Name:_____ ( )	Class:_____

100

GREENDALE SECONDARY SCHOOL
Preliminary Examination 2022

MATHEMATICS **4048/02**

Paper 2 **23 August 2022**

Secondary 4 EXP/ 5 NA **2 hours 30 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your index number and name in the spaces at the top of this page.
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 **100.**

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Strand										
Marks										

No of additional booklets/ writing paper used		**No of additional graph paper used**	

This document consists of 25 printed pages, including this cover page and 1 blank page.

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

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

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[Turn over for Question 1]

Answer **all** questions.

1 **(a)** Solve the inequality $\frac{3x-1}{3} < \frac{2x+1}{4}$.

Answer _____ [2]

(b) Express as a single fraction in its simplest form $\frac{7x}{(4-3x)^2} - \frac{2}{4-3x}$.

Answer _____ [2]

(c) Simplify $\left(\frac{m^{10}}{49n^6}\right)^{-\frac{1}{2}}$.

Answer _____ [2]

(d) Simplify $\dfrac{50x^2-32}{5x^2-11x-12}$.

Answer _____ [3]

(e) Solve the simultaneous equations.

$$4x-5y=16$$
$$6x+3y=10$$

Answer $x =$ _____

$y =$ _____ [3]

2 Two bus companies use 3 different types of buses – Small, Medium and Big.

The table below shows the number of bus trips on 3 consecutive days.

			Bus companies	
			Company A	Company B
Number of bus trips	Day 1	Small	8	15
		Medium	20	30
		Big	6	5
	Day 2	Small	10	15
		Medium	20	35
		Big	12	6
	Day 3	Small	6	8
		Medium	13	14
		Big	9	5

The information for the number of trips on Days 1, 2 and 3 can be represented by the matrices $P = \begin{pmatrix} 8 & 15 \\ 20 & 30 \\ 6 & 5 \end{pmatrix}$, $Q = \begin{pmatrix} 10 & 15 \\ 20 & 35 \\ 12 & 6 \end{pmatrix}$ and $R = \begin{pmatrix} 6 & 8 \\ 13 & 14 \\ 9 & 5 \end{pmatrix}$ respectively.

(a) Evaluate $A = \frac{1}{3}(P + Q + R)$

Answer $A =$ $\begin{pmatrix} & \\ & \\ & \\ & \\ & \end{pmatrix}$ [2]

(b) Describe what is represented by the elements of A.

Answer

_____

_____

_____[1]

(c) Let $B = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix}$.

(i) State which matrix, $3AB$ or $3BA$, exists.
Answer

_____

_____[1]

(ii) Describe what the elements of the matrix that exists in **(c)(i)** represent.
Answer

_____

_____[1]

(d) The number of passengers per trip on a small, medium and big bus is 12, 25 and 50 respectively.

(i) Write down the product of P and two other matrices such that the elements in this product represent the **total** number of passengers the two bus companies carry on Day 1. You need not evaluate this product.

Answer

[2]

(ii) Company A charges \$22 per passenger.

Find the total amount that Company A collects on Day 1.
Answer

[2]

