ST JOSEPH'S INSTITUTION
PRELIMINARY EXAMINATION 2025
(YEAR 4)

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS **4052/01**

Paper 1 **15 August 2025**

Candidates answer on the Question Paper. **2 hours 15 minutes (10:15 – 12:30)**

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use 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 marks for this paper is 90.

This document consist of **27** printed pages and **1** blank page.

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 At a football match, the attendance was reported as 26 500 people, rounded to the nearest hundred.

Using x to represent the possible number of people who attended the match, write down an inequality in x.

Answer ..... [1]

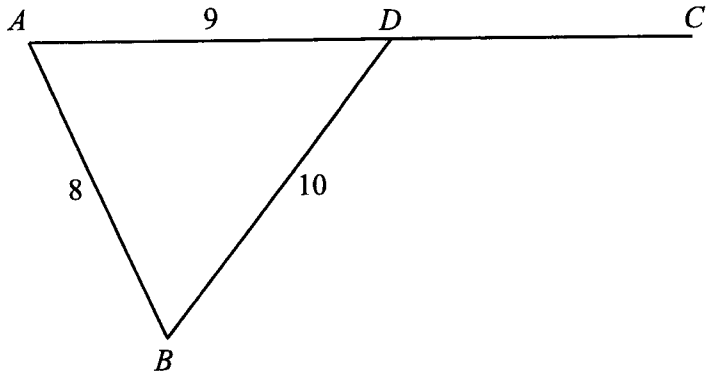
---

2 Joseph invested \$50 000 at a simple interest of r% per year.
After q months the interest was \$$I$.

Write down and simplify an expression for I, in terms of q and r.

Answer $I =$ ..... [2]

3



ABD is a triangle.
ADC is a straight line.
$AB = 8$ cm, $AD = 9$ cm and $BD = 10$ cm.

Without using a calculator, find the exact value of $\cos \angle BDC$.

Answer $\cos \angle BDC =$ ..... [2]

4 Jane either walks or cycles to school.

The probability that she cycles to school is $\frac{1}{5}$.

(a) Write down the probability that Jane walks to school.

Answer ..... [1]

(b) There are 190 days in a school year.

Find the number of days Jane is likely to walk to school in a school year.

Answer ..... days [1]

---

5 A polygon has n sides.

When the number of sides is doubled, the interior angle is increased by 20°.

Find the value of n.

Answer $n =$ ..... [2]

---

6 The marks of 19 students in a Science test are shown in the stem-and-leaf diagram.

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

Key 2 | 6 means 26 marks

(a) Write down the median mark.

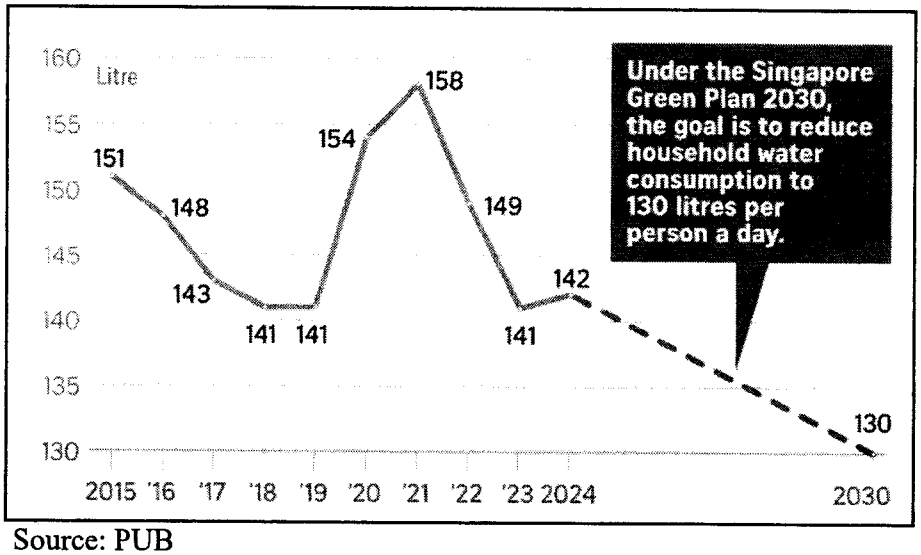
Answer ..... [1]

(b) The range of marks for the Science test is 32.

Find the value of x.

Answer $x =$ ..... [1]

7 The graph shows the average daily household water consumption per person in Singapore over the years.



Source: PUB
Straits Times Graphics

(a) Under the Singapore Green Plan 2030, find the projected percentage reduction in household water consumption from 2024 to 2030.

Answer ..... % [1]

(b) State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

.....

.....

..... [2]

8 Simplify $\left(\frac{16m^6}{9q^8}\right)^{-\frac{3}{2}}$.

Answer ..... [2]

---

9 The number N is a multiple of 18 and is both a perfect square and a perfect cube.

Find the smallest possible value of N.

Answer $N =$ ..... [2]

---

10 Write as a single fraction in its simplest form $\frac{1}{2-x} - \frac{3x+2}{x^2-7x+10}$.

Answer ..... [3]

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

$T_1 = 1^2 + 1^2 = 2$

$T_2 = 5^2 + 2^2 = 29$

$T_3 = 9^2 + 3^2 = 90$

$T_4 = 13^2 + 4^2 = 185$

(a) Evaluate T_5.

Answer $T_5 =$ ..... [1]

(b) T_n is the nth term of the sequence.

