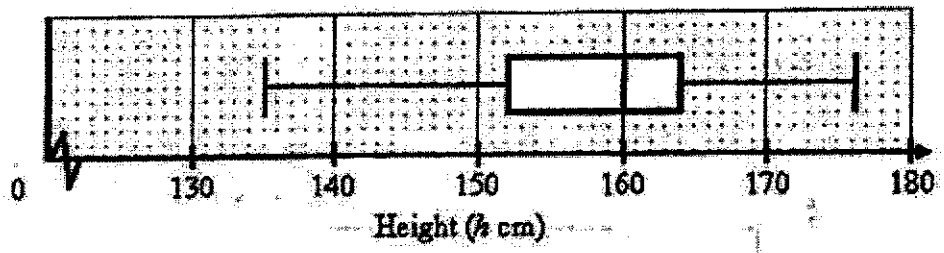
Answer all the questions.

1 The population of Singapore was approximately 5.7 million in 2020.
Given that 11% of the population were 65 years old and above, calculate the number of residents who were below 65 years old. Give your answer in standard form.
[1 million = 1×10^6]

Answer ..... [2]

2 The height of 120 students from a secondary school were measured.
The box and whisker diagram below illustrates the height obtained.



It was found that the measurements were inaccurate. The correct height of each student was found to be 3 cm more than recorded.

(a) Find the correct median.

Answer ..... cm [1]

(b) Find the correct interquartile range.

Answer ..... cm [1]

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3

$\xi = \{x: x \text{ is an integer and } 1 \leq x \leq n\}$
$A = \{x: x \text{ is a multiple of 2}\}$
$B = \{x: x \text{ is a perfect square}\}$

(a) Given that $B = \{1, 4, 9\}$, state the maximum value of n.

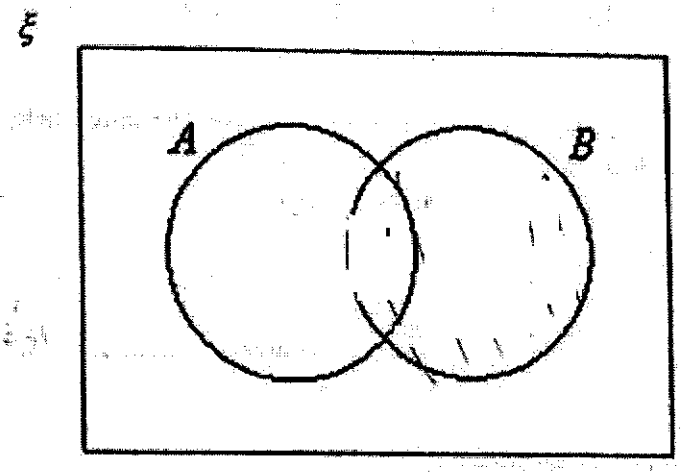
Answer $n =$ ..... [1]

(b) Using your answer in (a), list the elements in $A' \cap B$.

Answer ..... [1]

(c) Draw a Venn diagram to illustrate the information above. [2]

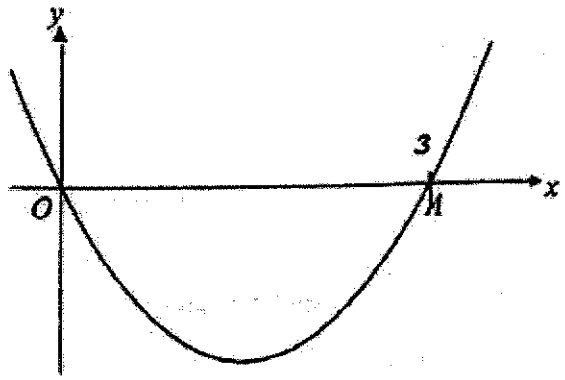
Answer



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4 The diagram shows the graph of $y = x^2 - 6x$.



(a) The graph passes through the origin and cuts the x-axis at the point A. Find the coordinates of A.

Answer A (....., ...) [1]

(b) Find the coordinates of the minimum point on the graph.

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

(c) Other than the point (0, 0), there is a point P on the graph where the x and y coordinates are equal. Find the coordinates of the point P.

Answer P (....., ...) [2]

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5 (a) Simplify $\sqrt{12x^3 \div 3x^7}$, leaving your answer in positive index.

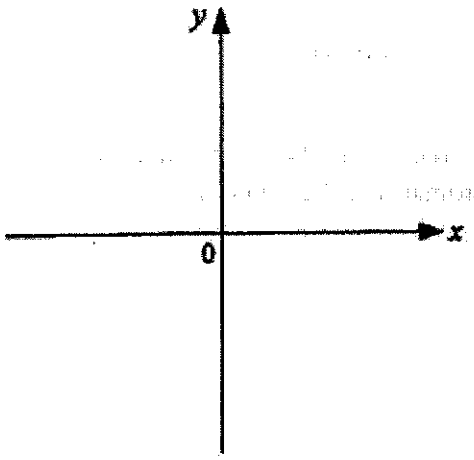
Answer ..... [1]

(b) Given that $4^{3x+1} - 8^x = 0$, find the value of x.

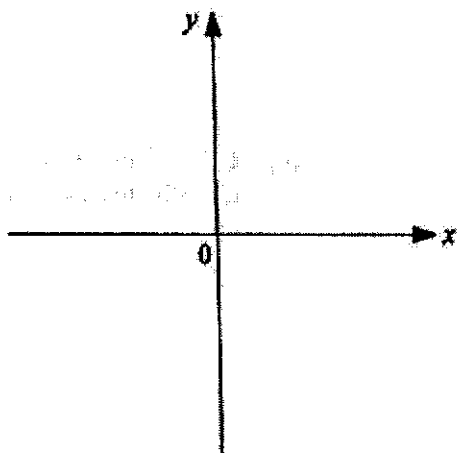
Answer $x =$ ..... [2]

6 (a) On the axes given, sketch the following graphs, indicating the x and y intercepts if any.

(i) $y = -x^2$ [1]



(ii) $y = 3^x$ [1]



(b) Hence, explain why the equation $3^x + x^2 = 0$ has no solution.

Answer .....

.....

..... [1]

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7 A bag contains four cards, numbered 1, 2, 3 and 5.
Two cards are taken from the bag at random, one after the other, **without replacement.**

(a) Complete the possibility diagram to present the outcomes. [1]

		1st Card			
		1	2	3	5
2nd Card	1				
	2				
	3				
	5				

(b) Find, in its simplest form, the probability that
(i) both cards have numbers more than 2.

Answer ..... [1]

(ii) the product of the numbers is a prime number.

Answer ..... [1]

8 (a) Solve the equation $\frac{1}{2-x} - \frac{6}{x^2-4} = 3$.

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

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(b) If $kx^2 - 120x + 144$ is a perfect square, find the value of k.

Answer $k =$ ..... [1]

9 (a) Express $x^2 - 13x - 7$ in the form $(x - a)^2 + b$.

Answer ..... [2]

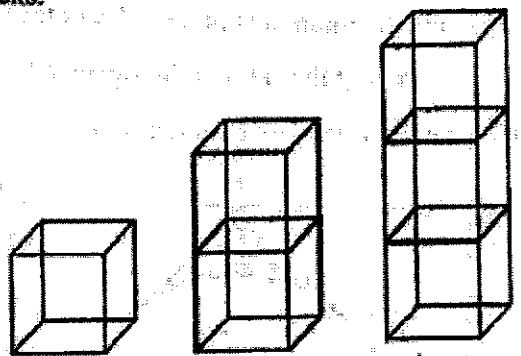
(b) **Hence, solve the equation $x^2 - 13x - 7 = 0$, giving your answers correct to two decimal places.**

Answer $x =$ ..... or ..... [2]

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10 Each of the shapes below represents a 3-dimensional structure formed by joining identical sticks.



1st shape 2nd shape 3rd shape

(a) The number of sticks required to form each shape is given below.

Order of shapes	No. of sticks
1st shape	12
2nd shape	20
3rd shape	28

What is the number of sticks required for the 4th shape?

Answer ..... [1]

(b) How many sticks will be required to form a shape with 20 cubes?

Answer ..... [1]

(c) Find a formula for the number of sticks required for the *n*th shape.

