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CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2020

CANDIDATE NAME	
CLASS	
REGISTER NUMBER	

MATHEMATICS 4048/01

Paper 1 **28 August 2020**

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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 number of marks for this paper is 80.

/ 80

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

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Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 Evaluate $1.15 \div 15$, correct to 3 significant figures.

Answer ..... [1]

---

2 Solve the inequalities $\frac{5}{3}p \leq 2p - 1 < 10$.

Answer ..... [2]

---

3 Simplify $\left(\frac{p^6}{9q^4}\right)^{-\frac{1}{2}}$.

Answer ..... [2]

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4 Factorise completely $6ab^2 - 3b - 1 + 2ab$.

Answer …… [2]

---

5 Use factorisation to solve the equation.

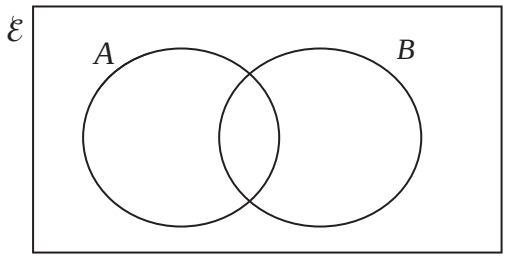
$$3x^2 + 5x - 2 = 0$$

Answer x = …… or …… [2]

---

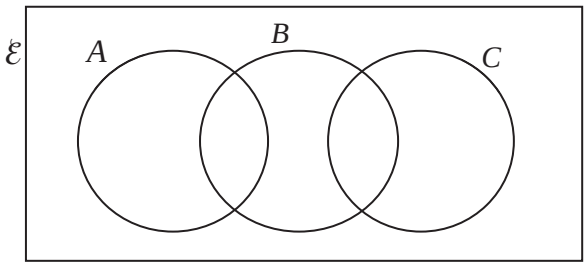
6 **(a)** On the Venn diagram, shade the region which represents $A \cup B'$. [1]

Answer



(b) $\{x\} \subset (A \cap B) \cup C$, $x \notin A$ and $B = \{w, y, z\}$.
On the diagram, mark and label a point to represent element *x*. [1]

Answer



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7 **(a)** The time taken to paint a wall is inversely proportional to the number of workers.
3 workers take 8 hours.
Find the time it would have taken 5 workers to paint the wall.

Answer …….hours [1]

(b) The surface area of a sphere is directly proportional to the square of its radius.
The surface area of a sphere is A cm^2 and its radius is r cm.
The radius is increased by 200%.
Find, in terms of A, the surface area of the new sphere.

Answer …….cm^2 [1]

---

8 $m = \dfrac{n\left(2 - p^2\right)}{p^2 + 1}$

Express p in terms of m and n.

Answer p = …… [2]

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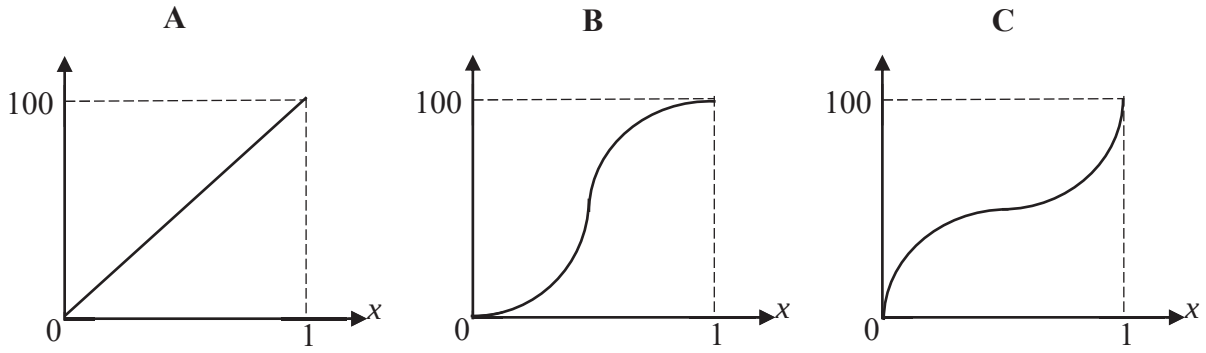
9 In a class of m students, the mean mark of a Mathematics test is 65.
In another class of n students, the mean mark of the same Mathematics test is 82.
The mean mark of the two classes is 74.

Find the value of $\frac{m}{n}$.

Answer ..... [2]

---

10 **(a)** The diagram shows the cumulative frequency curves of three distributions.



Arrange the three distributions in the order of their standard deviations, from the smallest to the largest.

Answer .....… < ……. < ……. [1]

(b) There are n data points in a distribution.

The mean, standard deviation and interquartile range of the distribution are m, s and r respectively.

3 is added to **each** data point in the distribution.

Write down, in terms of m, s and r, the new mean, standard deviation and interquartile range.

Answer mean = ……..……...

standard deviation = …….

interquartile range = ……. [1]

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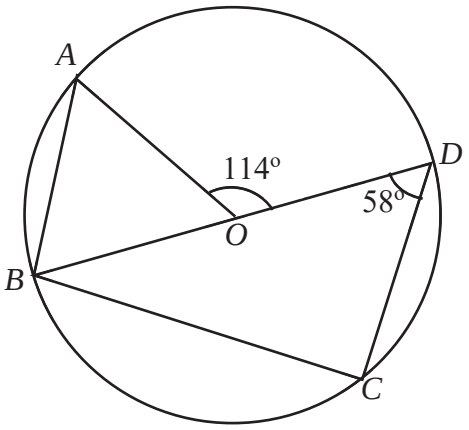
11



Points A, B, C and D lie on a circle centre O.
BOD is a straight line.
Angle $AOD = 114^\circ$ and angle $BDC = 58^\circ$.
Explain why AB is not parallel to DC.

Answer

……..…….

…….. [2]

---

12 The hire-purchase price of the refrigerator is 116% of the cash price.
The hire-purchase price is a deposit of 12% of the cash price plus 24 monthly payments of \$195.
Find the cash price of the refrigerator.

Answer \$.....…… [3]

[Turn over

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13 Peter has a collection of 54 toy vehicles.
24 are cars, 12 are vans and the rest are trucks.

(a) Write, in its simplest form, the ratio of cars to vans to trucks.

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

(b) Peter decides to reduce his collection.
He sells c cars, v vans and t trucks.
The ratio of cars to vans to trucks he has now is 2 : 2 : 1.

Given that he sold

- at least one of each type of vehicle and
- the smallest possible number of vehicles,

find c, v and t.

