KENT RIDGE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

MATHEMATICS
PAPER 2   4048/02

SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)

Tuesday 23 August 2022   **2 hours 30 minutes**

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Name: _____ (   )   Class: Sec_____

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.

Do not open this question paper until you are told to do so.

Answer **all** the 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.

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

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

The total mark for this paper is 100.

	For Examiner's Use
Total	**100**

This Question Paper consists of 24 printed pages, including this page.

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

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

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

1 **(a)** Solve the inequality $\frac{4x+1}{3} > \frac{3-2x}{5}$.

Answer *(a)* …………………….…………... [2]

(b) Simplify $\left(\frac{16a^{12}}{b^8}\right)^{-\frac{1}{4}}$, leaving your answer in positive indices.

Answer *(b)* …………………….…………... [2]

(c) Express $\frac{x}{(5-2x)^2} - \frac{3}{2x-5}$ as a single fraction in its simplest form.

Answer *(c)* …………………….…………... [2]

(d) Solve these simultaneous equations.

$$7x + 6y = 33$$
$$5x - 4y = 7$$

Answer   *(d)* $x =$ ………….………....

$y =$ ………….………....   [3]

(e) Simplify $\dfrac{25x^2 - 16}{15x^2 + 7x - 4}$.

Answer   *(e)* ………………….………..... [3]

2 A theatre sells tickets for a musical performance based on different categories. The table below shows the number of tickets sold for two consecutive nights for week 1.

	Cat 1	Cat 2	Cat 3
Saturday	430	635	335
Sunday	430	585	310

(a) Represent the information in a 2×3 matrix **M**.

Answer   *(a)* ……………….…………….... [1]

(b) The ticket price is $98 for Cat 1, $78 for Cat 2 and $48 for Cat 3.

Represent the prices in a 3×1 matrix **P**.

Answer   *(b)* ………………….…………... [1]

(c) Evaluate the matrix $\mathbf{T} = \mathbf{MP}$.

Answer   *(c)* ………………….………….... [2]

(d) State what each element of matrix **T** represents.

Answer   *(d)*

………………….……………………………….…………………….………….…...

………………….……………………………….…………………….………….…...

………………….……….……………………….…………………….………….…...... [1]

(e) The elements of matrix **S**, where $\mathbf{S} = \mathbf{XM}$, represents the total number of tickets sold for each category for both nights respectively. Write down matrix **X**.

Answer   *(e)* ………………….…………….... [1]

3 Solid *A* shows a solid formed by joining a hemisphere of radius *r* to one end of a cylinder of height *r*. The other end of the cylinder is attached to a cone of height *h* cm.

r cm

r cm

h cm
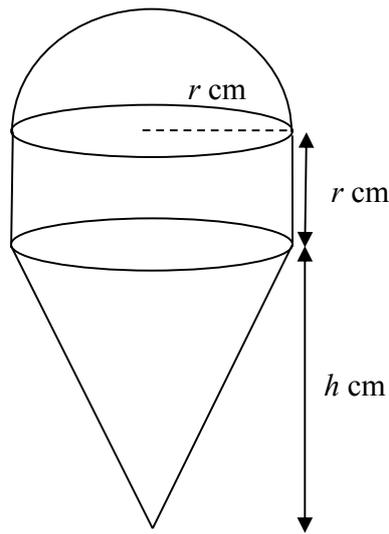
Solid *A*

(a) Find, in terms of π and *r*, the total volume of the hemisphere and cylinder.

Answer   *(a)* …………………………….. cm³ [1]

(b) The volume of the cone is half of the volume of the entire Solid *A*.
Show that $h = 5r$.

Answer

[2]

(c) Given that the volume of the hemisphere is 54π cm³, find the volume of Solid *A*.

Answer   *(c)* …………………..……….. cm³ [3]

(d) The whole Solid *A* is then melted down to form a prism, Solid *B*.
The cross-section is a trapezium with the parallel sides measuring 6 cm and 10 cm.