Answer ..... [1]

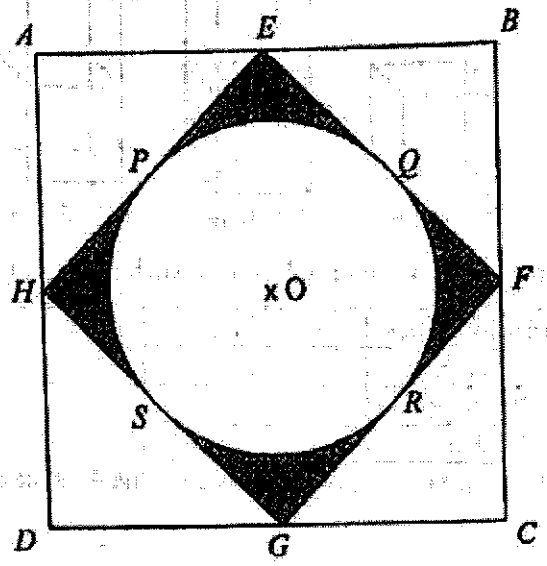
(d) If there are 1000 sticks available, what is the largest number of cubes can you form in the 3-dimensional structure.

Answer ..... [1]

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11 The diagram below shows a square *ABCD* with side 20 cm. A second square *EFGH* is obtained by joining the midpoints of the sides of the square *ABCD*. A circle, with centre O, is drawn touching the sides of the square *EFGH* at *P*, *Q*, *R* and *S*. Calculate the shaded area, leaving your answer in terms of π.



Answer ..... cm^2 [3]

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12 The prime factorisation of the following numbers are as follows,

$$18 = 2 \times 3^2$$
$$270 = 2 \times 3^3 \times 5$$
$$7560 = 2^3 \times 3^3 \times 5 \times 7$$

(a) $18n$ is both a perfect square and a perfect cube.
Write down the smallest possible value of n.

Answer $n =$ ..... [1]

(b) The highest common factor of 270 and k is 18.
The lowest common multiple of 270 and k is 7560.
Find the value of k.

Answer $k =$ ..... [1]

13 (a) Simplify $3(2x + 1)^2 - 4(3x - 1)$.

Answer ..... [2]

(b) Factorise $8a^4 - 2a^2$ completely.

Answer ..... [2]

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14 Given that $a > 1$ and $b > 1$, find a possible set of integer values for a and b such that the solution to the inequalities $10 + ax \geq x$ and $9 + x > bx$ is $-2 \leq x < 3$.

Answer $a =$ ....., $b =$ ..... [4]

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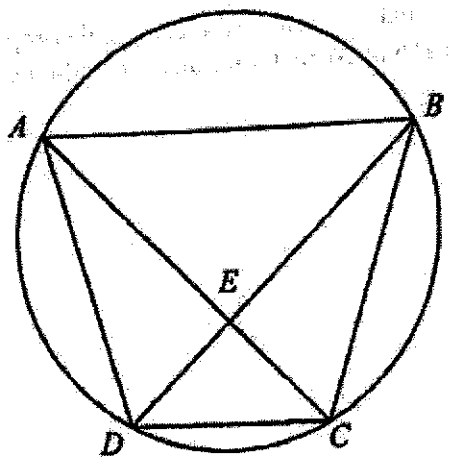
15 David wants to deposit $\$P$ into a bank to earn interest.
Bank *SA* offers simple interest of 4% per annum while Bank *UK* offers compound interest of 4% compounded yearly.
The difference between simple interest and compound interest for a period of 7 years is \$449. Find P and correct your answer to the nearest hundred.

Answer $P =$ ..... [4]

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16 In the figure, AB, BC, CD and AD are chords of the circle. AC and BD intersect at E. It is given that $AD = BC$.



(a) Prove that triangle ADE is congruent to triangle BCE, stating your reasons clearly.

Answer .....

.....

.....

..... [2]

(b) If $BD = 23$ cm, $CE = 8$ cm and $AD = 17$ cm, determine whether AC and BD are perpendicular to each other. Explain your answer

Answer .....

.....

.....

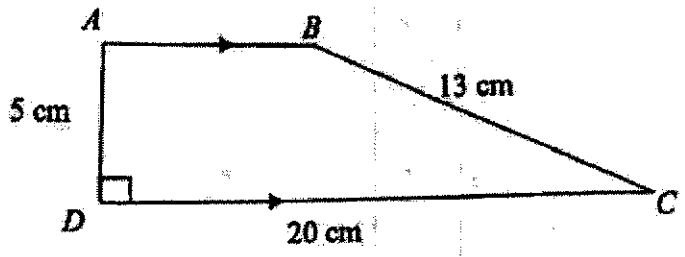
.....

..... [2]

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17 The diagram shows a trapezium $ABCD$ where AB is parallel to DC.
Given that $\angle ADC = 90°$, $AD = 5$ cm, $DC = 20$ cm and $BC = 13$ cm.



(a) Find the length of AB.

Answer ..... cm [2]

(b) Write down, as a fraction, the value of

(i) $\sin \angle ABC$,

Answer ..... [1]

(ii) $\cos \angle ABC$.

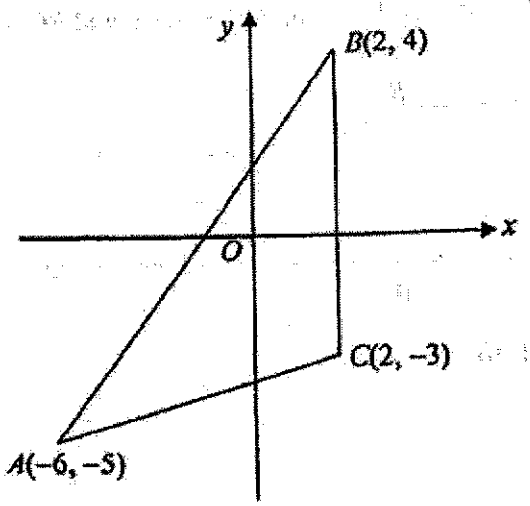
Answer ..... [1]

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18 In the diagram, $A(-6, -5)$, $B(2, 4)$, $C(2, -3)$ and O is the origin.



(a) Find the column vector $\overrightarrow{AB}$.

Answer $\overrightarrow{AB}$ = ... [1]

(b) Find $|\overrightarrow{AB}|$.

Answer $|\overrightarrow{AB}|$ = ... units [1]

(c) Calculate the area of ΔABC.

Answer ..... units^2 [1]

(d) Calculate the shortest distance from C to AB.

Answer ..... units [1]

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(e) Find the position vector of D, given that $\overrightarrow{OD} = 2\overrightarrow{AB}$.

Answer $\overrightarrow{OD}$ = [redacted] [2]

(f) Given that the coordinates of E is $(6,5)$, find the equation of the line OE.

Answer ..... [1]

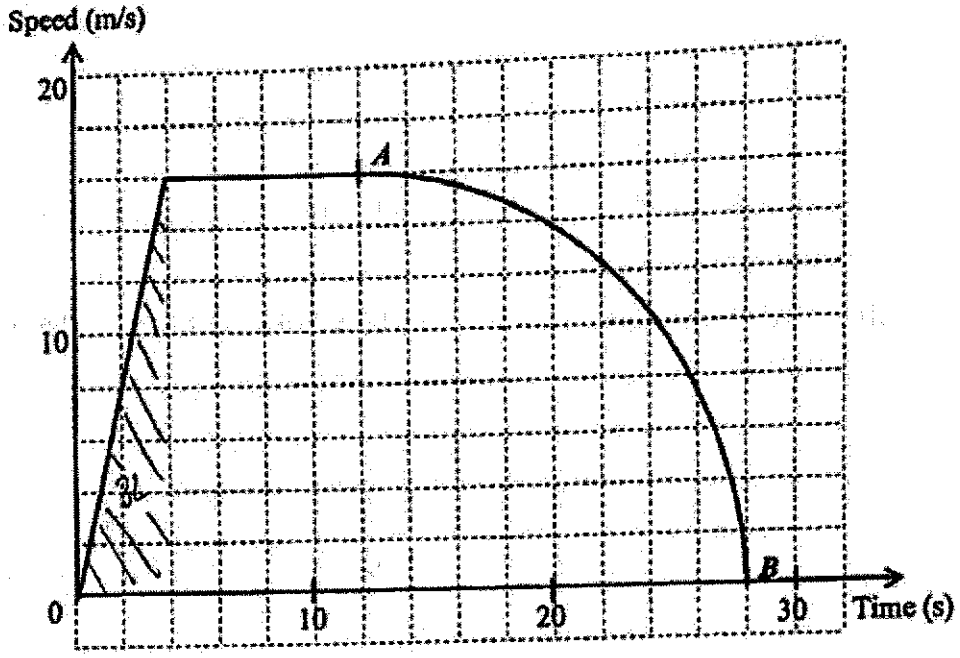
(g) Another line l has equation $2x - 3y = 5$ and l intersects with line OE at the point P. Find the coordinates of P.

