



**ST JOSEPH'S INSTITUTION
END-OF-YEAR EXAMINATION 2020
YEAR 2**

CANDIDATE
NAME

CLASS

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INDEX
NUMBER

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MATHEMATICS

Paper 1

2 October 2020

Candidates answer on the Question Paper.

**1 hour 15 minutes
(0800 – 0915)**

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.
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.

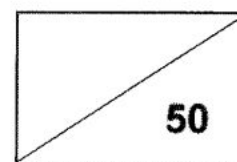
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

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

At the end of the examination, fasten all your work securely together.

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

The total marks for this paper is 50.



Answer **all** the questions

- 1 Factorise completely $a^2b + 3ac - ab^2 - 3bc$.

Answer [2]

- 2 Express $\frac{2}{a+b} - \frac{3}{b}$ as a single fraction in its simplest form.

Answer [2]

- 3 Solve this equation.

$$\frac{a}{4} - \frac{2a}{5} = \frac{1}{10}$$

Answer [2]

- 4 (a) Factorise completely $4x^2 + 12xy + 9y^2$.

Answer [1]

- (b) Use your result in (a) to factorise $4x^2 + 12xy + 9y^2 - 16$ completely.

Answer [2]

- 5 A straight line, L_1 has equation $3x + 2y = c$. It passes through the point $(1, 3)$.

(a) Find c

Answer [1]

(b) Find the gradient of L_1 .

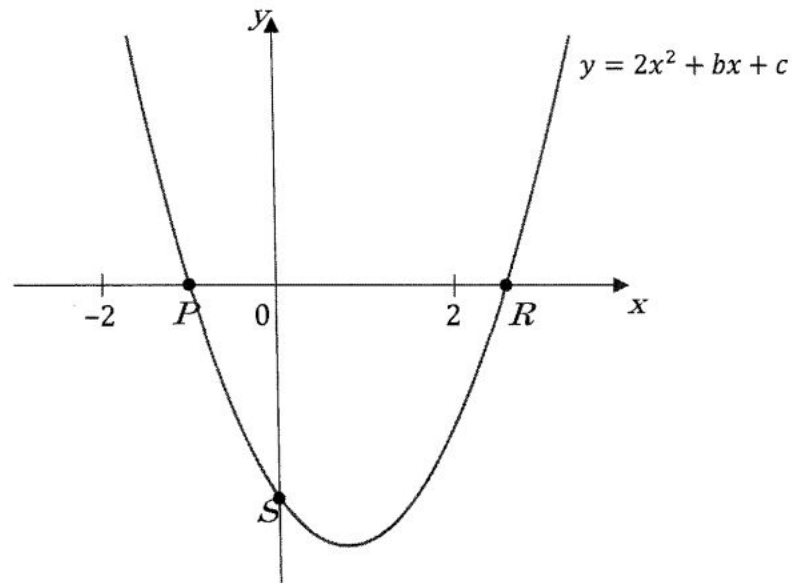
Answer [2]

- 6 The line with equation $2x + 3y = 6$ intersects the line $-2x + y = -3\frac{1}{3}$ at the point T

Find the coordinates of T

Answer (.....) [3]

- 7 The equation of a curve is $y = 2x^2 + bx + c$.
The points $P(-1,0)$, $R(2.5,0)$ and $S(0,-5)$ lie on the curve.



- (a) (i) Write down the value of c

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

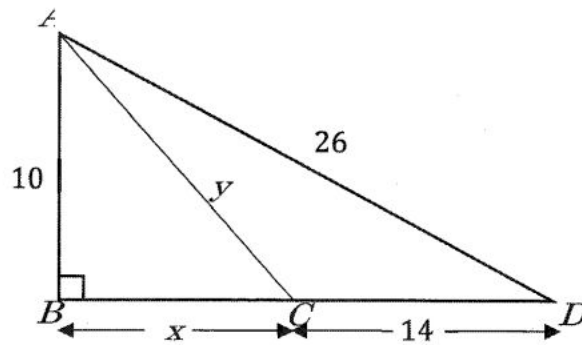
- (ii) Find the value of b

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

- (b) A line passes through R and cuts y -axis at $(0,5)$.
Find the equation of the line.

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

8



In triangle ABD , AB is perpendicular to BD . BD is a straight line.
 $AB = 10$ cm, $AD = 26$ cm, $CD = 14$ cm, $BC = x$ cm and $AC = y$ cm.

Find

(a) the value of x

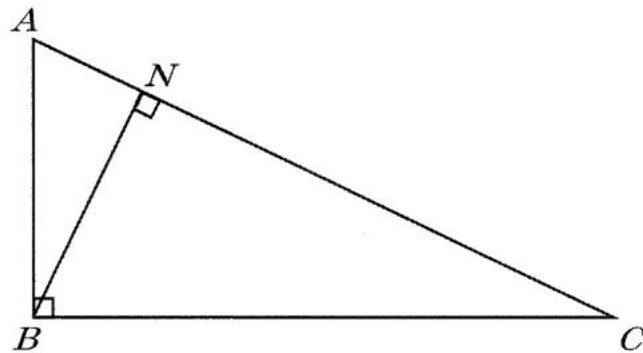
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Answer $x = \dots\dots\dots$ [2]

(b) the value of y

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

9



- (a) Explain why $\angle ACB = \angle ABN$

Answer

.....

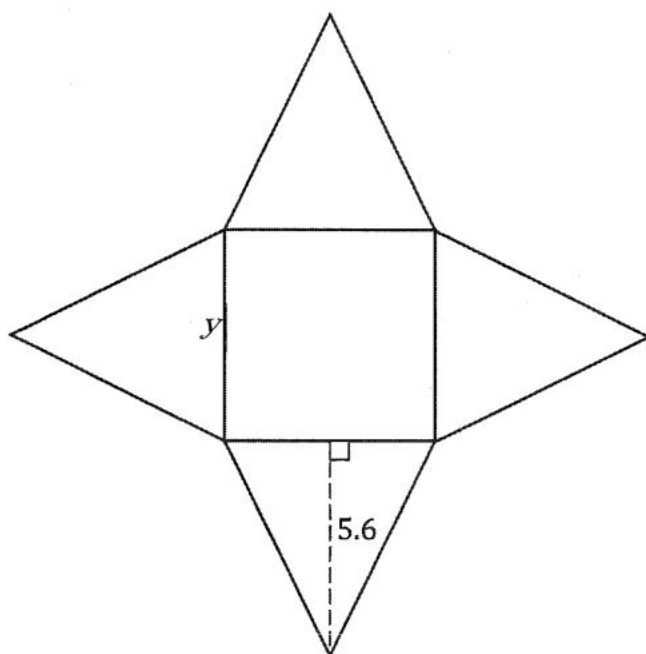
.....