10 cm

y

6 cm

20 cm
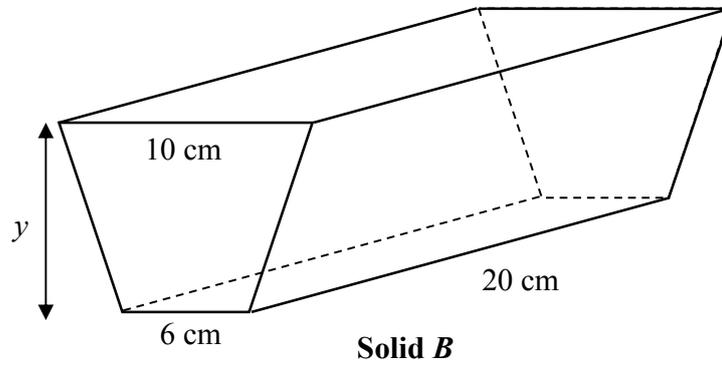
Solid *B*

Find *y*, the height of the cross-section of Solid *B*.

Answer   *(d)* ………………..………… cm [3]

4   *W, X, Y* and *Z* are points on a horizontal ground and *PW* is a vertical flag pole. $WX = 7$ m, $WZ = 3$ m, $XY = 10$ m, $\angle WYZ = 20^\circ$ and $\angle WZY = 28.6^\circ$.
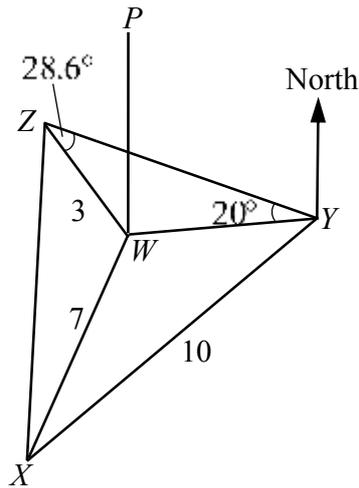
(a)   Calculate *WY*.

Answer   *(a)* …………………..……….. m   [2]

(b)   Show that $\angle WXY = 20.2^\circ$, correct to 1 decimal place.

Answer

[3]

(c) The bearing of *Z* from *Y* is 308º. Find the bearing of *W* from *Z*.

Answer *(c)* …………………….……..…. º [2]

(d) Given that $PX = 8$ m, calculate the height of the flag pole *PW*.

Answer *(d)* …………………….……….. m [1]

(e) *T* is a point along *XY*. Find the greatest angle of elevation of the top of the flag pole *P* from *T*.

Answer *(e)* …………………….………… º [3]

5 **(a)** The nth term of a sequence is given by $T_n = \frac{6n-5}{3n}$.

(i) Use the formula to find T_7, giving your answer as an improper fraction.

Answer *(a)(i)*……………….…………….. [1]

(ii) Explain why $\frac{64}{33}$ is not a term in the sequence.

Answer *(a)(ii)*

…………………………………………………………………………………...

…………………………………………………………………………………...

…………………….…………………………...………………………….……... [1]

(iii) Show that $\frac{1}{3} \le T_n < 2$.

Answer

[2]

(b) The first four terms of another sequence of numbers are given below.

$$T_1 = 4 = 2 \times 3 - 2$$
$$T_2 = 10 = 3 \times 4 - 2$$
$$T_3 = 18 = 4 \times 5 - 2$$
$$T_4 = 28 = 5 \times 6 - 2$$

(i) Find T_{10}.

Answer   *(b)(i)*………………………….... [1]

(ii) Show that $T_n = n^2 + 3n$.

Answer

[2]

(iii) Given that $T_k = 208$, use (b)(ii) to find the value of k.

Answer   *(b)(iii)* $k =$ ……….……………. [3]

6 The amount of mass loss in kilograms of 200 members was recorded by Amazing Fitness Centre over a one year period.

The cumulative frequency curve shows the distribution of the results.