Answer P (....., ...) [2]

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19 The diagram below shows the speed-time graph of a car for a journey.
The car accelerates uniformly for 4 seconds and remains at constant speed for the next 8 seconds. It then decelerates for the next 16 seconds.
It is given that AB is an arc of a quadrant.



(a) Find the acceleration when time is 2 seconds.

..... m/s^2 [1]

(b) Taking π to be $\frac{22}{7}$, find the total distance travelled for the entire journey.

Answer ..... m [2]

(c) **On the diagram above,** draw the journey of a motorcycle if it accelerates from 6 m/s at the rate of 0.2 m/s^2 for 30 seconds. [1]

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20 Jamie is a café owner.
Her café sells an assortment of cakes and drinks.
During the weekend period, she needs to prepare the cakes and drinks to be sold.
The matrix **C** shows the number of cakes and cups of drinks she has to prepare each day.

$$\mathbf{C} = \begin{array}{c} \begin{matrix} \text{Cake} & \text{Latte} & \text{Mocha} \end{matrix} \\ \begin{bmatrix} 32 & 60 & 50 \\ 40 & 100 & 125 \\ 24 & 80 & 75 \end{bmatrix} \end{array} \begin{matrix} \\ \text{Friday} \\ \text{Saturday} \\ \text{Sunday} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{D} = 4\mathbf{C}$.

Answer $\mathbf{D} =$..... [1]

(b) Jamie charges $7.50 for each cake, $5 for each cup of latte and $6 for each cup of mocha.
Represent the prices in a 3×1 matrix **P**.

Answer $\mathbf{P} =$..... [1]

(c) Evaluate the matrix $\mathbf{E} = \mathbf{DP}$.

Answer $\mathbf{E} =$..... [2]

(d) State what the elements of **E** represent.

Answer

..... [1]

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21 The diagram below is a map of three neighbourhood clusters A, B and C, whereby 1 cm on the map represents 0.5 km actual distance.

(a) A hospital H is to be built. The town planner was given some constraints:

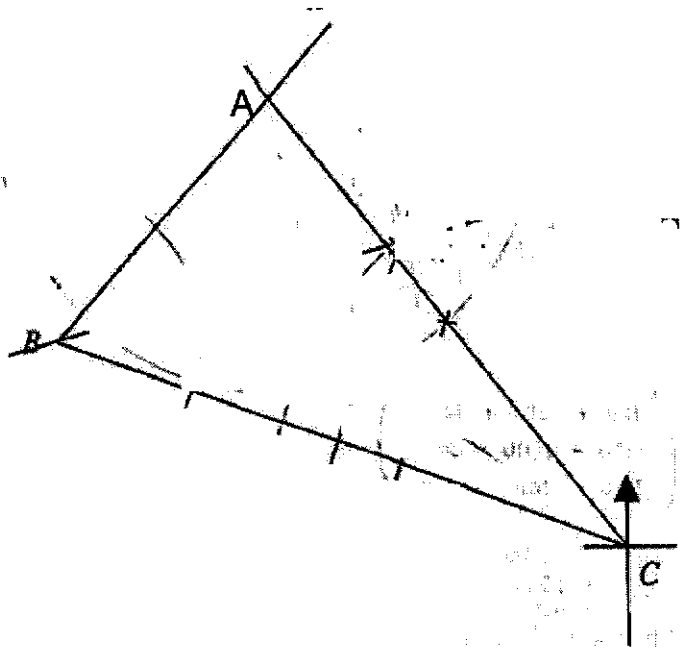
The hospital must be equidistant from the roads AB and BC.

The hospital must be equidistant from points B and C.

Using only ruler and compasses, identify where on the map the hospital is to be built and label it H. [2]

(b) Neighbourhood C has a police station within it. An incident was reported at a location with a bearing of 320° from the police station, 2 km away from neighbourhood A, within the neighbourhood clusters A, B and C. Identify the incident location and label it T. [2]

Ans



End of Paper

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Bendemeer 2021 Prelim 4E5N EM Paper 2 Marking Scheme

1 (a) Given that $= \frac{3x-2z}{5-x}$,

(i) Evaluate y when $x = -6$ and $z = 4$. [1]

$$y = \frac{3(-6)-2(4)}{5-(-6)}$$
$$= -\frac{26}{11}$$
$$= -2\frac{4}{11}$$ - B1

(ii) Express x in terms of y and z. [2]

$$5y - xy = 3x - 2z$$
$5y + 2z = x(3 + y)$ - M1

$x = \frac{5y+2z}{3+y}$ - A1

(b) Simplify $\left(\frac{28a^{-8}}{16b^{10}}\right)^{-\frac{1}{2}}$ expressing your answer in positive index. [2]

$(\frac{16a^8b^{10}}{25})^{\frac{1}{2}}$ - M1

$= \frac{4a^4b^5}{5}$ - A1

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(c) $\frac{3x-1}{3} < \frac{6+x}{2}$ [2]

$6x - 2 < 18 + 3x$ - M1

$3x < 20$

$x < 6\frac{2}{3}$ - A1

(d) Simplify $\frac{1-4x^2}{8x^2-10x+3}$. [3]

$\frac{(1+2x)(1-2x)}{(4x-3)(2x-1)}$ - M2 for factorizing the numerator & denominator

$= -\frac{(1+2x)}{(4x-3)}$ - A1

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2 Mr Lim used to drive to Johor Bahru, Malaysia, over the weekend for staycation and he would fill up the petrol tank of his car before coming back. In Malaysia, he would pay Malaysia Ringgit, MYR$125 for x litres of petrol. Due to the current COVID-19 situation, Mr Lim no longer travels to Malaysia. He found that he will be getting 28 litres of petrol less for Singapore dollars S$40 which is equivalent to MYR$125 in Singapore.

(a) Calculate the currency exchange rate from Singapore dollars to Malaysia Ringgit. [1]

S$40 = MYR $125
S$1 = MYR $3.125 - B1

(b) Write down an expression, in terms of x, the cost of 1 litre of petrol in Singapore. [1]

$\frac{40}{x-28}$ - B1

(c) Given that the petrol cost more in Singapore by S$1.20 per litre than the petrol in Malaysia, form an expression in terms of x and show that it simplifies to $3x^2 - 84x - 2800 = 0$. [3]

$\frac{40}{x-28} - \frac{40}{x} = 1.20$

$40x - 40x + 1120 = 1.2x^2 - 33.6x$ - M1

$1.2x^2 - 33.6x - 1120 = 0$ - M1

$3x^2 - 84x - 2800 = 0$ - A1

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(d) Solve the equation $3x^2 - 84x - 2800 = 0$. [3]

$x = \frac{-(-84) \pm \sqrt{(-84)^2 - 4(3)(-2800)}}{2(3)}$ - M1

$x = \frac{-(-84) \pm \sqrt{40656}}{6}$ - M1

$= 47.6$ or -19.6 - A1

(e) Find the price of petrol per litre in Singapore. [1]

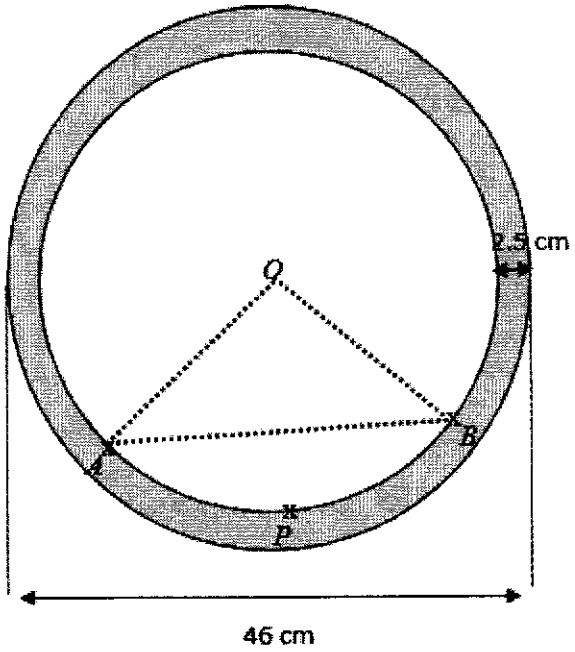
$$\frac{40}{47.6 - 28}$$

= \$2.04 / litre - B1

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3 (a) A dartboard below consists of two concentric circles with centre O. The difference between the radii of the two circles is 2.5 cm. The diameter of the dartboard is 46 cm.



