35 – 8:55	\$6.00	\$2.00
8:55 – 9:00	\$4.00	\$1.50

ERP Rates		
Time period	CTE slip road to PIE (Changi) / Serangoon Road	AYE to City before Alexandra Road
7:30 – 7:35	-	-
7:35 – 8:00	-	-
8:00 – 8:05	\$2.50	\$0.50
8:05 – 8:30	\$3.00	\$1.00
8:30 – 8:35	-	\$1.50

- (a) The distance between Mr Lim's home and workplace is 31 km.
Mr Lim drives to work.
One day, to cut down on travelling time, Mr Lim travelled through the KPE gantry at 7:50 and passed the AYE gantry at 8:22.
Calculate the total ERP charges paid by Mr Lim.

Answer \$. [1]

- (b) On some days, Mr Lim travels from home to Town using alternative routes to avoid all the ERP charges. His speed-time graph is shown below.



- (i) The total distance travelled by Mr Lim to Town is 19.5 km.
Find the value of v .

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

- (ii) Calculate the acceleration between 0800 and 0803.

Answer $\dots\dots\dots$ km/h² [1]

- 10 (c) The cost of fuel from Shell is shown below

Company	Diesel cost per litre	Regular petrol cost per litre	Premium petrol cost per litre
Shell	\$2.40	\$2.79	\$3.50

The fuel consumption of Mr Lim's car was 8 litres/100 km and his car uses regular petrol.

Mr Lim decided to fetch a colleague, Mr Goh, on his way to work.

Mr Lim drove for an additional 4 km and travelled through both the KPE gantry and AYE gantry 10 minutes later than his usual timing.

To cut down on his transport expenses, Mr Lim decided to charge Mr Goh 30% of his total transport expenses to work, which consist of the ERP charges and fuel cost incurred based on a 20-day work month.

If Mr Goh took public transport in the morning, he would have to pay \$3.89.

Which is a cheaper transport option for Mr Goh based on a 20-day work month? Justify your decision and show your method clearly.

Answer

.....
..... [5]

End of Paper

Answer Key

1a	$x < \frac{7}{13}$	1bi	8650
1bii	$k \pm \sqrt{\frac{Fr}{m}}$	1c	$\frac{2x}{2x+3}$
1d	2.25 or -0.45		
2a	5.00	2bi	-
2bii	2.02		
3a	-	3b	336
3c	\$25.20		
4a	0.33	4b	-
4c	$x = 2, c = 5$	4di	-
4dii	-30	4diii	1.35 or 4.6
5a	-	5aii	85°
5bi	1.743	5bii	10.3
5biii	5.82		
6ai	10.2	6aii	$y = 5x - 22$
6aiii	$y = 3$	6b	-
6ci	12.4	6cii	19
7ai	142	7aii	9
7bi	-	7bii	Mean = 14.1, SD = 15.4
7c	-		
8a	-	8b	-
8c	$\frac{34}{75}$		
9ai	23.8	9aii	59.3
9b	7	9c	62.7°
10a	\$4	10bi	80
10bii	500	10c	-

NAME	CLASS	INDEX No.



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2023

SUBJECT : Mathematics (Revised)
4052/01

DATE : 15 August 2023

LEVEL : Secondary 4G3

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 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 of the marks for this paper is 90.

<i>For Examiner's Use</i>	
<i>Score</i>	/90

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

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

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

1. Given that q and r are integers such that $-3 < q < 5$ and $6 \leq r \leq 10$ find

(a) smallest value of qr ,

Answer..... [1]

(b) largest value of $r - q^2$.

Answer..... [1]

2. Without the use of calculators and **using algebraic identities**,

show how you would evaluate $123^2 - 77^2$

Answer..... [2]

3. Solve $2^d + 2^d + 2^d + 2^d = 1$

Answer $d =$ [2]

4. Kendro has a collection of 420 books. He wants to arrange the books on shelves with each shelf having the same number of books. Each shelf cannot hold more than 34 books. What is the minimum number of shelves he needs?

Answer..... shelves [2]

5. A bag contains $2x$ blue marbles and 12 red marbles. x blue marbles are added to the bag such that now the probability of choosing a blue marble is $\frac{3}{7}$. Find the value of x .

Answer $x =$ [2]

6. Write as a single fraction in its simplest form $\frac{1}{2x-1} - \frac{2}{4x^2-1}$.

Answer..... [3]

7. Benedict drives D kilometres to work. He takes M minutes to reach his workplace.
Express as metres per second, his speed in terms of D and M .

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

8. 5 machines take 8 hours to complete a job. If 3 of the machines work at half their normal rate, how long will it take the five machines to complete the same job?

Answer.....hrs min [3]

9. Solve $5p^2 - 7p - 9 = 0$ correct to three decimal places.

Answer $p =$ or [3]

10. P is inversely proportional to Q^3 .

(a) When $Q = \frac{1}{6}$, $P = 54$. Find P when $Q = \frac{1}{3}$.

Answer..... [2]

(b) A change in Q produces a change in P .

When Q increase by 100%, what is the percentage change in P ?

Answer..... % [2]

11. Solve the following set of simultaneous equations.

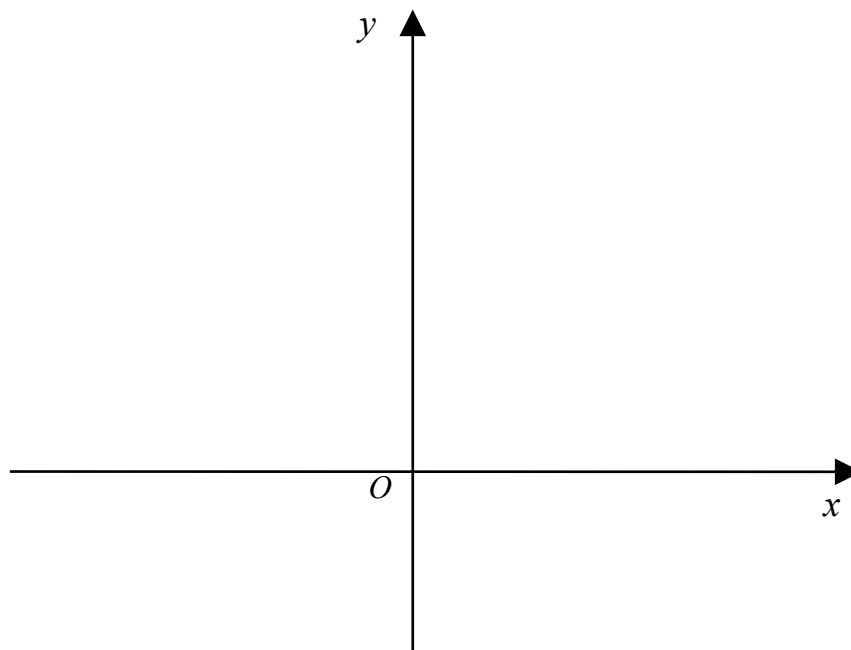
$$2x + 3y = 7$$

$$x - y = 3$$

Answer $x = \dots\dots\dots y = \dots\dots\dots$ [3]

12. The graph of a quadratic function $y = -(x+k)(x-5)$ has a maximum point at $(2, 9)$.

- (a) **Sketch** the graph on the axes below. Indicate clearly the coordinates where the graph crosses both axes.