No. of members
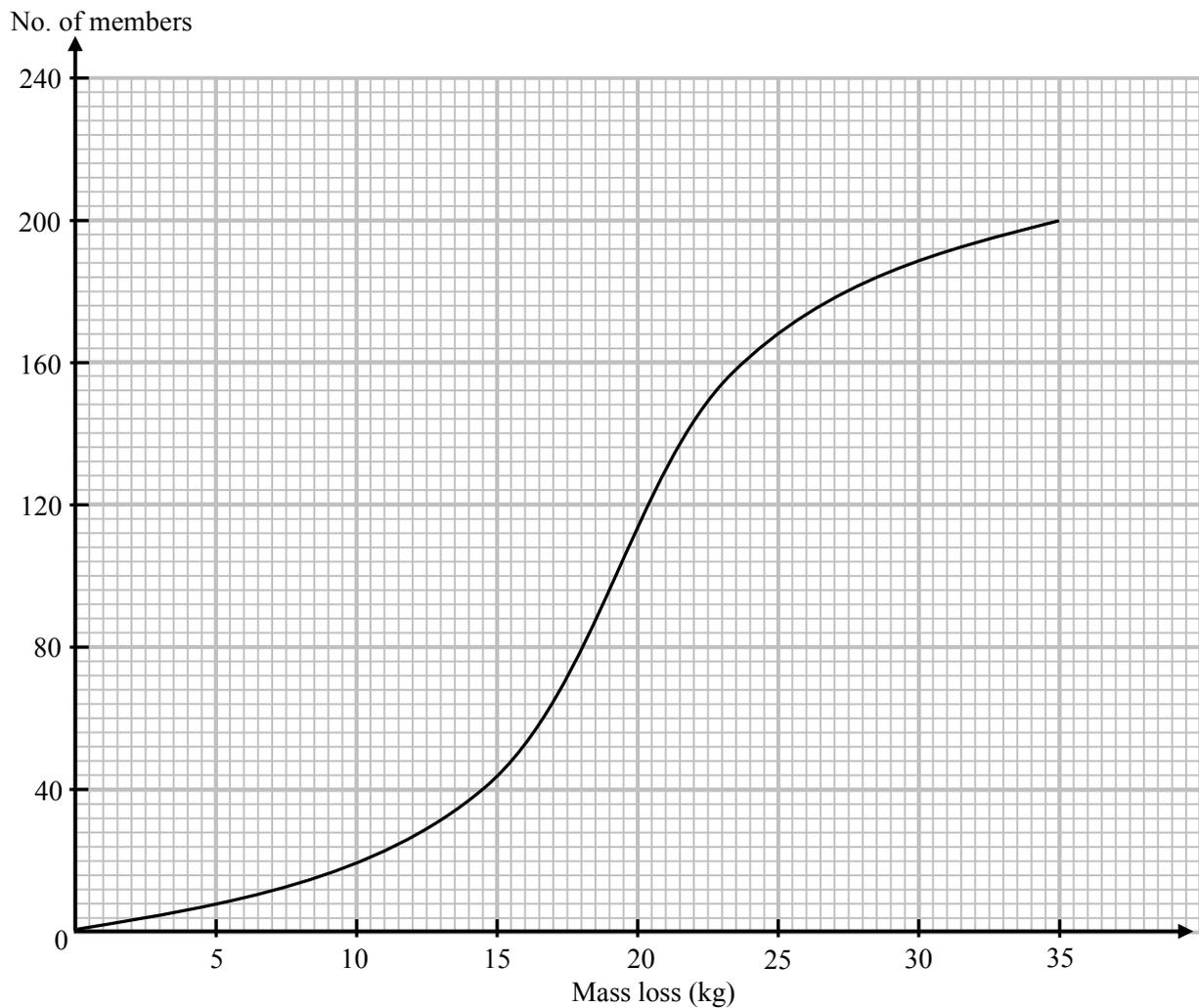
Mass loss (kg)

Use the curve to estimate

(a) the median mass loss,

*Answer (a)* ……………………..……….. kg [1]

(b) the interquartile range of the mass loss.

Answer (b) …………………….……….. kg [2]

(c) In order to encourage members to be active in their mass loss, Amazing is waiving a one month membership fee for members who managed to lose at least x kg in a year. Given that 10% of the members managed to qualify for the waiver, find the value of x.