Answer c = ...

v = ...

t = ... [2]

---

14 Two cones are geometrically similar.
The total surface area of the smaller cone is 80 cm^2.
The total surface area of the larger cone is 180 cm^2.
The volume of the smaller cone is 168 cm^3.
Calculate the volume of the larger cone.

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

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15 **(a)** Factorise $x^4 - 4y^2$.

Answer ..... [1]

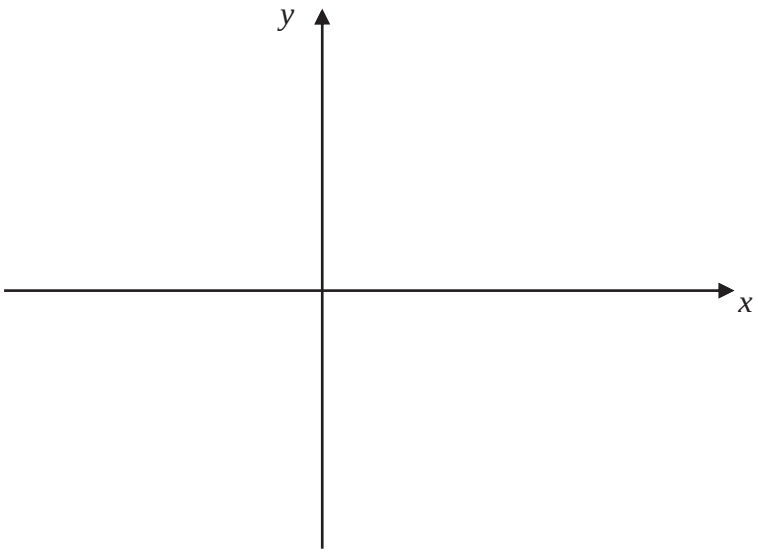
(b) **Hence** factorise completely $x^4 - 4(2x-1)^2$.
Write your answer as simply as possible.

Answer..... [2]

---

16 Sketch the graph of $y = 4 - (x-1)^2$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point of the curve. [3]

Answer



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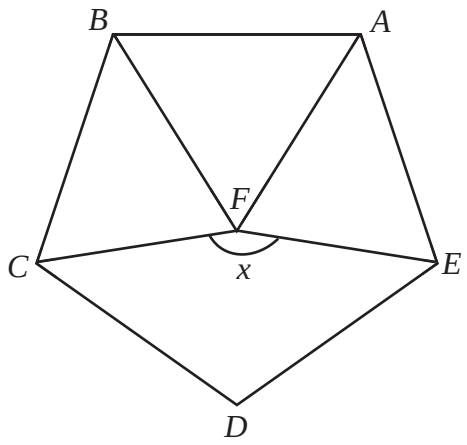
17 In the diagram, *ABCDE* is a regular pentagon and *ABF* is an equilateral triangle.



Find x.

Answer x = …… [3]

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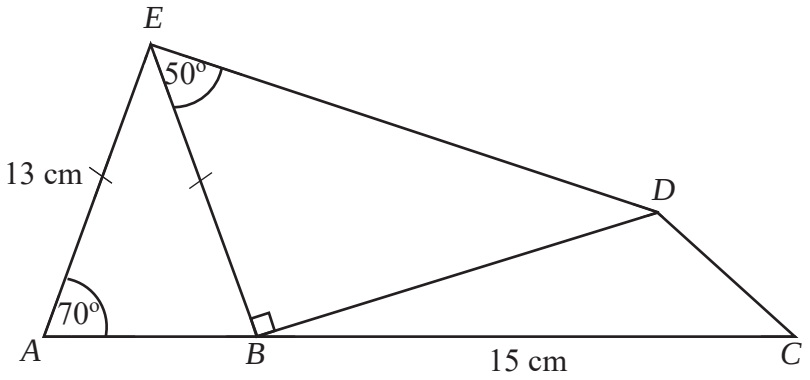
18



In the diagram, *ABC* is a straight line, *AE* = *BE* = 13 cm and *BC* = 15 cm.
Angle *EAB* = 70°, angle *EBD* = 90°, and angle *BED* = 50°.
Calculate the area of the quadrilateral *ACDE*.

Answer …….....……cm^2 [4]

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19 The times taken by students in Class A and Class B in a 4 × 10 m shuttle run are illustrated in the stem-and-leaf diagram.

Class A											Class B									
										9	8									
8	8	5	5	3	2	2	1	0	0	10	1	1	2	2	2	3	*x*	8	9	9
					6	4	3	3	0	11	2	2	3	4	4	7				
								2	2	12	1									

Key: 0 | 10 | 1 means a time of 10.0 seconds taken by a student of Class A and a time of 10.1 seconds taken by a student of Class B

(a) Find the median time taken by Class A.

Answer …….seconds [1]

The table below shows the performance grade for the various components of a physical fitness test.

Performance grade	**No. of Sit-ups in 1 min**	**Standing Broad Jump**	**Sit & Reach Distance**	**No. of Pull-ups in 30 sec**	**4 × 10m Shuttle Run Time**	**2.4 km Run-Walk time (min : sec)**
A	> 42	> 237 cm	> 45 cm	> 7	< 10.2 sec	< 10:41
B	40 – 42	228 – 237	42 – 45	6 – 7	10.2 – 10.3	10:41-11:40
C	37 – 39	218 – 227	38 – 41	5	10.4 – 10.5	11:41-12:40
D	34 – 36	208 – 217	34 – 37	3 – 4	10.6 – 10.9	12:41-13:40
E	30 - 33	198 – 207	29 – 33	1 – 2	11.0 – 11.3	13:41-14:40

(b) A minimum performance grade of ‘E’ is required for a pass in each component. Calculate the percentage of students in Class B who passed the shuttle run component.

Answer ……% [1]

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19 **(c)** The probability of students in Class B obtaining at least a performance grade of 'C' in shuttle run is $\frac{4}{9}$.

Find the possible values of x.

Answer x = …….. [2]

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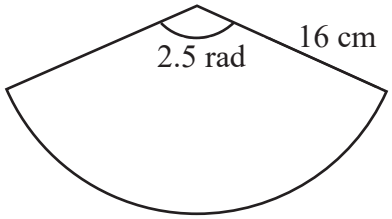
20 The isoperimetric quotient, IQ, is used to measure how much like a circle a shape is.

It is calculated from : $IQ = \dfrac{\text{area of shape}}{\text{area of circle that has the same perimeter as the shape}}$

The diagram shows a sector of a circle with radius 16 cm and a sector angle 2.5 radians.



Find the isoperimetric quotient of the sector.

Answer ……..…..…… [4]

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21 **(a)** Write 756 as the product of its prime number.