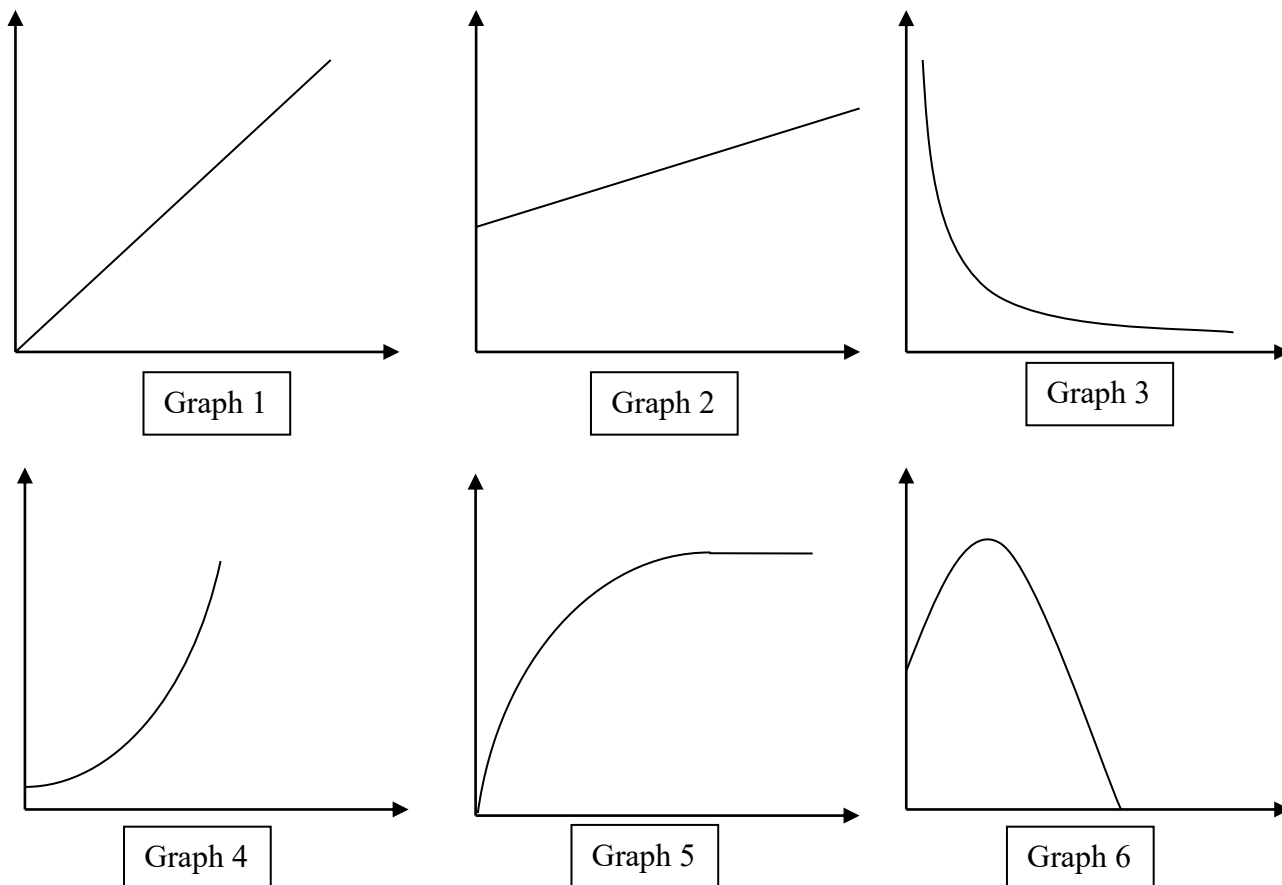


[4]

- (b) Write the equation of the function in the *completed square* form.

Answer..... [1]

13.



- (a) The population of bacteria doubles every minute.
Graph of population against time will look like graph..... [1]
- (b) The fare of a taxi ride consists of a flag down charge of \$5 with additional charge of 20 cents per 100 meters.
Graph of taxi fare against distance travelled will look like graph [1]
- (c) A car accelerates from rest until it reaches a constant speed.
Graph of the speed of the car against time will look like graph [1]

14.



The diagram shows two geometrically similar packets of flour.

The amount of material used to make the smaller packet is 1200 cm^2 .

The amount of material used to make the larger packet is 4800 cm^2 .

- (a) The larger pack is 36 cm in width.

Calculate the width of the smaller packet of flour.

Answer..... cm [2]

- (b) The smaller packet can hold 500 g of flour.

Calculate the mass of flour in the larger packet.

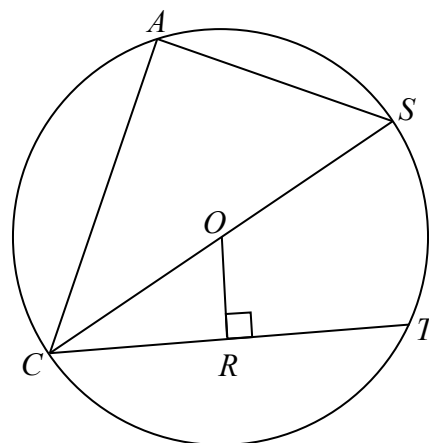
Answer..... kg [2]

15. In the diagram, CS is the diameter of circle with center O .

Chord $CA = CT$.

OR is perpendicular to chord CT .

Show that triangle ORC is similar to triangle SAC .



Answer:

.....

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.....