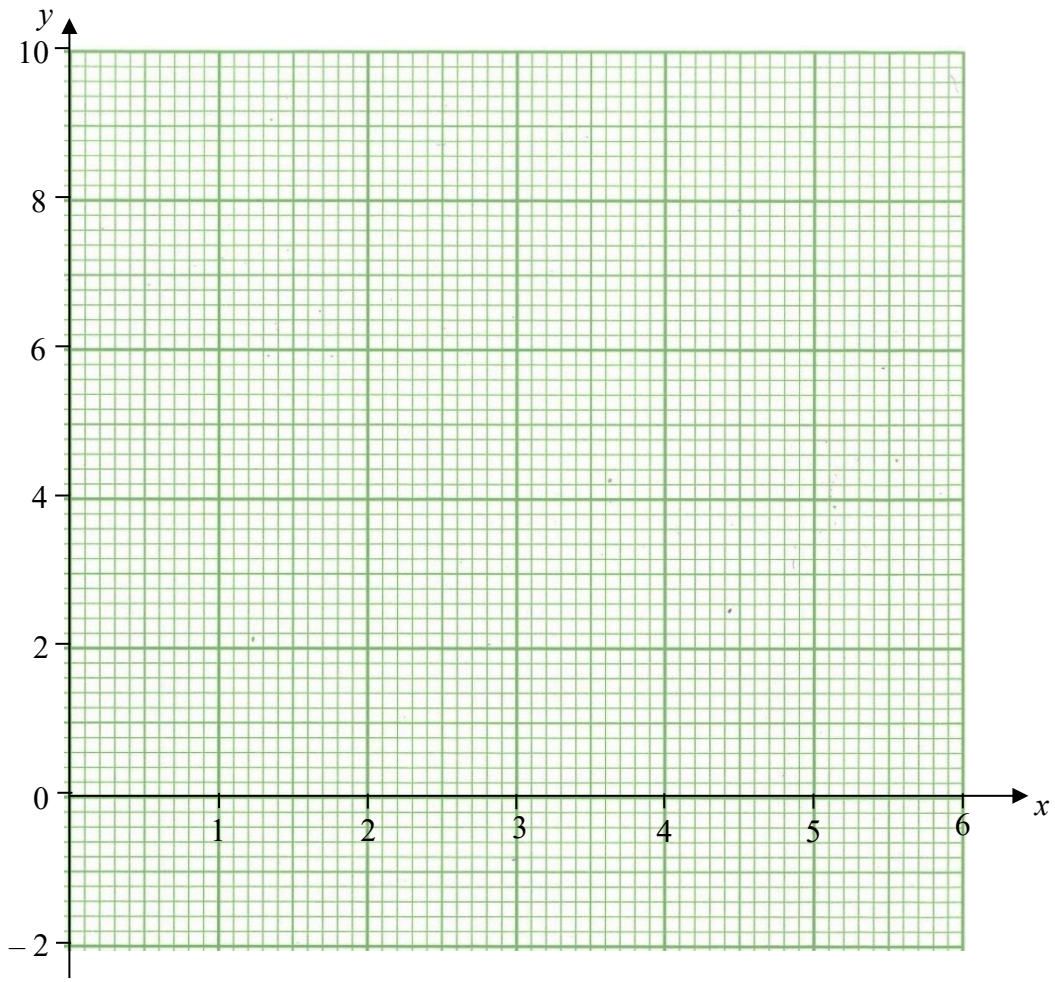
3 **(a)** Complete the table of values of $y = 3x + \frac{8}{x} - 10$.

Give your answer correct to 1 decimal place.

x	0.5	1	1.5	2	3	4	5	6
y	7.5	1	–0.2	0	1.7	4	6.6	

[1]

(b) On the grid, draw the graph of $y = 3x + \frac{8}{x} - 10$ for $0.5 \le x \le 6$.



[3]

(c) Use your graph to find the solutions of the equation $3x + \frac{8}{x} = 15$ in the range $0.5 \leq x \leq 6$.

Answer $x =$ _____ or _____ [2]

(d) **(i)** On the grid in part **(b)**, draw the line $2y = x + 1$ for $0 \leq x \leq 6$.

[2]

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

Answer $x =$ _____ and _____ [2]

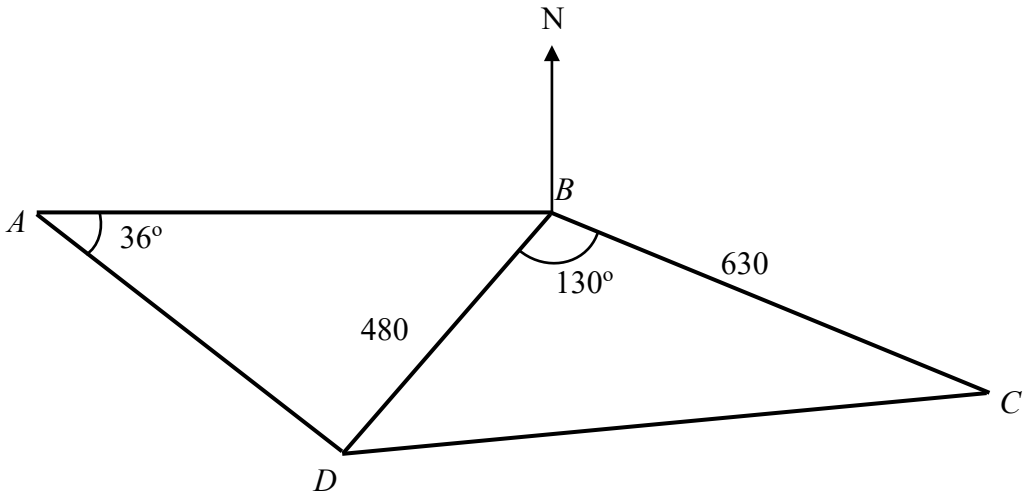
(iii) These values of x are the solutions of the equation $5x^2 + Bx + C = 0$.
Find the value of B and of C.

Answer $B =$ _____

$C =$ _____ [3]

4 The diagram shows the position of four points A, B, C and D on level ground.
B is due east of A, the bearing of D from B is 242º, angle CBD = 130º and angle BAD = 36º.

