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**ANG MO KIO SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY FOUR EXPRESS / FIVE NORMAL ACADEMIC**

MATHEMATICS
Paper 2

4048/02

Tuesday

31 August 2021

2 hours 30 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page.

Write in dark blue or black pen on both sides of the paper.

You may use a pencil for any diagrams or graphs.

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

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

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

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

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

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

The total of the marks for this paper is **100**.

For Examiner's Use
100

Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 (a) Simplify $\frac{(3ab)^2}{3} \div \frac{2a}{b^0}$

Answer [2]

(b) $a = \sqrt{\frac{b+2c}{3-b}}$

(i) Evaluate a when $b = -4$ and $c = 3$.

Answer [1]

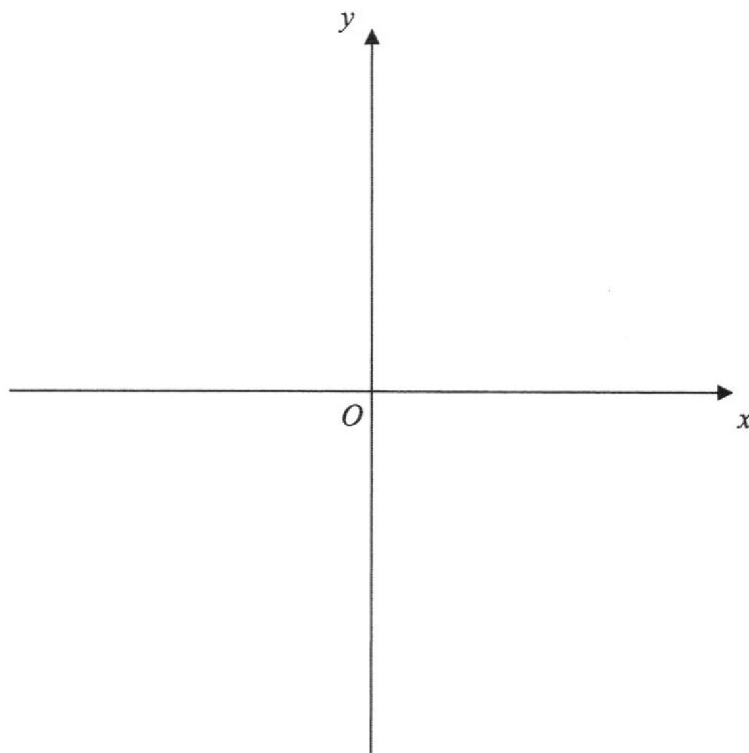
(ii) Express b in terms of a and c .

Answer [3]

- (c) (i) Express $9 - 5x + x^2$ in the form $p + (q + x)^2$.

Answer [2]

- (ii) Sketch the graph of $y = 9 - 5x + x^2$ on the axes below.

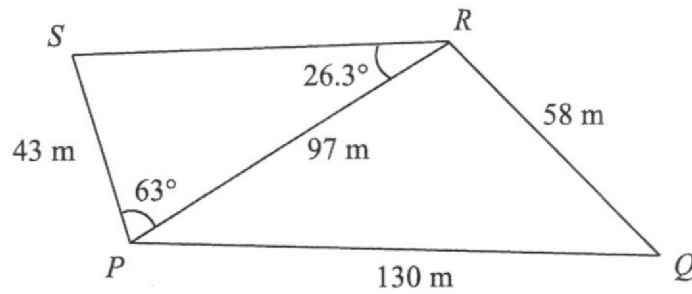


[2]

- (iii) Write down the equation of the line of symmetry for $y = 9 - 5x + x^2$.

Answer [1]

- 2 The diagram represents a field $PQRS$ on horizontal ground in which $PS = 43$ m, $PQ = 130$ m, $QR = 58$ m, $PR = 97$ m, $\angle PRS = 26.3^\circ$ and $\angle RPS = 63^\circ$.



- (a) Find angle PRQ .

Answer $^\circ$ [3]

- (b) Calculate the area of the field $PQRS$.

Answer m^2 [3]

- (c) Calculate the shortest distance from S to PR .

Answer m [2]

- (d) A pole is erected at S . T is the top of the pole. Given that the angle of elevation of T from P is 3.9° , find the range of the angles of elevation of T along the path PR .

Answer $^\circ$ to $^\circ$ [5]

- 3 (a) The price of an iPad Air is \$1 299 in Singapore. The price of the same iPad Air in Japan is ¥104 280. The exchange rate between Singapore dollars (\$) and Japanese Yen (¥) is $\$1 = ¥81.49$.
Where should you buy the iPad Air from?

I should buy the iPad Air from because

.....

.....

[3]

- (b) The price of a MacBook Air increased from \$999 in 2012 to \$1299 in 2020. The price increased by $x\%$ every year. Find the value of x .