Answer   *(c)* $x =$ ………………….………… [1]

(d) This box-and-whisker plot represents the distribution of the mass loss of 200 members of another fitness centre, Supreme Fitness Centre.
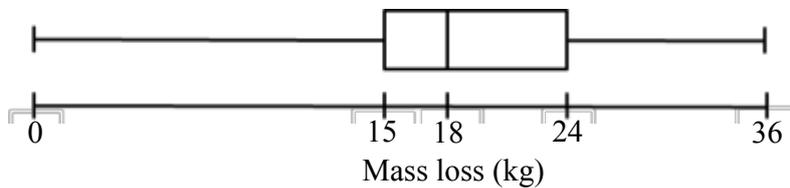
Mass loss (kg)

Make two comments comparing the mass loss of the members in the two fitness centres.

Answer   *(d)*

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………………………...

………………………….………………………….…………………….………….... [2]

(e) Amazing Fitness Centre decides to offer "Gold" and "Platinum" membership based on the total mass loss for a year.

Members who lose at least 10 kg but less than 25 kg will be offered "Gold".

Members who lose at least 25 kg will be offered "Platinum".

(i) A member from Amazing Fitness Centre is chosen at random.

Find the probability that the member selected qualifies for a "Gold" membership.

Answer *(e)(i)*……………….……………….. [1]

(ii) Two members from Amazing Fitness Centre are chosen at random.

Andy says that the probability that both members qualify for a "Platinum" membership is $\frac{16}{625}$.

Explain what he has done wrong and find the correct probability.

Answer *(e)(ii)*

……………….……………….……………….……………….……………….…………...

……………….……………….……………….……………….……………….…………...

……………….……………….……………….……………….……………….…………...

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……………….……………….……………….……………….……………….…………...

……………….……………….……………….……………….……………….………….. [2]

7 **(a)** Triangle *ABC* is equilateral. *CAD* and *ABE* are straight lines and *AD* = *BE*.
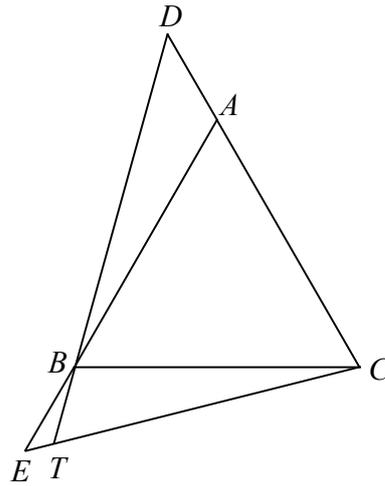
Show that triangle *ABD* and triangle *BCE* are congruent. State your reasons clearly.

Answer *(a)*

………………………………………………………………………………………...

………………………………………………………………………………………...

………………………………………………………………………………………...

………………………………………………………………………………………...

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……………………………………………………………………………….……….. [3]

(b) The diagram shows a straight line passing through the points B (3, 4) and C (7, 6).
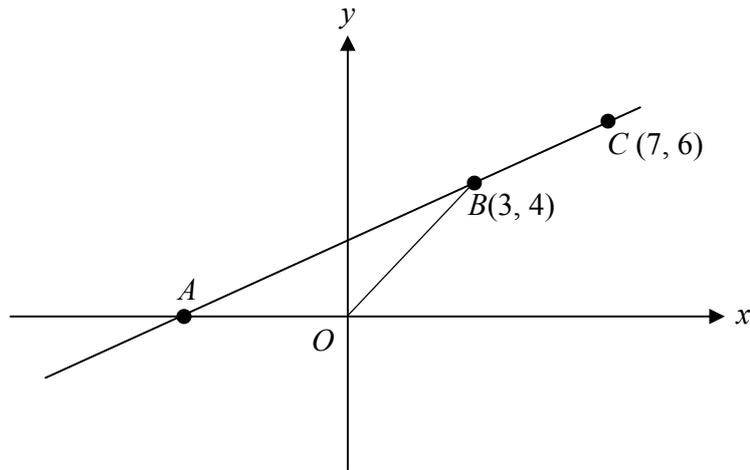
(i) Line BC cuts the x-axis at A. Find the area of triangle OAB.

Answer　　*(b)(i)*…………….…………. units^2 [3]

(ii) Another point D is such that ΔABO is similar to ΔACD. Find the coordinates of point D.