BD = 480 m and BC = 630 m.



(a) Find

(i) the bearing of A from D,

Answer _____ ° [1]

(ii) the distance of AD.

Answer _____ m [3]

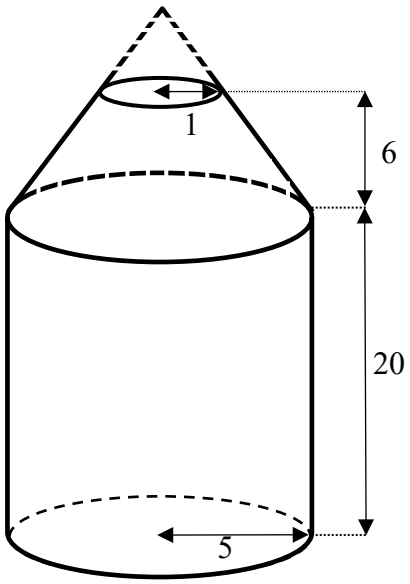
(b) A helicopter is flying at a height of 4800 m. Calculate the angle of depression of point B, from the helicopter when it is vertically above C.

Answer _____ ° [2]

(c) A man is standing due west of B at a point P, such that he is equidistant from both A and D. Find the distance between the point P and D.

Answer _____m [3]

5 A bottle of paint is in the shape of a frustrum of a right circular cone and a cylinder attached to it. The frustrum has a vertical height of 6 cm and a top radius of 1 cm. The attached cylinder has a radius of 5 cm and a height of 20 cm.
The thickness of the bottle is negligible.



(a) Show that the total capacity of the paint bottle is 1765.6 cm^3, correct to 1 decimal place. [5]

Answer

(b) The paint bottle is filled with 1500 cm^3 of paint. Calculate the percentage of the bottle's capacity that is not filled.

Answer _____% [1]

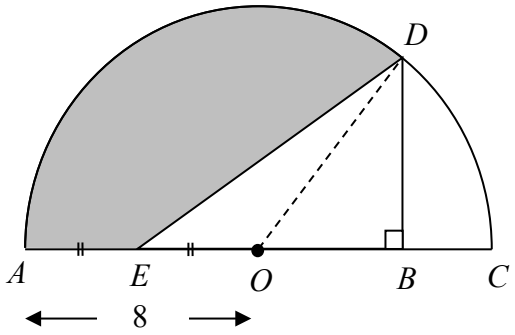
(c) Given that the mass of the empty paint bottle is 30 g and the density of the paint is 3 g/cm^3, find the total mass of a brand new bottle consisting of 1500 cm^3 of paint, leaving your answer in kg.

Answer _____kg [2]

(d) The paint bottle is available in a similar bottle of a larger size. Given that the larger bottle has three times the capacity of the smaller bottle, find the base area of the larger bottle.

Answer _____ cm^2 [2]

6 **(a)** The diagram shows a semicircle with centre O and radius 8 cm. BD is perpendicular to AC, E is the midpoint of AO and $\tan \angle DOB = \frac{3}{4}$.



Calculate

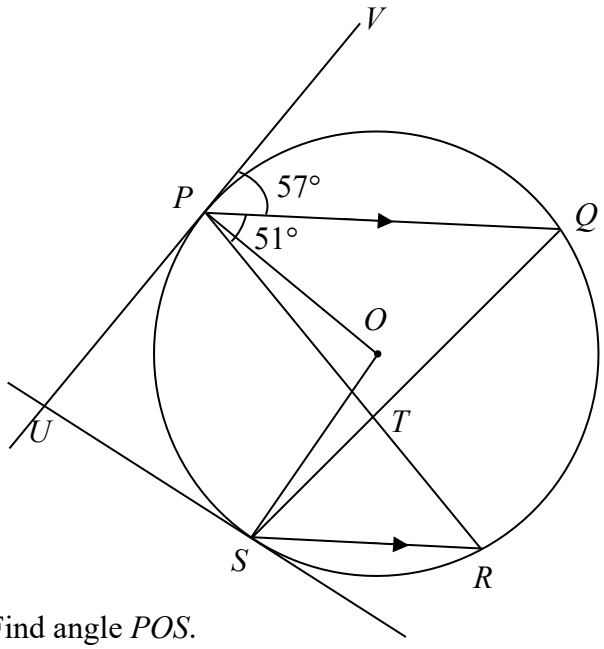
(i) the area of the shaded region AED,

Answer _____ cm^2 [3]

(ii) the perimeter of the shaded region AED.