..... [3]

16. The point $A(-2, -1)$ is translated to point $B(1, -5)$.

Find the magnitude of the translation vector.

Answer units [3]

17. $\xi = \{\text{integers } x : 3 < x < 14\}$
 $M = \{\text{multiples of } 3\}$
 $F = \{\text{factors of } 36\}$
 $C = \{\text{composite numbers}\}$

(a) (i) List the elements in F .

Answer[1]

(ii) Find $n(C \cap F)$.

Answer[1]

(b) Underline the correct statement from the list below.

$$(C \cup F)' = \{5, 7, 11, 13\} \quad M \subset F \quad M \cap C' = \{0\} \quad [1]$$

18. A triangle with two known sides of 17 cm and 10 cm, has an area of 50 cm^2 . Calculate the possible values of the angle subtended between the two known sides.

Answer and [3]

19. A packet contains some seeds that produces either red, blue or yellow flowers.

The company that sells these packets guarantee that for each packet, $\frac{3}{7}$ of the seeds will produce red flowers, $\frac{2}{5}$ will produce blue flowers and the rest will produce yellow flowers.

(a) What is the probability that if a seed is planted, the colour of the flower will be yellow?

Answer[1]

(b) If each packet has 35 seeds each, draw a tree diagram to show the probabilities of the possible outcomes of picking two seeds.

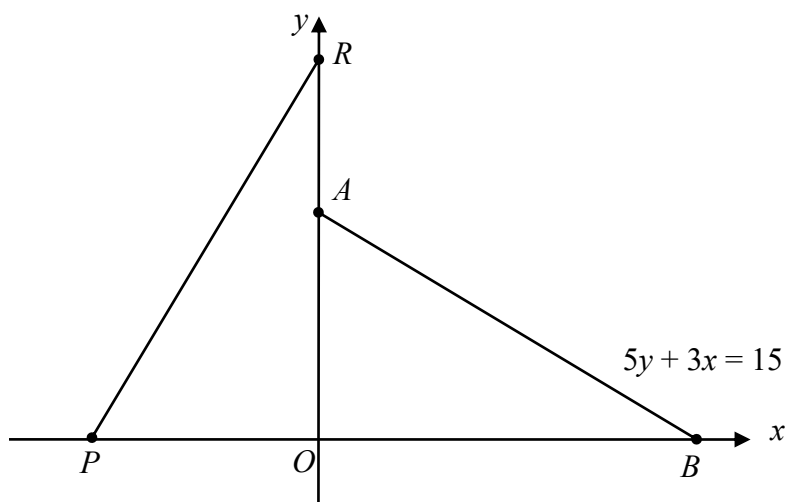
Answer:

[3]

(c) Calculate the probability that the two seeds will produce flowers of different colour?

Answer[2]

20.



Triangle AOB is congruent to triangle POR .

- (a) The equation of the line AB is $5y + 3x = 15$.

Find the equation of the line PR in the form $y = mx + c$.

Answer[3]

- (b) Find the perpendicular distance of O to the line AB ,

Answer units [3]

21. The heights of a group of 14 students were measured.

The results are shown in the stem and leaf diagram.

15		8	8	9			
16		0	2	4	7	7	
17		1	2	2	4	8	9

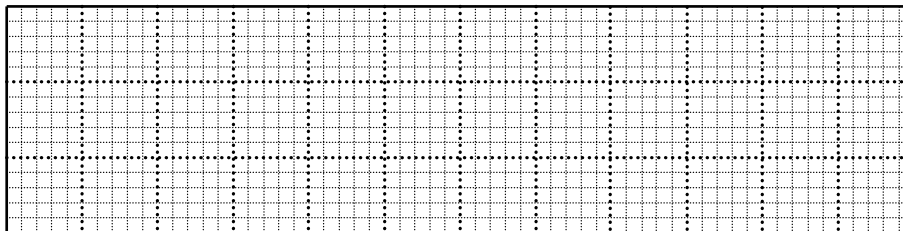
Key: 16 | 2 means 162 cm

- (a) Find the median height.

Answer cm [1]

- (b) Draw the box and whisker diagram for the set of data.

Answer



[3]

- (c) Two students joins the group. One has a height of 160 cm and the other has a height greater than 190 cm. Without further calculations, explain how will this affect the median and standard deviation?

Answer:

.....

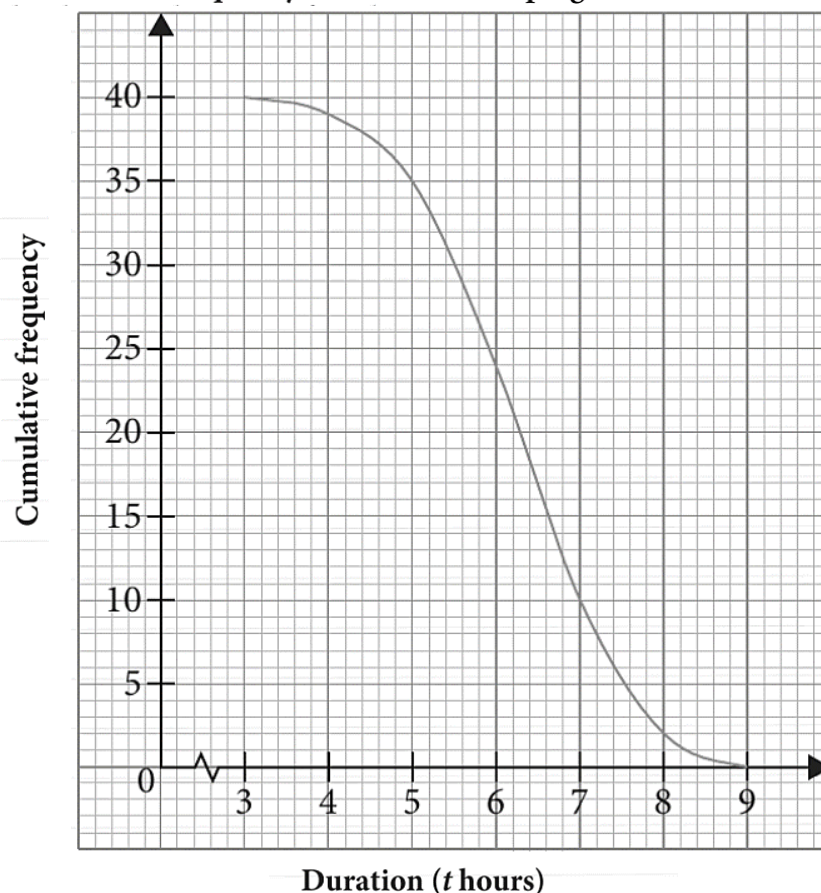
.....