Find an expression, in terms of n, for T_n, in the form $an^2 + bn + c$ where a, b and c are integers.

Answer $T_n =$ ..... [3]

12 The frequency table shows the number of mistakes made by a class in a Mathematics quiz.

Number of mistakes	0	1	2	3	4	5
Number of students	3	x	9	6	2	1

(a) If the distribution is bimodal (has two modes), state the value of x.

Answer $x =$ ..... [1]

(b) If the median number of mistakes is 2, find the largest possible value of x.

Answer $x =$ ..... [2]

---

13 Mr Lee travels at 20 km/h for 35% of the total distance travelled and at a speed of 30 km/h for the remaining distance.

Calculate Mr Lee's average speed in km/h for the total distance travelled.

Answer ..... km/h [3]

---

14 Two sets of test scores are shown below.

Set A: 60, 60, 60, 60, 60

Set B: 50, 55, 60, 65, 70

(a) Without any calculation, explain which set has the larger standard deviation?

.....

.....

..... [2]

(b) Set C has a standard deviation of 7.
Every value is increased by 10, then multiplied by 2.

Find the new standard deviation.

Answer ..... [1]

15 $\varepsilon = \{x : x \text{ is an integer and } 1 \leq x < 25\}$
$P = \{x : x \text{ is a multiple of } 3\}$
$R = \{x : (x-3)(x-7) = 0\}$

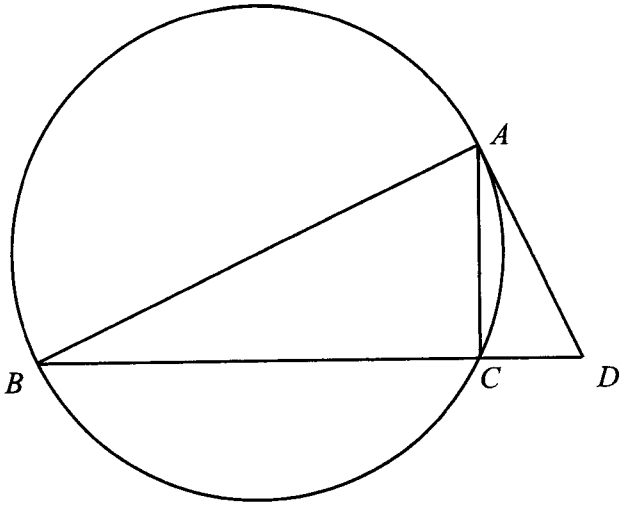
(a) List the elements contained in the set $P \cap R'$.

Answer ..... [2]

(b) A number q is chosen at random from the universal set.
Find the probability that $q \in P \cup R$.

Answer ..... [2]

16



A, B and C are points on a circle.
AB is the diameter of a circle.
AD is the tangent to the circle at point A and BD is a straight line that passes through point C.

(a) Show that triangle ABD is similar to triangle CAD.

Answer

[2]

(b) Given that $BD = 25$ cm, $DC = 9$ cm and $DA = x$ cm.

Find the value of x.

Answer $x =$ ..... [2]

17 F is directly proportional to v^2.

Find the percentage change in F when v is reduced by 20%.

Answer ..... % [3]

---

18 **(a)** Factorise $x^2 - 169$.

Answer ..... [1]

(b) Use your answer to **part (a)** to find the two factors of 1431 other than 1 and 1431.

Answer ..... , ... [2]

---

19 **(a)** A reservoir has an area of 1.44 km^2.
The area of the reservoir on the map is 6.25 cm^2.

Express the scale of the map in the form 1:n.

Answer ..... [2]

(b) The actual length of a running track is x m.

Find an expression of the length of the running track on the map in centimetres.

Answer ..... cm [1]

20 A rectangular box has dimensions 120 cm by 84 cm by 96 cm.
Sally would like to fill the box completely with identical, largest possible cubes.

(a) Find the largest possible length of each side of the cube.

Answer ..... cm [2]

(b) How many such cubes can fit exactly into the box?

Answer ..... [2]

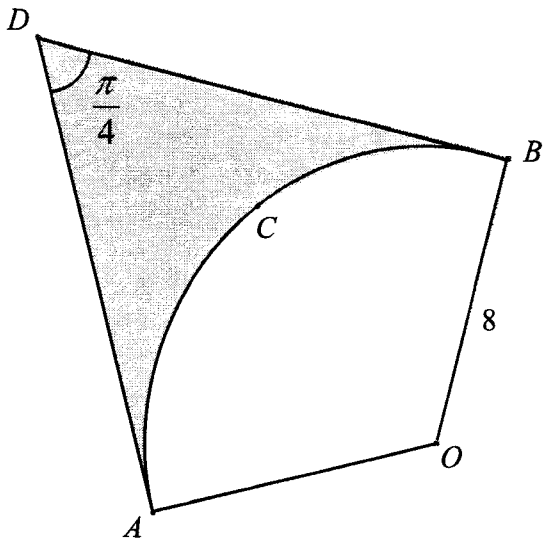
21 **(a)** Factorise completely $2x^2 - 4xy - x + 2y$.

Answer ..... [2]

(b) Solve the quadratic equation $2x^2 - 8x = 7$ by completing the square.
Give your solutions correct to two decimal places.

Answer $x =$ ..... or ..... [3]

22



ACB is an arc of a circle with centre O and radius 8 cm.

AD and BD are tangents to the circle at A and B and angle $ADB = \frac{\pi}{4}$.

