Calculator Model:

KENT RIDGE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

MATHEMATICS **4048 / 01**
Paper 1

SECONDARY 4 EXPRESS /5 NORMAL ACADEMIC

Thursday 18 August 2022 **2 hours**

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Name: ______________________________ (   ) **Class:** ____________

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.

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

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

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 **80**.

For Examiner's Use	
Total	80

This Question Paper consists of **17** printed pages, including this page.

Setter: Mr Jeffrey Chen **[Turn over**

For Examiner's Use

Mathematical Formulae

For Examiner's Use

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

For Examiner's Use

Answer **all** the questions.

For Examiner's Use

1 Calculate $\frac{-(-9)-\sqrt[3]{19\times(-18)^2-4\times(7-40)}}{3\times 3.6}$.

Answer ..... [1]

---

2 Given that y is directly proportional to the $(3x + 7)^2$, and that $y = 6$ when $x = -4$.

(a) Express y in term of x.

Answer (a) ..... [2]

(b) Hence, find the values of x when $y = 15.36$.

Answer (b) ..... [2]

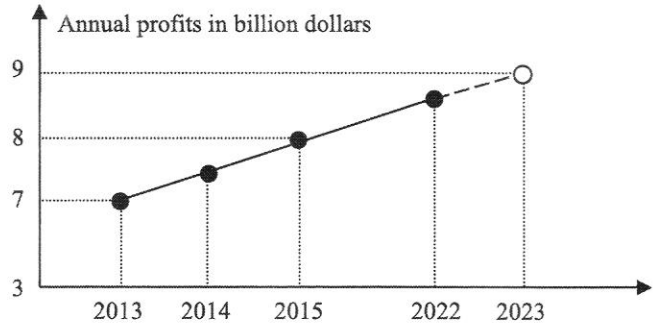
---

3 Simplify $\frac{4}{aw^2} \div \frac{16a^3}{5w}$.

Answer ..... [2]

For Examiner's Use

4 A company used the following line graph to show the annual profits made over a period of time.



State one aspect of the graph that may be misleading and explain how the annual profits in 2023 can be projected wrongly.

Answer .....

.....

.....

..... [2]

For Examiner's Use

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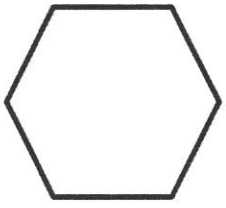
5 The ratio of the **area** of a regular hexagon : area of an equilateral triangle = 49 : 9.
Show that the ratio of the **perimeter** of a regular heptagon : perimeter of triangle is 42 : 9.



Hexagon

Equilateral triangle

Answer

[2]

For Examiner's Use

6 Town A and Town B are 100 km apart. At 0800, James departs for Town B from Town A, driving at a constant speed of 70 km/h. Kim departs at the same time as James for Town A from Town B, driving at a constant speed of 50 km/h. What time will James and Kim pass each other?

For Examiner's Use

Answer ..... [3]

---

7 A bag contains 2 gold balls, r red balls and s silver balls where $r \times s$ is prime number and $r < s$. The total number of balls is 10.

(a) Find the probability of choosing a non-gold ball.

Answer (*a*) ..... [1]

(b) Find the probability of choosing a red ball.

Answer (*b*) ..... [2]

For Examiner's Use

8 Solve the equation $\frac{x}{3} - \frac{3x-7}{4} = 8$

For Examiner's Use

Answer $x =$ ..... [3]

---

9 **(a)** Simplify $-4(2a + b) + 7(b - 3a)$.

Answer (a) ..... [2]

(b) Factorise completely $12xy + 6x^2 - 2y - x$.

Answer (b) ..... [2]

For Examiner's Use

10 Make b the subject of the formula $3b + 8d = 2ab + 5$.

For Examiner's Use

Answer ..... [2]

11 In the Idol contest, $\frac{7}{9}$ of the school's population decided to vote.

There were 3 contestants and the votes for these contestants were divided in the ratio of $\frac{1}{3} : \frac{5}{6} : 0.5$. Given that the school's population has 1440 students, calculate the number of students who voted for the contestant with the most votes.

Answer ..... students [2]

For Examiner's Use

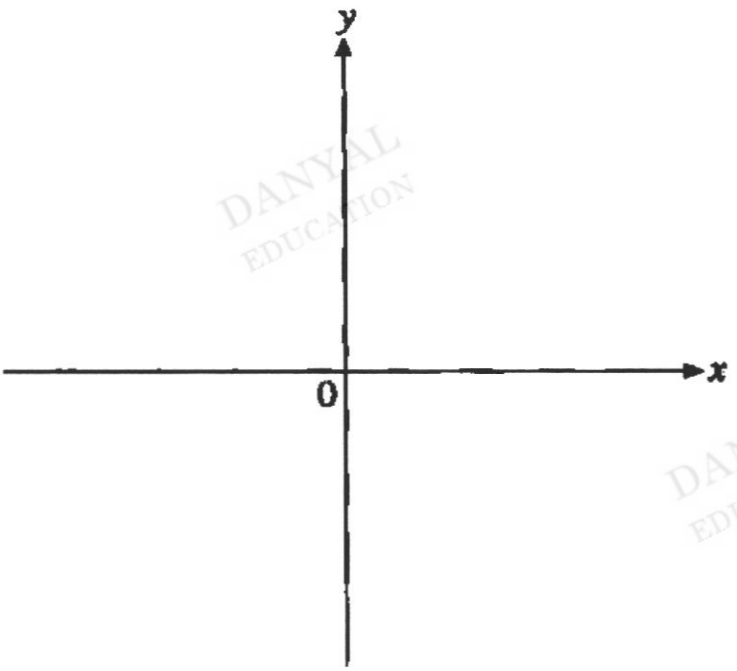
12 **(a)** Express $x^2 + 5x + 4$ in the form $(x + p)^2 + q$.

For Examiner's Use

Answer (*a*) ..... [2]

(b) Sketch the graph of $y = x^2 + 5x + 4$.
Indicate clearly the values where the graph crosses the x- and y- axes.

Answer (b)



[2]

(c) Write down the coordinates of the minimum point of the graph of $y = x^2 + 5x + 4$.

Answer (*c*) (..... , ...) [1]

For Examiner's Use

13 In 2010, the population of the United Kingdom was 6.3×10^7.

(a) In the same year the population of Singapore was 4.7×10^6.

How many more people lived in the United Kingdom than in Singapore in 2010?
Give your answer in standard form, to 2 decimal places of accuracy.

Answer (a) ..... [2]

(b) In Singapore, John pays SGD$2.98 for one litre of petrol.
On a visit to United Kingdom, he paid £5.88 for five litres of petrol.

1 pound dollar (£) = 1.70 Singapore dollars (SGD).

Is the petrol cheaper in Singapore or United Kingdom and by how much?
Give your answer in SGD$.

Answer (b) ....., SGD$ ..... [3]

---

14 It is given that x is 20% lesser than m and y is 30% greater than n.

Determine if $\frac{x}{y}$ is lesser or greater than $\frac{m}{n}$.

Show your working clearly.

Answer .....

..... [3]

For Examiner's Use

15 Mr Koh borrows \$950 at a rate of r % per year compounded **quarterly**.
At the end of 10 years, he has paid \$2200.

Calculate the value of r.

Answer $r =$ ..... [3]

---

16 **(a)** Given that $2^a + 2^a + 2^a + 2^a = 32$, find the value of a.

Answer (*a*) $a =$ ..... [2]

(b) Solve the equation $25^{x+2} \times 125 \div 5^{-x} = 1$.

Answer (*b*) $x =$ ..... [3]

For Examiner's Use

17 P, Q and R are points such that $\angle PQR = 75°$ and $PR = 9$ cm.
The line PQ has been drawn for you.

(a) Using compass, protractor and ruler only, construct the triangle PQR.