..... [1]

- (b) It is given that $BN = 20$ cm and $AB = 25$ cm.
Find $\angle ACB$

Answer [2]

10



The diagram shows the net of a right pyramid with a square base of side y cm. Each triangular face has an area of 8.4 cm^2 and height of 5.6 cm .

Find

- (a) the value of y

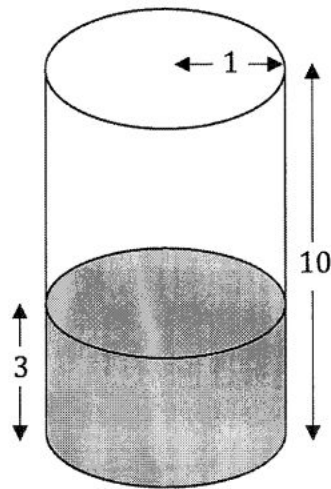
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Answer $y = \dots\dots\dots$ [2]

- (b) the volume of the pyramid.

Answer $\dots\dots\dots \text{cm}^3$ [3]

11



The diagram shows an open cylindrical tank of radius 1 m and height 10 m. The tank contains water to a depth of 3 m.

- (a) Calculate the area of the tank which is in contact with the water, leaving your answers in terms of π .

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Answer m² [2]

- (b) Calculate the volume of water in the tank, leaving your answer in litres.

Answer litres [2]

- 12 y is directly proportional to $(x + 2)^2$ and $x > 0$.
The table below shows the corresponding values of x and y

x	p	2
y	4.5	8

- (a) Find the equation connecting x and y .

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Answer [2]

- (b) Find the value of p

Answer $p =$ [2]

- 13 There are x girls and 42 boys in a group.
The probability of selecting a girl from the group is $\frac{2}{9}$.

(a) Find the number of girls in the group.

Answer [2]

- (b) How many more boys are needed to join the group so that the probability of selecting a boy from the group will be $\frac{4}{5}$?

Answer [2]

- 14 Sixteen boys and fifteen girls took a test.
The scores are shown in the stem-and-leaf diagram.

Boys		Girls
9 9 5 0	5	2 2 4 7 8 8
8 8 4 4 1 1	6	0 3 3 3 5 5
1 1 1 1	7	1 3
1 0	8	1
Key (Boys) : 4 6 means 64		Key (Girls) : 6 0 means 60

- (a) Write down the mode of the girls' score.

Answer [1]

- (b) Write down the median of the boy's score.

Answer [1]

- (c) Explain briefly whether the boys or the girls performed better in the test.

Answer

 [1]

- 15 (a) Construct the triangle ABC such that angle $ACB = 110^\circ$, angle $ABC = 33^\circ$ and $AB = 10$ cm. AB has already been drawn for you. [1]

A

 B

- (b) Draw DE such that E is 3.5 cm from A on the diagram, such that triangle ABC and triangle AED are similar. Measure the length of DE

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

- (c) By using similarity, **calculate** the length of BC

Answer $BC = \dots\dots\dots$ cm [2]

END OF PAPER



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YEAR 2**

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MATHEMATICS

Paper 2

7 October 2020

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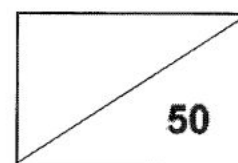
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This document consists of **11** printed pages including this cover page.

[Turn Over

Answer **all** the questions

- 1 (a) (i) Express $\frac{y}{4x-2xy} - \frac{1}{2x}$ as a single fraction in its simplest form.

Answer [2]

- (ii) Use your result in part (a)(i) to make x as the subject of the formula

$$\frac{y}{4x-2xy} - \frac{1}{2x} = 1.$$

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Answer $x =$ [3]

- 2 (a) Simplify $1 \div 4x^{-2}$.

Answer [1]

- (b) Simplify $\frac{9w^4z^5}{7(xy)^3} \times \left(\frac{3xy^2}{343wz}\right)^{-2}$, expressing your answers in positive index form.

Answer [3]

- 3 According to the National Parks Board, Singapore Bukit Timah Nature Reserve has an area of about 1.69 km^2 .

- (a) The map has a scale of 1 cm to 500 m.

Calculate the area, in square centimetres, of the nature reserve on the map.

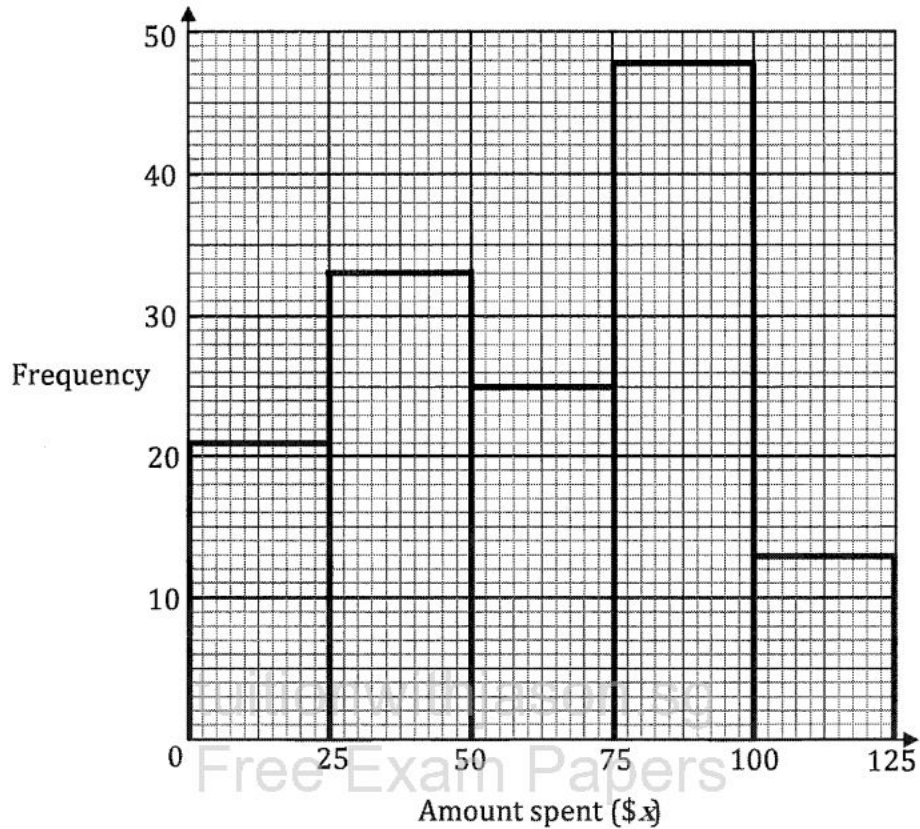
Answer cm^2 [2]

- (b) On another map, the area is represented by 0.4225 cm^2 .