(i) Given that A , P and B are three points on the smaller circle and the arc length of $APB = 11\frac{7}{18}\pi$ cm. Find angle AOB in terms of π. [2]

$11\frac{7}{18}\pi = (20.5)(\theta)$ - M1

$\theta = \frac{5}{9}\pi$ - A1

(ii) A dart is thrown, find the probability that it will land in the segment APB. Correct your answer to 2 decimal places. [3]

Area of segment $= \frac{1}{2}(20.5^2)\left[\frac{5}{9}\pi - \sin\left(\frac{5}{9}\pi\right)\right]$

$= 159.80$ - M1

Area of circle $= \pi(23^2)$

$= 1661.90$ - M1

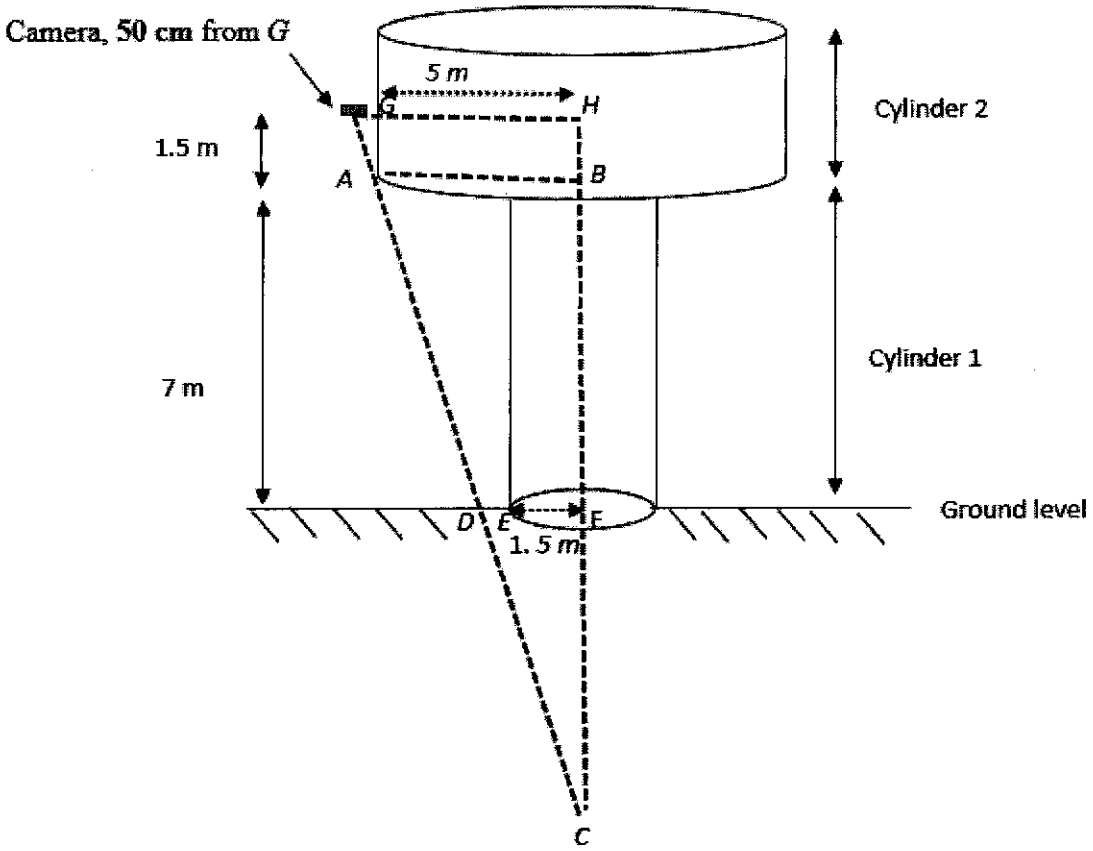
Probability $= \frac{159.80}{1661.90}$

$= 0.10$ - A1

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(b) The diagram below shows a watch tower. It is made up of 2 parts, cylinder 1 and cylinder 2 with radius $EF = 1.5$ m and $GH = 5$ m respectively. Cylinder 1 has a height of $BF = 7$ m from the ground level. A camera is fixed at 1.5 m above from the base of cylinder 2 and 50 cm horizontally away from G.



(i) Show that FC is 8 m. [2]

$\frac{5.5}{5} = \frac{8.5+FC}{7+FC}$ - M1

$38.5 + 5.5FC = 42.5 + 5FC$

$FC = \frac{4}{0.5}$

$FC = 8$ m - A1

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(ii) If an intruder is hiding between *DE*, he cannot be captured by the camera and *DE* is referred as the blind spot. How high should the tower be raised so that there will not be any blind spot? [3]

Let x be the height that the tower should be raised

$\frac{5}{1.5} = \frac{15}{8-x}$ - M1

$40 - 5x = 22.5$ - M1

$x = \frac{17.5}{5}$

$x = 3.5\ m$ - A1

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4 (a) During the Home Base Learning (HBL) period, the times taken by a group 30 students in Class A to complete an assignment were recorded and represented in the Stem-and-Leaf diagram below.

2	3	5	5	7	7	8	8	9	
3	2	2	3	4	5	6	6	7	9
4	0	1	1	2	4	6	6	7	
5	2	2	4	5					
6									
7	2								

Key : 2 | 3 means 23 minutes

(i) 40% of the students took more than x minutes to complete their assignment. Find x. [1]

(ii) $\frac{40}{100} \times 30 = 12$

$x = 40\ min$ - B1

(iii) Find the median time. [1]

Median = 36.5 min - B1

(iv) Is the median or the mean a better measure of central tendency in this distribution? Explain. [2]

The median will be a better measure. – B1
There are outliers in the data. Or There is an extreme value. – B1

(v) Find the standard deviation of the times taken. [2]

Standard deviation $= \sqrt{\frac{46707}{30} - \left(\frac{1141}{30}\right)^2}$
$= 10.5$

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(vi) The standard deviation of the times taken by students in Class B was 9.02. Compare and comment on one difference between the two distributions. [1]

The standard deviation in class B is lower, hence the times taken by students in class are more consistent. – B1

(b) The table summarises the age of 235 employees in a company who went for vaccination.

Age (years)	$20 \leq x < 30$	$30 \leq x < 40$	$40 \leq x < 50$	$50 \leq x < 60$
Male	37	46	20	15
Female	30	35	32	20

(i) If one employee is selected at random, find, as a fraction in its lowest term, the probability that this person is less than 30 years of age or at least 50 years of age. [2]

$\frac{67}{235} + \frac{35}{235}$ - M1

$= \frac{102}{235}$ - A1

(ii) When two employees are selected at random, Randy claimed that the chances of selecting one male and one female under the age of 30 is at least 0.04. Justify if he is correct. [2]

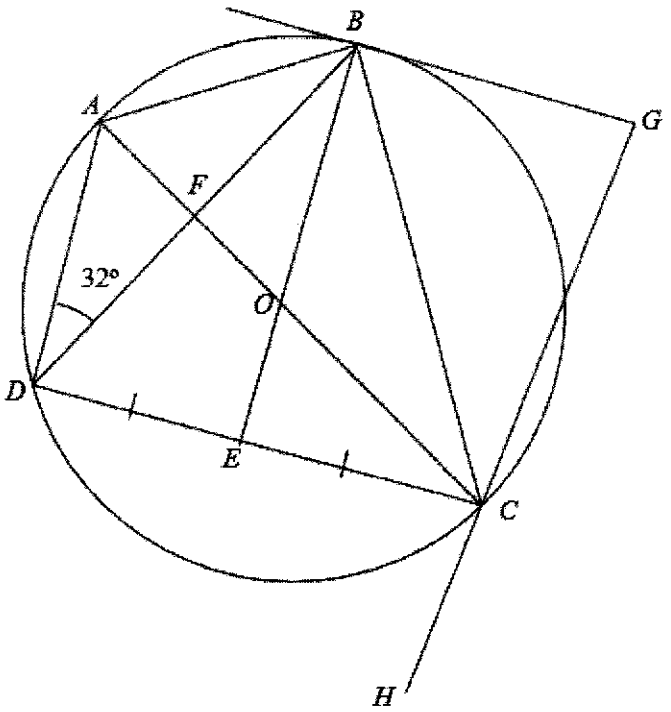
$2[\frac{37}{235} \times \frac{30}{234}]$

$= 0.0404$ - M1

He is correct - A1

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5 In the diagram shown below, $ABCD$ are points on the circle with centre O and diameter AC. BE passes through O and the ratio of $DE : CE$ is 1:1. F is the intersection of BD and AC. BG is a tangent to the circle and HCG is a straight line. Angle $ADB = 32°$.