Answer

P ——————————— Q

[2]

(b) Construct the perpendicular bisector of PQ. [1]

(c) Construct the angle bisector of $\angle PQR$. [1]

For Examiner's Use

18 $\xi = \{x : x \text{ is an integer}, 4 \leq x \leq 16\}$

$A = \{4, 9, 16\}$

$B = \{4, 6, 7, 8, 9, 10, 16\}$

(a) Draw a Venn diagram showing ξ, A and B and place each of the elements in the appropriate part of the diagram.

[2]

(b) Describe the elements in set A.

..... [1]

(c) List the element(s) contained in the set $A \cap B'$.

Answer (c) ..... [1]

---

19 The scale of a map is 2 cm to 1 km.

(a) The actual length of a road is 8.5 km. Find the length of the road on the map in cm.

Answer (a) .....cm [1]

(b) The area of a plot of land on the map is 9 cm^2.

Find the actual area of the plot of land in km^2.

Answer (b) .....km^2 [2]

For Examiner's Use

20 **(a)** Written as a product of its prime factors, $360 = 2^3 \times 3^2 \times 5$.

(i) Find the prime factors of 756, giving your answer in index notation.

Answer (*a*) (*i*) ..... [2]

(ii) Find the highest common factor of 360 and 756.

Answer (*a*) (*ii*) ..... [1]

(b) Written as a product of its prime factors, $9801 = 3^4 \times 11^2$.

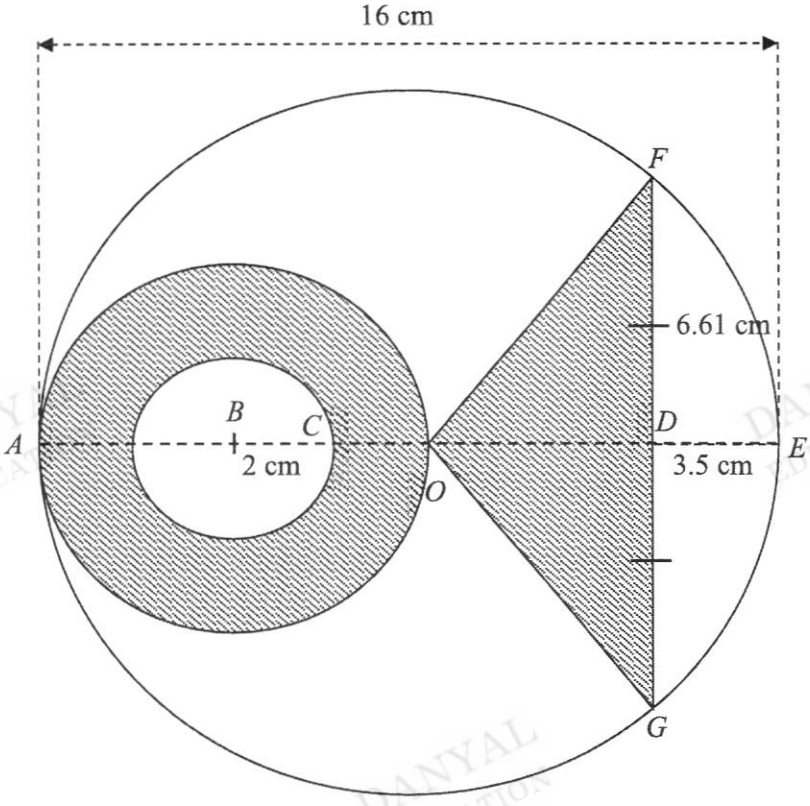
The number $\frac{9801m}{n}$ is a perfect cube where m and n are prime numbers.
Find the values of m and n.

Answer (*b*) m = ..., n = ... [2]

For Examiner's Use

21 The diagram below (not drawn to scale) shows the diagram of a medal plaque. The plaque consists of a circle with center O, a uniform circular ring with center B and triangle OFG. OD is the height of the triangle OFG.

$AOE = 16$ cm, $BC = 2$ cm, $DF = DG = 6.61$ cm and $DE = 3.5$ cm.



(a) Show that OD is 4.5 cm.

Answer

[1]

For Examiner's Use

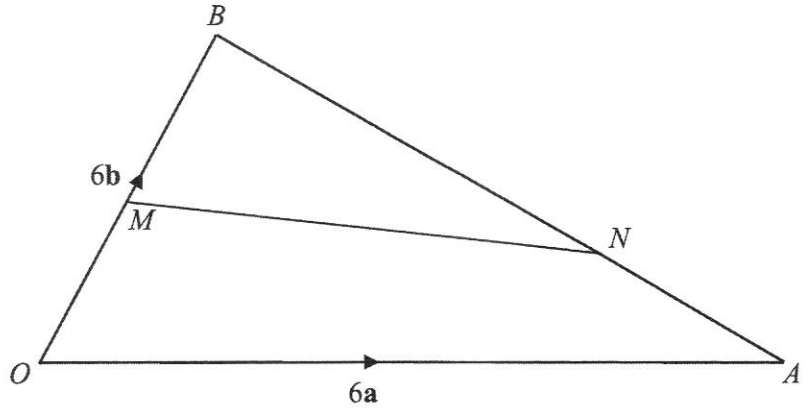
(b) The shaded region will be painted with gold paint which cost \$2.00 per cm^2. The un-shaded region will be painted with silver paint which cost \$1.20 per cm^2. Find the cost of painting of the plaque.

For Examiner's Use

Answer (*b*) \$..... [5]

For Examiner's Use

22 In the diagram, $\overrightarrow{OA} = 6\mathbf{a}$, $\overrightarrow{OB} = 6\mathbf{b}$ and $3\overrightarrow{AN} = \overrightarrow{AB}$. M is the mid-point of OB.



(a) Express $\overrightarrow{AN}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$ in its simplest form.

Answer (*a*) ..... [2]

(b) Express $\overrightarrow{ON}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$ in its simplest form.

Answer (*b*) ..... [1]

(c) Hence, or otherwise, show that $\overrightarrow{NM} = \boldsymbol{b} - 4\mathbf{a}$.

Answer

[2]

For Examiner's Use

(d) P is a point, not shown on the diagram, such that $\overrightarrow{MP} = 3\overrightarrow{MN}$.

(i) Find the position vector of P.

Answer $(d)(i)$ ..... [2]

(ii) Write down 2 facts about the points O, A and P.

Answer .....

.....

..... [2]

End of Paper

Calculator Model:

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**

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.

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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.

Setter: Mr Tommy Lee **[Turn over**

Mathematical Formulae

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

For Examiner's Use

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

For Examiner's Use

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]

For Examiner's Use

(d) Solve these simultaneous equations.

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

Answer *(d)* $x =$ .....

$y =$ ..... [3]

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

Answer *(e)* ..... [3]

For Examiner's Use

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.

For Examiner's Use

	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]

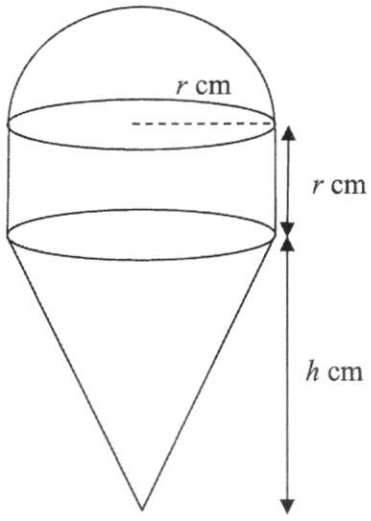
(e) The elements of matrix **S**, where $\mathbf{S} = \mathbf{XM}$, represents the total number of tickets sold for each category for both nights respectively. Write down matrix **X**.