.....

..... [2]

22. The duration, in hours, that 40 students slept for on a Wednesday night were recorded. The cumulative frequency curve shows the duration, t hours, and the number of students who slept for more than t hours

Cumulative frequency curve for the sleeping duration of students



- (a) Estimate the interquartile range.

Answer hours [2]

- (b) What fraction of students slept for less than 7 hours?

Answer [1]

- (c) A student claims that at least half of the students surveyed got less than 6 hours of sleep. Comment if the data supports this claim.

Answer:

.....

 [2]

23. In the scale drawing, P and T are airports.

Scale: 1 cm : 200 km



- (a) Find the bearing of P from T .

Answer [1]

- (b) A radar station, R , is to be built equidistant from P and T and West of T . By constructing the perpendicular bisector of PT , locate and mark the position of the radar station.

[2]

- (c) What is the actual distance of the radar station to airport P ?

Answer km [2]

24. The first four terms of a number sequence, M is given as follows:

$$M_1 = 2^2 - 1^2$$

$$M_2 = 5^2 - 2^2$$

$$M_3 = 8^2 - 3^2$$

$$M_4 = 11^2 - 4^2$$

- (a) Evaluate M_5 .

Answer[1]

- (b) Write down in terms of n , a simplified formula for the value of M_n .

Answer $M_n =$ [2]

- (c) Explain why the value of M_n is always an odd value.

Answer:

.....
.....
.....
.....
.....
..... [1]

25. Dayan and Christopher have some Japanese Yen (¥), Malaysian Ringgit (RM) and Euros (€). The number of foreign currencies they each have is given by the matrix **C**.

$$\mathbf{C} = \begin{pmatrix} \text{¥} & \text{RM} & \text{€} \\ 7500 & 12 & 52 \\ 9000 & 30 & 8 \end{pmatrix} \begin{matrix} \text{Dayan} \\ \text{Christopher} \end{matrix}$$

- (a) Below is the exchange rate to convert the currencies to Singapore dollar (S\$) in June.

¥ 1 – S\$0.01

RM 1 – S\$0.3

€ 1 – S\$1.50

- (i) Represent this information as 3×1 matrix **R**, such that **J** = **CR** represents the amount of Singapore dollars each boy will get if they convert their currencies in June

Answer **R** =[1]

- (ii) Evaluate **J**.

Answer **J** =[1]

- (b) In September, the exchange rate for the Japanese Yen and the Euro changed while the exchange rate for the Ringgit remained unchanged. The boys will get 8% less if they convert the Yen to the Singapore dollar and 10% more if they convert the Euro to the Singapore dollar.

- (i) The matrix $\mathbf{T} = \begin{pmatrix} a & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1.1 \end{pmatrix}$ is such that **TR** gives the new exchange rates. What is the value of *a*?

Answer *a* =[1]

(ii) Find **TR**.

Answer **TR** =[1]

(iii) Find **S = CTR**.

Answer **S** =[1]

(iv) Explain what the elements of **S – J** represent.

Answer:

.....
.....
.....
..... [1]

ANSWERS

1. -20 10

2. 9200

3. -2

4. 14

5. 3

6. $\frac{1}{2x+1}$

7. $\frac{50D}{3M}$

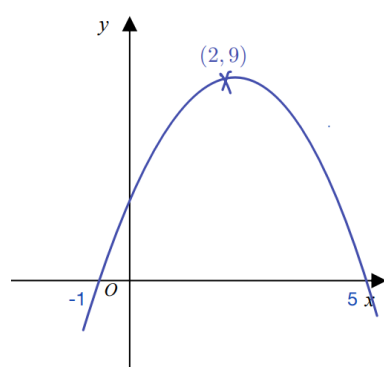
8. 11hr 26min

9. -0.813 or 2.213

10. $\frac{27}{4}$ -87.52%

11. $\frac{16}{5}$ $\frac{1}{5}$

12.



$$y = -(x - 2)^2 + 9$$

13. Graph 4 / Graph 2 / Graph 5

14. 18 4kg

15. $CR = \frac{1}{2}CT$ (Perpendicular line from centre bisect chord).
 $\therefore CR = \frac{1}{2}CA$ ($AC = CT$)
 $CO = \frac{1}{2}CA$ (radius = 1/2 diameter)
 $\widehat{ACS} = \widehat{RCO}$ (because $AC = CT$, CS bisect angle ACT)
 By SAS similarity Rule, -B1
 Triangle ORC is similar to triangle SAC.

16. $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$

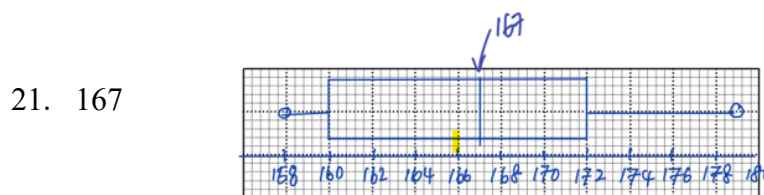
17. $\{4, 6, 9, 12\}$ 4 $(C \cup F)' = \{5, 7, 11, 13\}$

18. 144.0°

19. $\frac{6}{35}$ $\frac{384}{595}$

ver:

20. $y = -\frac{5}{3}x + 5$ 2.57



Since one of the added data is less than the median, and the other is more than the median, the median will remain unchanged...
 However, 190 is a significant outlier, causing the spread of data to increase, hence standard deviation will increase.

22. 15 0.45 At the 6 hour mark, the cumulative frequency is 24. Therefore the number of students who have less than 6hr of sleep = 40-24=16 Therefore claim is false.

23. see solution

24. (a) $= 14^2 - 5^2$
 $= 171$

(b) $Mn = (-1 + 3n)^2 + n^2$
 $= 9n^2 - 6n + 1 + n^2$
 $= 8n^2 - 6n + 1$

(c) $m_n = 2n(4n^2 - 3) + 1$

always even + odd = odd

25. $\begin{pmatrix} 0.01 \\ 0.3 \\ 1.50 \end{pmatrix} \quad \begin{pmatrix} 156.6 \\ 111 \end{pmatrix} \quad 0.92 \quad \begin{pmatrix} 0.0092 \\ 0.3 \\ 1.65 \end{pmatrix} \quad \begin{pmatrix} 158.4 \\ 105 \end{pmatrix}$

.....
 The elements of S-J represents the difference in SGD each

 boy will get if they convert their currencies

 in Sept instead of June.....