(a) Find, stating your reasons,

(i) angle BCA. [1]

angle $BCA = 32^0$ (angles in the same segment) - B1

(ii) angle BAC [2]

angle $ABC = 90^0$ (angle in a semi-circle is 90^0) - M1

angle $BAC = 180^0 - 90^0 - 32^0$ -A1
$= 58^0$

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(iii) angle BOC [2]

angle BDC = angle BAC (angles in the same segment)
$= 58^0$ - M1

angle BOC = 2 angle BDC (angles at the centre is 2 times the angle at circumference)
$= 2 \times 58°$
$= 116°$ - A1

(iv) angle BFO [2]

angle $CBD = 180^0 - 2(58^0)$ (perpendicular from ctr bisects, chord, ΔDBC is an isosceles Δ)
$= 64^0$

angle $FBO = 64° \div 2$
$= 32^0$ - M1

angle BFO + angle $FBO = 116^0$ (sum of interior angle = ext. angle)
angle $BFO + 32^0 = 116^0$

angle $BFO = 84^0$ - A1

(b) Given that angle $HCE = \alpha$, Show that angle $BGH = \alpha$. [3]

angle $EBG = 90^0$ (tangent perpendicular to radius) – M1

angle $GBC = 90^0 - 32^0$
$= 58^0$

angle BCD = angle $BDC = 58^0$

angle $BGH + 58^0$ = angle BCD + angle HCE - M1
angle $BGH + 58^0 = 58^0 + \alpha$
angle $BGH = \alpha$ - A1

Or
angle EBG = 90^0(tangent perpendicular to radius) M1

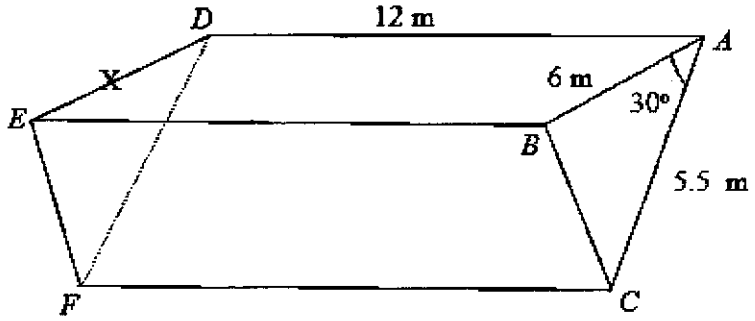
angle BEC = 90^0(perpendicular from the centre of circle bisects chord) M1

given HCG is a straight line, angle HCE and angle BGH are corresponding angles.

Hence if angle $HCE = \alpha$, $BGH = \alpha$.

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6 The diagram shows an empty triangular prism with three rectangular faces and two congruent triangular faces. $AB = 6$ m, $AC = 5.5$ m and $AD = 12$ m. Angle $CAB = 30°$. FX is the shortest distance from F to DE.



(a) Show that FX is 2.75m. [1]

$\sin 30° = \frac{FX}{5.5}$ - B1

FX = 2.75 m

(b) Calculate the length of AX. [2]

$\cos 30° = \frac{DX}{5.5}$

DX = 4.76 - M1

$(AX)^2 = 12^2 + 4.76^2$

AX = 12.9 m - A1

(c) Calculate the length from A to F. [2]

$(AF)^2 = (AX)^2 + (FX)^2$

$(AF)^2 = (12.9)^2 + (2.75)^2$ - M1

AF = 13.2 m - A1

OR

$(AF)^2 = (DA)^2 + (DF)^2$

$(AF)^2 = (12)^2 + (5.5)^2$ - M1

AF = 13.2 m - A1

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(d) Calculate the length of BC, hence or otherwise find surface area of the prism. [3]

$BC = \sqrt{6^2 + 5.5^2 - 2(6)(5.5)\cos 30}$
$= 3.0153$ m - M1

Surface area $= 2[\left(\frac{1}{2}\right)(6)(5.5)\sin 30] + (12 \times 6) + (12 \times 3.0153) + (12 \times 5.5)$ - M1
$= 191$ m^2 (3 s.f) - A1

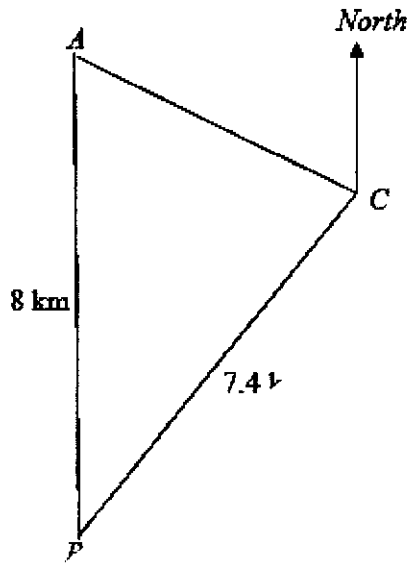
(e) Calculate the amount of water, in litres, that can be filled into this prism.
[1 l = 1000 cm^3] [2]

Volume $= \frac{1}{2}(6)(5.5)\sin 30° \times 12$
$= 99$m^3 - M1

1000000 cm^3= 1m^3
99 000000cm^3 = 99 000 l - A1

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7 In the diagram below, A, B and C are points on level ground where A is due north of B. $AB = 8$ m and $BC = 7.4$ m. The bearing of B from C is 223°.



(a) Find angle ABC. [1]

angle $ABC = 223^0 - 180^0$
$= 43^0$ - B1

(b) Calculate the distance of AC. [2]

$AC = \sqrt{8^2 + 7.4^2 - 2(8)(7.4)\cos 43°}$ - M1
$= 5.67$ m - A1

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(c) A 6 m high flag pole is placed at C.
Find the greatest angle of elevation of the top of the flag pole along the path AB. [3]

Let the shortest distance from C to BA be x

$\sin 43° = \frac{x}{7.4}$
$x = 5.04678$ - M1

Let the greatest angle of elevation be θ
$\tan\theta = \frac{6}{5.04678}$ - M1
$\theta = 49.9°$ - A1

(d) Given an object X is 5 m away from C and the bearing of X from B is 080^0.
Find the two possible values of angle BXC. [3]

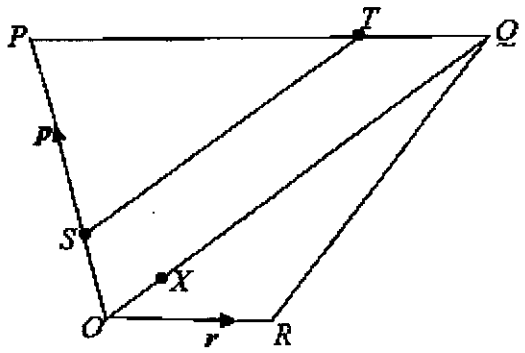
angle CBX $= 80^0 - 43^0$
$= 37^0$

$\frac{\sin BXC}{7.4} = \frac{\sin 37°}{5}$

$sinBXC = \frac{\sin 37° \times 7.4}{5}$
$BXC = 63.0° \; or \; 180° - 63.0°$
$= 63.0°$ or 117.0^0

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8 In the diagram, $OPQR$ is a trapezium. Given that $2OR = PQ$, $OX = \frac{1}{5}OQ$ and $OS = \frac{1}{2}P$. T is a point on PQ such that ST is parallel to OQ.



(a) Express in terms of **p** and **r** where $\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$,

(i) $\overrightarrow{RS}$ [1]

$\overrightarrow{RS} = \overrightarrow{RO} + \overrightarrow{OS}$
$= -\mathbf{r} + \frac{1}{2}\mathbf{p}$ -B1

(ii) $\overrightarrow{OQ}$ [1]

$\overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ}$
$= \mathbf{p} + 2\mathbf{r}$ -B1

(iii) $\overrightarrow{RX}$ [2]

$\overrightarrow{RX} = \overrightarrow{RO} + \overrightarrow{OX}$
$= -\mathbf{r} + \frac{1}{5}(\mathbf{p} + 2\mathbf{r})$ -M1
$= \frac{1}{5}\mathbf{p} - \frac{3}{5}\mathbf{r}$ -A1

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(b) Show that R, X and S lie on a straight line. [2]

$\overrightarrow{RX} = \frac{1}{5}\boldsymbol{p} - \frac{3}{5}\boldsymbol{r}$

$= \frac{3}{5}(-\boldsymbol{r} + \frac{1}{3}\boldsymbol{p})$ - M1

$= \frac{3}{5}\overrightarrow{RS}$ - A1

$\overrightarrow{RX}$ and $\overrightarrow{RS}$ are parallel vectors, since they have a common point R, R, X and S lie on a straight line.