Answer …….……... [1]

(b) k is the smallest possible integer such that $\sqrt{756k}$ is an integer N.
Find N.

Answer $N =$ ……... [2]

(c) On one visit to her local swimming pool, Ally swims 40 lengths.
The first length she swims is Length 1, the second is Length 2 and so on.
She swims on her back on lengths which have numbers that are multiples of 4 or 5.
Calculate the number of lengths that she swims on her back.

Answer …….……...lengths [2]

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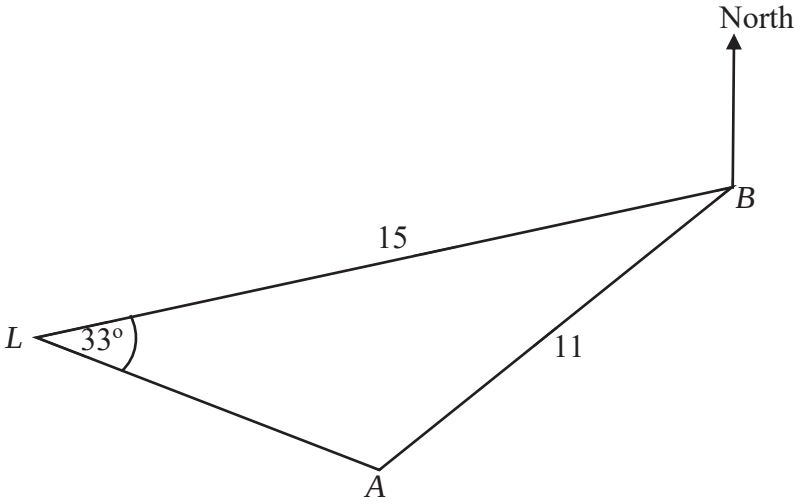
22



The diagram shows the positions of two ships, A and B, and a lighthouse L.
$AB = 11$ km, $BL = 15$ km and angle $ALB = 33°$.
The bearing of L from B is 250°.

(a) Find the bearing of L from A.

Answer ……..…….. [2]

(b) Calculate the **obtuse** angle LAB.

Answer ……..…… [3]

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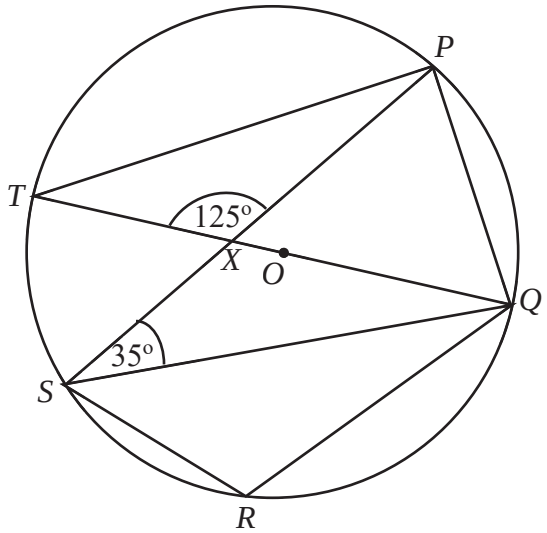
23



Points P, Q, R, S and T lie on the circle.
QT is a diameter of the circle, centre O.
X is the point of intersection of PS and QT.
Angle $PXT = 125^\circ$ and angle $PSQ = 35^\circ$.

Find, giving reasons for each statement,

(a) angle PQT,

Answer ……..…….. [3]

(b) angle QRS.

Answer ……..…….. [3]

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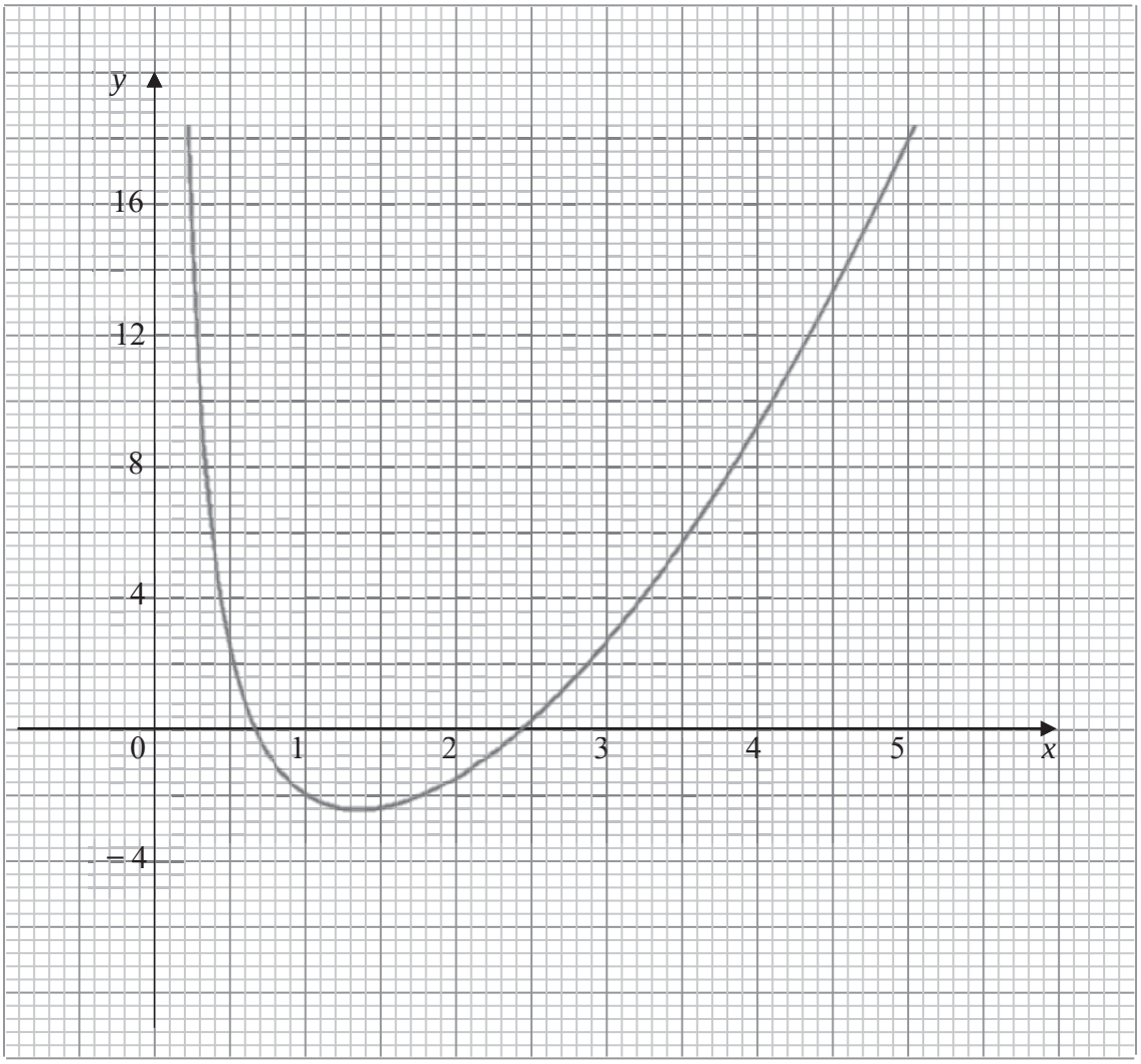
24 The graph of $y = x^2 + \frac{5}{x} - 8$ for $x > 0$ is drawn on the grid.