Answer _____ cm [3]

(b) A circle $PQRS$ with centre O has parallel chords PQ and SR. The chord PR intersects the chord SQ at T. The tangents produced from points P and S meet at U. Angle $QPR = 51°$ and angle $QPV = 57°$.



(i) Find angle POS.

Answer _____ ° [2]

(ii) Show that triangle PQT is an isosceles triangle.
Give a reason for each statement you make.
Answer

_____

_____

_____

_____ [2]

(iii) Explain if a circle can be formed by passing through the points O, P, U and S. State your reason clearly.

Answer

_____

_____

_____

_____ [2]

7 The times taken by two groups of students, Group *A* and Group *B*, to complete a puzzle were recorded.

The results are shown in the stem-and-leaf diagram.

Group *A*				Group *B*	
		9	2		
		2	3	1	1
	2	0	4	2	5
	1	1	5	4	4
6	4	3	6	1	2
			7		
			8		
			9	6	

Key (Group *A*)

2 | 3 means 32 minutes

Key (Group *B*)

4 | 2 means 42 minutes

(a) Write down the median time for Group *A*.

Answer _____min [1]

(b) Find the interquartile range of Group *B*.

Answer _____min [2]

(c) Calculate the standard deviation of Group *B*.

Answer _____ [1]

(d) Would the interquartile range or standard deviation be a more appropriate representation of the spread of times for Group *B*? Explain your answer.

Answer

_____

_____

_____

_____

_____[1]

8 $PQRS$ is a parallelogram.

P is the point $(-8, -2)$, Q is the point $(-6, 2)$ and $\overrightarrow{QR} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$.

(i) Find the vector $\overrightarrow{PQ}$.

Answer _____ [1]

(ii) Use vectors to show whether the point $A(-11, 7)$ lies on the line PQ.

Answer

[3]

(iii) Find the length of PR.

Answer _____ units [2]

(iv) Find the equation of the line RS.

Answer _____ [3]

9 A shopkeeper mixed 30 kg of Brand *A* tea, which he bought at \$32 per kg, with 20 kg of Brand *B* tea, which he bought at \$35 per kg.
He sold all the mixture at \$40 per kg.

(a) Determine whether the shopkeeper made a gain or loss from this transaction. Show your working clearly.
Answer

[2]

(b) Mrs Tan bought some packets of coffee for \$800. **Each** packet of coffee cost \$$x$.

(i) Write down an expression, in terms of x, for the number of packets of coffee bought.

Answer _____ [1]

It was found that 2 packets were damaged and had to be thrown away. Mrs Tan then sold **each** of the remaining packets of coffee for \$2 more than what she paid for.

(ii) Write down an expression, in terms of x, for the total sum received from the sale of the packets of coffee. (You do not need to simplify the expression.)

Answer _____ [1]

(iii) Given that Mrs Tan made a profit of \$99 from the sale of the packets of coffee, form an equation in x and show that it reduces to

$$2x^2 + 103x - 1600 = 0 .$$

Answer

[3]

(iv) Solve the equation $2x^2 + 103x - 1600 = 0$.

Answer _____ [3]

(v) Find the number of packets of coffee sold.

Answer _____ [1]

10 Mr Tan is thinking of installing solar energy panels at the house that he stays in. Solar panels can help to generate some of the electricity needed in the house. Information that Mr Tan needs can be found in Annex *A*.

(a) For the first 6 months of 2022, calculate the

(i) average monthly amount of electricity (in kWh) used by Mr Tan,

Answer _____kWh [2]

(ii) average monthly amount of money that Mr Tan paid for electricity usage.

Answer _____ [2]

(b) Calculate the maximum number of solar panels that can be installed on the roof of Mr Tan's house.

Answer _____ [1]

(c) Considering all the given information, should Mr Tan go ahead with the installation of the solar panels for his house?

Justify your answer and show your calculations clearly.

Answer

[5]

Annex *A*

Table 1: Records of electricity usage by Mr Tan

Electricity usage for 2022 (kWh)					
Jan	Feb	Mar	Apr	May	Jun
1107.8	1066.3	1123.6	1259	1249.5	1281.6

Table 2: Charges for electricity usage

Electricity tariff: 21.39 cents per kWh (Charges subjected to 7% Goods and Service Tax)

Table 3: Details on installing solar panels for Mr Tan's house.

Dimensions of the roof area for solar panel installation	9 m by 4 m
Dimension of 1 solar panel	1.65 m by 1 m
Cost of installing 10 solar panels (this is not subjected to 7% Goods and Service Tax)	$6250
Average amount of electricity produced by 1 solar panel	19 kWh per month
Life span of solar panels	20 years

End of paper