Answer *(e)* ..... [1]

For Examiner's Use

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.

For Examiner's Use



Solid *A*

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

Answer *(a)* ..... cm^3 [1]

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

Answer

[2]

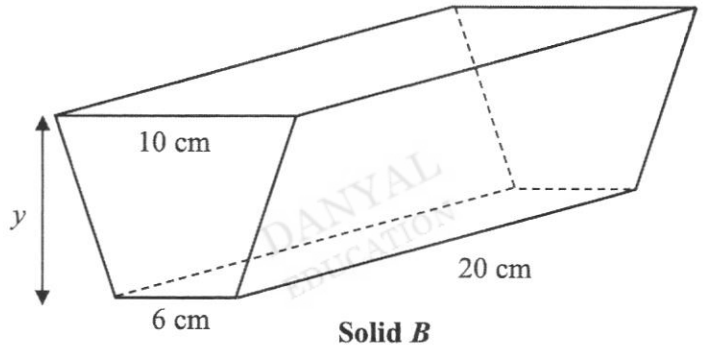
For Examiner's Use

(c) Given that the volume of the hemisphere is 54π cm^3, find the volume of Solid A.

For Examiner's Use

Answer *(c)* ..... cm^3 [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.



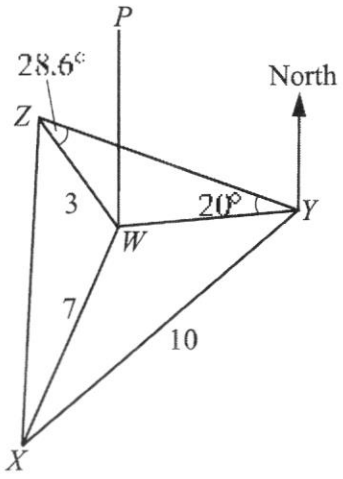
Solid *B*

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

Answer *(d)* ..... cm [3]

For Examiner's Use

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, $\angle WYZ = 20°$ and $\angle WZY = 28.6°$.



(a) Calculate WY.

Answer *(a)* ..... m [2]

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

Answer

[3]

For Examiner's Use

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

Answer *(c)* ..... ° [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)* ..... ° [3]

For Examiner's Use

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 $\frac{1}{3} \leq T_n < 2$.

Answer

[2]

For Examiner's Use

(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]

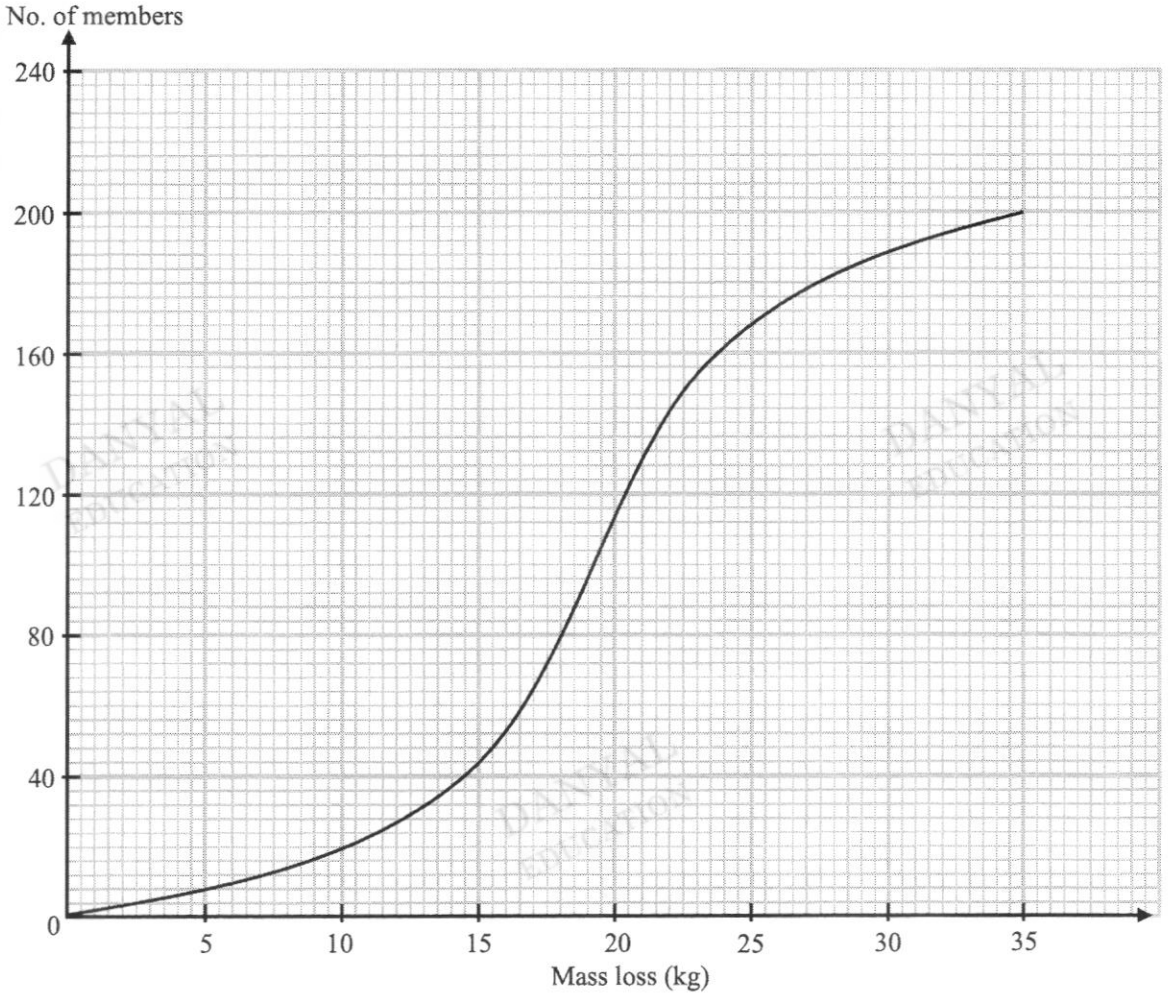
(iii) Given that $T_k = 208$, use (b)(ii) to find the value of k.

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

For Examiner's Use

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.



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]

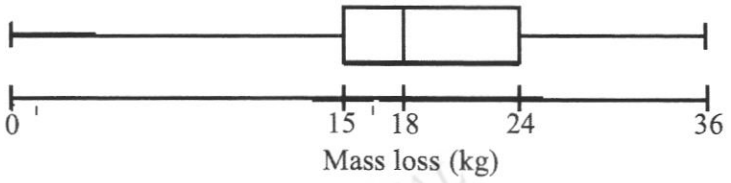
For Examiner's Use

(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.

For Examiner's Use

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.



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

Answer (d)

.....

.....

.....

.....

.....

..... [2]

For Examiner's Use

(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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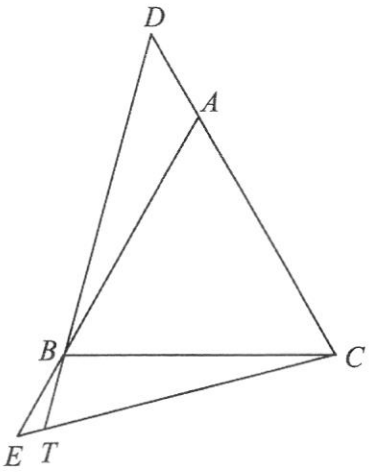
..... [2]

For Examiner's Use

7 **(a)** Triangle ABC is equilateral. CAD and ABE are straight lines and $AD = BE$.

For Examiner's Use



Show that triangle ABD and triangle BCE are congruent. State your reasons clearly.