(a) Find the length of AD.

Answer ..... cm [2]

(b) Find the area of the shaded area.

Answer ..... cm^2 [3]

23 A paint shop mixes three base colours (Red, Blue, Yellow) to create three shades, A, B, and C.
1 can of Shade A needs 2 litres of red, 3 litres of blue and 1 litre yellow base colours.
1 can of Shade B needs 1 litre of red, 2 litres of blue and 4 litres of yellow base colours.
1 can of Shade C needs 3 litres of red, 1 litre of blue and 2 litres of yellow base colours.
The matrix **M** shows the number of litres of each base colour needed for 1 can of each shade.

$$\begin{matrix} & \text{A} & \text{B} & \text{C} & \\ \mathbf{M} = & \begin{pmatrix} 2 & 1 & 3 \\ 3 & 2 & 1 \\ 1 & 4 & 2 \end{pmatrix} & & & \begin{matrix} \text{Red} \\ \text{Blue} \\ \text{Yellow} \end{matrix} \end{matrix}$$

(a) The shop wants to make 4 cans of Shade A, 2 cans of Shade B, and x cans of Shade C.

Represent this information in a 3×1 column matrix, **N**, in terms of x.

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

(b) Find, in terms of x, the matrix $\mathbf{L} = \mathbf{MN}$.

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

(c) State what each of the element in matrix **L** represents.

.....

.....

..... [1]

(d) The shop has 25 litres of red, 25 litres of blue, and 25 litres of yellow base colours in stock.

Find the largest integer value of x so that none of the base colours runs out.

Answer $x =$ ..... [2]

24 Bag A contains 5 red balls and 3 blue balls.
Bag B initially contains x red balls and 2 blue balls.
A ball is drawn at random from Bag A and placed into Bag B.
Then, a ball is drawn at random from Bag B.

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

Answer

[2]

(b) The probability of drawing a red ball from Bag A and a red ball from Bag B is $\frac{5}{12}$.

Find the value of x.

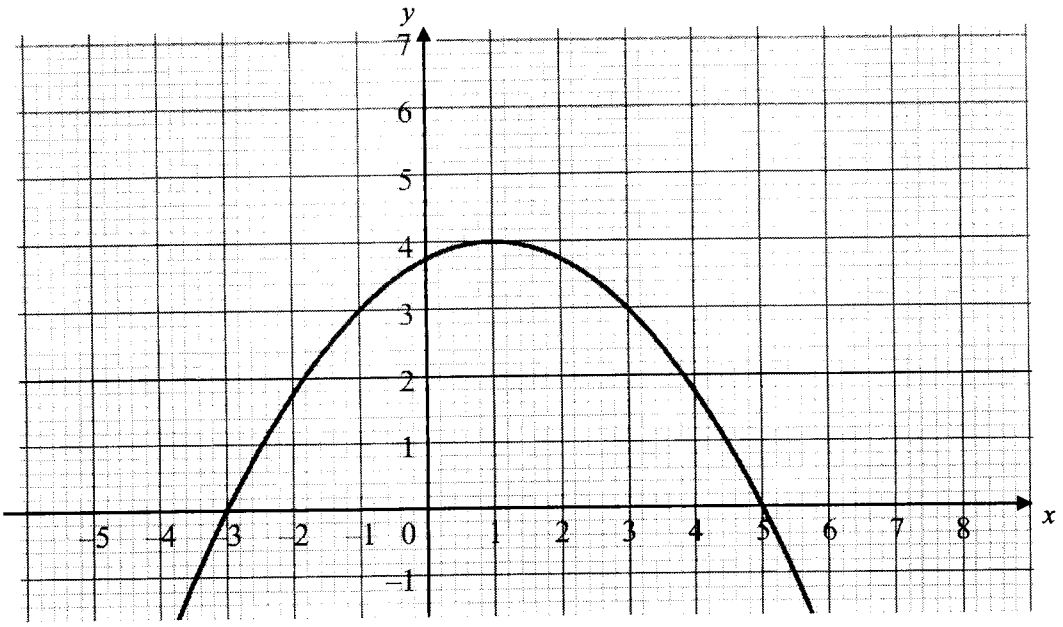
Answer $x =$ ..... [2]

(b) Explain how the value of x affects the probability of drawing a blue ball from Bag B.

.....

..... [1]

25 The graph of $y = -0.25x^2 + 0.5x + 3.75$ is drawn on the grid.



(a) Write down the equation of the line of symmetry of the graph.

Answer ..... [1]

(b) By drawing a tangent, find the gradient of the curve at $x = 3$.

Answer gradient = ... [2]

(c) Explain how you can determine, from the graph, for a given value of m, whether $-0.25x^2 + 0.5x + 3.75 = m$ has two, one, or no real solutions.

.....