Answer *(b)(ii)* (………… , …………)   [1]

(iii) Find the numerical value of $\dfrac{area\ of\ OBCD}{area\ of\ \Delta ACD}$.

Answer *(b)(iii)*…………….…………….. [2]

8 The variables x and y are connected by the equation

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

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

x	-3	-2	-1	0	1	2	3	4
y	p	4.4	3.8	2	0.2	-0.4	1.4	6.8

(a) Find the value of p.

Answer   *(a) p =* …………………..………. [1]

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

(c) The equation $\frac{x^3}{5} - 2x = 3$ has only one solution.

Explain how this can be seen from your graph.

Answer   *(c)*

………………………………………………..…………………………………….…………...

………………………………………………..…………………………………….…………...

………………………………………..…………..…………………………….…………...…... [2]

(d) (i) On the same grid in (b), draw the line $y = -2x + 5$ for $-1 \leq x \leq 3$.   [1]

(ii) Write down the x-coordinate of the point where this line intersects the curve.

Answer   *(d)(ii) x =* …………….…..………… [1]

(iii) This value of x is a solution of the equation $x^3 + Ax + B = 0$.

Find the value of A and the value of B.

Answer   *(d)(iii) A =* …………….………..

$B =$ ……………..……...... [3]

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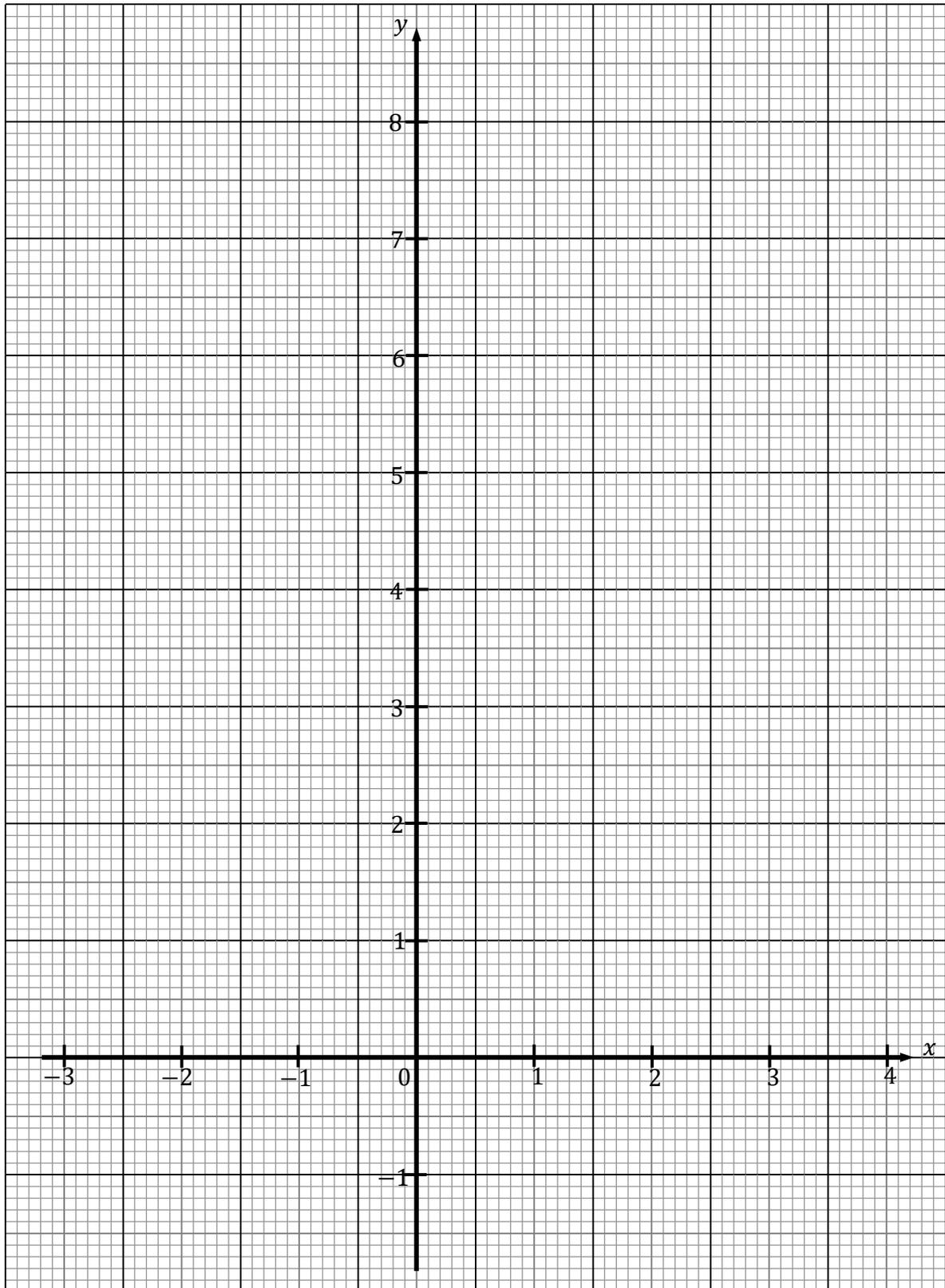
Answer (b)