(c) Find the value of

(i) $\frac{Area\ of\ \Delta ORQ}{Area\ of\ \Delta OPQ}$, [1]

$\frac{Area\ of\ \Delta ORQ}{Area\ of\ \Delta OPQ} = \frac{1}{2}$ -B1

(ii) $\frac{Area\ of\ \Delta PST}{Area\ of\ \Delta POQ}$ [1]

$\frac{Area\ of\ \Delta PST}{Area\ of\ \Delta POQ} = \left(\frac{2}{3}\right)^2$

$= \frac{4}{9}$ - B1

(iii) $\frac{Area\ of\ \Delta OXR}{Area\ of\ trapezium\ ORPQ}$ [2]

$\frac{Area\ of\ \Delta OXR}{Area\ of\ trapezium\ ORPQ} = \frac{1}{15}$ - B2

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9 An electrical company wants to launch a new air purifier. After calculating the material, production and marketing costs, if the new air purifier is to be priced at \$$x$ (in hundreds), the estimated profit \$y (in thousands) per month is given by the formula $\boldsymbol{y = 5(25x - 5x^2 - 10)}$.

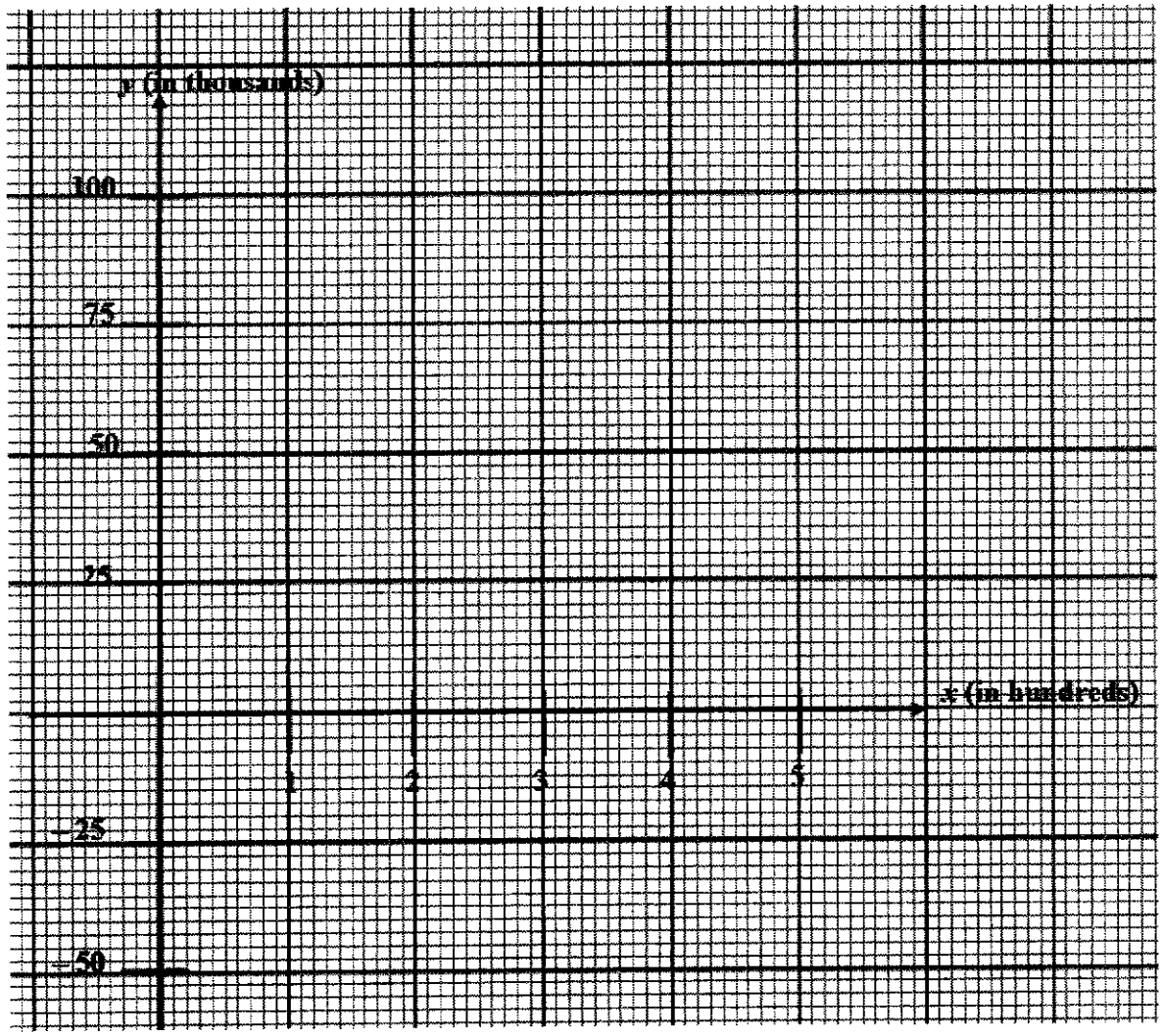
Some corresponding values of x and y, correct to two decimal places, are given in the table below.

x (in hundreds)	0	1	1.5	2	2.5	3	3.5	4
y (in thousands)	- 50	50	81.25	100	p	100	81.25	50

(a) Calculate the value of p. [1]

$p = 106.25$ - B1

(b) On the grid given, draw the graph of $\boldsymbol{y = 5(25x - 5x^2 - 10)}$ for $0 \leq x \leq 4$ where x is in hundreds. [3]



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(c) Use your graph, find

(i) the profit if the air purifier is to be priced at \$120. [1]

\$63750 B1 (Award marks based on graph)

(ii) the amount that the air purifier should be priced in order to earn the maximum profit. [1]

\$250

(d) Write down an inequality to describe the range of values of x in order to make a profit. [1]

$0.45 < x < 4.55$

(e) What could be a possible reason for the loss of profit if the air purifier is priced at a higher price. [1]

There may be less people buying due to the high cost.
Or
More money needs to be spent at marketing.
Or any other logical reason

(f) By drawing a tangent, find the gradient of the curve at $x = 4$. [2]

$\text{tangent} = \frac{100-10}{3.3-4.5}$

$= -75$ - A1 accept $(-65) - (-85)$

(g) By adding a suitable straight line on the same axis, find the solution of the $5(5x^2 - 25x + 25) = 0$ [2]

$25x^2 - 125x + 125 = 0$

$125x - 25x^2 - 125 = 0$

$125x - 25x^2 - 125 + 75 = 75$

$125x - 25x^2 - 50 = 75$ - M1

$x = 1.4\ , x = 3.6$ - A1

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10 In March, The Straits Times reported on the increase in electricity and gas tariffs for household in Singapore.



THE STRAITS TIMES

Electricity and gas tariffs for households in Singapore to increase for second quarter

PUBLISHED MAR 31, 2021, 7:08 PM SGT

SINGAPORE - The electricity tariff for just over half of households in Singapore will rise by 8.6 per cent for the second quarter of this year, compared with the previous quarter, said SP group on Wednesday (March 31).

This increase is mainly due to the higher cost of fuel for producing electricity by the power generation companies, it added.

For the period between April 1 and June 30, the electricity tariff will increase from 20.76 cents per kilowatt hour (kwh) to 22.55 cents per kwh, excluding the goods and services tax (GST).

Including GST, the rate for the second quarter is 24.13 cents per kwh.

The average monthly electricity bill for families living in four-room Housing Board flats will increase by $5.62 before GST, said SP Group.

The electricity tariff is calculated from four components, including energy costs that reflect the cost of imported natural gas.