Express the scale of this map in the form of 1: x .

Answer [2]

- 4 (a) The histogram shows the amount of money spent by 140 shoppers in the supermarket.



- (i) Using the class intervals $0 < x \leq 25$, $25 < x \leq 50$ and so on, complete the frequency table below. [1]

Amount spent (in \$x)	Number of customers
$0 < x \leq 25$	21

- 4 (a) (ii) Find the estimated mean of the amount spent.

Answer \$ [2]

- (iii) Find the probability of a shopper selected spending not more than \$50.

Answer [1]

- (b) The frequency table shows the number of goals scored in a series of soccer matches.

Number of goals	0	1	2	3	4	5
Number of matches	3	10	a	15	4	3

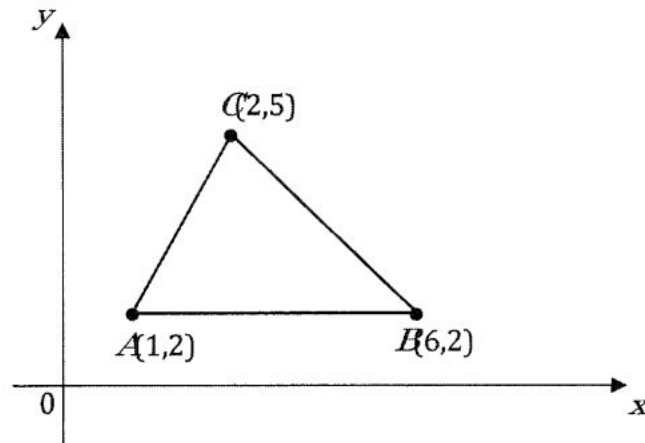
- (i) If the mean number of goals is 2.2, find the value of a .

Answer $a =$ [2]

- (ii) If the median number of goals is 2, find the smallest possible value of a .

Answer $a =$ [2]

- 5 A , B and C are the points $(1,2)$, $(6,2)$ and $(2,5)$.



- (a) Find the area of triangle ABC

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Answer sq units [2]

- (b) Show that angle ABC is 36.87° when corrected to 2 decimal places.

Answer On space above [2]

6 Deborah planned to spend \$42 buying papayas at \$ x per kilogram.

- (a) Write down an expression in terms of x for the number of kilograms she expected to buy.

Answer kg [1]

- (b) It was found that the price had increased by \$1 per kilogram.

Write down an expression in terms of x for the number of kilograms she actually bought for \$42.

Answer kg [1]

- (c) She actually bought 7 kg less than what she expected.

Form an equation in x and show that it reduces to

$$x^2 + x - 6 = 0.$$

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Answer On space above [3]

- (d) Solve the equation $x^2 + x - 6 = 0$.

Answer [2]

- (e) Using your answer from part (d), find the number of kilograms she actually bought.

Answer kg [1]

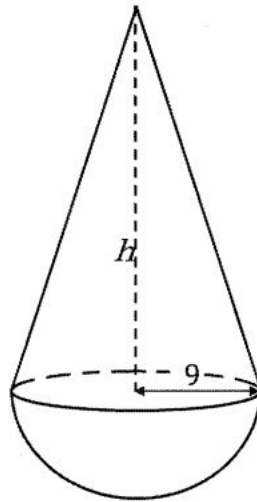
**Diagram I**

Diagram I shows a solid made from a cone and a hemisphere.
 The radius of the cone and the hemisphere is 9 cm.
 The height of the cone is h cm.

- (a) Given that the volume of the solid is $1053\pi \text{ cm}^3$, find the value of h

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

- (b) Find the total surface area of the solid.

Answer $\dots\dots\dots \text{ cm}^2$ [3]

- 7 (c) The solid in Diagram I is melted down and form into a new solid, as shown in Diagram II. The new solid is made from a cylinder and two hemispheres. The radius of the hemisphere is 6 cm.

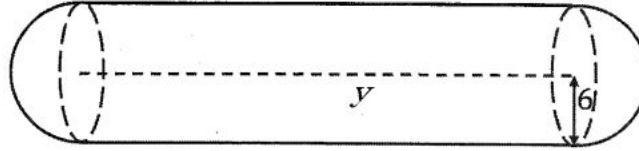


Diagram II

Find the length of the cylinder, y , in Diagram II.

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

- 8 An arch can be modelled by a parabola with equation $y = -x^2 + 100x$, where x is the horizontal distance, in metres, from the foot of the arch and y is the height, in metres, above ground. The width of the arch at its base is 100 m.

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

x (metres)	0	20	40	60	80	100
y (metres)	0	1600	p	2400	1600	0

- (a) Calculate the value of p .

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

- (b) Using a scale of 1 cm to represent 10 m, draw a horizontal x -axis for $0 \leq x \leq 100$.
Using a scale of 1 cm to represent 200 m, draw a vertical y -axis for $0 \leq y \leq 2800$.

On your axes, plot the points given on the table on the grid provided (in the next page), and join them with a smooth curve. [3]

- (c) Write down the equation of the line of symmetry.