NAME	CLASS	INDEX No.



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2023

SUBJECT : Mathematics (Revised)
4052/02

DATE : 16 August 2023

LEVEL : Secondary 4G3

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class, and Index No. in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

For π , use either your calculator value of 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 of the marks for this paper is 90.

<i>For Examiner's Use</i>	
<i>Score</i>	/90

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.

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

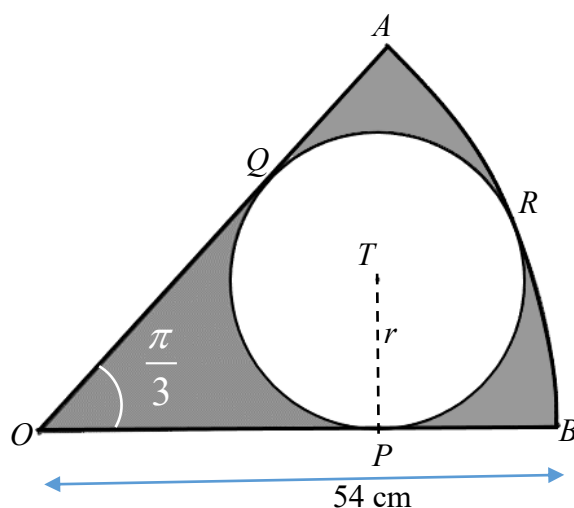
$$a^2 = b^2 + c^2 - 2bc \cos A$$

Statistics

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

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

1.



In the diagram, the circle with centre T and radius r cm, is enclosed in the sector OAB with centre O and radius 54 cm such that they intersect at P , Q and R . The angle AOB is $\frac{\pi}{3}$ radians.

- (a) Find OT in terms of r .

Answer [1]

- (b) Show that the radius of the circle is 18 cm.

Answer:

.....

 [2]

- (c) Find the area of the shaded region in terms of π .

Answer cm^2 [3]

2. (a) The cash price of a new car is \$140 000.

(i) Rishi buys the car on hire purchase.

He pays a deposit of one fifth of the cash price.

He then makes monthly payments of \$2000 for seven years.

Calculate as a percentage, the amount he had to pay above the cash price.

Answer % [3]

(ii) The original value of the car is its cash price of \$140 000.

Each year the value of the car decreases by 10% of its value at the start of the year.

At the end of three years, Rishi decides to sell the car.

Calculate the reduction in the value of the car compared with its original value.

Answer \$ [3]

- (b) Rishi's car uses fuel at an average of 7 litres per 100 km driven.

In an average year Rishi drives 12000 km.

Rishi currently pays \$2.55 per litre of fuel.

Assuming the price of fuel remains constant, calculate the amount Rishi would expect to spend on fuel in one year.

Answer \$..... [2]

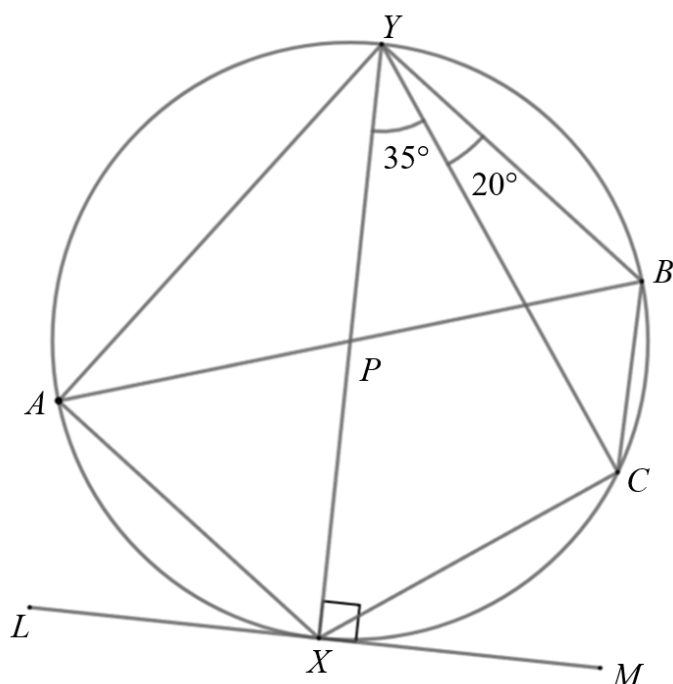
- (c) Rishi's car insurance costs \$888 for one year.

He can either pay the total amount at the start of the year or make 12 equal monthly payments. The insurance company charges an extra 7% for making monthly payments.

Find the total amount of each monthly payment, correct to the nearest cent.

Answer \$..... [2]

3.



Angle $XYZ = 35^\circ$ and angle $CYB = 20^\circ$.

AB is a diameter of the circle.

LM is a tangent to the circle at point X .

(a) Show that P is the centre of the circle,

Answer:

.....

 [2]

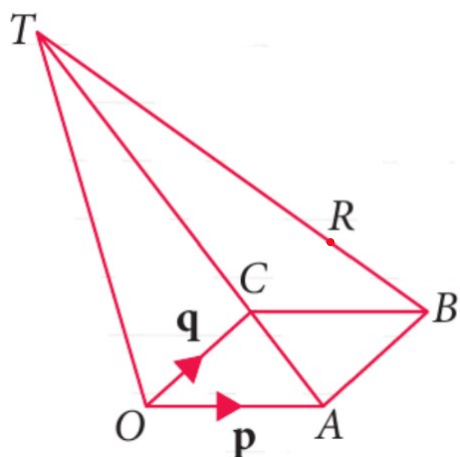
Find, giving reasons for each answer,

(b) angle XAB = because
.....
..... [2]

(c) angle XCB = because
.....
..... [2]

(d) angle XPB = because
.....
..... [2]

4.



$OABC$ is a parallelogram. ACT is a straight line.

R is a point on BT such that $4RT = 3BT$.

$\overrightarrow{OC} = \mathbf{q}$, $\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{TC} = 3(\mathbf{p} - \mathbf{q})$.

