

2020 SM2

Class	Name	Index No.
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ST. HILDA'S SECONDARY SCHOOL

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END-OF-YEAR EXAMINATION 2020

Mathematics

Level: Secondary 2 Express
Additional Materials: NIL

Date of Exam: 6 October 2020
Duration: 2 hours 30 minutes

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.
You may use an 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

Section A & Section B

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

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.

For Examiner's Use		
Section A		50
Section B		50
Total		100

Set by: Mr Eric Tan

Checked by: Ms Joanne Tay, Mr Peter Neo, Ms Cindy Tan

Mathematical Formulae*Mensuration*

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

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

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

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

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Section A
Answer **all** the questions.

- 1 (a) Calculate $\frac{4.5^2}{18.22+5.11}$.

Write down the first 6 digits on your calculator display.

Answer [1]

- (b) Write your answer to **part (a)** correct to 4 significant figures.

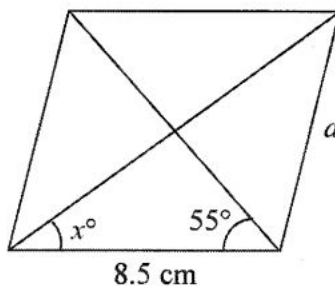
Answer [1]

- 2 Apples are sold in cartons of 120.
Berries are sold in cartons of 160.
A fruit wholesaler bought the same number of apples and berries.
Find the smallest number of cartons of apples bought by him.

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Answer [2]

- 3 The diagram shows a sketch of a rhombus.



- (a) Write down the value of a .

Answer $a =$ [1]

- (b) Find x .

Answer $x =$ [1]

- 4 The table below shows the x -coordinates and the corresponding y -coordinates of some points that lie on a straight line graph.

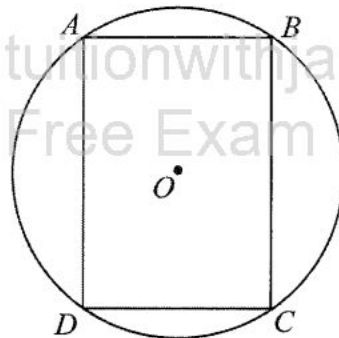
x	1	3	5
y	3	9	15

Explain if y is directly proportional to x .
Show your workings clearly.

Answer

[2]

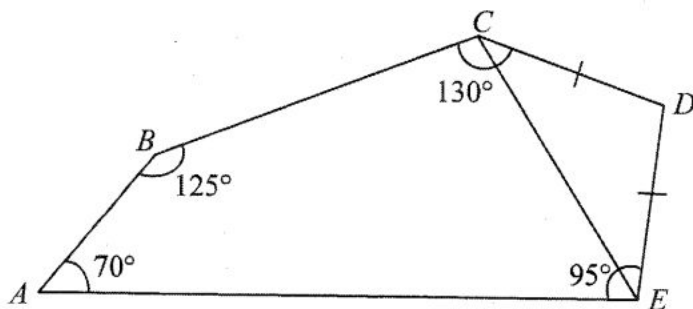
- 5 The diagram shows a rectangle $ABCD$ inscribed in a circle with centre O .
The length of the rectangle is 12 cm and the breadth is 5 cm.
The diagonals of the rectangle pass through the centre O .



Find the radius of this circle.

Answer cm [3]

- 6 The diagram shows a pentagon, $ABCDE$.
Triangle CDE is an isosceles triangle.
Angle $BAE = 70^\circ$, angle $ABC = 125^\circ$, angle $BCD = 130^\circ$ and angle $AED = 95^\circ$.



Find angle DEC .