Answer $x =$ [2]

- (c) The table shows the sales of Apple's iPhone and the total revenue for 2019 and 2020.

Year	2019	2020
Number of iPhone	187.2 million	196.9 million
Revenue from sale of iPhones	\$142 billion	\$138 billion
Total revenue from all Apple's products	\$260 billion	\$274 billion

- (i) Calculate how many more iPhones were sold in 2020 than in 2019. Give your answer in standard form.

Answer [1]

- (ii) Calculate the percentage decrease in iPhone's revenue from 2019 to 2020.

Answer % [2]

- (iii) Calculate the percentage of Apple's total revenue that comes from the sales of iPhone in 2020.

Answer % [2]

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

$$y = \frac{x^3}{2} + 3x - 5.$$

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

x	-4	-3	-2	-1	0	1	2	3	4
y	-49	-27.5	-15	-8.5	-5	-1.5	5	17.5	p

- (a) Find the value of p .

Answer $p =$ [1]

- (b) On the grid opposite, draw the graph of $y = \frac{x^3}{2} + 3x - 5$ for $-4 \leq x \leq 4$ [3]

- (c) Use your graph to write down an inequality in x to describe the range of values of where $y > 10$.

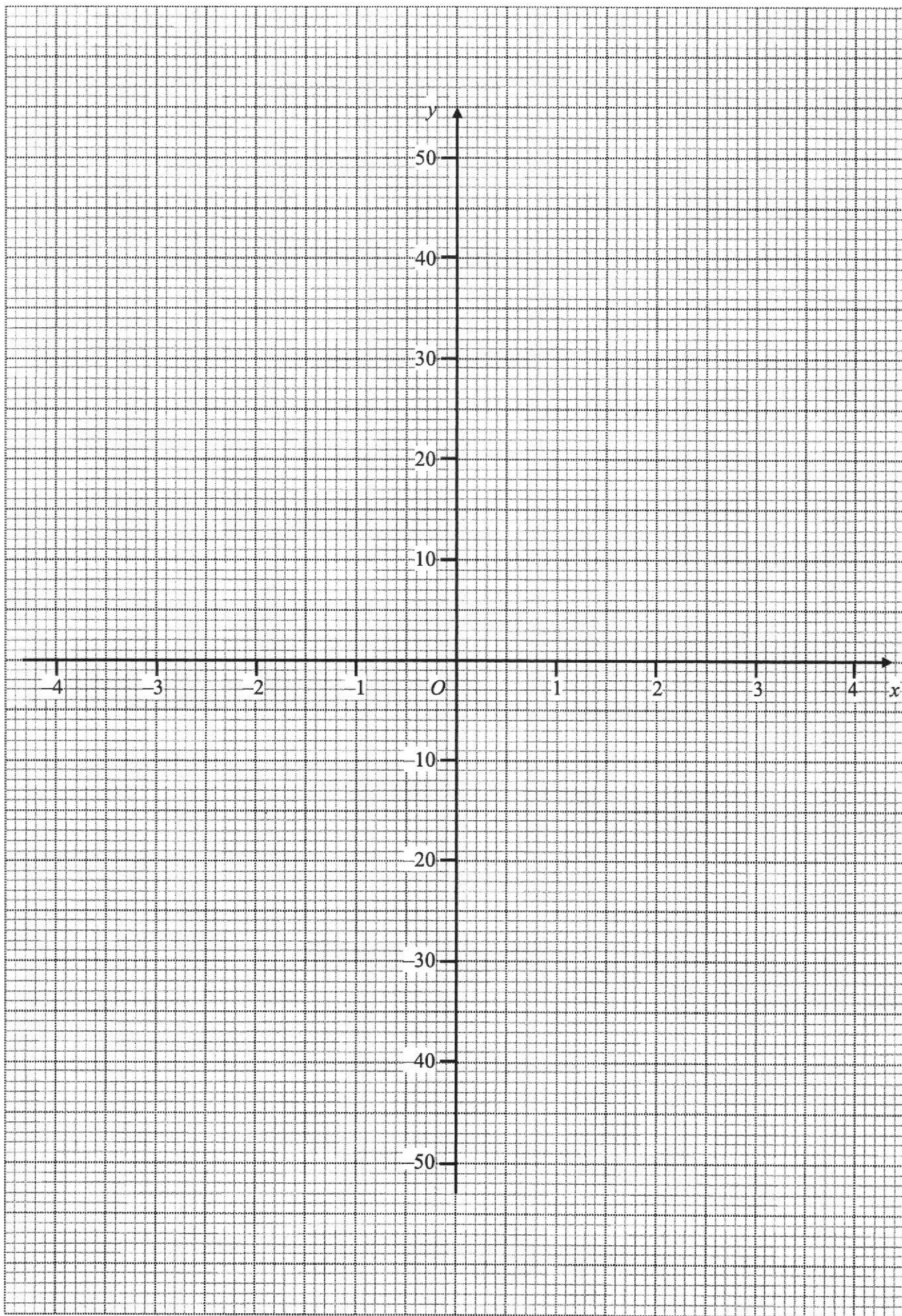
Answer [1]

- (d) (i) On the same grid, draw the graph of $3y - 29x + 5 = 0$ for $-4 \leq x \leq 4$. [2]

- (ii) Show that the points of intersection of the line and the curve give the solution of the equation $3x^3 - 40x - 20 = 0$.