(a) Express as simple as possible, in terms of $\mathbf{p}$ and $\mathbf{q}$,

(i) $\overrightarrow{OB}$,

Answer [1]

(ii) $\overrightarrow{OT}$,

Answer [1]

(iii) $\overrightarrow{AT}$,

Answer [2]

(iv) $\overrightarrow{RT}$,

Answer [2]

(b) Show that CR is parallel to AB .

Answer:

.....

 [2]

(c) Find the value of

(i) $\frac{CR}{OC}$

Answer [1]

(ii) $\frac{\text{area of } \triangle TCR}{\text{area of } \triangle TAB}$

Answer [1]

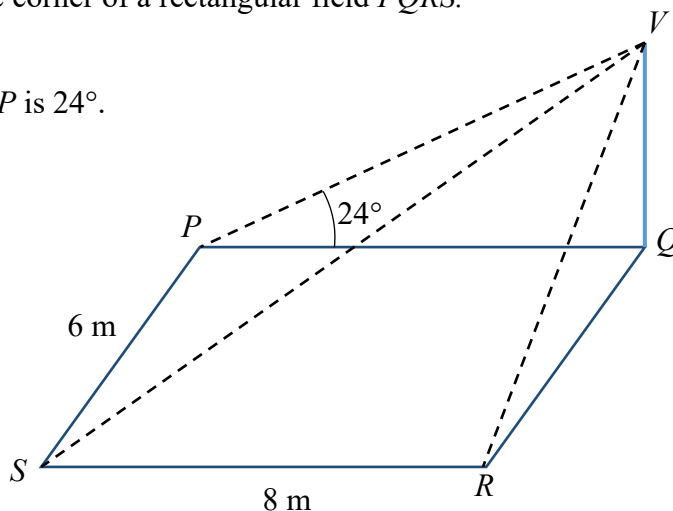
(iii) $\frac{\text{area of } \triangle TOC}{\text{area of } \triangle TCR}$

Answer [1]

5. (a) A vertical pole, VQ , stands at one corner of a rectangular field $PQRS$.

$PS = 6$ m and $SR = 8$ m.

The angle of elevation of V from P is 24° .



Find

- (i) the length of the vertical pole VQ ,

Answer m [1]

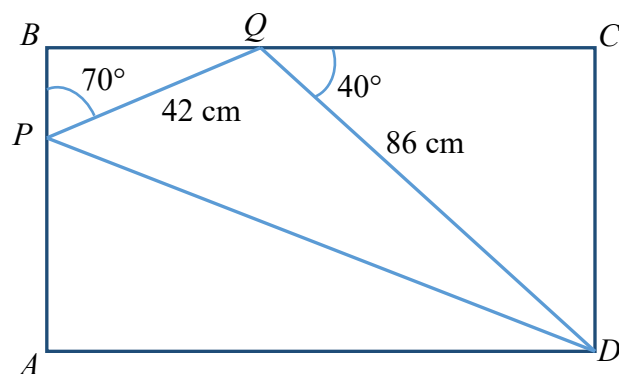
- (ii) the line of sight distance VS ,

Answer m [2]

- (iii) the greatest angle of depression from V to the diagonal PR .

Answer [3]

(b)

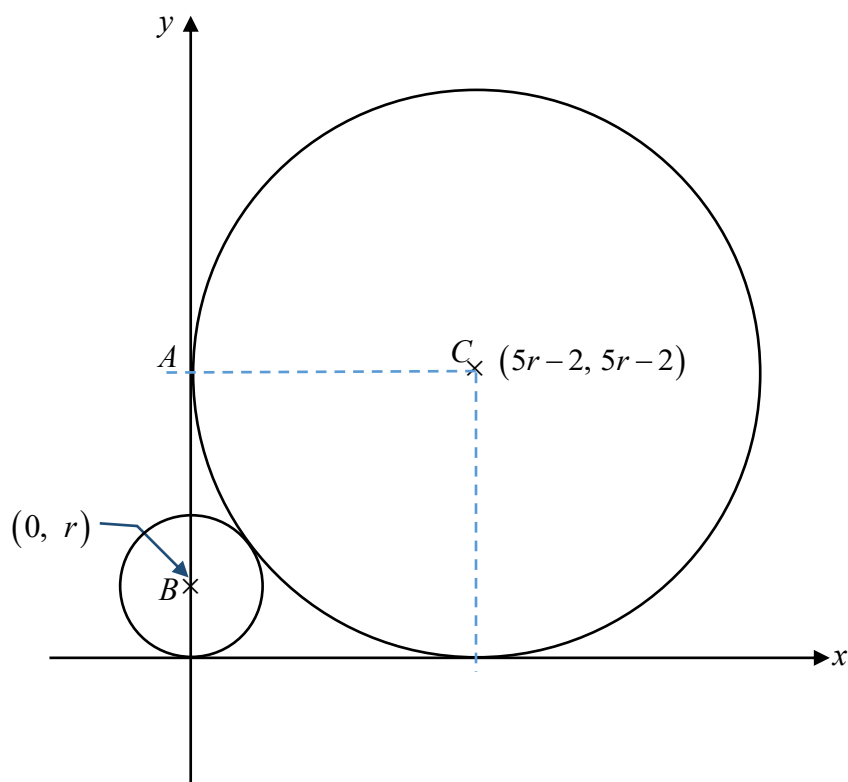


In the diagram, $ABCD$ is a rectangle. The points P and Q lie on AB and BC respectively such that $PQ = 42$ cm, $QD = 86$ cm, angle $BPQ = 70^\circ$ and angle $CQD = 40^\circ$.

Find angle APD .

Answer [5]

6.



In the diagram, the smaller circle with radius r and centre B , is tangential to the x -axis at the origin. It also just touches the larger circle with centre C $(5r-2, 5r-2)$. Both axes are tangents to the larger circle.

- (a) Express in terms of r the length of AB .

Answer [1]

- (b) Express in terms of r the length of BC .

Answer [1]

- (c) Form an equation in terms of r and show that it reduces to

$$5r^2 - 12r + 4 = 0$$

Answer:

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (d) Solve the $5r^2 - 12r + 4 = 0$ by factorisation only.

Answer $r = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (e) Explain why you would reject one of the values of r .