Answer (a)

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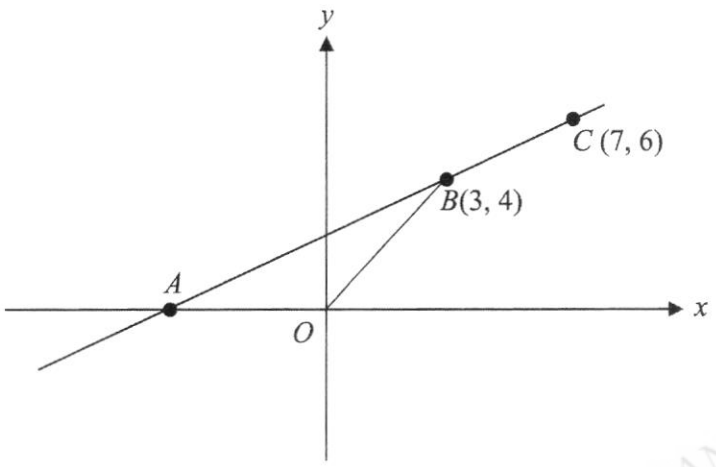
..... [3]

For Examiner's Use

(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]

For Examiner's Use

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

For Examiner's Use

Answer *(b)(ii)* (....., ...) [1]

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

Answer *(b)(iii)*..... [2]

For Examiner's Use

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.

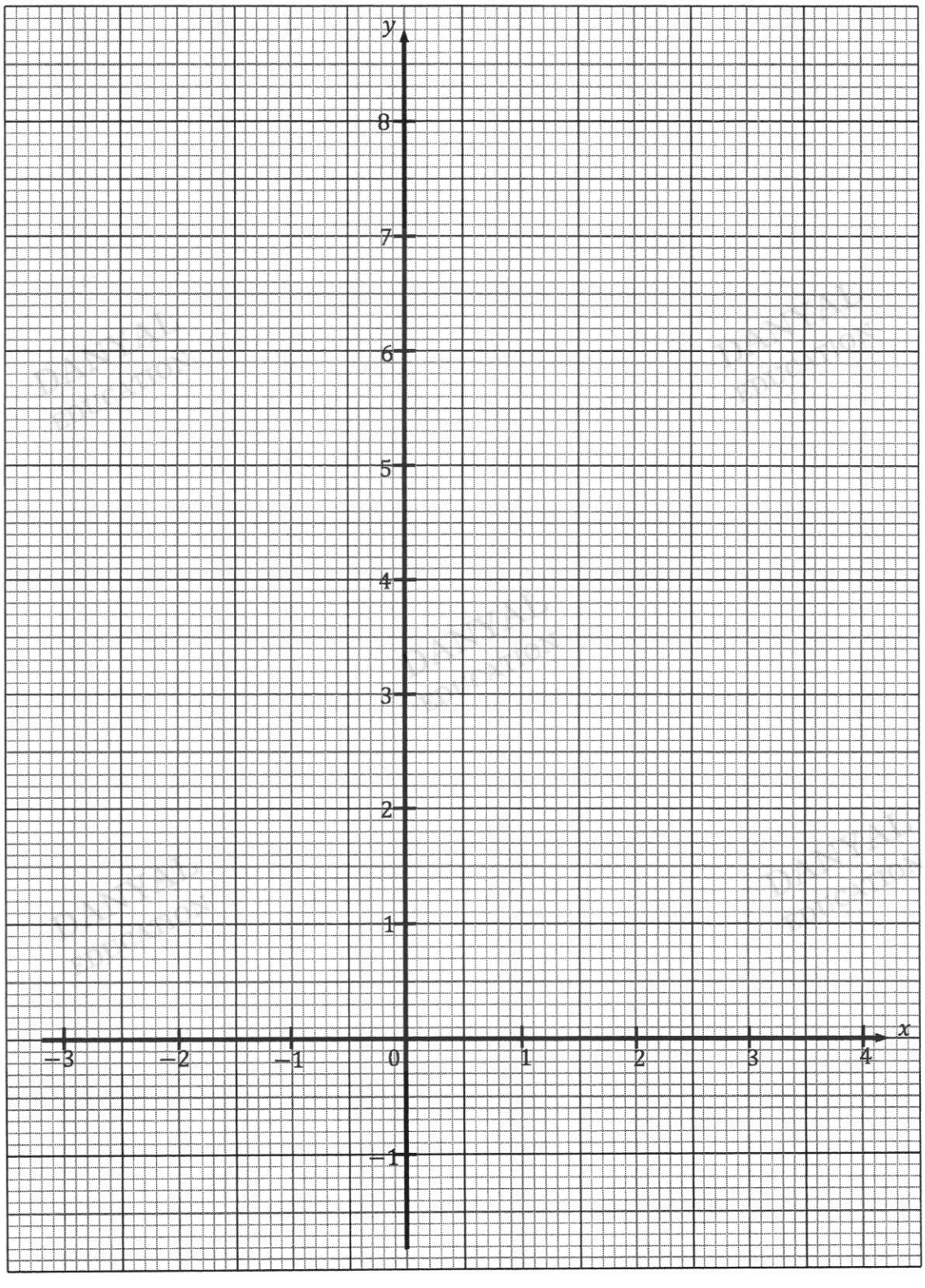
Answer (d)(iii) $A =$ .....

$B =$ ..... [3]

For Examiner's Use

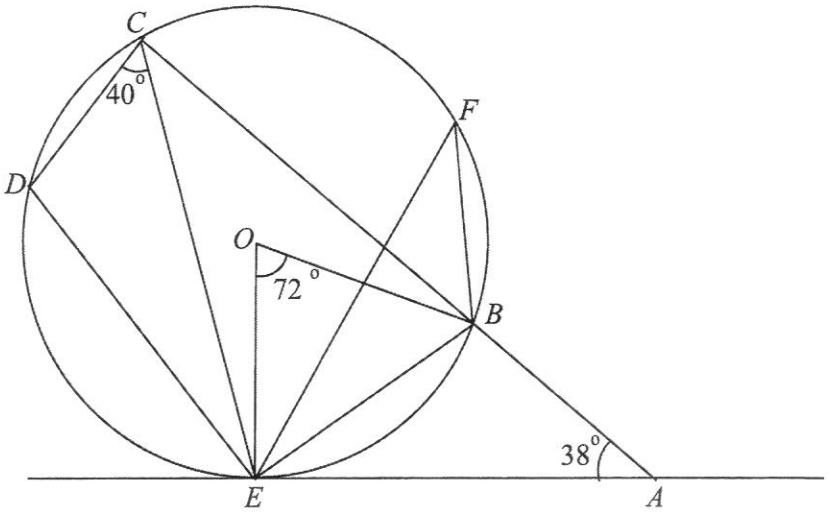
For Examiner's Use

Answer (b)



For Examiner's Use

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.

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

Find, giving reason(s) for each answer,

(i) angle OBA,

Answer *(a)(i)*..... ° [2]

(ii) angle DEB,

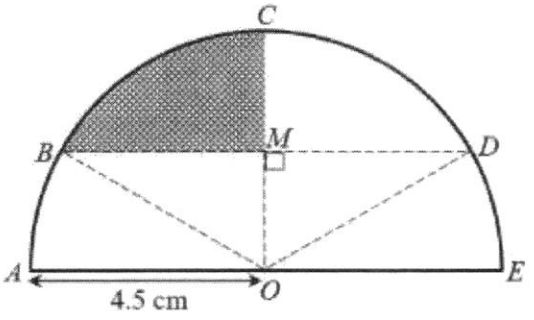
Answer *(a)(ii)*..... ° [2]

(iii) angle OEC.

Answer *(a)(iii)*..... ° [3]

For Examiner's Use

(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.