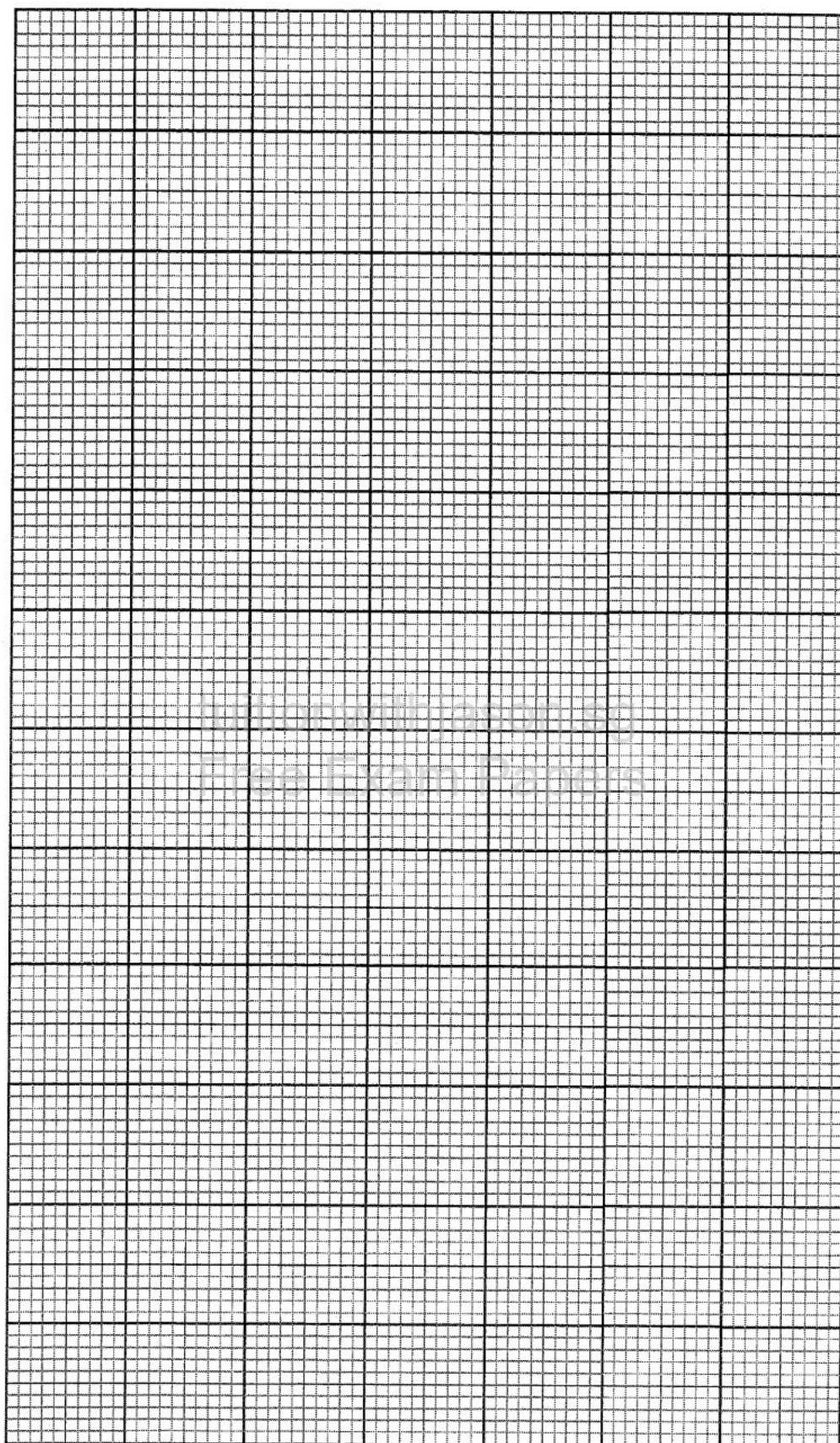
Answer $\dots\dots\dots$ [1]

- (d) Use your graph to estimate the maximum height of the arch.

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

- (e) A rod is used to attach two points where $y = 1000$.
Use your graph to estimate the length of the rod.

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

**END OF PAPER**

2020 Year 2 EOY PAPER 1 (MARK SCHEME)

- 1 Factorise completely $a^2b + 3ac - ab^2 - 3bc$.

1	$a(ab + 3c) - b(ab + 3c)$ $= (ab + 3c)(a - b)$
---	--

- 2 Simplify $\frac{2}{a+b} - \frac{3}{b}$.

2	$\frac{2b - 3(a+b)}{b(a+b)}$ $= \frac{2b - 3a - 3b}{b(a+b)}$ $= \frac{-3a - b}{b(a+b)} \quad \text{OR} \quad \frac{-3a - b}{ab + b^2}$
---	--

- 3 Solve this equation.

$$\frac{a}{4} - \frac{2a}{5} = \frac{1}{10}$$

3	$\frac{a}{4} - \frac{2a}{5} = \frac{1}{10}$ $\frac{5a - 8a}{20} = \frac{2}{20}$ $\frac{-3a}{20} = \frac{2}{20}$ $a = -\frac{2}{3}$
---	--

- 4 (a) Factorise completely $4x^2 + 12xy + 9y^2$.

4(a)	$4x^2 + 12xy + 9y^2$ $= (2x + 3y)^2$
------	--------------------------------------

- 4 (b) Use your result in (a) to factorise $4x^2 + 12xy + 9y^2 - 16$ completely.

4(b)	$4x^2 + 12xy + 9y^2 - 16$ $= (2x + 3y)^2 - 4^2$ $= (2x + 3y - 4)(2x + 3y + 4)$
------	--

- 5 A straight line, L_1 has equation $3x + 2y = c$. It passes through the point $(1, 3)$.

(a) Find c .

5(a)	$\text{Sub } (1, 3),$ $3(1) + 2(3) = c$ $c = 9$
------	---

(b) Find the gradient of L_1 .

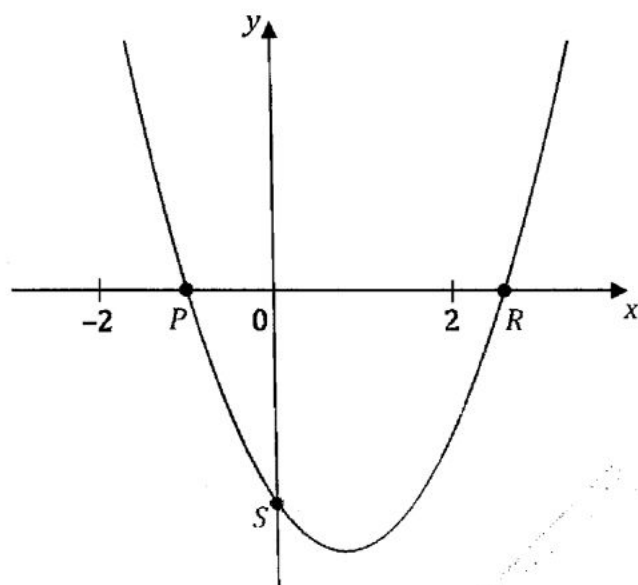
5(b)	$2x + 3y = 9$ $y = -\frac{2}{3}x + \frac{3}{2}$ $\text{Gradient} = -\frac{2}{3}$
------	---

- 6 The line with equation $2x + 3y = 6$ intersects the line $-2x + y = -3\frac{1}{3}$ at the point T .

Find the coordinates of T .