(a) Use the graph to find the least value of $x^2 + \frac{5}{x} - 8$.

Answer …… [1]

(b) Explain why there is no solution for $x^2 + \frac{5}{x} - 4 = 0$ for $x > 0$.

Answer

……

…… [2]

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24 **(c)** The points of intersection of the curve and the line $y = 8 - 2x$ give the solutions of an equation.

(i) Find the equation, giving your answer in the form $ax^3 + bx^2 + cx + d = 0$.

Answer …… [2]

(ii) Use the graph to solve the equation found in part (ci).

Answer x = …… or …… [2]

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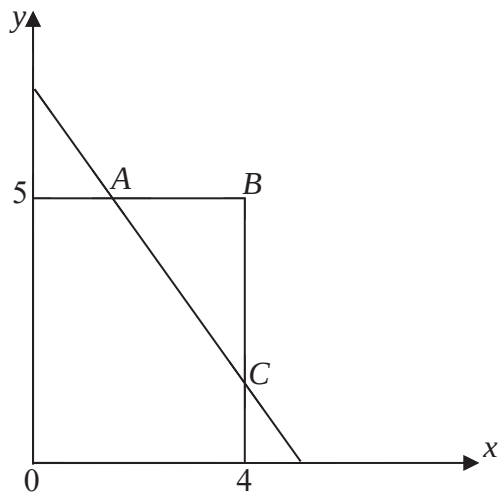
25



In the diagram, *AB* is parallel to the *x*-axis and *BC* is parallel to the *y*-axis.
Line *AC* crosses the *x*-axis at $(5, 0)$ and the *y*-axis at $(0, 7)$.

(a) Find the equation of *AC*.
Give your answer in the form $ay = bx + c$, where a, b and c are integers.

Answer ……..……... [2]

(b) Find the area of triangle *ABC*.

Answer ……..……units^2 [3]

(c) The line $y = px$, where p is an integer, passes through triangle *ABC*.
Find the greatest possible value of p.

Answer p = ….……... [1]

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CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2020

CANDIDATE NAME	
CLASS	
REGISTER NUMBER	

MATHEMATICS 4048/02

Paper 2

1 September 2020

Candidates answer on the Question Paper.

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided on the work you hand in
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Give answers in degrees to one decimal place.
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The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

100

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

[Turn over

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Mathematical Formulae

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

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

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

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

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[Turn over for Question 1]

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1 **(a)** Simplify

(i) $\dfrac{3a}{b^3} \div \dfrac{9a^2}{(2b)^3}$,

Answer ..... [1]

(ii) $\dfrac{50-8y^2}{4y^2-6y-10}$.

Answer ..... [3]

(b) Write as a single fraction in its simplest form $\dfrac{3}{6x-2} + \dfrac{2}{(3x-1)^2}$.

Answer ..... [2]

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(c) Solve $\frac{4}{x+1}-1=\frac{9}{2x+7}$.

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

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2 **(a)** The number of people involved in community development activities in 2018 and 2019 are summarised on the table.
In 2019, 12% were children and the number of adult was 28% more than that in 2018.

	Number of participants	
	2018	**2019**
Children	2336	**(i)**
Youth	4216	3714
Adults	**(ii)**	8096
Seniors	6810	6516

Find the missing numbers in the table.

Answer (i) ..... children [2]

(ii) ..... adults [2]

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(b) **(i)** In May 2019, there were 1.49 million visitors to Singapore.
In May 2020, there were 878 visitors to Singapore.

The ratio number of visitors in May 2020 : number of visitors in May 2019 can be written in the form 1 : k.

Find k.
Give your answer in standard form, correct to 3 significant figures.

Answer k = ... [1]

(ii) The total number of days spent by the visitors in May 2019 is 5.08 million days.
Calculate the mean number of days spent by a visitor in May 2019.

Answer ..... days [1]

(c) Alan invested 9600 US dollars (US$) in an account paying compound interest at 2.4 % per year.

After 6 years, he withdraws the total amount and converts it to Singapore dollars ($) at the exchange rate of $1 = US$0.72.
The bank charges an administrative fee of 1.5% for the currency conversion.

Calculate the total amount Alan receives.

Answer $ ..... [4]

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3 In shop A, T-shirts with black and white prints are sold at \$8.70 each and T-shirts with colour prints are sold at \$10.20 each.
In shop B, a T-shirt with black and white prints costs \$0.30 less and a T-shirt with colour prints costs \$0.50 more than shop A.

This information can be represented by the matrix $\mathbf{S} = \begin{array}{c} \begin{array}{cc} \text{A} & \text{B} \end{array} \\ \begin{pmatrix} 8.70 & -0.30 \\ 10.20 & 0.50 \end{pmatrix} \end{array} \begin{array}{l} \\ \text{B/W} \\ \text{C} \end{array}$.

(a) Jen buys 10 T-shirts with black and white prints and 20 T-shirts with colour prints.
Kate buys 20 T-shirts with black and white prints and 12 T-shirts with colour prints.
Lin buys 18 T-shirts with black and white prints and 10 T-shirts with colour prints.

Represent this information in a 3×2 matrix **Q**.

Answer $\mathbf{Q} = \begin{pmatrix} & \\ & \\ & \end{pmatrix}$ [1]

(b) Evaluate the matrix $\mathbf{P} = \mathbf{QS}$.

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

(c) State what each of the elements in the second column of **P** represents.

Answer .....

.....

.....

..... [2]

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(d) **(i)** Shop A makes a profit of 50% on each T-shirt it sells.
Kate buys her T-shirts from shop A.

Find the profit shop A makes.

Answer $ ..... [1]

(ii) Shop B makes a profit of x% on each T-shirt it sells.
Lin buys her T-shirts from shop B.

Find and simplify an expression, in terms of x, for the profit shop B makes.