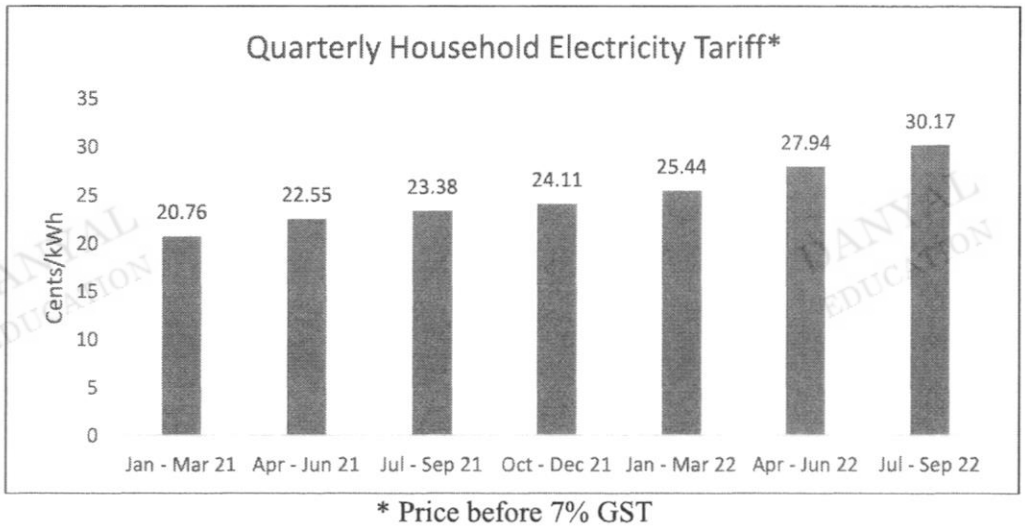
Answer *(b)(iii)*..... cm^2 [3]

For Examiner's Use

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.



* 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]

For Examiner's Use

(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.

For Examiner's Use

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

For Examiner's Use

(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

KENT RIDGE SECONDARY SCHOOL
Preliminary Examination P1 2022

Marking Scheme

MATHEMATICS **4048/01**

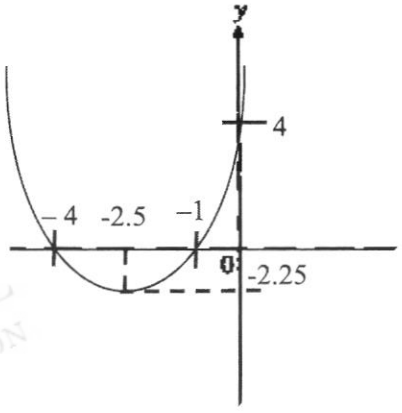
SECONDARY 4 EXPRESS/ 5 NORMAL ACADEMIC

18 August 2022 **2 hours**

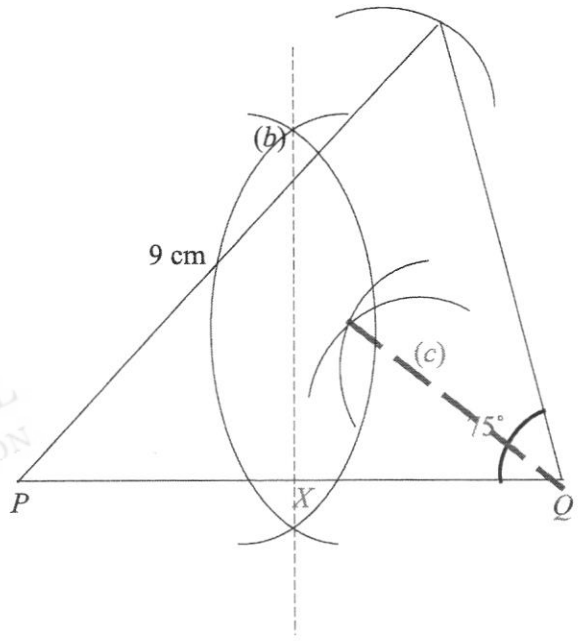
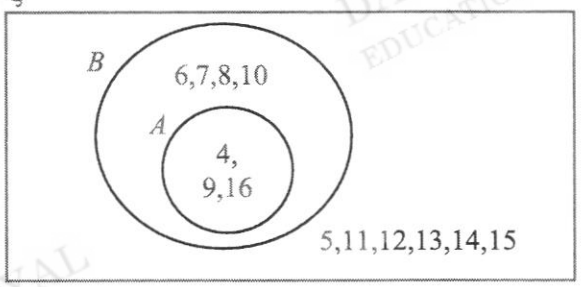
Question	Solution	Mark/ Remark
Q1	-0.876	[B1]
Q2 (a)	$y = k(3x + 7)^2$ $6 = k(-12 + 7)^2$ $k = 6/25$ or 0.24 $y = 0.24(3x + 7)^2$ OR $y = 6/25(3x + 7)^2$	[M1] [A1]
Q2(b)	$15.36 = 0.24(3x + 7)^2$ $64 = (3x + 7)^2$ $3x + 7 = 8$ or -8 $x = 1/3$ or $x = -5$	[M1 15.36 ÷ their k seen] [A1 both answer must be seen]
Q3	$\frac{4}{aw^2} \div \frac{16a^3}{5w}$ $= \frac{4}{aw^2} \times \frac{5w}{16a^3}$ $= \frac{5}{4wa^4}$	[M1× and 5/4 seen] [A1]

Q4	1. The scale on the vertical axis does not start from zero. 2. The scale on the axes are inconsistent/ not equally spaced, therefore projection of the profit will be inaccurate. 3. Data from 2013 to 2022 cannot be used to predict future profit. 4. 2015 to 2022 is not linear.	[B1 for point 1 only] [B1 Either point 2 or 3 or 4 only]
Q5	Ratio of the side regular hexagon : equilateral triangle = 7: 3 Ratio of the perimeters hexagon : triangle = $7 \times 6 : 3 \times 3$ = 42: 9	
Q6	Let x be the time taken in hour when they meet $70x + 50x = 100$ $120x = 100$ $x = 5/6$ hours = 50 minutes 0800 + 0050 = 0850 They will meet at 0850 or 8.50 am **OR** Let y be the distance $(100 - y) / 50 = y / 70$ $50y = 7000 - 70y$ $120y = 7000$ $y = 700/12$ time taken = (700/12) /70 = 5/6 hours = 50 minutes 0800 + 0050 = 0850 They will meet at 0850 or 8.50 am	[M1] [M1 5/6 h or 50 min] [A1] [M1] [M1 distance /speed] [A1]
Q7 (a)	4/5 or 0.8 or 80%	[B1] [B0 for 8/10]
Q7(b)	$r + s = 8$ $r \times s$ = Prime therefore $r = 1$ and $s = 7$ P(choosing a red ball) = 0.1 or 1/10	[M1 able to deduce 1 and 7] [A1]

Q8	$\frac{x}{3} - \frac{3x-7}{4} = 8$ $\frac{4x}{12} - \frac{9x-21}{12} = 8$ $4x - 9x + 21 = 96$ $-5x = 75$ $x = -15$	[M1 common deno] [M1 multiply by 12 and allow 1 slip, the slip cannot be the negative sign] [A1]
Q9(a)	$-8a - 4b + 7b - 21a$ $= 3b - 29a$	[M1 any 2 terms are expanded correctly]
Q9 (b)	$= 6x(2y + x) - (2y + x)$ $= (6x - 1)(2y + x)$	[M1 allow 1 slip] [A1] [A0 if 1 slip is found]
Q10	$3b + 8d = 2ab + 5$ $3b - 2ab = 5 - 8d$ $b(3 - 2a) = 5 - 8d$ $b = \frac{5 - 8d}{(3 - 2a)}$	[M1 regroup **and** factorise b] [A1]
Q11	$7/9 \times 1440 = 1120$ $\frac{1}{3} : \frac{5}{6} : 0.5 = 2 : 5 : 3$ 10 units represent 1120 5 units represent 560 OR $\frac{\frac{5}{6}}{(\frac{1}{3}+\frac{5}{6}+\frac{1}{2})} \times 1120 = 560$	[M1 for 1120 or 2: 5: 3 is seen] [A1] [M1 + A1]