- (iii) Use your graph to solve equation $3x^3 - 40x - 20 = 0$. [2]

Answer $x =$ or or [2]



- 5 The first three terms in a sequence of numbers T_1, T_2, T_3, \dots are given below.

$$T_1 = 2 \times 1^2 + 2 = 4$$

$$T_2 = 2 \times 2^2 + 3 = 11$$

$$T_3 = 2 \times 3^2 + 4 = 22$$

- (a) (i) Write down the fourth line of the sequence.

Answer [1]

- (ii) Find an expression, in terms of n , for T_n .

Answer $T_n =$ [1]

- (iii) Determine if 1175 can be one of the numbers in the sequence.

Answer

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..... [2]

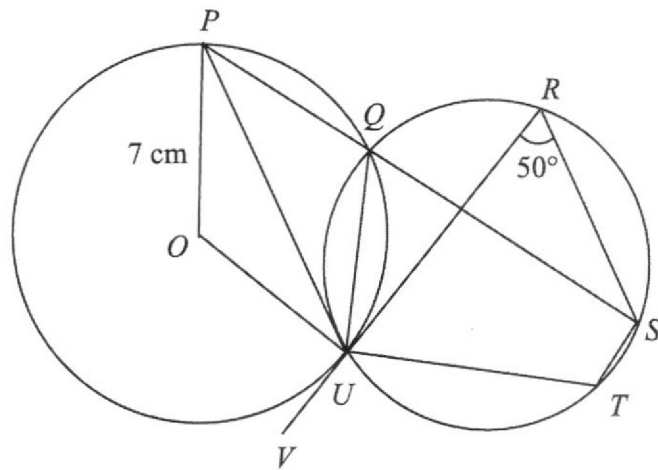
- (b) The first four terms in another sequence are 2, 5, 8, 11.
- (i) Find an expression, in terms of n , for the n th term, S_n , of this sequence.

Answer $S_n =$ [1]

- (ii) Find the 53rd term of this sequence.

Answer [1]

- 6 (a) In the diagram below, RUV is a tangent to the circle with centre O , angle $SRU = 50^\circ$ and PQS is a straight line.



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

Answer^o [1]

- (b) reflex angle POU ,

Answer^o [2]

- (c) angle PUO ,

Answer^o [1]

- (d) angle PUR .

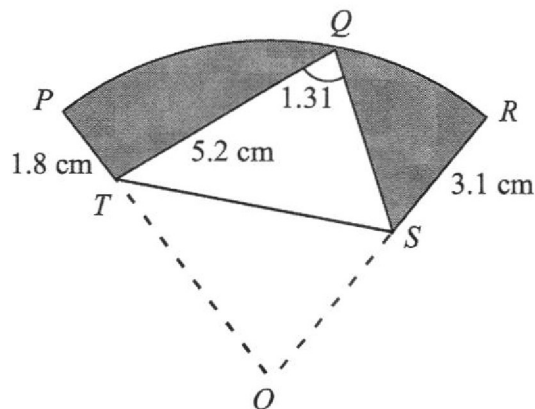
Answer^o [1]

- (ii) What can you say about the lines RS and PU ? Explain.

Answer

[1]

- (b) In the diagram below, $OPQR$ is a sector of a circle with centre O . The sector is folded such that the centre O touches the arc PR at point Q . Angle $TQS = 1.31$ radians, $PT = 1.8$ cm, $QT = 5.2$ cm and $RS = 3.1$ cm.



- (i) Find the length of arc PQR .

Answer cm [1]

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

Answer cm^2 [3]

7 A pond in an ecogarden contains 2500 litres of water.

- (a) A large pump have a water supply of x litres per minute. Write down an expression, in terms of x , for the number of minutes the pump would take to fill up the pond.

Answer min [1]

- (b) A small pump have a water supply of $(x - 10)$ litres per minute. Write down an expression, in terms of x , for the number of minutes the pump would take to fill up the pond.

Answer min [1]

- (c) It takes 4 hours longer to fill up the pool using the small pump than it does using the large pump.