Answer $ ..... [1]

(iii) The profits both shops make in the above sales are the same.

Find x.

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

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

$$T_1 = 3^2 + 3 = 12$$
$$T_2 = 4^2 + 5 = 21$$
$$T_3 = 5^2 + 7 = 32$$
$$T_4 = 6^2 + 9 = 45$$

(a) Find T_5.

Answer ..... [1]

(b) **(i)** Show that the nth term of the sequence, T_n , is given by $(n + 1)(n + 5)$.

Answer

[2]

(ii) Hence, given that $T_p = 221$, find the prime factors of 221.

Answer ..... , ... [3]

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(c) **(i)** Write down and simplify an expression, in terms of n, for T_{n-1}.

Answer ..... [1]

(ii) Hence explain why the difference between two consecutive terms in the sequence is always odd.

Answer

[2]

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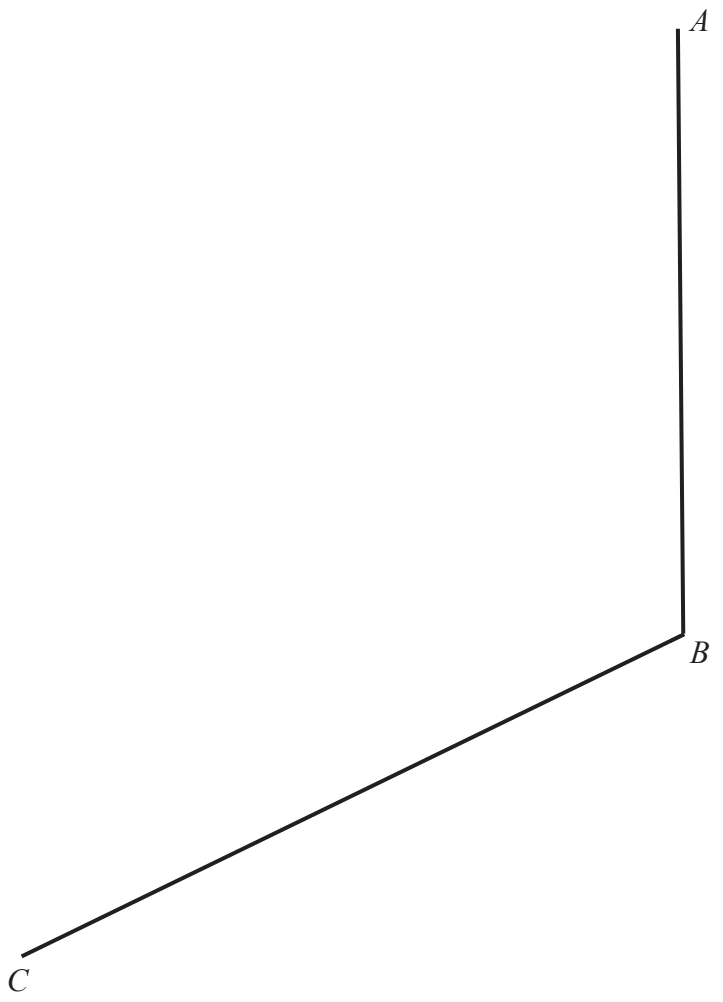
5

Scale : 1 cm to 20 m



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In the scale drawing, *A*, *B* and *C* are the three corners of park *ABCD*, with *B* due south of *A*.

(a) **(i)** *D* is on a bearing of 305° from *B* and is equidistant from *B* and *C*.
By constructions, complete the scale drawing of park *ABCD*. [2]

(ii) Measure the bearing of *D* from *A*.

Answer ..... [1]

(b) A playground in the park is nearer to *BC* than to *DC* and less than 120 m from *A*.
Shade the region where the playground is located. [2]

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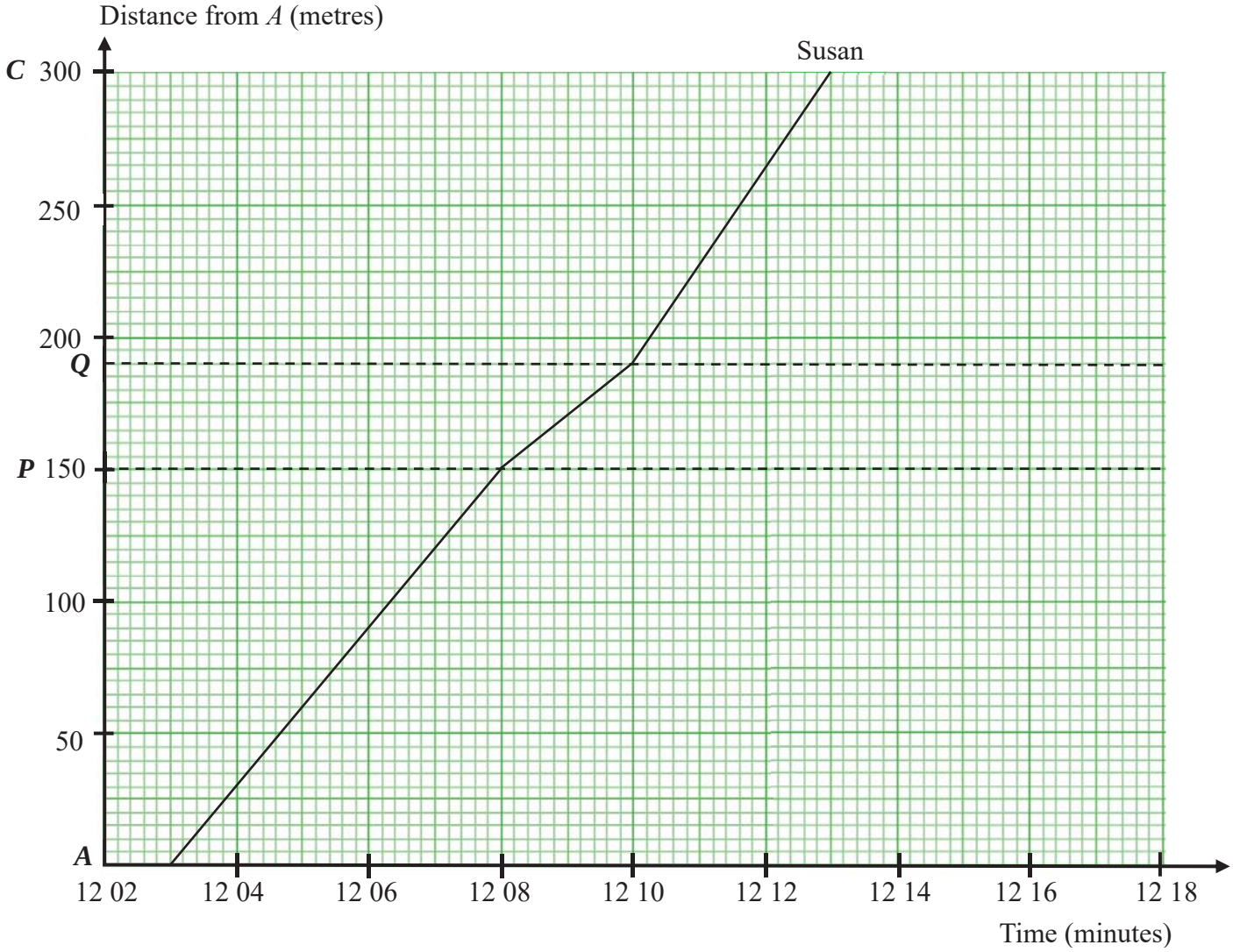
(c) *APQC* is a walking trail in the park where *AP* = 150 m and *QC* = 110 m.
PQ is a narrow bridge. Susan leaves *A* at 12 03.
The distance-time graph shows Susan's walk from *A* to *C*.