Q12 (a)	$x^2 + 5x + 4$ $= (x + 2.5)^2 - 2.25$	[B1 $(x + 2.5)^2$ B1 –2.25 if not working is shown]
Q12(b)		[C1 shape (min curve) [P1 1. cuts at the x axis at -1 and -4 with min shape 2. cuts at y axis at 4.
Q12(c)	Min pt (-2.5, -2.25)	[B1 or ECF 1 from (a)]
Q13 (a)	$6.3 \times 10^7 - 4.7 \times 10^6 = 58300000$ $58300000 = 5.83 \times 10^7$	[M1 showing subtraction] [A1 for conversion to standard form] [A0 if 5.8×10^7]
Q13(b)	£5.88 ÷ 5 = £1.176 £1 = SGD $1.70 £1.176 = SGD $1.9992 2.98 – 2.00 = 0.98 United Kingdom is cheaper and by SGD$0.98.	[M1 for comparing 1 litre] [M1 conversion of pound to SGD] [A1 must show UK and **SGD**$0.98]
Q14	$x = 0.8m$ $y = 1.3n$ x/y = 0.8m/1.3n x/y = 8m/13n 8m/13n < m/n	[M1 for 0.8 or 1.3 shown] [M1 able to show the fraction of x/y OR ECF 1 for their version of fractions]

	Thus, x/y is lesser than m/n	[B1 must say lesser and show comparison between 8m/13n and m/n] [No B1 if they just conclude]
Q15	r/4 or 40 $2200 = 950\,(1+(r/4)/100)^{10\times4}$ $2.315789474 = (1+r/400)^{40}$ $\sqrt[40]{2.315789474} = (1+\frac{r}{400})$ $1.021215686 - 1 = r/400$ $0.021215686 \times 400 = 8.49$ $r = 8.49$	[B1] [M1 ÷ *by their* $\sqrt[x]{y}$ [A1]
Q16(a)	$4\,(2^a) = 32$ $2^a = 8$ $a = 3$	[M1 able to show 4 or 2^2] [A1]
Q16(b)	$5^{2(x+2)} \times 5^3 \div 5^{-x} = 5^0$ $5^{(2x+4)+3+x} = 5^0$ $3x + 7 = 0$ $x = -7/3$	[M1 to show $1 = 5^0$ or $5^{2(x+2)} \times 5^3$ [M1 use indices law to combine the power] [A1]

Q17(a)		(a) [C1 for the arc] [G1 for the triangle with $PR = 9$ cm ± 0.1 cm and $\angle PQR = 75°$ ±1°] (b) [G1 at PX with 4 cm ± 0.1] (c) [G1 at ∠Q with 37.5°±1°]
Q18(a)	ξ 	[C2 – all correct]
Q18(b)	A= {x : x is a **perfect square**}	[B1 bold keyword]
Q18(c)	$A \cap B' = \{\ \}$ or ϕ	[B1] No B1 for {ϕ}
Q19 (a)	2 cm : 1 km 17 cm : 8.5 km	 [B1]
Q19(b)	4 cm^2 : 1 km^2 1 cm^2 : 0.25 km^2 9 cm^2 : 2.25 km^2	[M1 conversion] [A1]

Q20 (a)(i)	$756 = 2^2 \times 3^3 \times 7$	[M1+ A1]
Q20(a) (ii)	$360 = 2^3 \times 3^2 \times 5$ $756 = 2^2 \times 3^3 \times 7$ HCF $= 2^2 \times 3^2$ $= 36$	 [B1] [B0 index notation]
Q20 (b)	$m = 11$ $n = 3$	[B1] [B1]
Q21 (a)	$8 - 3.5 = 4.5$ OR By Pythagoras' theorem, $OD^2 = 8^2 - (6.61)^2$ OD $\approx$ 4.5 cm (shown)	[B1] must show subtraction from radius
Q21(b)	Area of biggest circle $= 64\pi$ cm^2 Area of the shaded triangle $= 0.5 \times 4.5 \times (13.22)$ $= 29.745$ cm^2 Area of region between 2 concentric circles $= 16\,\pi$ cm$^2 - 4\pi$ cm^2 $= 12\pi$ cm^2 Area of the unshaded region $= 64\pi$ cm$^2 - 12\pi$ cm$^2 - 29.745$ cm^2 $= 52\pi - 29.745$ cm^2 Cost of shaded region with gold paint $= (12\pi + 29.745) \times \$2$ $= \$134.8882237$ Cost of unshaded region with silver paint $= (52\pi - 29.745) \times \$1.20$ $= \$160.3413816$ Total cost of the plaque $= \$134.8882237 + \$160.3413816$ $= \$295.23$	[M1 for area of biggest circle or triangle found] [M1] [M1 for unshaded region] [M1 Finding the cost of shaded or unshaded region or ECF 1] [A1 for addition of costs]

Q22(a)	$3\overrightarrow{AN} = 6\mathbf{b} - 6\mathbf{a}$ $\overrightarrow{AN} = 2\mathbf{b} - 2\mathbf{a}$ or $2(\mathbf{b}-\mathbf{a})$	[M1 for vector AB = 6b- 6a OR 1/3 of their = $\overrightarrow{AB}$ [A1]
Q22(b)	$\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$ $= 6\mathbf{a} + 2\mathbf{b} - 2\mathbf{a}$ $= 4\mathbf{a} + 2\mathbf{b}$ $= 2(2\mathbf{a} + \mathbf{b})$	[B1]
Q22 (c)	$\overrightarrow{NM} = \overrightarrow{OM} - \overrightarrow{ON}$ $= 3\mathbf{b} - (4\mathbf{a} + 2\mathbf{b})$ $= \mathbf{b} - 4\mathbf{a}$ OR $\overrightarrow{NM} = \overrightarrow{NA} + \overrightarrow{AO} + \overrightarrow{OM}$ $= -2\mathbf{b} + 2\mathbf{a} - 6\mathbf{a} + 3\mathbf{b}$ $= \mathbf{b} - 4\mathbf{a}$	[M1 OR $\overrightarrow{NO} + \overrightarrow{OM}$] [A1 shown] [M1] [A1 shown]
Q22(d)(i)	$\overrightarrow{MP} = 3\overrightarrow{MN}$ $\overrightarrow{OP} - \overrightarrow{OM} = 3(-\mathbf{b} + 4\mathbf{a})$ $\overrightarrow{OP} - 3\mathbf{b} = -3\mathbf{b} + 12\mathbf{a}$ $\overrightarrow{OP} = 12\mathbf{a}$	[M1] [A1]
Q22(d) (ii)	$\overrightarrow{OP} = 12\mathbf{a}$ $\overrightarrow{OP} = 2(6\mathbf{a})$ $\overrightarrow{OP} = 2\overrightarrow{OA}$ 1. Since $\overrightarrow{OP} = 2\overrightarrow{OA}$, OP // OA. 2. A is the common point, O, A and P are collinear. 3. OP is twice the length of OA. 4. $\lvert OP \rvert = 2\lvert OA \rvert$	[B1 with working] [B1 with working] [B1] [B1 magnitude]

For Examiner's Use

Calculator Model:

KENT RIDGE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

MATHEMATICS
PAPER 2 **4048/02**

SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)

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

Name: ____________________ (   ) **Class: Sec** ____________

MARK SCHEME

The total number of the marks for this section is 100.