Source : https://www.straitstimes.com/singapore

(a) Based on the newspaper report, what is the average monthly electricity usage in kwh for a four –room Housing Board flat? [2]

$\frac{562}{22.55-20.76}$ - M1

= 314 kwh - A1

(b) What is the monthly average electricity bill, including GST, after the price increase for a four-room Housing Board flat? [2]

$314 \times 22.55 \times 1.07$ - M1

= $75.76 - A1

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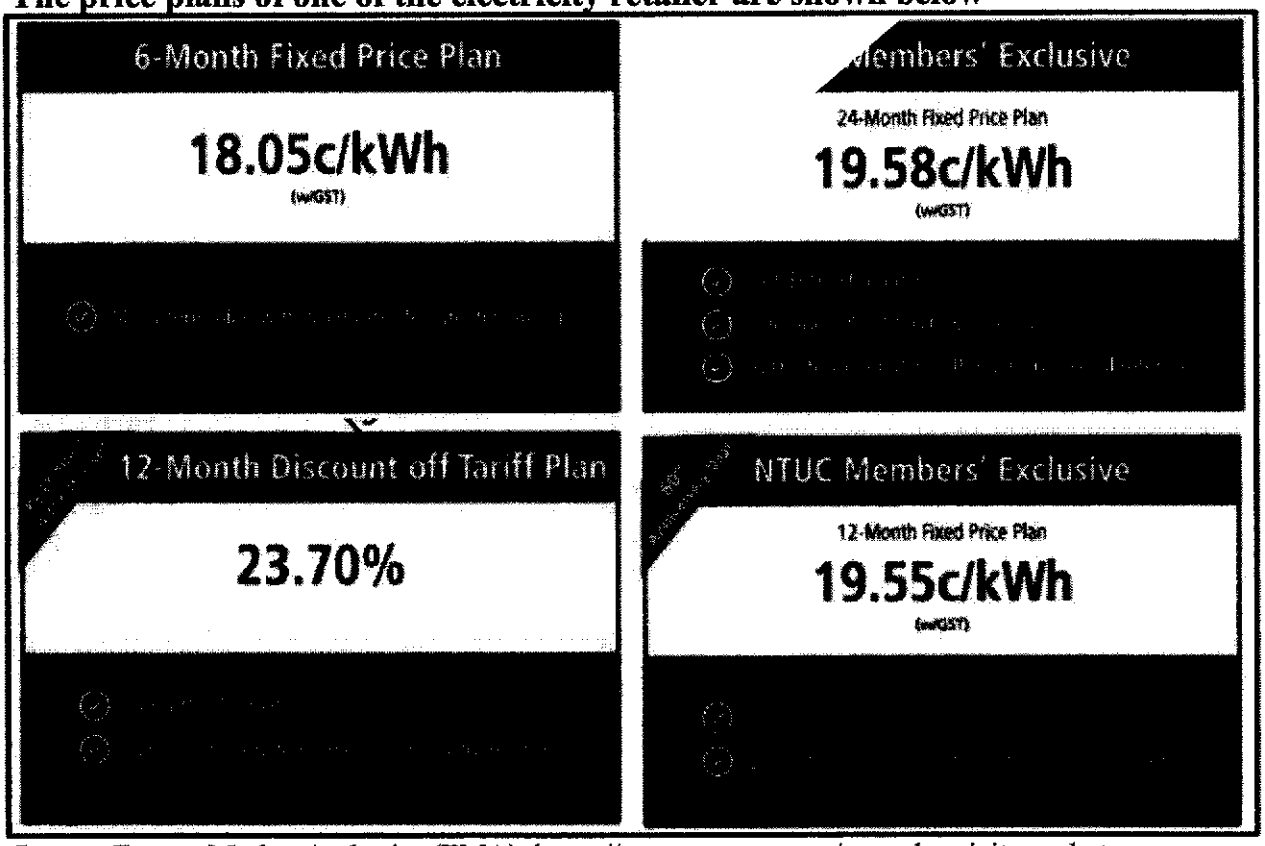
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Since 1 November 2018, consumers of electricity can choose to buy electricity from a retailer of their choice, or continue to buy from Singapore Power (SP) Group at the regulated tariff.

Consumer Advisory for Open Electricity Market

- **Switching to an electricity retailer is not compulsory.** There is no deadline for switching, so take your time to understand your options before making a decision.
- **Switching to a retailer will not affect your electricity supply.** SP Group will continue to operate the national power grid and deliver electricity to you.
- **There are two types of standard price plans:**
  - **Fixed Price Plans** are more suitable for consumers who prefer a constant electricity rate throughout the contract duration. The electricity rate may be higher or lower than the regulated tariff during the contract duration, as the regulated tariff is reviewed every quarter.
  - **Discount Off the Regulated Tariff Plans** provide a fixed discount off the regulated tariff, but the electricity rates will change when the regulated tariff changes. These plans are more suitable for consumers who do not mind changes in electricity rates every quarter so long as it is lower than the regulated tariff.

The price plans of one of the electricity retailer are shown below



Source: Energy Market Authority (EMA), https://www.ema.gov.sg/openelectricitymarket.aspx

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(c) Mr Lim stays in a four-room Housing Board flat.
Based on the average usage of electricity of a typical a four-room Housing Board flat, calculate the difference in the total amount Mr Lim will have to pay for electricity if he chooses between the **" 12-Month Discount Off Tariff Plan"** or **" NTUC Members' Exclusive Plan."** [Also consider all rebate in the calculation] [3]

$\frac{76.3}{100} \times 22.55 \times 314$
$= \$54.03$
$= \$57.80\ (w\ gst)$
Total for the year $= (57.80 \times 12) - 20 = \$673.69$ - M1

19.55×314
$= \$61.387$

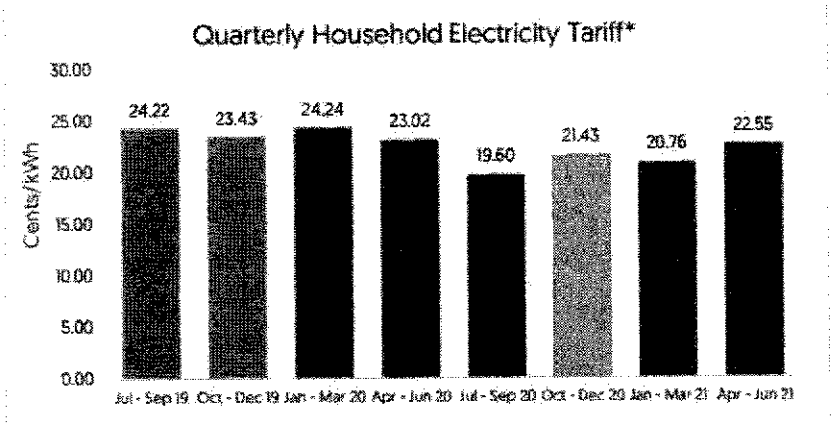
Total for the year $= (61.387 \times 12) - 30 = \$706.64$ - M1

$\$706.64 - \$673.60 = \$32.95$ - A1

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(d) Mr Lim wants to choose the most cost effective plan. He will not be referring any of his friends to get rebate. Given the additional information given below, suggest a suitable plan for Mr Lim. Justify any decisions you made and show your calculations clearly. [2]



Source https://www.ema.gov.sg/Residential_Electricity_Tariffs.aspx

Using the 4-room flat usage and the year's tariff rate for estimation

$(100\% - 23.7\%) \times x < 18.05$
$x < 23.66$ cents - M1

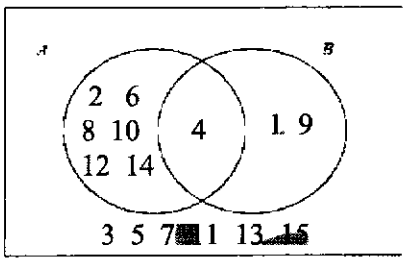
If the tariff is less than 23.66, it will be more cost effective for Mr Lim to choose the " 12-Month Discount Off Tariff Plan".

Based on the charts, there are two months where the tariff is more than 23.66 cents. Hence at this point of time, " 12-Month Discount Off Tariff Plan" is a better choice. – A1

~END OF PAPER~

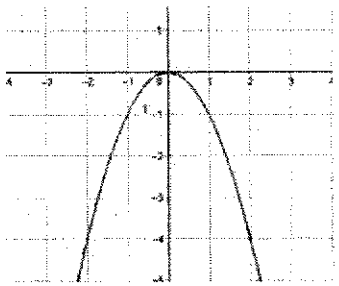
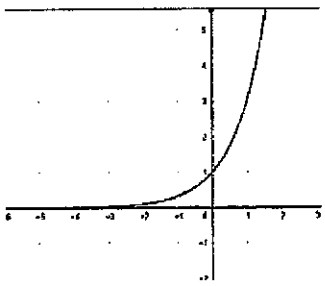
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Bendemeer Se 2021_Secondary 4E5N_Preliminary Exam Mathematics Paper 1_Marking Scheme