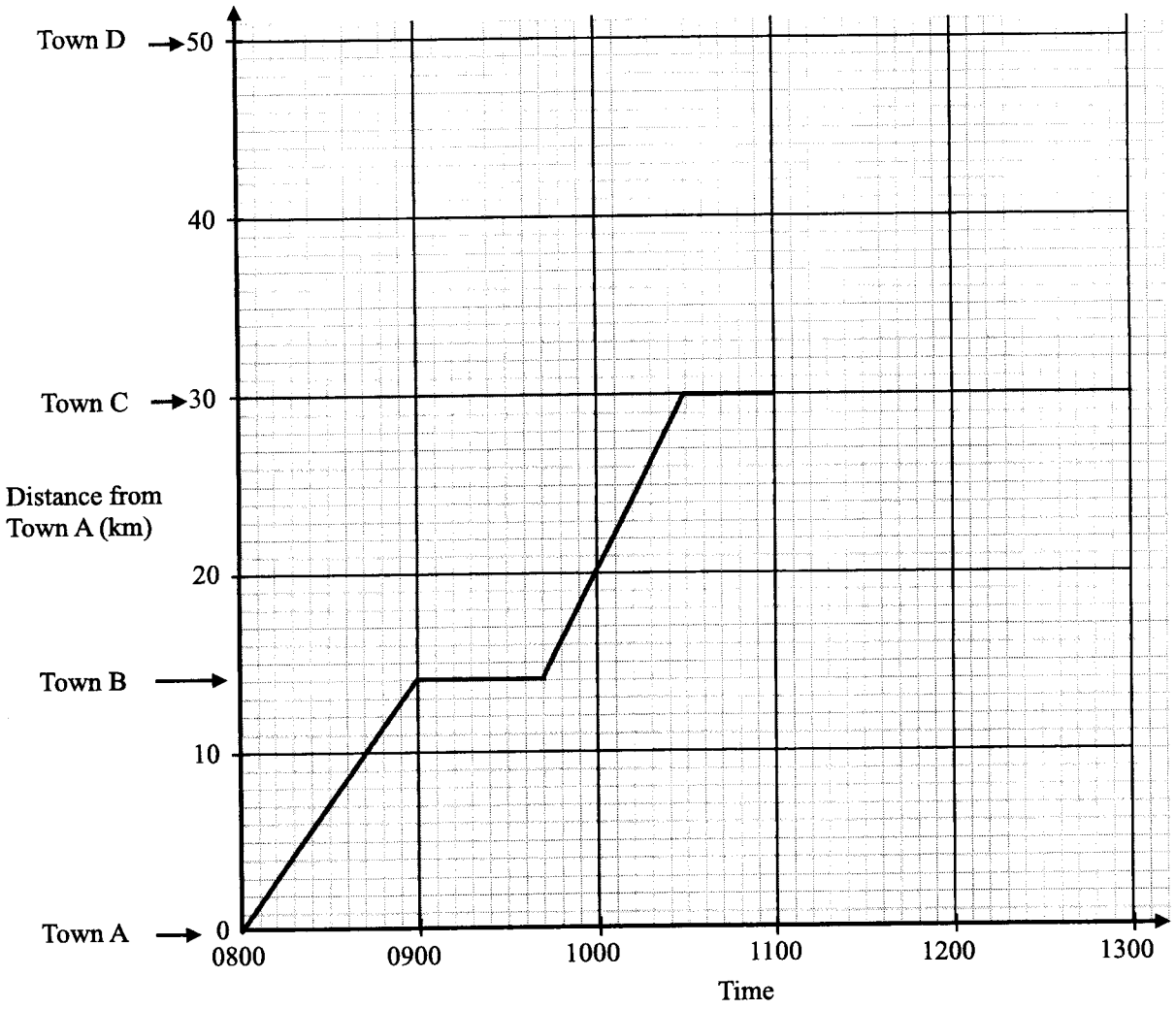
.....

..... [1]

(d) By drawing a suitable straight line on the grid, solve the equation $-0.25x^2 + 0.5x + 1.25 = -0.5x$.

Answer $x =$ ..... or ..... [3]

26 Lily leaves Town A at 0800 and cycles to Town C.
The travel graph shows Lily's journey.



(a) Write down what happens at 0930.

.....

..... [1]

(b) Find Lily's average speed, in kilometres per hour, from Town B to Town C.

Answer ..... km/h [2]

(c) Lily leaves Town C at 1100.
She continues to Town D at a constant speed of $16\frac{2}{3}$ kilometres per hour.

On the travel graph, complete Lily's journey. [2]

(d) Emily leaves Town C at 1030 and arrives at Town D at 1236.
She cycles at a constant speed on the same road as Lily, without stopping.

Draw a line on the travel graph to show Emily's journey. [1]

(e) Find the distance from Town D when Emily and Lily pass each other.

Answer ..... km [1]

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ST JOSEPH'S INSTITUTION
PRELIMINARY EXAMINATION 2025
(YEAR 4)

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS **4052/02**

Paper 2 **21 August 2025**

Candidates answer on the Question Paper. **2 hours 15 minutes (08:05 – 10:20)**

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
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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 marks for this paper is 90.

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[Turn over]

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

TURN OVER FOR QUESTION 1

1 **(a)** It is given that $a = \sqrt{\dfrac{3n}{2n+5k}}$.

(i) Find the value of a when $n = \dfrac{1}{3}$ and $k = \dfrac{2}{3}$.

Answer $a =$ ..... [1]

(ii) Express n in terms of a and k.

Answer $n =$ ..... [3]

(b) Solve the inequality $\frac{4-5x}{6} > 1 - \frac{x+5}{4}$.

Answer ..... [2]

(c) Solve the equation $\frac{x-2}{x+1} - \frac{x+3}{x-1} = 5$.

Give your solutions correct to 2 decimal places.

Answer $x =$ ..... or ..... [5]

2 **(a)** The total population of the Philippines was estimated at 114.9 million in June 2023 and 116.79 million in June 2025.

(i) Write 114.9 million in standard form correct to 3 significant figures.