6	$2x + 3y = 6 \quad \text{--- (1)}$ $-2x + y = -3\frac{1}{3} \quad \text{--- (2)}$ $(1) + (2): 4y = 2\frac{2}{3}$ $y = \frac{2}{3}$ $\text{Sub } y = \frac{2}{3} \text{ into (1)}$ $2x + 3\left(\frac{2}{3}\right) = 6$ $x = 2$ $\text{Coordinates are } \left(2, \frac{2}{3}\right)$
---	---

- 7 The equation of a curve is $y = 2x^2 + bx + c$.
The points $P(-1, 0)$, $R(2.5, 0)$ and $S(0, -5)$ lie on the curve.



- (a) (i) Write down the value of c .

7(a)(i)	$c = -5$
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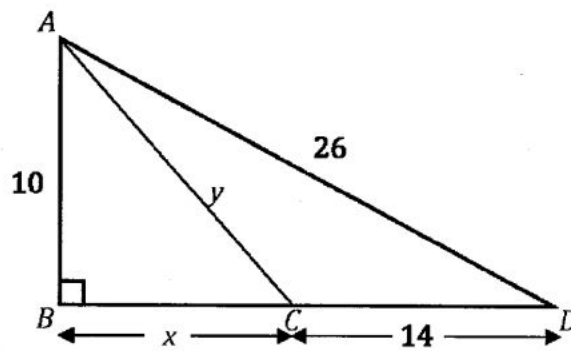
- (ii) Find the value of b .

7(a)(ii)	At $(-1, 0)$, $0 = 2(-1)^2 + b(-1) - 5$ $b = -3$
----------	--

- (b) A line passes through R and cuts y -axis at $(0, 5)$.
Find the equation of the line.

7(b)	Gradient of $= \frac{5-0}{0-2.5} = -2$ Therefore, equation of line is $y = -2x + 5$
------	---

8



In triangle ABD , AB is perpendicular to BD . BCD is a straight line.

$AB = 10$ cm, $AD = 26$ cm, $CD = 14$ cm, $BC = x$ cm and $AC = y$ cm.

Find

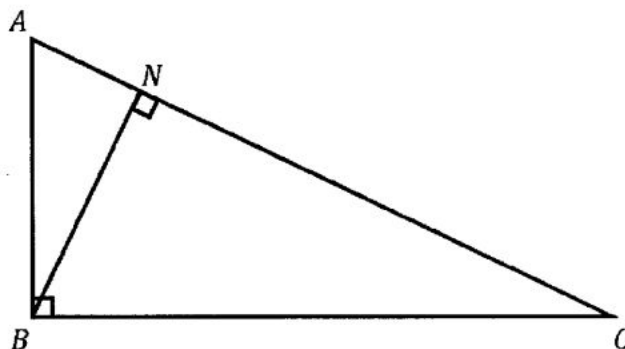
(a) the value of x .

8(a)	$(BD)^2 = 26^2 - 10^2$ $BD = \sqrt{576}$ $= 24$ $x = 24 - 14$ $= 10$
------	--

(b) the value of y .

8(b)	$y^2 = 10^2 + 10^2$ $y = \sqrt{200}$ $= 14.142$ $= 14.1 \text{ (3 s.f)}$
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9



(a) Explain why angle $ACB = \text{angle } ABN$.

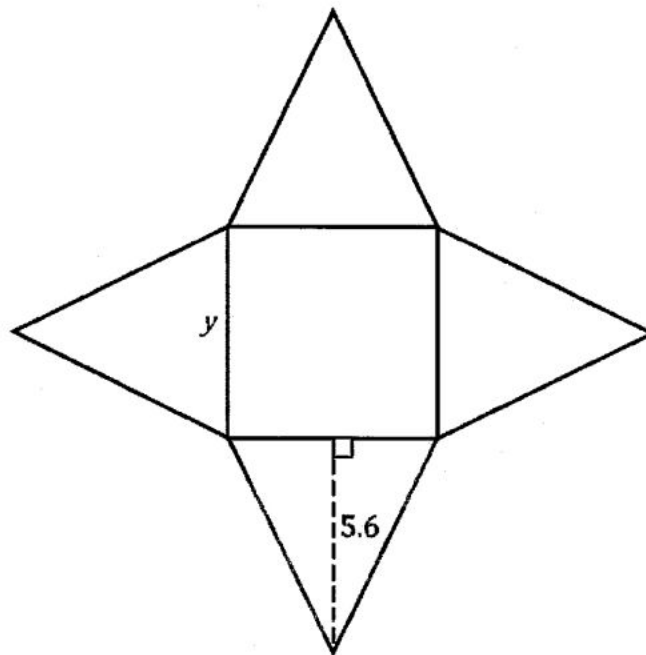
9(a)	Let $\angle ACB = x^\circ$ $\angle CBN = 90^\circ - x^\circ$ $\angle ABN = 90^\circ - (90^\circ - x^\circ) = x^\circ$ Therefore, $\angle ACB = \angle ABN = x^\circ$
------	--

(b) It is given that $BN = 20 \text{ cm}$ and $AB = 25 \text{ cm}$.

Find angle ACB .

9(b)	$\cos \angle ABN = \frac{20}{25}$ $\angle ABN = \cos^{-1} \frac{20}{25}$ $= 36.9^\circ$ $\angle ACB = 36.9^\circ \text{ (to 1 dp)}$
------	---

10



The diagram shows the net of a right pyramid with a square base of side y cm. Each triangular face has an area of 8.4 cm^2 and height of 5.6 cm.

Find

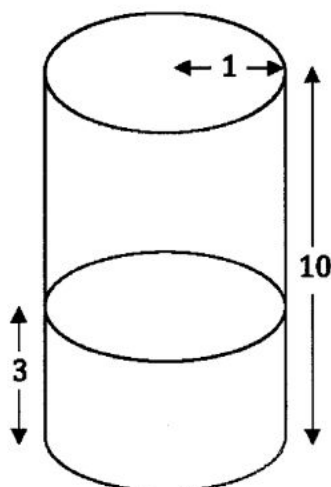
(a) the value of y .

10(a)	$\frac{1}{2}(5.6)y = 8.4$ $y = 3$
-------	-----------------------------------

(b) the volume of the pyramid.

10(b)	$h^2 = 5.6^2 - 1.5^2$ $h = \sqrt{29.11}$ $= 5.3953$ $\text{Volume} = \frac{1}{3} \times 9 \times 5.3953$ $= 16.186$ $= 16.2 \text{ cm}^3 \text{ (to 3 s.f.)}$
-------	---

11



The diagram shows an open cylindrical tank of radius 1 m and height 10 m. The tank contains water to a depth of 3 m.