Answer:

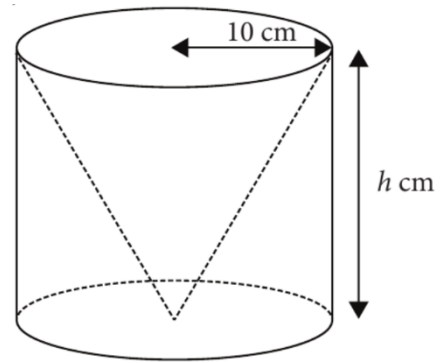
.....

.....

.....

..... [1]

7. The diagram shows a solid cylinder, with radius 10 cm and height h cm, from which a cone of the same radius and height is carved out. The volume of the remaining solid is $1500\pi \text{ cm}^3$



- (a)** Find the height h .

Answer cm [2]

- (b)** Show that the total surface area of the remaining solid is approximately 2500 cm^2 .

Answer:

..... [5]

- (c) (i) The cone that was carved out was melted to form spherical ball bearings each of radius 1.5 cm. Find the maximum number of ball bearings that can be formed.

Answer [2]

- (ii) Find the total surface area of all the ball bearings.

Answer [2]

8. (a) Complete the table of values for $y = 5 - x - \frac{3}{x}$.

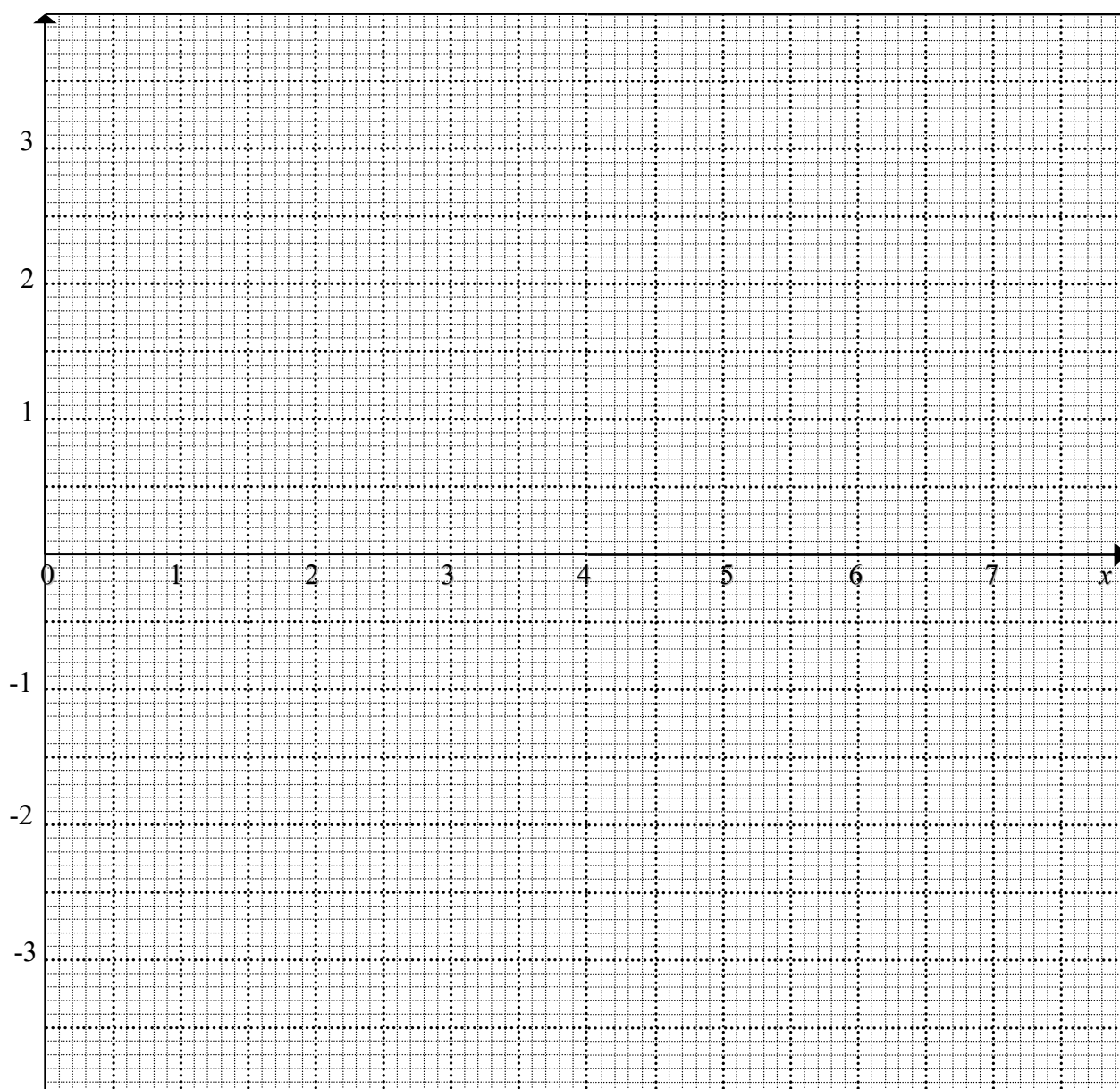
Give your answers correct to 1 decimal place where necessary.

[1]

x	0.5	1	1.5	2	3	4	5	6	7
y	-1.5	1	1.5	1.5	1	0.25	-0.6	-1.5	

- (b) On the grid, draw the graph of $y = 5 - x - \frac{3}{x}$ for $0.5 \leq x \leq 7$

[3]



- (c) Find the gradient of the curve at $x = 1$.

Answer [2]

- (d) Use your graph to find the solutions of the equation $x + \frac{3}{x} = 6$ in the range $0.5 \leq x \leq 7$.

Answer [2]

- (e) (i) On the grid, draw the line $x + 2y = 4$ for $0.5 \leq x \leq 7$. [1]

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

Answer [2]

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

Find the value of A and B .

Answer $A =$

$B =$ [2]

9. A car manufacturer has two new car models. Model X and model Y. Both cost the same to produce but they only intend to manufacture one of these models. In their decision making process they surveyed potential customers about their preferences. They emailed potential customers a brochure with detailed specifications and photos of both models and their intended price.

At the end of the brochure, they were asked which car they would purchase if they were looking to purchase a new car by completing the survey below, where

SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree.

Each of the options are given a value. For example, SD is given the value of 1 while SA is given a value of 5.

		SD	D	N	A	SA
Q1	I will buy Model X	1	2	3	4	5
Q2	I will buy Model Y	1	2	3	4	5

They had a total of 1000 respondents. The results were summarised below. From the table, we can see that 16 of the respondents chose “Disagree” for Model X.