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Answer $^\circ$ [3]

7 Solve the simultaneous equations

$$\frac{x}{3} - \frac{3y}{4} = 2$$

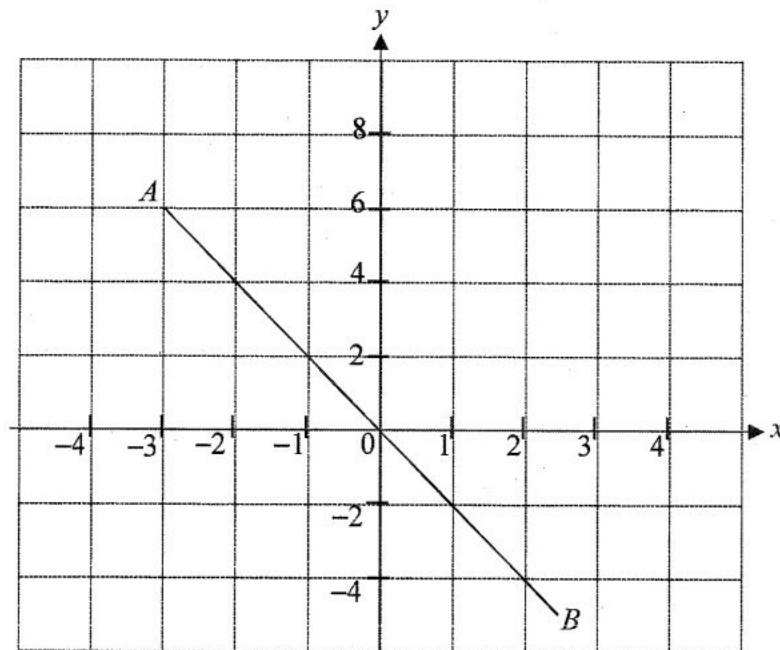
$$4x + 3y = 16$$

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Answer $x = \dots\dots\dots$

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

- 8 The diagram shows a line segment AB .



- (a) Find the gradient of the line AB .

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Answer [1]

- (b) State the equation of the line that is parallel to the y -axis and passes through the point A .

Answer [1]

- (c) Draw and label a line l_1 that has a zero gradient and a y -intercept of -4 . [1]

- 9 (a) Solve $2x^2 + 15x - 8 = 0$.

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

- (b) Hence, solve the equation $2(p-1)^2 + 15(p-1) - 8 = 0$.

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

- 10 The first four terms of a sequence are $-1, 2, 5$ and 8 .

- (a) Write down the next two terms in the sequence.

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

- (b) Find an expression for the n th term of the sequence.

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

- (c) Explain if 288 is a term of this sequence.

Answer $\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$

[2]

11. The scale of a map is 1 : 80 000.

(a) The length of a river is 5400 m.

Find the length, in centimetres, of the river on this map.

Answer cm [2]

(b) The area of a town on the map is 105 cm^2 .

Find the actual area, in square kilometres, of the town.

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Answer km^2 [2]

12 Factorise fully

(a) $8x^2 - 2$,

Answer [2]

(b) $15a^2 - 5ab + 2b - 6a$.

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Answer [2]

- 13 (a) 20 painters are able to paint 4 houses in 3 days.
5 painters fell sick before the start of painting and the remaining were told to paint 6 houses.
Assuming that all the painters paint at the same rate, how many days will be required to complete all the houses?

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Answer days [3]

- (b) The force of attraction, F Newtons, between two objects is inversely proportional to the square of the distance, d metres, between the objects.
 The force of attraction is 10 Newtons when the distance between the objects is 5 m.
 Find the value of F when the distance between the objects is 8 m.

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

- (c) It is given that y is directly proportional to the cube root of x .
 It is known that $y = 30$ for a particular value of x .
 Find the value of y when this value of x is increased by 700%.

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

- 14 (a) Expand and simplify $-6x - 6 - (x - 3)^2$.

Answer [2]

- (b) With the use of special algebraic identities, evaluate the value of 1001^2 .

Answer [2]

- (c) It is given that $p = \frac{4}{3q^2} + r$.

- (i) Find the value of p when $q = -2$ and $r = 1$.

Answer $p =$ [1]

- (ii) Express q in terms of p and r .

Answer [2]

Section BAnswer **all** the questions.

15 (a) Simplify $\frac{5a^2b}{7c} \div \frac{15b^2a}{4c^3}$.