- (a) Calculate the area of the tank which is in contact with the water, leaving your answers in terms of π .

11(a)	$\begin{aligned} \text{Area in contact with the water} &= \pi r^2 + 2\pi r h \\ &= \pi r(r + 2h) \\ &= \pi(1 + 2(3)) \\ &= 7\pi \text{ m}^2 \end{aligned}$
-------	--

- (b) Calculate the volume of water in the tank, leaving your answer in litres.

11(b)	$\begin{aligned} \text{Volume} &= \pi r^2 h \\ &= \pi 1^2 (3) \\ &= 9.4247 \text{ m}^3 \\ &= 9424.7 \text{ litres} \\ &= 9420 \text{ litres (to 3 s.f)} \end{aligned}$
-------	--

- 12 y is directly proportional to $(x + 2)^2$ and $x > 0$.

The table below shows the corresponding values of x and y .

x	p	2
y	4.5	8

- (a) Find the equation connecting x and y .

12(a)	$y \propto (x + 2)^2$ $y = k(x + 2)^2$ where k is a constant When $x = 2, y = 8$ $8 = k(2 + 2)^2$ $k = \frac{1}{2}$ $\therefore y = \frac{1}{2}(x + 2)^2$
-------	--

- (b) Find the value of p .

12(b)	When $x = p, y = 4.5$ $4.5 = \frac{1}{2}(p + 2)^2$ $(p + 2)^2 = 9$ $p = 1$
-------	---

- 13 There are x girls and 42 boys in a group.
The probability of selecting a girl from the group is $\frac{2}{9}$.

(a) Find the number of girls in the group.

13(a)	$\frac{x}{x+42} = \frac{2}{9}$ $9x = 2x + 84$ $7x = 84$ $x = 12$
-------	--

- 13 (b) How many more boys are needed to join the group so that the probability of selecting a boy from the group will be $\frac{4}{5}$?

13(b)	Let y be the number of boys to be added. $\frac{42+y}{42+12+y} = \frac{4}{5}$ $210 + 5y = 216 + 4y$ $y = 6$ The number of boys to be added is 6.
-------	---

- 14 Sixteen boys and fifteen girls took a test. The scores are shown in the stem-and-leaf diagram.

Boys		Girls
9 9 5 0	5	2 2 4 7 8 8
8 8 4 4 1 1	6	0 3 3 3 5 5
1 1 1 1	7	1 3
1 0	8	1
Key (Boys) : 4 6 means 64		Key (Girls) : 6 0 means 60

- (a) Write down the mode of the girls' score.

14(a)	The mode score for the girls is <u>63</u> .
-------	---

- (b) Write down the median of the boy's score.

14(b)	The median score for the boys is $\frac{64+68}{2} = \underline{66}$ marks
-------	---

- (c) Explain briefly whether the boys or the girls performed better in the test.

14(c)	Both the <u>median</u> (66) and <u>modal marks</u> (71) of the boys are higher than the girls (i.e. median is 63 and mode is 63), therefore the <u>boys performed better</u> .
-------	--

- 15 (a) Construct the triangle ABC such that angle $ACB = 110^\circ$, angle $ABC = 33^\circ$ and $AB = 10$ cm. AB has already been drawn for you. [1]

15(a)		OR

- (b) Draw DE , such that E is 3.5 cm from A , on the diagram, such that triangle ABC and triangle AED are similar. Measure the length of DE .

15(b)	From the diagram, $DE = 2.2$ cm
--------------	---------------------------------

- (c) By using similarity, calculate the length of BC .

15(c)	$\frac{AB}{AE} = \frac{BC}{ED}$ $\frac{10}{3.5} = \frac{BC}{2.2}$ $BC = 6.29 \text{ cm (to 3 sf)}$
--------------	--

END OF PAPER

2020 Year 2 EOY Paper 2 (Mark Scheme)

- 1 (a) (i) Express $\frac{y}{4x-2xy} - \frac{1}{2x}$ as a single fraction.

1(ai)	$\begin{aligned} \frac{y}{4x-2xy} - \frac{1}{2x} &= \frac{y}{2x(2-y)} - \frac{2-y}{2x(2-y)} \\ &= \frac{2y-2}{2x(2-y)} \\ &= \frac{2(y-1)}{2x(2-y)} \\ &= \frac{y-1}{x(2-y)} \end{aligned}$
-------	---

- (bii) Use your result in part (a) to make x as the subject of the formula

$$\frac{y}{4x-2xy} - \frac{1}{2x} = 1.$$

1(aii)	$\begin{aligned} \frac{y}{4x-2xy} - \frac{1}{2x} &= 1 \\ \frac{y-1}{x(2-y)} &= 1 \\ x &= \frac{y-1}{2-y} \end{aligned}$
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- 2 (a) Simplify $1 + 4x^{-2}$.

2(a)	$1 + 4x^{-2} = \frac{x^2}{4}$
------	-------------------------------

- (b) Simplify $\frac{9w^4z^5}{7(xy)^3} \times \left(\frac{3xy^2}{343wz}\right)^{-2}$, expressing your answers in positive index form.

2(c)	$\begin{aligned} &\frac{9w^4z^5}{7(xy)^3} \times \left(\frac{7^3wz}{3xy^2}\right)^2 \\ &= \frac{3^2w^4z^5}{7(x^3y^3)} \times \left(\frac{7^6w^2z^2}{3^2x^2y^4}\right) \\ &= \frac{w^4z^5}{x^3y^3} \times \frac{7^5w^2z^2}{x^2y^4} \\ &= \frac{16807w^6z^7}{x^5y^7} \end{aligned}$
------	---

- 3 According to the National Parks Board, Singapore Bukit Timah Nature Reserve has an area of about 1.69 km^2 .

(a) The map has a scale of 1 cm to 500 m.

Calculate the area, in square centimetres, of the nature reserve on the map.