Answer ..... [1]

(ii) The land area of the Philippines is about 300 000 square kilometres.
The government wants to keep the population density below 350 people per square kilometre.

Based on the June 2025 population figure, determine whether the Philippines has exceeded this density limit. Show your calculations.

Answer

.....

..... [2]

(b) The cost of making a bicycle was made up of three components: materials, wages, and factory rent.
These costs were split in the ratio 2 : 3 : 5, respectively.
In the following year, the cost of materials increased by 40%, the cost of wages was halved, and the cost of factory rent remained unchanged.

Based on these changes, calculate the percentage change in the total cost of making the bicycle.

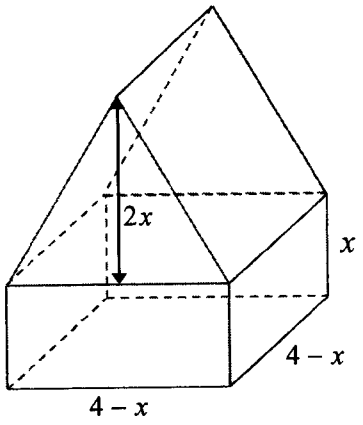
Answer .....% [2]

(c) Jia Min and 11 friends went for dinner.
The set meal cost $\$x$ per person excluding service charge and Goods and Services Tax (GST).
The restaurant applied a 10% service charge to the total meal cost, followed by a 9% GST on the amount including the service charge.
She collected \$30 from each of her 11 friends, then topped up the remaining \$29.70 herself to cover the full bill.

Find the value of x.

Answer $x =$ ..... [4]

3



The diagram shows a solid made up of a cuboid with dimensions $(4-x)$ cm by $(4-x)$ cm by x cm and a triangular prism stacked on top of it.
The height of the triangular prism is $2x$ cm.

(a) Show that the volume of the solid, y cm^3, is given by $y = 2x^3 - 16x^2 + 32x$.

Answer

[3]

(b) Explain why $0 < x < 4$.

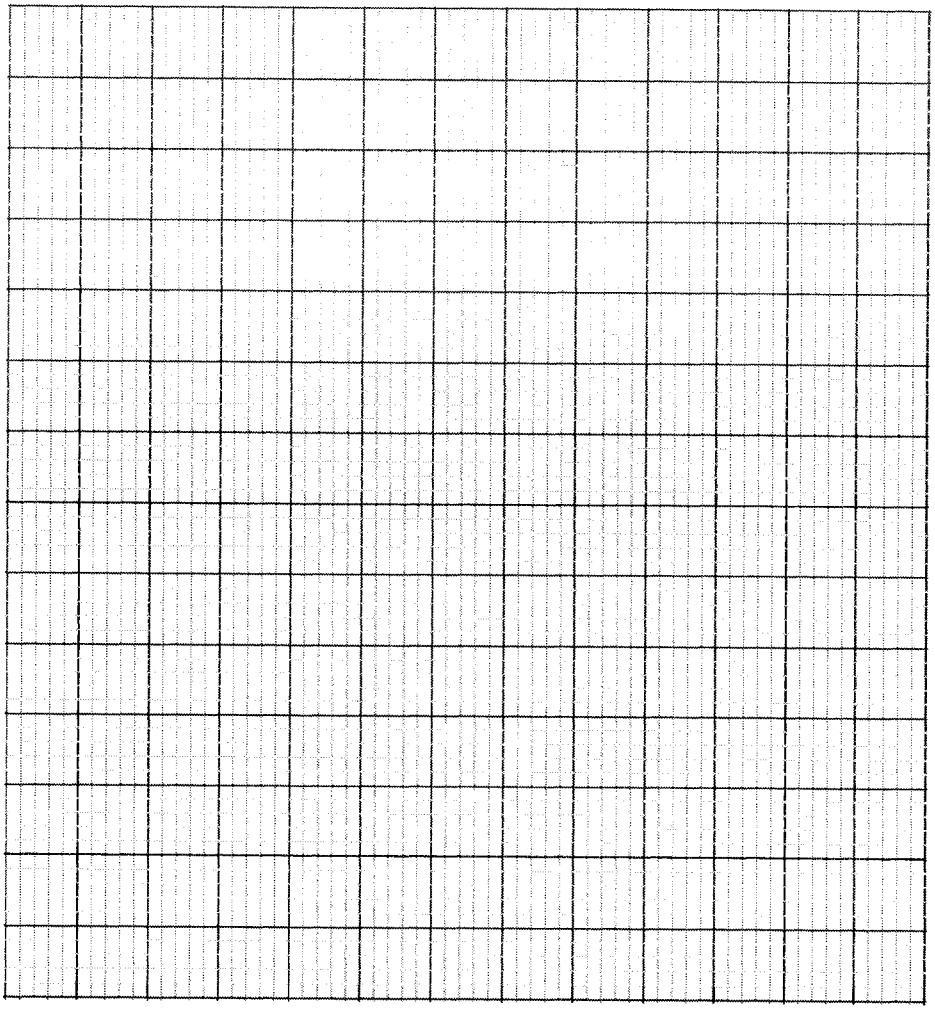
..... [1]

(c) Complete the table of values for $y = 2x^3 - 16x^2 + 32x$.

x	0.5	1	1.5	2	2.5	3	3.5
y	12.25	18	18.75	16	11.25	6	

[1]

(d) On the grid, draw the graph of $y = 2x^3 - 16x^2 + 32x$ for $0.5 \leq x \leq 3.5$.