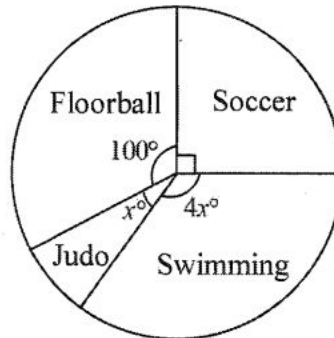
Answer [2]

(b) Express $\frac{3y}{(y-2)^2} + \frac{3}{4-2y}$ as a single fraction in its simplest form.

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Answer [3]

- 16 (a) The pie chart shows the different Co-Curricular Activities (CCA) that a group of students chose.



- (i) Given that there are 30 students who chose Floorball as their CCA, find the total number of students represented by the pie chart.

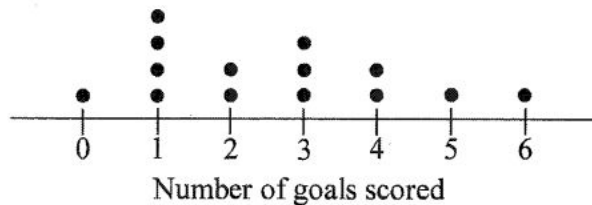
Answer students [1]

- (ii) Find the value of x .

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Answer $x =$ [1]

- (b) The dot diagram shows the number of goals scored by a football team in 14 matches.



- (i) Find the
(a) mode,

Answer [1]

- (b) median,

Answer [1]

(c) mean.

Answer [2]

- (ii) In another football match, the team scored a total of x goals.
 When this new data is added to the dot diagram, the median goals is 2.
 What is the largest possible value of x and explain your answer.

Answer $x = \dots\dots\dots$ because

.....
 [1]

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- 17 Rio cycled for 30 km at a constant speed of x km/h.

He then ran for the remaining 8 km at a constant speed of $(x-15)$ km/h.

- (a) Write down an expression, in terms of x , for the time in hours that Rio cycled.

Answer hours [1]

- (b) Write down an expression, in terms of x , for the time in hours that Rio ran.

Answer hours [1]

- (c) Given that the total time taken for the whole training is 2 hours, form an equation in x and show that it reduces to $x^2 - 34x + 225 = 0$.

Answer

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- (d) Solve the equation $x^2 - 34x + 225 = 0$.

[3]

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

- (e) Explain why one of the solutions in (d) is not a possible solution.

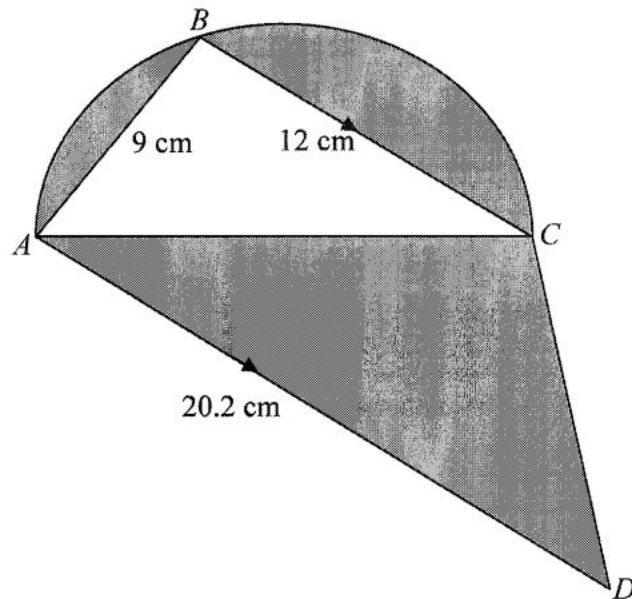
Answer

..... [1]

- (f) Find the time taken, in hours and minutes that Rio cycled.