(i) Find, in metres per second, Susan's speed as she walks from *A* to *P*.

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

Peter walks from *C* to *A*, walking at the same speed as Susan on the same stretches of the trail.
Peter arrives at *Q* at the time Susan arrives at *P*. He waits for Susan to clear the bridge before continuing his walk.

(ii) On the same axes, draw the distance-time graph for Peter's walk. [2]



(iii) From your graph, find the time Peter leaves *C*.

Answer ..... [1]

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[Turn over for Question 6]

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6 An old, empty tank has a capacity of 100 litres.

(a) A tap delivers 1 litre of water into the tank in x minutes.

Write down an expression, in terms of x, for the number of litres of water delivered into the tank in 30 minutes.

Answer ..... litres [1]

(b) One litre of water leaks from the bottom of the tank every $(x + 50)$ minutes.

Write down an expression, in terms of x, for the number of litres of water leaked from the tank in 30 minutes.

Answer ..... litres [1]

(c) After 30 minutes, the tank was a quarter filled.

Write down an equation to represent this information and show that it reduces to

$$x^2 + 50x - 60 = 0.$$

Answer

[3]

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(d) Solve the equation $x^2 + 50x - 60 = 0$, giving your solutions correct to three decimal places.

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

(d) The tap was turned off after 30 minutes.

Find the time taken for the tank to be **completely** emptied.
Give your answer in hours and minutes, correct to the nearest minute.

Answer ..... hours ..... minutes [2]

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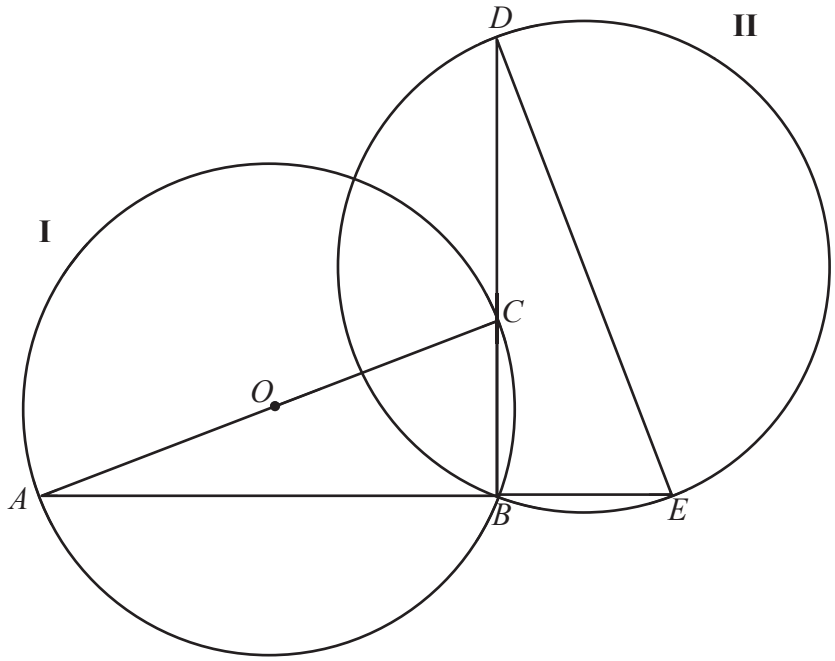
7 The diagram shows two congruent circles.



A, B and C lie on **circle I** and AC is the diameter of the circle, centre O.
B, D and E lie on **circle II** such that $BC = BE$.
BCD and ABE are straight lines.

(a) **(i)** Explain why DE is the diameter of **circle II**.

Answer

[2]

(ii) **Hence**, explain why the triangles in the diagram are congruent.

Answer

[2]

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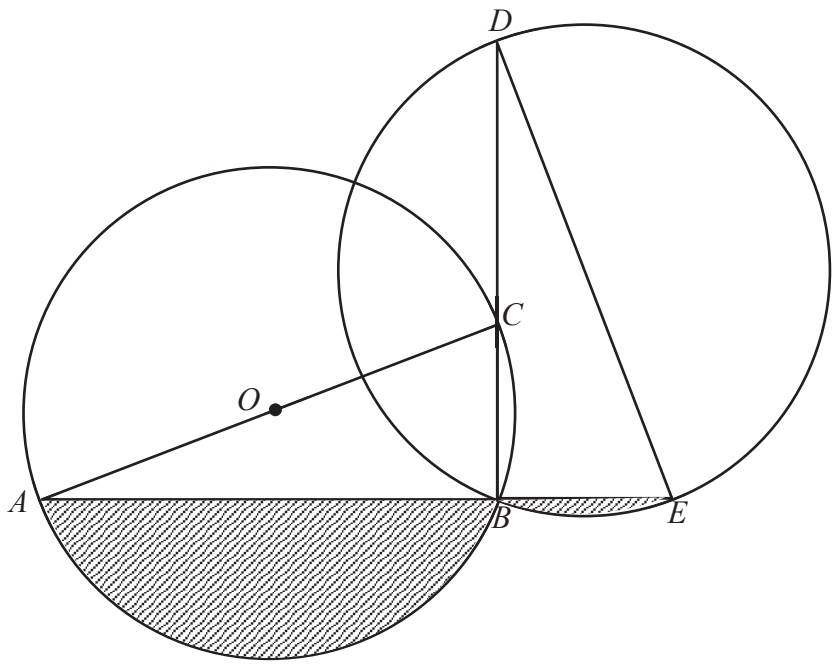

It is also given that $AC = 13$ cm and $CB = 5$ cm.