OPTIONS	Number of Respondents					$\sum f$	Mean	Standard deviation
	SD = 1	D = 2	N = 3	A = 4	SA = 5			
Model X (f_X)	7	16	628	347	2	1000		
Model Y (f_Y)		31	14	20		1000	1.907	1.611

However, Firdaus, head of the team to decide which model to manufacture, spilled coffee on the report and some of the data cannot be read. He decided to calculate the missing data himself.

- (a) Show how Firdaus may recalculate the mean and standard deviation of the survey results of Model X.

Answer:

Mean =

Standard deviation =..... [3]

- (b) Based on the mean scores, which model should Firdaus recommend the company to manufacture? Why?

Answer:

.....
.....
.....
..... [2]

- Answer:*

[4]

- (d) From experience, only about 10% of the surveyed respondents would purchase the new models. With the missing data found, should Firdaus change his recommendation? Why?

Answer:

.....

.....

.....

.....

.....

.....

.....

.....

..... [2]

END OF PAPER

Answers

$$1. \quad 54 - r \quad \sin \frac{\pi}{6} = \frac{r}{54 - r} \quad \therefore r = 18 \text{ cm} \quad 508.93$$

$$\frac{1}{2} = \frac{r}{54 - r}$$

$$2r = 54 - r$$

$$3r = 54$$

$$2. \quad 40\% \quad \$37940 \quad \$2142 \quad \$79.18$$

3. Since angle $YXM = 90^\circ$, by converse of "radius is perpendicular to tangent", YX must be a diameter of the circle. Since AB is also a diameter, the intersection, P , of XY and AB is the centre of the circle. [2]

55° (angles in the same segment)

125° (angles in opposite segment)

110° (angle at centre = 2 times angle at the circumference)

$$4. \quad p + q \quad 4q - 3p \quad 4q - 4p \quad \frac{3}{4}(3q - 4p)$$

$$\frac{3}{4} \quad \frac{9}{16} \quad \frac{3}{4}$$

$$\begin{aligned} \overrightarrow{CR} &= \overrightarrow{CT} + \overrightarrow{TR} \\ &= -3(p - q) - \frac{3}{4}(3q - 4p) \quad \therefore \overrightarrow{CR} = \frac{3}{4}\overrightarrow{AB} \\ &= -3p + 3q - \frac{9}{4}q + 3p \quad \therefore \overrightarrow{CR} \parallel \overrightarrow{AB} \\ &= \frac{3}{4}q \end{aligned}$$

$$5. \quad 3.56 \text{ m} \quad 10.6 \text{ m} \quad 36.6^\circ \quad 68.8^\circ$$

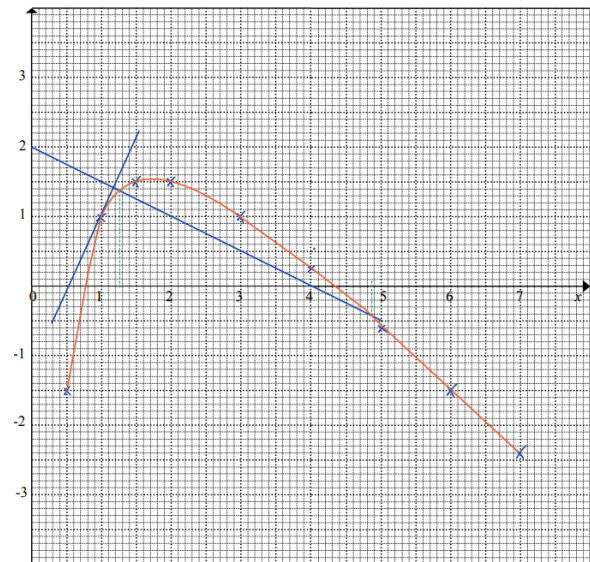
$$6. \quad 4r - 2, 5r - 2, \quad \begin{aligned} (6r - 2)^2 &= (5r - 2)^2 + (4r - 2)^2 \\ 36r^2 - 24r + 4 &= 25r^2 - 20r + 4 + 16r^2 - 16r + 4 \\ -5r^2 + 12r - 4 &= 0 \\ 5r^2 - 12r + 4 &= 0 \end{aligned}$$

$$r = \frac{2}{5} \text{ or } r = 2$$

If $r = 0.4$ then the centre of larger circle would be at $(0, 0)$. Which is not the case.

$$7. \quad 22.5 \text{ cm} \quad \begin{aligned} \text{Answer:} \\ \text{Slant length of one, } l &= \sqrt{22.5^2 + 10^2} = \frac{5\sqrt{97}}{2} \text{ cm} \\ \text{curved surface of cone} &= \pi(10)\left(\frac{5\sqrt{97}}{2}\right) = 25\sqrt{97}\pi \text{ cm}^2 \\ \text{curved surface of cylinder} &= 2\pi(10)(22.5) = 450\pi \\ \text{circular base} &= \pi(10)^2 = 100\pi \\ \text{Total surface area} &= 25\sqrt{97}\pi + 450\pi + 100\pi \\ &= 2501.4 \\ &\approx 2500 \end{aligned} \quad 166 \quad 4700$$

8. $-2.4 \leq x \leq 2$ $x = 0.55$ or $x = 5.4$
 $x = 1.3$ or $x = 4.7$
 $x^2 - 6x + 6 = 0$



9. $\bar{x} = \frac{7(1) + 16(2) + 628(3) + 347(4) + 2(5)}{1000} = 3.321$
 $\sigma = \sqrt{\frac{7(1)^2 + 16(2)^2 + 628(3)^2 + 347(4)^2 + 2(5)^2}{1000} - 3.321^2}$
 $= 0.544021$

Model X. This is because the mean for model X shows that the average response was greater than the 'neutral' score (3) about 3.321.

For model Y The mean is 1.907, which is between the 'disagree' range.

These means that in general model X was more favored by the respondents.

$a + b + 65 = 1000$

$9 + b = 935$

$\frac{9 + 3(12) + 14(3) + 20(4) + 5b}{1000} = 1.907$

$a + 5b = 1732$

$4b = 788$

$b = 197$

$a = 935 - 197 = 738$

Model Y has 197 respondents who strongly Agrees to purchase, while model X has only 2. Almost 20% of the respondents were highly favorable to buying model Y, which is significantly higher than the expected 10%. Hence, from this discovery, Firdaus should recommend Model Y instead.