9 **(a)**
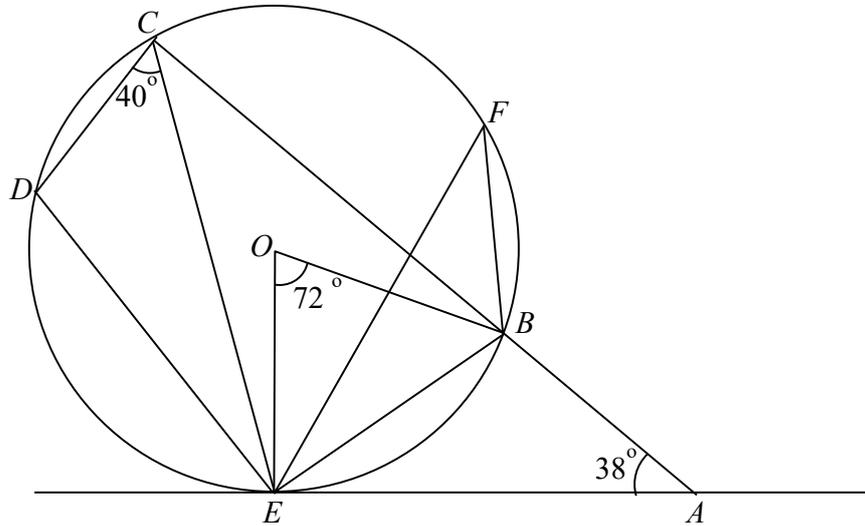
B, C, D, E and F are points on the circle with centre O.

AE is tangent to the circle and ABC is a straight line.

$\angle BAE = 38^\circ$, $\angle BOE = 72^\circ$ and $\angle DCE = 40^\circ$.

Find, giving reason(s) for each answer,

(i) angle OBA,

Answer *(a)(i)*……………….…………° [2]

(ii) angle DEB,

Answer *(a)(ii)*……………….…………° [2]

(iii) angle OEC.

Answer *(a)(iii)*……………….………..…° [3]

(b)
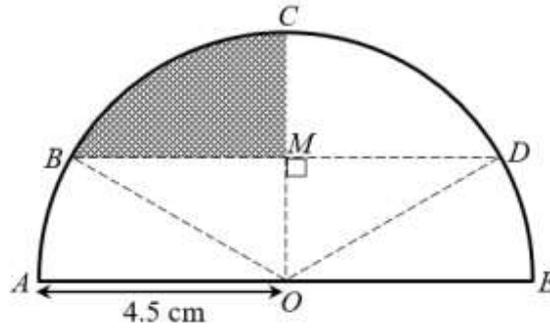
A semicircle $OABCDE$ with centre O has a radius of 4.5 cm.

Chord BD has a length of 6 cm and the perimeter of minor sector OAB is 12.785 cm.

(i) Calculate angle AOB in radians.

Answer *(b)(i)*…………………………… [2]

(ii) Explain why $BM = MD$.

Answer *(b)(ii)*

………………………………………………………………………………………...