(b) **(i)** Write down the value of cos $\angle ACD$.

Answer ..... [1]

(ii) **Hence**, find DO.

Answer ..... cm [4]

(c) Find the shaded area.

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

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8 A water feature stands on horizontal ground and shoots out a vertical jet of water through an opening on its top.
The height, h metres, of the jet above the ground t seconds after it leaves the water feature, can be modelled by the equation

$$h = \frac{2}{5} + \frac{96}{5}t - 28t^2 .$$

Some corresponding values of t and h, are given in the table below.

t	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
h	0.4	2.04	3.12	3.64	3.6	p	1.84	0.12

(a) Find the value of p.

Answer $p =$ ..... [1]

(b) On the grid opposite, draw the graph of $h = \frac{2}{5} + \frac{96}{5}t - 28t^2$ for $0 \le t \le 0.7$. [3]

(c) Find, in centimetres, the height of the water feature above the ground.

Answer ..... cm [1]

(d) Use your graph to estimate the maximum height reached by the jet of water and the time taken to reach this height.

Answer max height = ... m [1]

time = ... seconds [1]

(e) Use your graph to write down an inequality in t to describe the range of times when the jet of water is greater than 2.4 m above the ground.

Answer ..... [1]

(f) **(i)** By drawing a tangent, find the gradient of the curve at (0.5, p).

Answer ..... [2]

(ii) What does this gradient represent?

Answer ..... [1]

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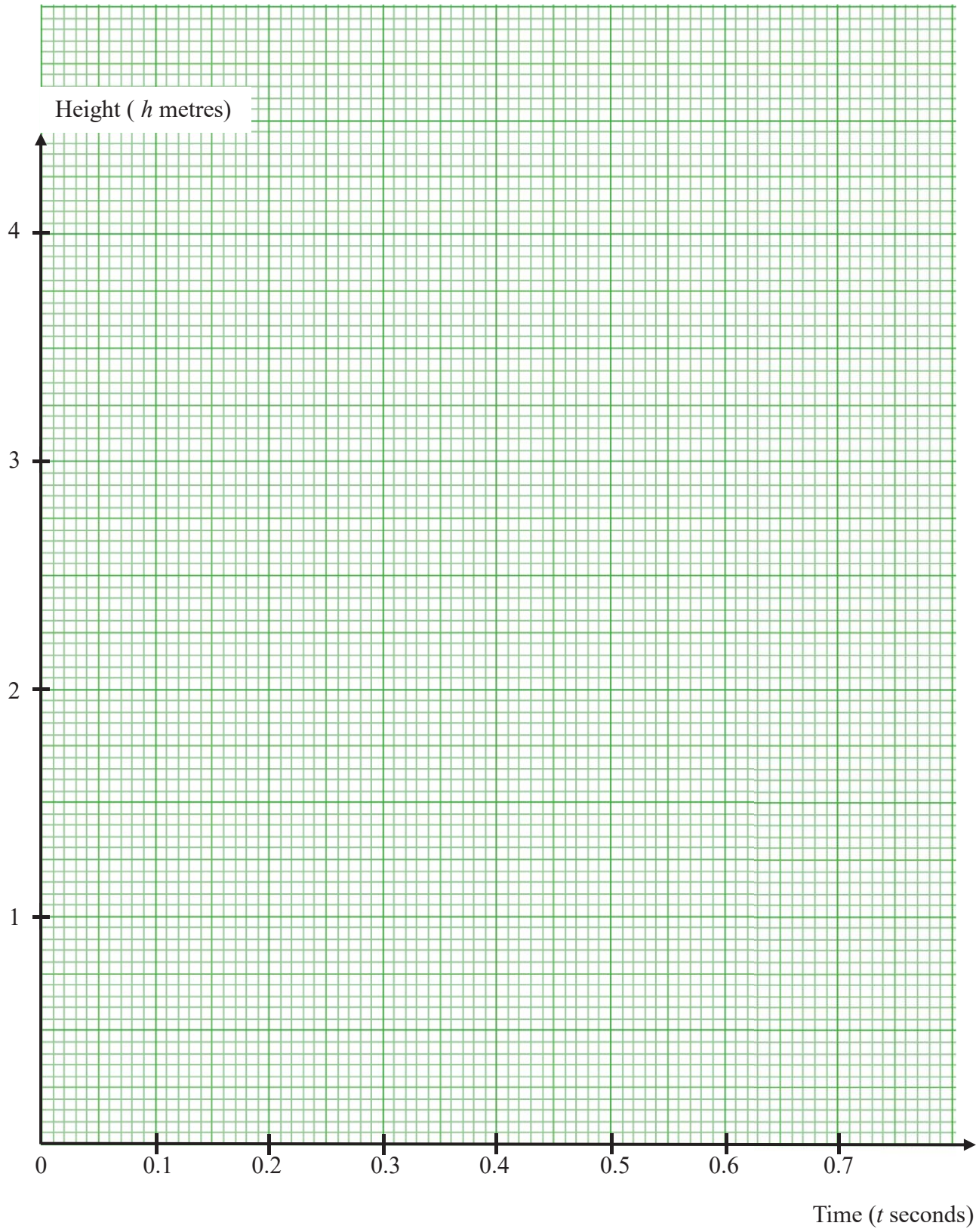

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9 **(a)** The times taken by 240 people to cast their votes, at polling station X, in a country's general election is shown in the grouped frequency table.

Time (t minutes)	$0 < t \leq 10$	$10 < t \leq 25$	$25 < t \leq 35$	$35 < t \leq 50$	$50 < t \leq 60$
Number of people	26	84	95	23	12