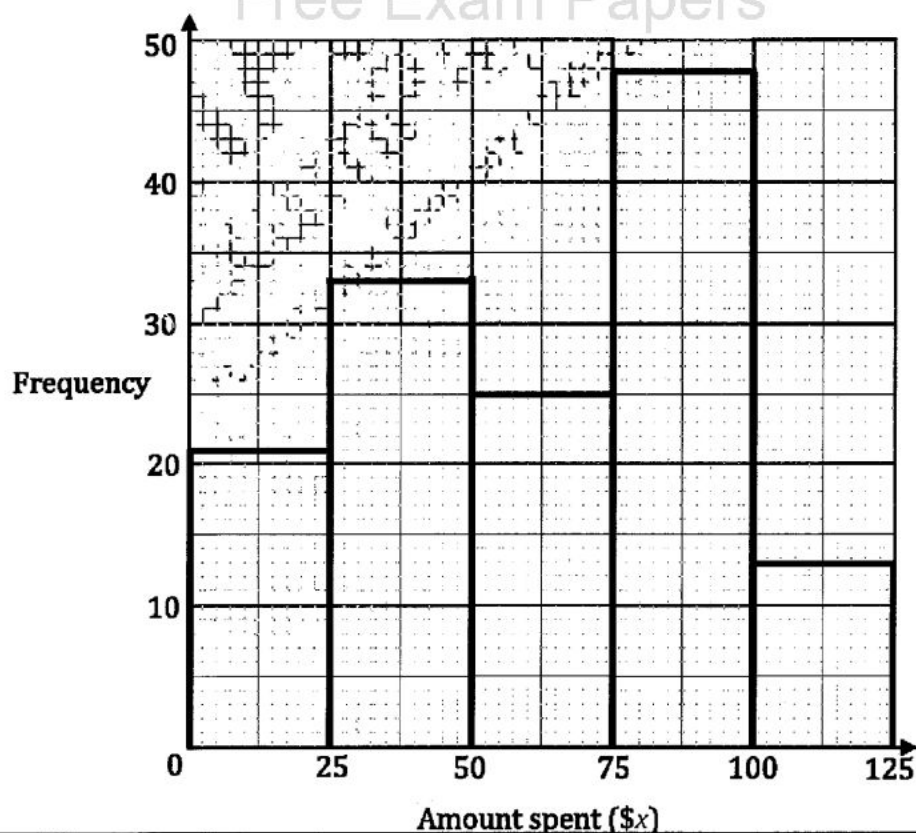
3(a)	$1 \text{ cm rep } 0.5 \text{ km}$ $1 \text{ cm}^2 \text{ rep } 0.25 \text{ km}^2$ $\text{Map area} = \frac{1.69}{0.25} \text{ cm}^2$ $= 6.76 \text{ cm}^2$
------	--

(b) On another map, the area is represented by 0.4225 cm^2 .

Express the scale of this map in the form of 1: r .

3(b)	$0.4225 \text{ cm}^2 \text{ to } 1.69 \text{ km}^2$ $1 \text{ cm}^2 \text{ to } 4 \text{ km}^2$ $1 \text{ cm to } 2 \text{ km}$ $1 \text{ cm to } 200000 \text{ cm}$ $1: 200\ 000$
------	--

- 4 The histogram shows the amount of money spent by 140 shoppers in the supermarket.



- 4 (ai) Using the class intervals $0 < x \leq 25$, $25 < x \leq 50$ and so on, complete the frequency table below.

[1]

4(ai)	Amount spent (in \$x)	Number of customers
	$0 < x \leq 25$	21
	$25 < x \leq 50$	33
	$50 < x \leq 75$	25
	$75 < x \leq 100$	48
	$100 < x \leq 125$	13

- (aii) Find the estimated mean of the amount spent.

4(aii)	Estimated mean $\frac{12.5 \times 21 + 37.5 \times 33 + 62.5 \times 25 + 87.5 \times 48 + 112.5 \times 13}{140}$ = \$62.32
--------	---

- (aiii) Find the probability of a shopper selected spending not more than \$50.

4(aiii)	$P(\leq \$50) = \frac{54}{140} = \frac{27}{70}$
---------	---

- 4 (b) The frequency table shows the number of goals scored in a series of soccer matches.

Number of goals	0	1	2	3	4	5
Number of matches	3	10	a	15	4	3

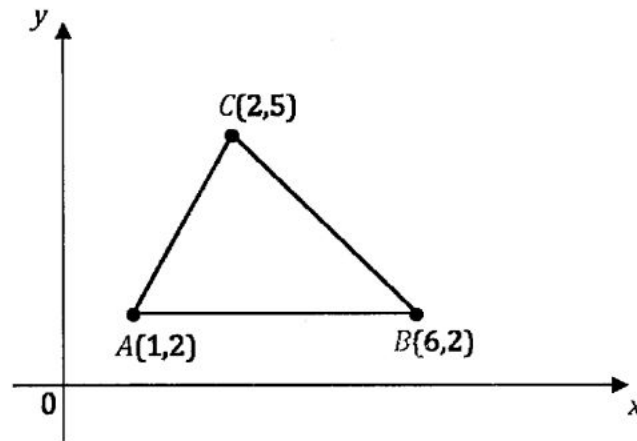
- (i) If the mean number of goals is 2.2, find the value of a .

4(bi)	$\frac{0 \times 3 + 1 \times 10 + 2 \times a + 3 \times 15 + 4 \times 4 + 5 \times 3}{3 + 10 + a + 15 + 4 + 3} = 2.2$ $86 + 2a = 77 + 2.2a$ $a = 45$
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- 4 (b) (ii) If the median number of goals is 2, find the smallest possible value of a .

4(bii)	$3 + 10 + a - 1 = 22$ $a = 10$
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- 5 A, B and C are the points $(1,2)$, $(6,2)$ and $(2,5)$.



- (a) Find the area of triangle ABC .

5(a)	Area of triangle $ABC = \frac{1}{2} \times 5 \times 3$ $= 7.5$ square units
------	---

- (b) Show that angle ABC is 36.87° when corrected to 2 decimal places.

5(b)	$\tan \angle ABC = \frac{3}{4}$ $\angle ABC = 36.87^\circ$ (shown)
------	--

6 Deborah planned to spend \$42 buying papayas at \$ x per kilogram.

- (a) Write down an expression in terms of x for the number of kilograms she expected to buy.

6(a)	$\frac{42}{x}$
------	----------------

- (b) It was found that the price had increased by \$1 per kilogram.

Write down an expression in terms of x for the number of kilograms she actually bought for \$42.

6(b)	$\frac{42}{x+1}$
------	------------------

- (c) She actually bought 7 kg less than what she expected.

Form an equation in x and show that it reduces to

$$x^2 + x - 6 = 0.$$

6(c)	$\frac{42}{x} - \frac{42}{x+1} = 7$ $42(x+1) - 42x = 7x(x+1)$ $7x^2 + 7x - 42 = 0$ $x^2 + x - 6 = 0 \text{ (Shown)}$
------	--

- (d) Solve the equation $x^2 + x - 6 = 0$.