………………………………………………………………………………………...

…………………………………………………………………………………….….... [1]

(iii) Calculate the shaded area.

Answer *(b)(iii)*…………………….…… cm² [3]

10 Mr Robert stay in a semi-detached house and is concerned about the rising electricity costs. After reading about solar power from the newspaper, he is thinking of installing solar panels to reduce his family's electricity bills.

The cost of electricity per kilowatt hour (kWh) is known as the electricity tariff rate, which is revised every quarter by SP Power.

Information about the electricity tariff rates and monthly electricity consumptions by domestic customers are provided below.

Quarterly Household Electricity Tariff*
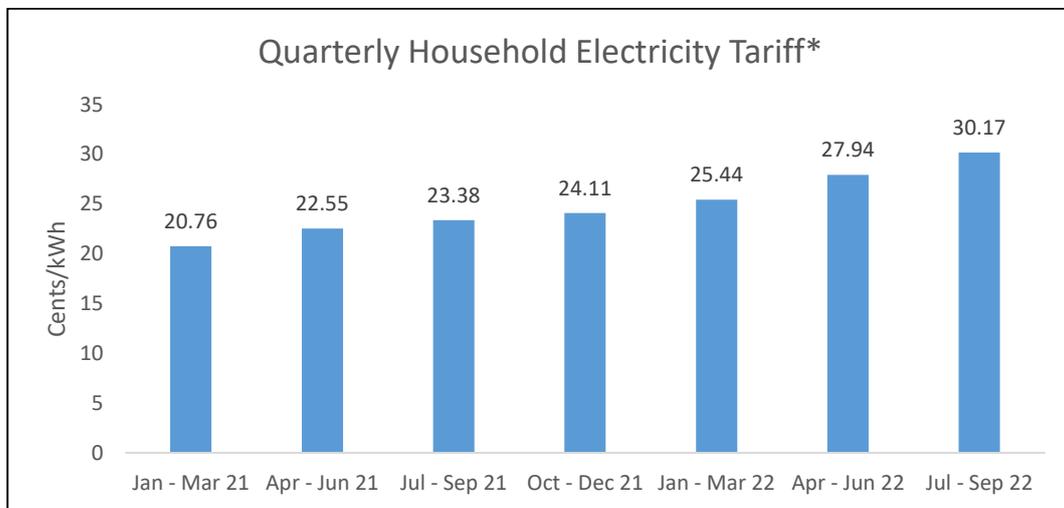
* Price before 7% GST

Type of Premise	Average Monthly Consumption (kWh)
Apartment	573.27
Terrace	872.82
Semi-Detached	1195.87
Bungalow	2364.58

Table 1: Average monthly electricity consumption of domestic customers

Adapted from https://www.spgroup.com.sg/sp-services/understanding-the-tariff

(a) The electricity tariff rate for Oct – Dec 22 is expected to increase by 8% from Jul – Sep 22 due to geopolitical reasons and shortage of resources.

Calculate the electricity tariff rate for Oct – Dec 22 to 2 decimal places

Answer   *(a)* …………………..… ₵/kWh [1]

(b) Mr Robert is currently with Best Power on a 12 month plan that offers a 6% discount off the electricity tariff rate. Estimate Mr Robert's amount paid for his family's electricity consumption in Oct 2022 after GST.

Answer *(b)* $…………………..……........... [3]

Mr Robert decides to consult another electricity provider to enquire about solar energy and solar panel installation. After an assessment is done on his house, he received an information sheet shown in the table below.

Dimensions of roof area for installation	9 metres by 4 metres
Dimension of 1 solar panel	1.65 metres by 1 metre
Cost of installing every 10 solar panels	$6250
Average amount of electricity produced by 1 solar panel	19 kWh per month
Lifespan of solar panels	20 years

Table 2: Information sheet for solar panel installation for Mr Robert

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(c) Suggest whether Mr Robert should go ahead with installing solar panels for his house. Justify any decision you make and show your calculations clearly.

Answer   *(c)*

…………………………………………………………………………………………...

…………………………………………………………………………………………...

……………………………………………………….…………………………….……....... [6]

End of Paper