[3]

(e) Use your graph to find the smallest value of x when the volume of the solid is equal to 15 cm^3.

Answer $x =$ ..... [1]

(f) Explain how the graph shows that the volume of the solid cannot be equal to 20 cm^3.

.....

..... [1]

4

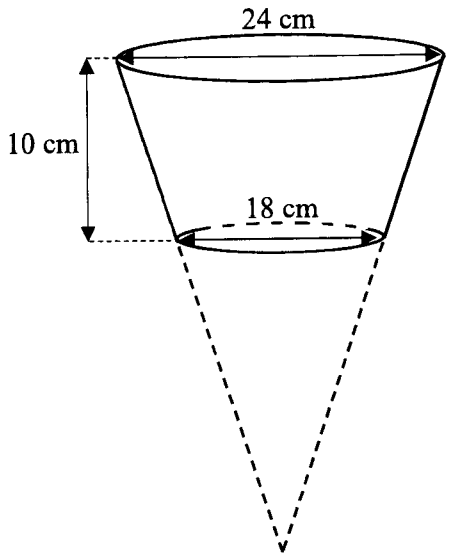


Figure 1

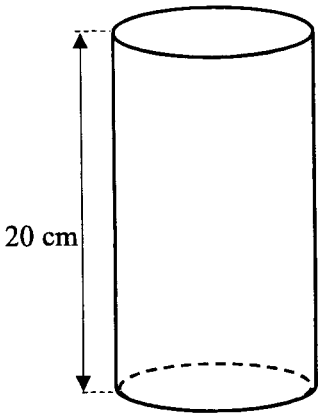


Figure 2

(a) Figure 1 shows a container in the shape of a frustum of a cone.
The container has an open circular top with a diameter of 24 cm and a circular base with a diameter of 18 cm.
It is completely filled with water to a height of 10 cm.

Calculate the volume of water in the container, in litres, leaving your answer in terms of π.

Answer ..... litres [4]

(b) All the water is poured into an open cylindrical container of height 20 cm, as shown in Figure 2.

The water fills the cylinder to $\frac{3}{4}$ of its height.

Calculate the surface area of the cylindrical container that is not in contact with the water.

Answer ..... cm^2 [4]

5 The equation of line p is $3x - 2y = 6$.
The equation of line q is $x + y = 5$.
The two lines intersect at point T.

(a) Find the coordinates of point T.

Answer (..... , ...) [3]

(b) Line q intersects the x-axis at point A and the y-axis at point B.

Find the shortest distance from the origin O to the line segment AB.

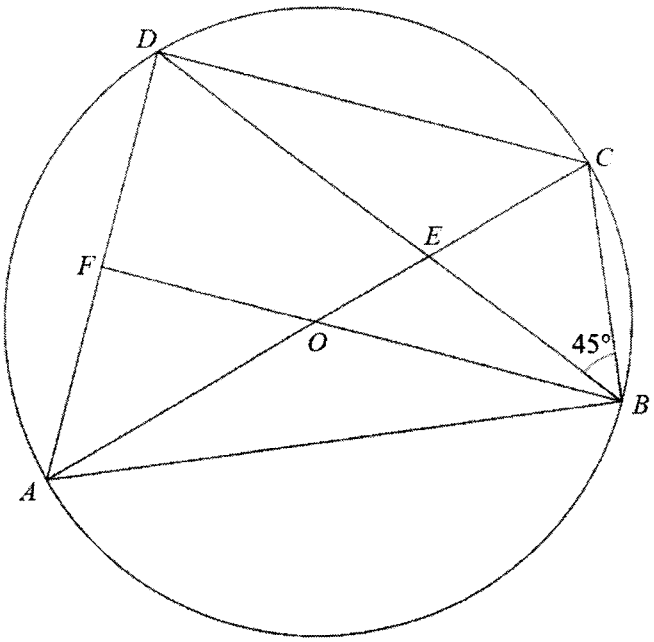
Answer ..... units [4]

(c) Points O, B, R and T are vertices of a trapezium, where OB is parallel to RT.
The area of trapezium is 18 square units.

Write down the two possible y-coordinates of point R.

Answer *y- coordinates of* R = ... or ..... [3]

6



The diagram shows a circle $ABCD$, centre O.
F is the midpoint of the chord AD.
BF passes through O.
E is the point of intersection of BD and diameter AC.
Angle $DBC = 45°$.

(a) Prove that triangle ABF is congruent to triangle DBF.
Give a reason for each statement you make.

Answer

[2]

(b) Find, giving reasons for each answer,

(i) angle DAC,

Answer Angle $DAC =$ ..... [1]

(ii) angle *DCA*,

Answer Angle *DCA* = ... [1]

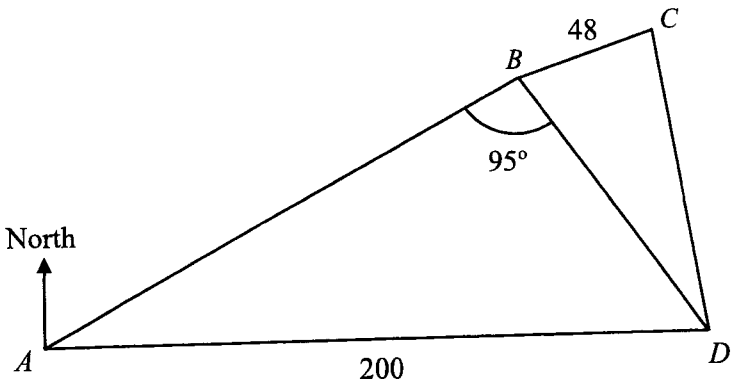
(iii) angle *AOB*,

Answer Angle *AOB* = ... [2]

(iv) angle *AED*.