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

$$6x^2 - 60x - 625 = 0.$$

Answer

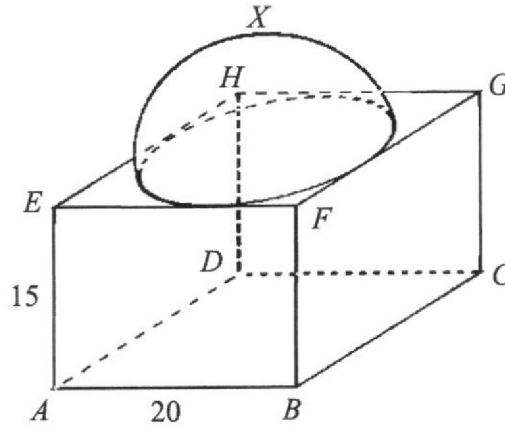
- (d) Solve the equation $6x^2 - 60x - 625 = 0$, giving your solutions correct to one decimal place.

Answer $x =$ or [3]

- (e) Find the time taken for the 2 pumps to operate together to fill up the pond.
Give your answer in hours and minutes correct to the nearest minute.

Answer hr min [3]

- 8 The diagram shows a building structure in the shape of a hemisphere on top of a cuboid.
- The circumference of the base of the hemisphere touches the four edges of the top of the cuboid.
- Point X is the highest point of the structure at the top of the hemisphere.
- $AB = 20$ m and $AE = 15$ m.



- (a) Find the height of the whole structure.

Answer m [1]

- (b) Calculate the volume of the building structure.

Answer m³ [3]

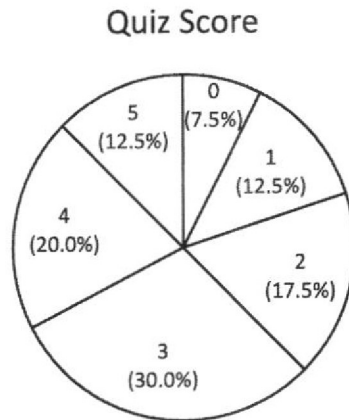
- (c) Calculate the surface area of the building structure.

Answer m² [3]

- (d) Find angle XAC .

Answer ° [3]

- 9 (a) The pie chart below shows the distribution of score for 40 students in a quiz. A student can score a minimum of 0 and a maximum of 5 in the quiz.



- (i) Find the number of students getting the score of 3.

Answer [1]

- (ii) Find the median score for the quiz.

Answer [1]

- (iii) Find the range of score for the quiz.

Answer [1]

- (iv) Find the interquartile range of the score for the quiz.

Answer [1]

- (b) A box contains some green and some red cards. Each card comes with a picture of a living thing or a non-living thing. The table below shows the probabilities of drawing a card at random from the box

	Green	Red
Living thing	$\frac{1}{12}$	$\frac{1}{3}$
Non-living thing	$\frac{1}{4}$	m

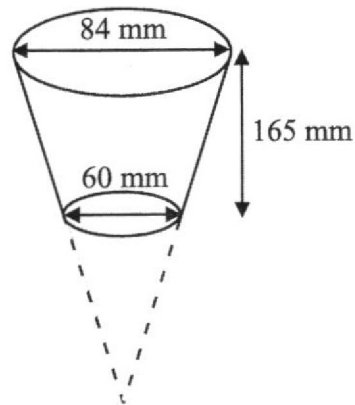
- (i) Find the value of m .

Answer $m =$ [1]

- (ii) Given that there are 60 cards in the box, how many cards with a picture of a non-living thing should be removed so that there is an equal probability of drawing a card with a living or non-living thing from the box.

Answer [2]

- 10 A disposable plastic cup can be represented by a right frustum which is a parallel truncation of a right cone as shown in the diagram below. The cup has a diameter of 84 mm at the top, a diameter of 60 mm at the bottom and a height of 165 mm.



- (a) Show that the plastic cup has a volume of 678019 mm^3 .

Answer

- (b) Bubbles Bubble Tea sells beverages using disposable cup of two sizes. The dimensions of the cups are given in the table below.

The material cost for manufacturing the cups are given in the table below.

The minimum thickness of a plastic cup is 0.25 mm for the manufacturing of the whole cup.

The minimum thickness of a paper cup is 0.35 mm for the side of the cup and 0.70 mm for the bottom of the cup.

Size	Top diameter	Bottom diameter	Height of cup	Selling Price of beverage
Regular	84 mm	70 mm	130 mm	\$5.00
Large	84 mm	60 mm	165 mm	\$6.50

Material	Thickness (mm)	Cost per m ² (\$)
Paper	0.35	\$0.62
Plastic	0.25	\$0.65

The shop needs 1500 large cups each week. Given that the cost of material for 1500 large plastic cups is \$39.24, which material should the shop use for the manufacturing the cups?

Answer The shop should use for manufacturing
the cups because

.....
.....

[8]