For Examiner's Use	
Total	**/ 100**

Penalty:
1. Poor presentation for algebraic notations and solving equations (–1 overall)
2. Accuracy errors (–1 overall)

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

For Examiner's Use

S/n	Solutions	Marks	Comments
1(a)	$5(4x+1) > 3(3-2x)$ $20x + 5 > 9 - 6x$	M1	
	$26x > 4$ $x > \frac{2}{13}$	A1	Do not accept $x > 0.154$
1(b)	$\left(\frac{b^8}{16a^{12}}\right)^{\frac{1}{4}}$	M1	
	$= \frac{b^2}{2a^3}$	A1	
1(c)	$\frac{x}{(5-2x)^2} + \frac{3}{5-2x}$ $= \frac{x+3(5-2x)}{(5-2x)^2}$	M1	$\frac{x}{(2x-5)^2} - \frac{3(2x-5)}{(2x-5)^2}$ M1
	$= \frac{15-5x}{(5-2x)^2}$	A1	Accept $\frac{5(3-x)}{(5-2x)^2}$ or $\frac{5(3-x)}{(2x-5)^2}$
1(d)	$14x + 12y = 66$ .....(1) $15x - 12y = 21$ .....(2) (1) + (2): $29x = 87$	M1	Equivalent method or Substitution method
	$x = 3$, y= 2	A1,A1	
1(e)	$\frac{(5x+4)(5x-4)}{(5x+4)(3x-1)}$	M2	
	$= \frac{5x-4}{3x-1}$	A1	
Q2: Penalize 1 mark for the entire question if no brackets are written.			
2(a)	$\begin{pmatrix} 430 & 635 & 335 \\ 430 & 585 & 310 \end{pmatrix}$	B1	
2(b)	$\begin{pmatrix} 98 \\ 78 \\ 48 \end{pmatrix}$	B1	
2(c)	$\begin{pmatrix} 107750 \\ 102650 \end{pmatrix}$ Value of both elements correct **and** correct matrix order to award B2	B1 B1	
2(d)	The elements represent the total price of the tickets from **all categories** sold on **Saturday and Sunday respectively**	B1	
2(e)	$(1 \quad 1)$	B1	
3(a)	Volume $= \frac{2}{3}\pi r^3 + \pi r^3 = \frac{5}{3}\pi r^3$	B1	
3(b)	$\frac{2}{3}\pi r^2 h = \frac{5}{3}\pi r^3 + \frac{1}{3}\pi r^2 h$ $\frac{1}{3}\pi r^2 h = \frac{5}{3}\pi r^3$ $h = 5r$ (shown)	M1 A1	

For Examiner's Use

3(c)	$\frac{2}{3}\pi r^3 = 54\pi$ $r^3 = 81$ $r = 4.3267$	M1	
	Volume of Solid A $= \frac{5}{3}\pi(4.3267)^3 + \frac{1}{3}\pi(4.3267)^2(5 \times 4.3267)$	M1 Ecf	
	$= 848$ cm^3 (3sf)	A1	
3(d)	$\frac{1}{2} \times (10+6) \times y \times (20) = 848.2014$	M1	$\frac{1}{2} \times (10+6) \times y$: M1
	Height $= \frac{848.2014}{8 \times 20}$	M1 Ecf	
	$= 5.30$ cm	A1	
4(a)	$\frac{WY}{\sin 28.6} = \frac{3}{\sin 20}$	M1	
	$WY = \frac{3}{\sin 20} \times \sin 28.6 = 4.20$ m (3sf)	A1	
4(b)	$4.1988^2 = 7^2 + 10^2 - 2(7)(10)\cos \angle WXY$	M1 Ecf	
	$\angle WXY = \cos^{-1}\left(\frac{7^2 + 10^2 - 4.1988^2}{2(7)(10)}\right)$	M1 Ecf	
	$= 20.2^o$ (1dp) shown	A1	
4(c)	Bearing $= 180 - (360 - 308) + 28.6$	M1	$(360 - 308)$ seen: M1
	$= 156.6°$ (1dp)	A1	
4(d)	Height $= \sqrt{8^2 - 7^2} = 3.87$ m (3sf)	B1	
4(e)	Shortest $WT = 7 \sin 20.2224 = 2.41966$ m	M1	
	Greatest angle of elevation $= \tan^{-1}\frac{3.87298}{2.41966}$	M1 Ecf	
	$= 58.0°$ (1dp)	A1	

For Examiner's Use

S/n	Solutions	Marks	Comments
5(a)(i)	$\frac{37}{21}$	B1	
5(a)(ii)	Solving $\frac{6n-5}{3n} = \frac{64}{33}$ $n = 27.5$ Since n is not a positive integer, $\frac{64}{33}$ is not a term in the sequence.	B1	Accept: Since the numerator must always be an odd number, $\frac{64}{33}$ is not a term in the sequence.
5(a)(iii)	$T_n = 2 - \frac{5}{3n}$ When $n = 1$, $T_1 = \frac{1}{3}$ Since $0 < \frac{5}{3n} \leq \frac{5}{3}$ for integer values of $n \geq 1$, therefore $\frac{1}{3} \leq 2 - \frac{5}{3n} < 2$ Accept since $\frac{5}{3n} > 0$, $2 - \frac{5}{3n} < 2$ or equivalent reasoning.	M1 A1	Finding $T_1 = \frac{1}{3}$ M1 Do not accept substituting values of n to give a few cases of T_n.
5(b)(i)	130	B1	
5(b)(ii)	$T_n = (n+1)(n+2) - 2$	M1	
	$= n^2 + 2n + n + 2 - 2$ $= n^2 + 3n$ (shown)	A1	
5(b)(iii)	$T_k = k^2 + 3k = 208$ $k^2 + 3k - 208 = 0$	M1	
	$(k+16)(k-13) = 0$	M1	
	$k = -16$ (reject), $k = 13$	A1	No A1 without method
6(a)	19.25 kg	B1	Accept 19<Q2<19.5
6(b)	IQR = 22.5 − 15.75	M1	Accept 22.25<Q3<23 Accept 15.5<Q1<16
	= 6.75 kg	A1	Accept 6.25<IQR<7.5
6(c)	27.5 kg	B1	
6(d)	On the average, members in Amazing lost more mass as the median mass loss is higher than Supreme (18 kg)	B1	
	The **spread** of the mass loss of the members **in Amazing is smaller** as the **interquartile range of Amazing is smaller than Supreme** (9 kg)	B1	

For Examiner's Use

6(e)(i)	$\frac{168-20}{200} = \frac{37}{50}$	B1	Accept 0.74
6(e)(ii)	Andy calculated the probability with replacement	B1	
	Correct probability = $\frac{32}{200} \times \frac{31}{199} = \frac{124}{4975}$	B1	Accept 0.0249 (3sf)
7(a)	AD = BE (given)	M2 (all 3)	Accept (angles on a st line). Accept if 60° labelled on diagram to show $\angle BAD = \angle CBE$.
	$\angle CAB = \angle CBA = 60°$ (interior angles of equilateral triangle) $\angle BAD = \angle CBE = 180 - 60 = 120°$ (adj angles on a st line)		
	AB = BC (sides of equilateral triangle)		
	Therefore, $\Delta ABD \equiv \Delta BCE$ (SAS)	A1	Award A1 if M2 awarded
7(b)(i)	Let A be (a, 0): $\frac{6-0}{7-a} = \frac{6-4}{7-3}$ $a = -5$	M1	Finding gradient $\frac{6-4}{7-3}$ M1
	Area = $\frac{1}{2} \times 5 \times 4$	M1 Ecf	
	= 10 units^2	A1	
7(b)(ii)	Let point D be (d, 0). OB // DC $\frac{6-0}{7-d} = \frac{4}{3}$, $d = 2.5$ D is (2.5, 0)	B1	Or scale factor = $\frac{3}{2}$, AD = $\frac{3}{2} \times 5 = 7.5$ units
7(b)(iii)	$\frac{area\ of\ \Delta ABO}{area\ of\ \Delta ACD} = \left(\frac{5}{7.5}\right)^2 = \frac{4}{9}$	M1 Ecf	
	$\frac{area\ of\ OBCD}{area\ of\ \Delta ACD} = \frac{5}{9}$	A1	