Answer Angle *AED* = ... [2]

7



The diagram shows a field $ABCD$ on horizontal ground crossed by a path BD.
D is due east of A.
$AD = 200$ m, $BC = 48$ m and angle $ABD = 95°$.
The bearing of B from A is $045.8°$.

(a) Calculate BD.

Answer $BD =$ ..... m [2]

(b) The area of triangle BCD is 3300 m^2.

Calculate the bearing of C from B.

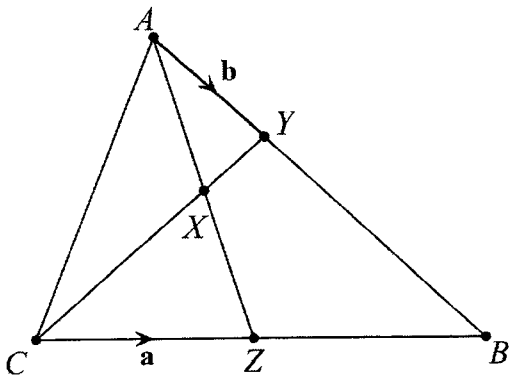
Answer ..... [3]

(c) A vertical tower of height 80 m stands at C.
Sally walks from B to D and reaches a point P where the angle of elevation of the top of the tower from P is the greatest.

Find the angle of elevation of the top of the tower from P.

Answer ..... [4]

8



ABC is a triangle.
Y is the point on AB such that $AY : AB = 1 : 3$.
X is the midpoint of AZ.
Z is the midpoint of CB.
$\overrightarrow{CZ} = \mathbf{a}$ and $\overrightarrow{AY} = \mathbf{b}$.

(a) Express $\overrightarrow{AC}$, as simply as possible, in terms of **a** and **b**.

Answer $\overrightarrow{AC} =$ ..... [1]

(b) Express $\overrightarrow{XZ}$, as simply as possible, in terms of **a** and **b**.

Answer $\overrightarrow{XZ} =$ ..... [1]

(c) Express $\overrightarrow{CX}$, as simply as possible, in terms of **a** and **b**.

Answer $\overrightarrow{CX} =$ ..... [1]

(d) Express $\overrightarrow{CY}$, as simply as possible, in terms of **a** and **b.**

Answer $\overrightarrow{CY}$ = ... [1]

(e) Hence, use your result to **(c)** and **(d)**, to explain why C, X and Y are collinear.

Answer

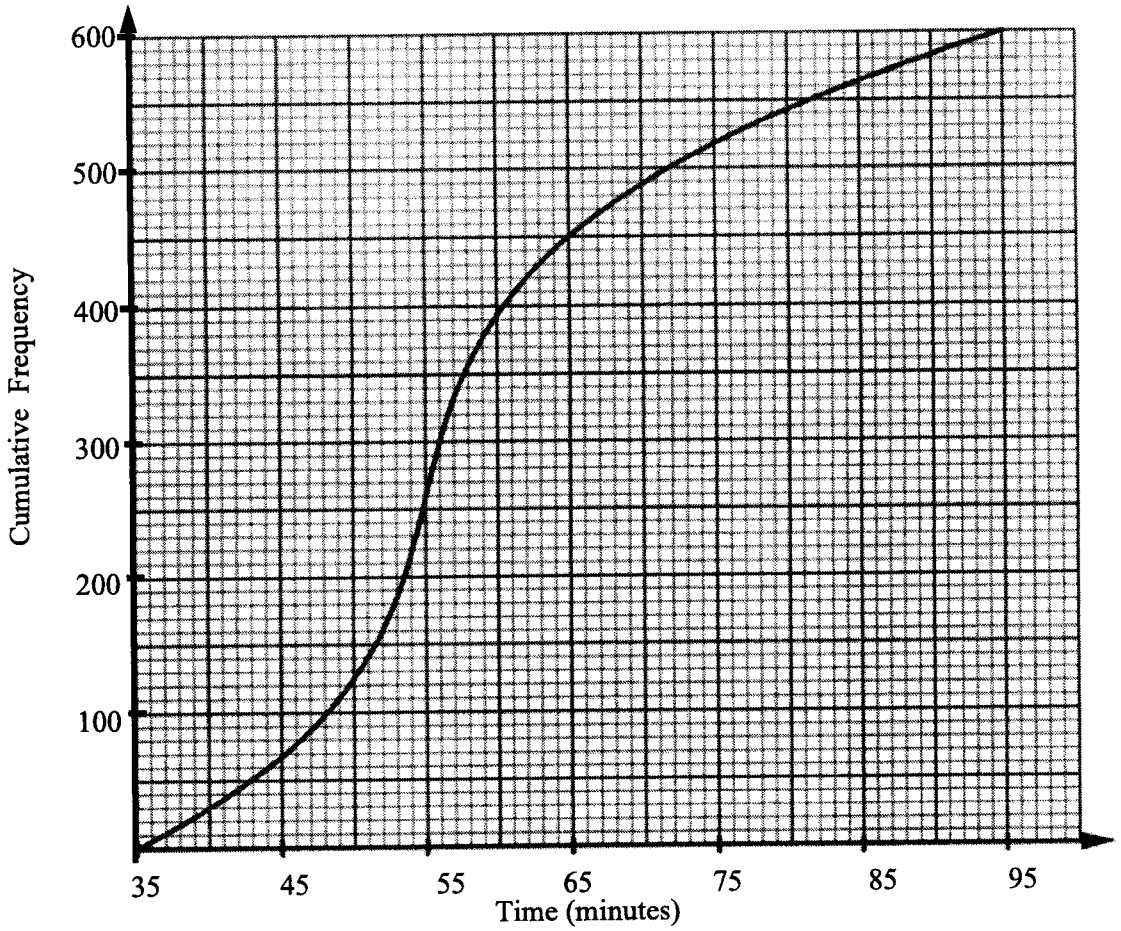
.....