Answer hour minutes [1]

- 18** The diagram shows a semicircle ABC joined with triangle ACD .
 AC is the diameter of the semicircle and the radius is 7.5 cm.
 ABC forms a triangle in the semicircle.
 $AB = 9$ cm, $BC = 12$ cm and $AD = 20.2$ cm.
 BC is parallel to AD .



- (a) State the name of the quadrilateral $ABCD$.

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Answer [1]

- (b) Show that triangle ABC is a right-angled triangle.

Answer

 [2]

- (c) Find the shaded area.

Answer cm^2 [3]

- (d) (i) Find $\tan \angle ACB$.

Answer [1]

- (ii) Find angle CAD , giving reason for your answer.

Answer[°] [2]

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- 19 The variables x and y are connected by the equation $y = -x^2 + 14x - 24$.
Some corresponding values of x and y are given in the table below.

x	0	1	2	4	6	8	10	12
y	-24	-11	0	16	24	p	16	0

- (a) Calculate the value of p .

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

- (b) On the grid opposite, draw the graph of $y = -x^2 + 14x - 24$ for $0 \leq x \leq 12$. [3]

- (c) State the equation of the line of symmetry for $y = -x^2 + 14x - 24$.

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

- (d) From the graph, find the value of y when $x = 1.5$.

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

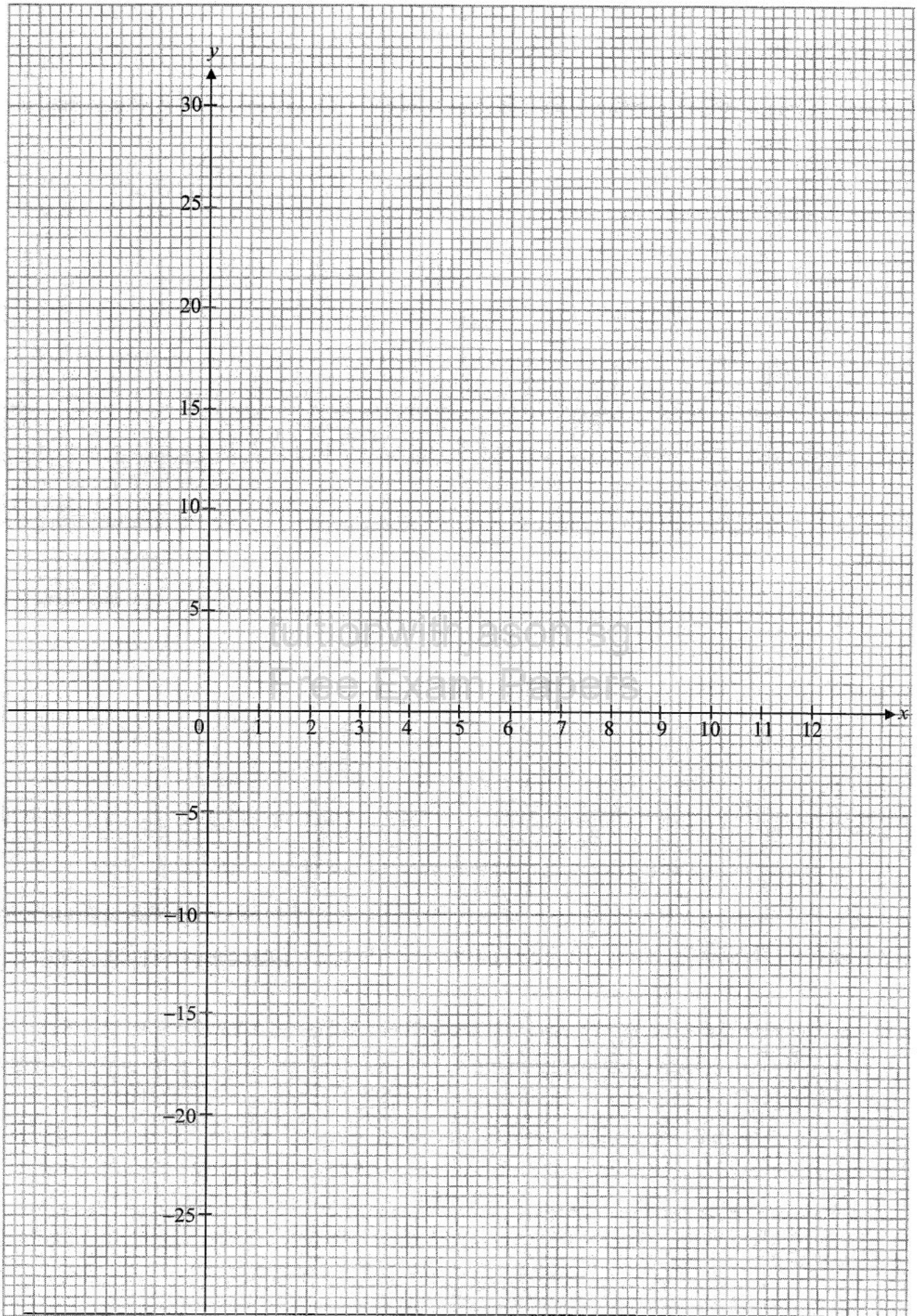
- (e) By drawing a tangent, find the gradient of the curve at the point (6, 24).