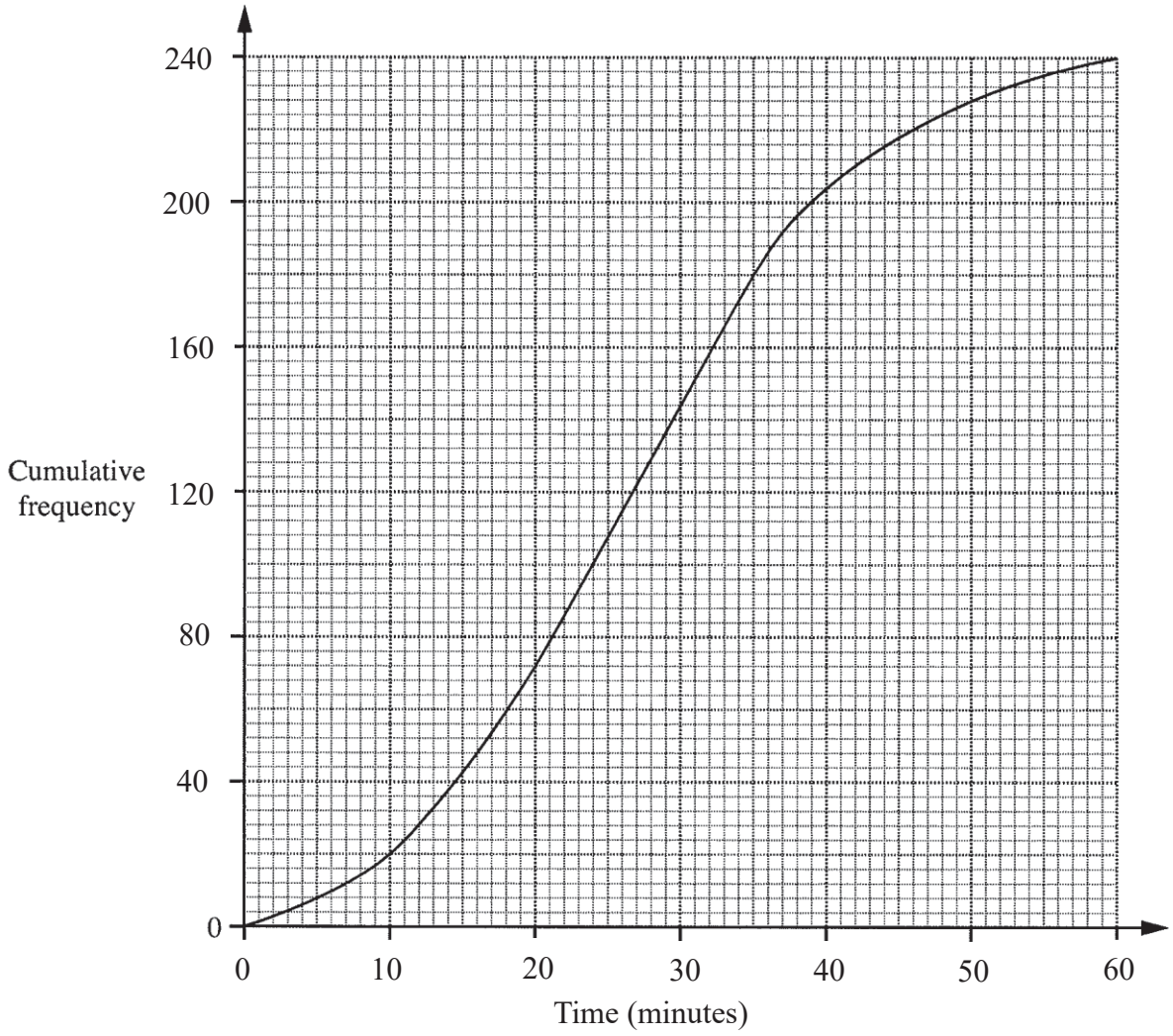
(i) Find an estimate for the mean time taken.

Answer ..... minutes [1]

(ii) Find an estimate of the standard deviation of the distribution.

Answer ..... minutes [1]

(b) The cumulative frequency curve shows the distribution of times taken by 240 people to cast their votes, at polling station Y.



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(i) Use the curve to estimate the

(a) median time,

Answer ..... minutes [1]

(b) interquartile range.

Answer ..... minutes [2]

(ii) People who took more than 30 minutes to cast their votes were unhappy with the process.

Find the number of people in polling station Y who were not happy with the process.

Answer ..... [1]

(c) For the following two parts, explain your answer, stating clearly the statistic you use to make your decision.

(i) Before the election, it was announced that the estimated time it would take to vote at any polling station is less than 30 minutes.
Was this estimate met in polling station Y?

Answer .....

..... [1]

(ii) " The times taken by people to cast their votes were closer together in station X than in station Y."
Is the statement correct?

Answer .....

..... [1]

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(d) Inside the polling station, voters queued at different sections to cast their votes. The table shows the distribution of the 240 people in polling station X to Sections A, B, C and D.

Section	Number of voters
A	38
B	115
C	74
D	13

After voting, voters were randomly surveyed for their feedback.

(i) One voter was selected.
Find the probability that she was from Section A.

Answer ..... [1]

(ii) Two voters were selected.
Find the probability that

(a) they were both from Section B,

Answer ..... [1]

(b) one was from Section C or D, and the other was from Section B.

Answer ..... [2]

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[Turn over for Question 10]

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10 **(a)** **Diagram 1** shows a figure made up of 3 congruent circles enclosed by a perimeter. The circles touch each other and the radius of each circle is 3 cm.

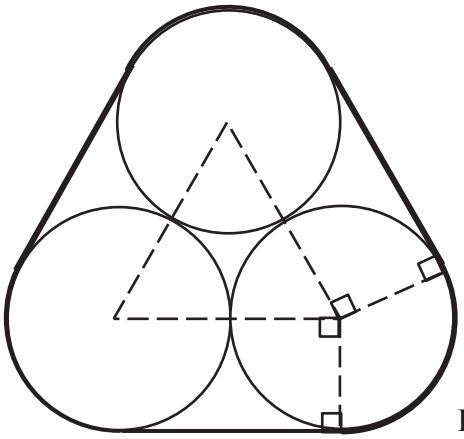

Diagram 1

(i) Show that the length of the perimeter is 36.85 cm, correct to 2 decimal places.

Answer

[2]

(ii) Show that the area of the figure is 97.86 cm^2, correct to 2 decimal places.

Answer

[3]

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(b) Mr Tan imports tennis balls and repackages them for sale. He wants to use eco-friendly packaging plastic containers as they do less harm to the environment and to improve the "Brand Image" of his product.

However eco-friendly plastic containers are more expensive than traditional plastic containers. Mr Tan is searching for a container design that uses the least amount of eco-friendly packaging material.

He narrows his search to the two designs shown in **Diagram 2** and **Diagram 3**.

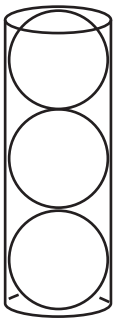

Diagram 2

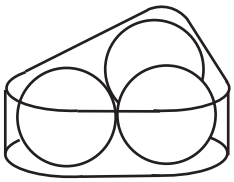

Diagram 3

Diagram 2 shows a closed cylinder.
The balls touch each ends and the sides of the cylinder.

Diagram 3 is a closed triangular box where the corners are curved.
Each ball touches the top, the bottom and the sides of the box.
Each ball also touches the other two balls.
Diagram 1 is the plan view of this design.

Which container design should Mr Tan adopt?
Explain your decision with clear working.
In your investigation, model a tennis ball as a sphere of radius 3 cm.

Answer

[5]

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