..... [2]

(f) Calculate the value of $\frac{\text{area of triangle } ACY}{\text{area of triangle } ACZ}$.

Answer ..... [2]

9 School X recorded the number of minutes each of its 600 pupils took to complete Task A. The cumulative frequency curve shows the distribution of the results.



(a) Use the curve to estimate

(i) the median time taken,

Answer ..... minutes [1]

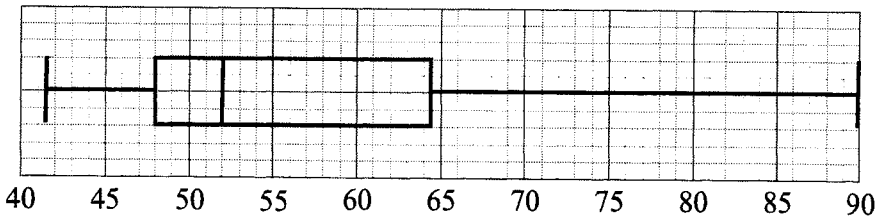
(ii) the interquartile range,

Answer ..... minutes [1]

(iii) the probability that a pupil chosen at random from the school took more than 70 minutes.

Answer ..... [2]

(b) The box-and-whiskers plot shows the time taken by 600 pupils from School Y to complete Task A.



(i) Make a comment on the performance of the students from the two schools.

.....

..... [1]

(ii) It is given that a value is an outlier if it is below $Q1 - 1.5 \times \text{IQR}$ or above $Q3 + 1.5 \times \text{IQR}$, where $Q1$ is the lower quartile, $Q3$ is the upper quartile and $\text{IQR} = Q3 - Q1$.

If a randomly selected student from either school took 88 minutes to complete the task, explain for which school this result would be more unexpected.

Answer

.....

..... [2]

(c) The times taken by School X to complete another task, Task B, have the same interquartile range but a smaller median.

Describe how the cumulative frequency curve will be different from the given curve in **(a)**.

.....

..... [1]

10 In Singapore, stamp duties are taxes imposed on transactions related to the purchase or sale of properties. There are three main types of stamp duties:

Type 1: Buyer's Stamp Duty (BSD)

BSD is applicable for all property purchases and is computed based on the purchase price or market value, whichever is higher.

- Buyer's Stamp Duty (BSD) rates

On or after 15 Feb 2023		
Purchase price or market value of the property	**BSD rates for residential properties**	**BSD rates for non-residential properties**
First $180,000	1%	1%
Next $180,000	2%	2%
Next $640,000	3%	3%
Next $500,000	4%	4%
Next $1,500,000	5%	5%
Remaining amount	6%	

Type 2: Additional Buyer's Stamp Duty (ABSD)

ABSD applies on top of BSD for certain property purchases, depending on the buyer's residency status and number of properties owned.

Additional Buyer's Stamp Duty (ABSD) rates is computed based on the purchase price or market value, whichever is higher.

Profile of buyer	**ABSD rates from 16 Dec 2021 to 26 Apr 2023**	**ABSD rates on or after 27 Apr 2023**
Singapore Citizens (SC) buying first residential property	Not applicable	Not applicable
SC buying second residential property	17%	20%
SC buying third and subsequent residential property	25%	30%
Singapore Permanent Residents (SPR) buying first residential property	5%	5%
SPR buying second residential property	25%	30%
SPR buying third and subsequent residential property	30%	35%
Foreigners (FR) buying any residential property	30%	60%

Type 3: Seller's Stamp Duty (SSD)

SSD applies if residential properties are sold within a specified holding period.

- Seller's Stamp Duty (SSD) rates in Singapore (2024)

How long property has been held	**SSD rate (of selling price or market value, whichever is higher)**
Up to one year	12%
More than one year and up to two years	8%
More than 2 years and up to 3 years	4%
More than 3 years	No SSD payable

Rachel is a Singapore citizen who owns one private residential property.
In March 2023, she decided to purchase a second private residential property, Property P, at the market price of $2 000 000 (excluding the stamp duties) and paid the full amount without taking loans.
In April 2025, Rachel receives an offer to sell Property P for $2 300 000.

(a) Calculate the total stamp duties Rachel paid when she purchased Property P in 2023.

Answer $ ..... [3]

(b) Property prices have been rising by 7% every year.
Determine whether Rachel should accept the offer to sell Property P in April 2025 or wait until April 2026 to sell it at market value. Justify your decision and show your calculations clearly.

Some other information:

- All calculations should exclude legal fees, agent commissions, loan/mortgage costs, renovation/maintenance costs, and effects of interest rate changes.
- Market environment and government housing policies are assumed stable, with no sudden changes.

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..... [6]

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