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

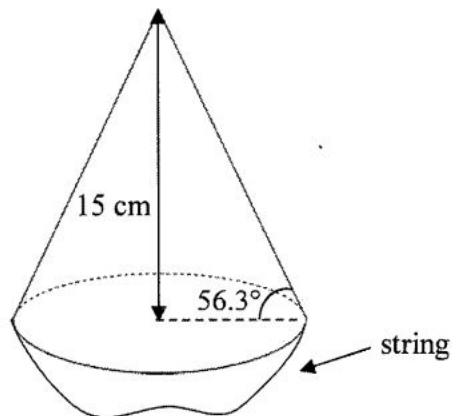
- (f) (i) On the same axes, draw the graph of $y = 2x - 4$ for $0 \leq x \leq 12$. [2]

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

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



- 20 A manufacturer produces a Christmas party hat that can be modelled by an **open** cone with a string attached at the base as shown below.
The cone has a height of 15 cm and the slant height is approximately 56.3° from the base of the cone.



- (a) Show that the slant height of the hat is 18.03 cm, correct to four significant figures.

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Answer cm [2]

- (b) Find the outer curved surface area of the hat.

Answer cm^2 [3]

- (c) The table below shows the manufacturing cost of a red Christmas party hat.

Material cost per unit area	\$0.005/cm ²
Cost of one tin of red paint	\$2.90
Cost of one string	\$0.25

The tin of red paint is used to paint the entire outer surface area of the hat and one tin of red paint can paint a total surface area of 3000 cm².

The manufacturer intends to produce 500 red Christmas party hats.

Suggest a sensible amount that the manufacturer should charge for a red Christmas party hat.

Justify the decision you make and show your calculations clearly.

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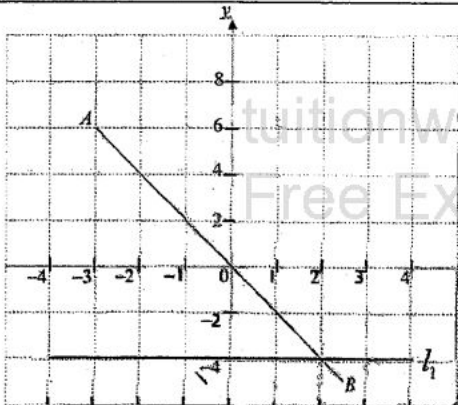
Answer

.....

.....