For Examiner's Use

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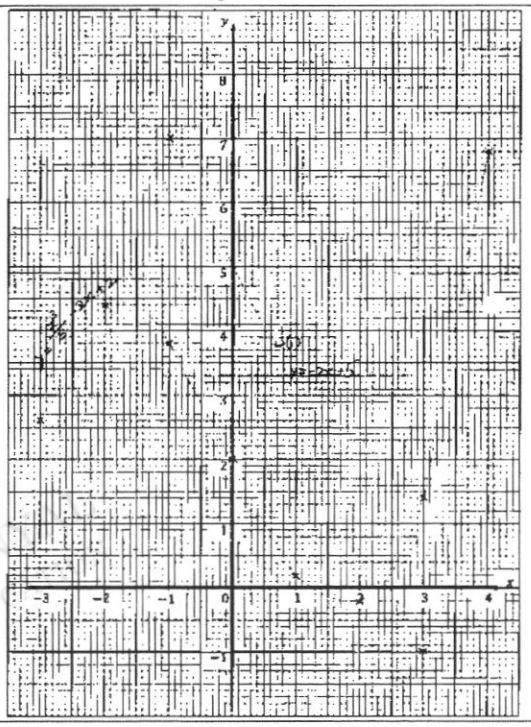
S/n	Solutions	Marks	Comments
8(a)	$p = 2.6$	B1	
8(b)		P2 C1	At least 4 points correct: P1 All 8 points correct: P2
8(c)	Line $y = 5$ **drawn or mentioned** or line indicated on graph to show x-coordinate solution	B1	
	The line $y = 5$ **intercepts the curve at only 1 point**, therefore $\frac{x^3}{5} - 2x = 3$ has only one solution	B1	
8(d)(i)	Line $y = -2x + 5$ drawn for $-1 \leq x \leq 4$	B1	
8(d)(ii)	$x = 2.45 \pm 0.2$	B1	Refer to their graph
8(d)(iii)	$\frac{x^3}{5} - 2x + 2 = -2x + 5$ $x^3 - 15 = 0$	M1	
	$A = 0, B = -15$	B1,B1	
Q9(a): Penalize 1 mark for each missing reason or wrong reason up to 2 marks			
9(a)(i)	$\angle OEA = 90$ (radius ⊥ tan) $\angle OBA = 360 - 90 - 72 - 38$ (angle sum of quadrilateral)	M1	
	$= 160°$	A1	
9(a)(ii)	$\angle BCE = 72 \div 2 = 36$ (∠ at centre = 2∠ at circumference) $\angle DEB = 180 - (36 + 40)$ (∠s in opp segments)	M1	
	$= 104°$	A1	

For Examiner's Use

9(a)(iii)	$\angle OBE = (180 - 72) \div 2 = 54$ ($\angle$ sum of isosceles triangle) $\angle EBA = 160 - 54 = 106$	M1	
	$\angle CBE = 180 - 106 = 74$ (adj $\angle$s on a st. line) $\angle OEC = 180 - 74 - 36 - 54$ ($\angle$ sum of triangle)	M1	
	$= 16°$	A1	
9(b)(i)	$r\theta = 12.785 - 4.5 - 4.5 = 3.785$	M1	
	$\theta = \frac{3.785}{4.5} = 0.841$ rad (3sf)	A1	
9(b)(ii)	The perpendicular from the centre of the circle to chord BD bisects the chord. Hence BM = MD.	B1	Accept $\Delta OMB \equiv \Delta OMD$ (RHS) or The **perpendicular** from the vertex of an **isosceles triangle** bisects the base
9(b)(iii)	Area of minor sector OAB $= \frac{1}{2}(4.5^2)(0.84111) = 8.5162$ cm^2 Alternatively: Area of minor sector OBCD $= \frac{1}{2}(4.5^2)(\pi - 2 \times 0.84111) = 14.7761$ cm^2	M1 M1	
	Area of triangle OBM $= \frac{1}{2}(4.5)(3)\sin(0.84111)$ $= 5.0313$ cm^2 Alternatively: Area of triangle OBD $= \frac{1}{2}(4.5^2)\sin(\pi - 2 \times 0.84111)$ $= 10.0622$ cm^2	M1 M1	
	Shaded area $= \frac{\pi(4.5)^2}{4} - 8.5162 - 5.0313$ $= 2.36$ cm^2 (3sf)	A1	Alternatively: Shaded area $= \frac{1}{2}(14.7761 - 10.0622)$ $= 2.36$ cm^2 (3sf)

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S/n	Solutions	Marks	Comments
10(a)	Electricity tariff rate for Oct-Dec 22 $= 1.08 \times 30.17 = 32.58$ ¢/kWh	B1	
10(b)	Amount paid before GST $= 1195.87 \times \$0.3258 \times 0.94$ $= \$366.2376$	M1	M1 for using 32.58
	Amount paid after GST $= 1.07 \times \$366.2376$	M1	
	$= \$391.87$	A1	Accept \$391.92 for using more accurate 32.5836 ¢/kWh in their calculation
10(c)	**No. of solar panels to be installed = 20** Based on $9 \div 1.65 \approx 5$ (length) and $4 \div 1 = 4$ (width) $5 \times 4 = 20$	P1	No. of solar panels. 20 seen: P1 Accept $9 \times 2 = 18$ panels Do not accept $\frac{9\times4}{1.65\times1} \approx 22$
	Average amount of **electricity produced per month** $= 20 \times 19 = 380$ kWh	E1	P1 × 19 (Their number of panels × 19)
	Average **cost per month after solar energy savings** $= (1195.87 - 380) \times \$0.3258 \times 0.94 \times 1.07$ $= \$267.35$	C1	$(1195.87 - E1) \times \$0.3258 \times 0.94 \times 1.07$ seen: C1 Accept if × 0.94 omitted
	Average **cost of installing** solar panels per month $= 2 \times \$6250 \div (20 \times 12) = \$52.08$	I1	$2 \times \$6250$ seen: I1 If their no. of solar panels > 20, accept $3 \times \$6250$
	Total average amount paid per month $= \$267.35 + \$52.08$ $= \$319.43 \ (< \$391.87)$	T1	**Their C1+ I1**
	Since the average amount paid by Mr Robert after installing the solar panels is less than what he is currently paying, he should proceed with the installation.	A1	Awarded independent of accuracy of T1

Alternative solution for 10(c) based on <u>total cost for 20 years</u>:

No. of solar panels to be installed = 20	P1
Average amount of **electricity produced per month** $= 20 \times 19 = 380$ kWh	E1
Cost for 20 years <u>before</u> solar energy savings $= \$391.87 \times (20 \times 12) = \$94048.80$	C1
Cost of installing solar panels$= 2 \times \$6250 = \$12500$	I1
Total cost for 20 years <u>after</u> solar energy savings including installation costs $(1195.87 - 380) \times \$0.3258 \times 0.94 \times 1.07 \times (20 \times 12) + \$12500 = \$76664.52$	T1
Since $\$76664.52 < \$94048.80$, he should proceed with the installation.	A1