6(d)	$x^2 + x - 6 = 0$ $(x-2)(x+3) = 0$ $x = 2 \text{ or } -3$
------	---

- (e) Using your answer from part (d), find the number of kilograms she actually bought.

6(e)	$\text{No. of kg} = \frac{42}{2+1}$ $= 14 \text{ kg}$
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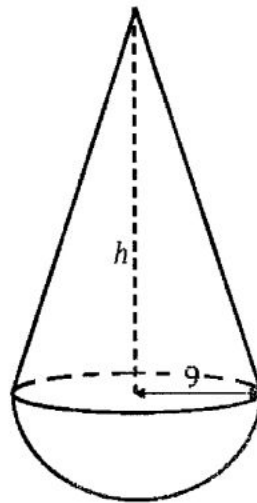


Diagram I

Diagram I shows a solid made from a cone and a hemisphere.

The radius of the cone and the hemisphere is 9 cm.

The height of the cone is h cm.

(a) Given that the volume of the solid is $1053\pi \text{ cm}^3$, find the value of h .

7(a)	$\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3 = 1053\pi$ $\frac{1}{3}\pi r^2 (h + 2r) = 1053\pi$ $\frac{81}{3}(h + 18) = 1053$ $(h + 18) = 39$ $h = 21$
------	--

(b) Find the total surface area of the solid.

7(b)	$l = \sqrt{21^2 + 9^2}$ $l = \sqrt{522}$ $\text{Total Surface area} = \pi r l + 2\pi r^2$ $= \pi r(l + 2r)$ $= 9\pi(\sqrt{522} + 18)$ $= 1154.9 \text{ (tr to 5 sf)}$ $= 1150 \text{ cm}^2 \text{ (to 3 sf)}$
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- 7 (c) The solid in Diagram I is melted down and form into a new solid, as shown in Diagram II. The new solid is made from a cylinder and two hemispheres. The radius of the hemisphere is 6 cm.

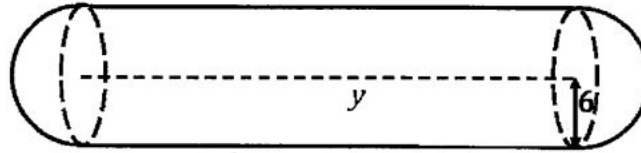


Diagram II

Find the length of the cylinder, y , in Diagram II.

7(c)	$\frac{4}{3}\pi r^3 + \pi r^2 h = 1053\pi$ $\pi r^2 \left(\frac{4}{3}r + y\right) = 1053\pi$ $36 \left(\frac{4}{3}(6) + y\right) = 1053$ $(8 + y) = \frac{117}{4}$ $y = 21.25 \text{ cm}$
------	---

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- 8 An arch can be modelled by a parabola with equation $y = -x^2 + 100x$, where x is the horizontal distance, in metres, from the foot of the arch and y is the height, in metres, above ground. The width of the arch at its base is 100 m.

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

x (metres)	0	20	40	60	80	100
y (metres)	0	1600	p	2400	1600	0

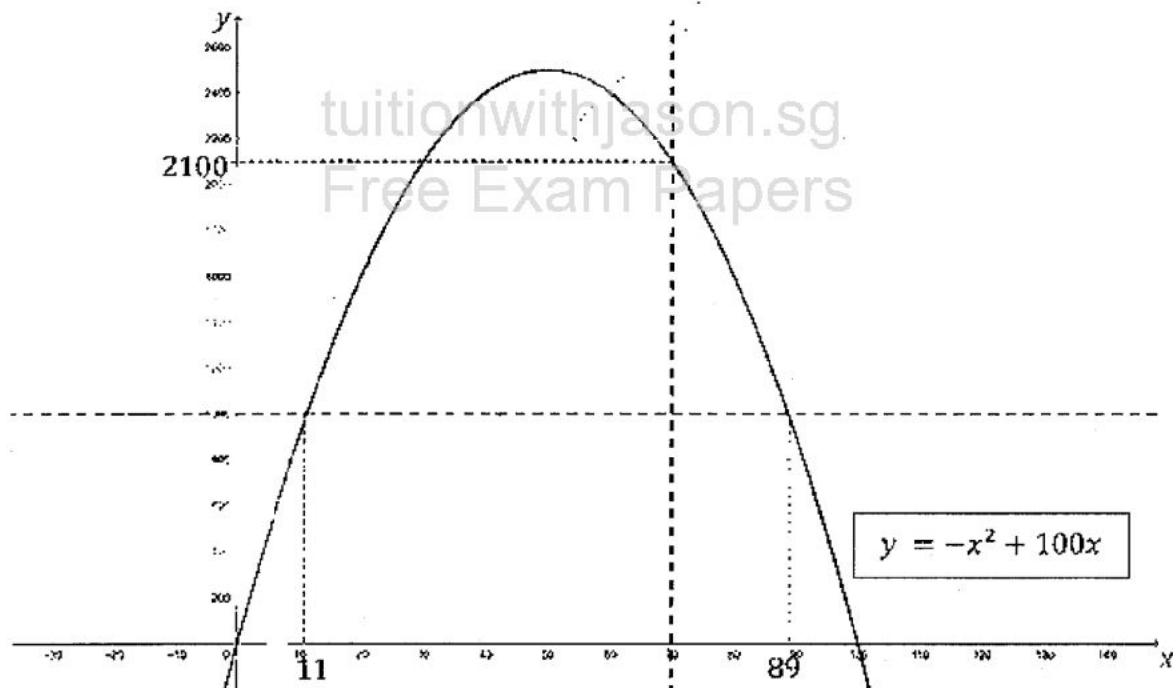
- (a) Calculate the value of p .

8(a) $p = 2400$

- (b) Using a scale of 1 cm to represent 10 m, draw a horizontal x -axis for $0 \leq x \leq 100$.

Using a scale of 1 cm to represent 200 m, draw a vertical y -axis for $0 \leq y \leq 2800$.

On your axes, plot the points given on the table on the grid provided (in the next page), and join them with a smooth curve. [3]



8(b) label axes (incl the correct intervals given)
correct plot
smooth curve (incl the max point at $x = 50$)

(c) Write down the equation of the line of symmetry.

8(c)	$x = 50$
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(d) Use your graph to estimate the maximum height of the arch,

8(d)	From graph, max. height = 2500 m
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(e) A cable is used to attach two points where $y = 1000$.

Use your graph to estimate the length of the cable.

8(e)	From graph, height = $89 - 11 = 78\text{m}$
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END OF PAPER

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