[4]

End of Paper

Sec 2Exp Mathematics (4048) End of Year Examination 2020 Answer	
Qn	Answers
1(a)	0.86798
1(b)	0.8680
2	4
3(a)	$a = 8.5 \text{ cm}$
3(b)	$x = 35$
4	$\frac{y}{x} = \frac{3}{1} = \frac{9}{3} = \frac{15}{5} = 3$ Since there is a <u>proportionality constant 3</u> that connects y and x, y is directly proportional to x.
5	Radius of the circle = 6.5 cm
6	$\angle DEC = 30^\circ$
7	$y = -\frac{2}{3}$ $x = 4\frac{1}{2}$
8(a)	Gradient of the line $AB = -2$
8(b)	$x = -3$
8(c)	
9(a)	$x = \frac{1}{2}$ or $x = -8$
9(b)	$p = 1\frac{1}{2}$ or $p = -7$
10(a)	11 and 14
10(b)	$T_n = 3n - 4$
10(c)	$n = 97\frac{1}{3}$ Since <u>n is not a positive integer</u>, 288 cannot be a term of this sequence.
11(a)	Length of river on the map = 6.75 cm
11(b)	Actual area of the town is 67.2 km^2
12(a)	$2(2x-1)(2x+1)$
12(b)	$(5a-2)(3a-b)$
13(a)	6 days
13(b)	$F = 3\frac{29}{32}$
13(c)	$y = 60$

14(a)	$-x^2 - 15$
14(b)	1002001
14(c)(i)	$p = 1\frac{1}{3}$
14(c)(ii)	$q = \pm \sqrt{\frac{4}{3(p-r)}}$
15(a)	$\frac{4ac^2}{21b}$
15(b)	$\frac{3y+6}{2(y-2)^2}$
16(a)(i)	Total no. of students = 108
16(a)(ii)	$x = 34$
16(b)(i) (a)	Mode = 1
16(b)(i) (b)	Median = 2.5
16(b)(i) (c)	Mean = 2.57 (3 s.f)
16(b) (ii)	$x = 2$ because the <u>median decreases to 2</u> therefore x has to be <u>smaller than or equal to 2</u> . Hence the largest possible value of x is 2.
17(a)	$\frac{30}{x}h$
17(b)	$\frac{8}{x-15}h$
17(c)	$\frac{30}{x} + \frac{8}{x-15} = 2$ $\frac{30(-15) + 8x}{x(x-15)} = 2$ $\frac{30x - 450 + 8x}{x(x-15)} = 2$ $\frac{38x - 450}{x(x-15)} = 2$ $38x - 450 = 2x^2 - 30x$ $2x^2 - 30x - 38x + 450 = 0$ $2x^2 - 68x + 450 = 0$ $x^2 - 34x + 225 = 0 \text{ (shown)}$
17(d)	$x = 25$ or $x = 9$
17(e)	When $x = 9$, $9 - 15 = -6$ hence the <u>running speed will be negative</u> which is not possible. Therefore, <u>$x = 9$ is not a possible solution.</u>
17(f)	Time taken by Rio to cycle = 1 hour and 12 minutes
18(a)	Trapezium

18(b)	$AB^2 + BC^2 = 9^2 + 12^2$ $= 225$ $AC^2 = 15^2$ $= 225$ $\therefore AB^2 + BC^2 = AC^2$ By the converse of Pythagoras' Theorem, $\triangle ABC$ is a right-angled triangle.
18(c)	Shaded area = 125 cm^2 (3 s.f)
18(d)(i)	$\tan \angle ACB = \frac{3}{4}$
18(d)(ii)	$\angle CAD = 36.9^\circ$ (1 d.p)
19(a)	$p = 24$
19(b)	Refer to Annex A.
19(c)	$x = 7$
19(d)	$y = -5$
19(e)	Gradient = $2\frac{11}{32}$
19(f)(i)	Refer to Annex A.
19(f)(ii)	$x = 2$ and $x = 10$
20(a)	Let l be the slant height of the cone. $\sin 56.3^\circ = \frac{15}{l}$ $l = 18.0298$ $l = 18.03 \text{ cm (4 s.f) (shown)}$
20(b)	Curved surface area of the hat = 567 cm^2 (3 s.f)
20(c)	Total cost to produce 1 red Christmas hat = \$3.63 (2 d.p) A sensible amount that the manufacturer should charge for a red Christmas party hat is \$4 so that he is able to make some profit from the sale.