1		$\frac{89}{100} \times 5.7 \times 10^6$ $= 5.073 \times 10^6$	M1 A1
2	(a)	163 cm	B1
	(b)	164 – 152 = 12 cm	B1
3	(a)	$n = 15$	B1
	(b)	{1, 9}	B1
	(c)		B2
4	(a)	A (6, 0)	B1
	(b)	Minimum point (3, –9)	B1
	(c)	Let $P(x, x^2 - 6x)$ $x^2 - 6x = x^2 - 7x$ $\therefore x = 7$ or $x = 0$ (rej) Hence, P(7, 7)	M1 A1
5	(a)	$\sqrt{\left(\frac{4}{x^4}\right)} = \frac{2}{x^2}$	B1
	(b)	$2^{2(3x+1)} = 2^{3x}$ $6x + 2 = 3x$ $\therefore x = -\frac{2}{3}$	M1 A1

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6	(a)	(i) $y = -x^2$  (ii) $y = 3^x$ 	B1, B1
	(b)	Since $x^2 \geq 0$ and $3^x > 0$ for all values of x, so $x^2 + 3^x > 0$ for all values of x, $\therefore 3^x + x^2 = 0$ has no solution. OR $3^x + x^2 = 0 \rightarrow 3^x = -x^2$. *Since there is no intersection point between* $y = -x^2$ *and* $y = 3^x$, *there is no solution for* $3^x + x^2 = 0$.	A1
7	(a)		B1
	(bi)	$\frac{1}{6}$	B1
	(bii)	$\frac{1}{2}$	B1
8	(a)	$\frac{1}{2-x} - \frac{6}{x^2-4} = 3$ $\frac{1}{2-x} - \frac{6}{(x-2)(x+2)} = 3$ $-(x+2) - 6 = 3(x^2-4)$ $0 = 3x^2 + x - 4$ $0 = (3x+4)(x-1)$	M1 M1 A½, A½

1st Card					
		1	2	3	5
2nd Card	1	X	(2, 1)	(3, 1)	(5, 1)
	2	(1, 2)	X	(3, 2)	(5, 2)
	3	(1, 3)	(2, 3)	X	(5, 3)
	5	(1, 5)	(2, 5)	(3, 5)	X

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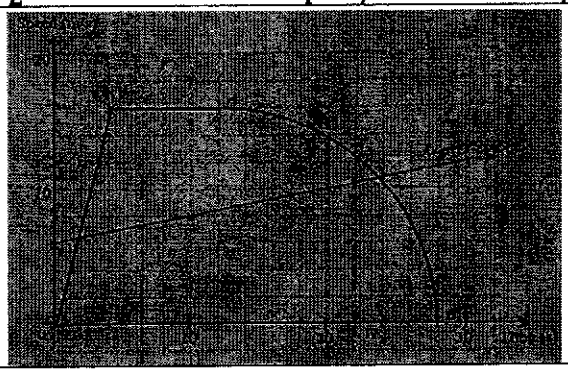
		$\therefore x = -\frac{4}{3}$ *or* $x = 1$	
	(b)	$kx^2 - 2(5x)(12) + (12)^2$ $kx^2 = (5x)^2$ $\therefore k = 25$	B1
9	(a)	$x^2 - 13x - 7$ $= \left(x - \frac{13}{2}\right)^2 - \left(\frac{13}{2}\right)^2 - 7$ $= \left(x - 6\frac{1}{2}\right)^2 - 49\frac{1}{4}$	M1 A1
	(b)	$\left(x - 6\frac{1}{2}\right)^2 - 49\frac{1}{4} = 0$ $x - 6\frac{1}{2} = \pm\sqrt{49\frac{1}{4}}$ $\therefore x = 13.52$ *or* $x = -0.52$	M1 A½, A½
10	(a)	36	B1
	(b)	164	B1
	(c)	$8n+4$	B1
	(d)	124	B1
11		EF = $\sqrt{10^2 + 10^2} = \sqrt{200}cm$ Area of EFGH = $\sqrt{200} \times \sqrt{200} = 200\ cm^2$ Area of Circle = $\pi\left(\frac{\sqrt{200}}{2}\right)^2 = 50\pi\ cm^2$ $\therefore$ *Shaded Area* $= 200 - 50\pi\ cm^2$	M1 M1 A1
12	(a)	$n = 2^5 \times 3^4 = 2592$	B1
	(b)	$k = 2^3 \times 3^2 \times 7 = 504$	B1
13	(a)	$3(4x^2 + 4x + 1) - 12x + 4$	M1

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		$= 12x^2 + 12x + 3 - 12x + 4$ $= 12x^2 + 7$	A1
	(b)	$2a^2(4a^2 - 1)$ $= 2a^2(2a + 1)(2a - 1)$	M1 A1
14		$10 + ax \geq x$ $ax - x \geq -10$ $x \geq \frac{-10}{(a-1)}$ $\frac{-10}{(a-1)} = -2$ $5 = a - 1$ $\therefore a = 6$ $9 + x > bx$ $9 > bx - x$ $\frac{9}{(b-1)} > x$ $\frac{9}{(b-1)} = 3$ $3 = b - 1$ $\therefore b = 4$	M1, M1 A1, A1
15		Bank SA: $I_{SA} = \frac{P \times 4 \times 7}{100} = 0.28P$ Bank UK: $A = P\left(1 + \frac{4}{100}\right)^7 = 1.31593P$ $I_{UK} = 0.31593P$ Given $0.31593P - 0.28P = 449$ $0.03593P = 449$ $\therefore P = 12495.9 = 12500$ *(nearest hundred)*	M1 M1 M1 A1
16	(a)	$\angle DAE = \angle CBE$ *(∠s in the same segment)* $\angle AED = \angle BEC$ *(Vertically opposite angles)* $AD = BC$ *(given)* $\therefore \Delta ADE \equiv \Delta BCE$ *(AAS Test)*	B1 B1
	(b)	$AE^2 + ED^2 = 15^2 + 8^2 = 289$ $AD^2 = 17^2 = 289$ $\therefore AE^2 + ED^2 = AD^2$ and by the converse of Pythagoras' theorem, $\angle AED = 90^o$, *so AC and BD are perpendicular to each other.*	M1 A1
17	(a)	$PC = \sqrt{13^2 - 5^2} = 12\ cm$ $\therefore AB = 20 - 12 = 8\ cm$	M1 A1
	(bi)	$\sin \angle ABC = \frac{5}{13}$	B1
	(bii)	$\cos \angle ABC = -\frac{12}{13}$	B1

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18	(a)	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \begin{pmatrix}2\\4\end{pmatrix} - \begin{pmatrix}-6\\-5\end{pmatrix} = \begin{pmatrix}8\\9\end{pmatrix}$	B1
	(b)	$\lvert\overrightarrow{AB}\rvert = \sqrt{8^2 + 9^2} = 12.0$	B1
	(c)	Area of $\Delta ABC = \frac{1}{2} \times 7 \times 8 = 28$	B1
	(d)	Length AB $= \sqrt{(2+6)^2 + (4+5)^2} = 12.04$ Shortest distance from C to $AB = \frac{28}{0.5 \times 12.04} = 4.65$	B1
	(e)	$\overrightarrow{CD} = 2\overrightarrow{AB}$ $\overrightarrow{OD} - \overrightarrow{OC} = 2\begin{pmatrix}8\\9\end{pmatrix}$ $\therefore \overrightarrow{OD} = \begin{pmatrix}2\\-3\end{pmatrix} + 2\begin{pmatrix}8\\9\end{pmatrix} = \begin{pmatrix}18\\15\end{pmatrix}$	M1 A1
	(f)	Gradient of OE $= \frac{5}{6}$ $\therefore y = \frac{5}{6}x$	B1
	(g)	$2x - 3\left(\frac{5}{6}x\right) = 5$ $\therefore x = -10, y = -8\frac{1}{3}$ So $P\left(-10, -8\frac{1}{3}\right)$	M1 A½, A½
19	(a)	$\frac{16}{4} = 4m/s^2$	B1
	(b)	$\frac{1}{2} \times 4 \times 16 + 8 \times 16 + \frac{1}{4} \times \frac{22}{7} \times 16^2 = 361\frac{1}{7}\ m$	M1, A1
	(c)		B1
20	(a)	$\boldsymbol{D} = 4\begin{pmatrix}32 & 60 & 50\\40 & 100 & 125\\24 & 80 & 75\end{pmatrix} = \begin{pmatrix}128 & 240 & 200\\160 & 400 & 500\\96 & 320 & 300\end{pmatrix}$	B1
	(b)	$\boldsymbol{P} = \begin{pmatrix}7.50\\5.00\\6.00\end{pmatrix}$	B1

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	(c)	$\boldsymbol{E} = \begin{pmatrix} 128 & 240 & 200 \\ 160 & 400 & 500 \\ 96 & 320 & 300 \end{pmatrix} \begin{pmatrix} 7.50 \\ 5 \\ 6 \end{pmatrix}$ $= \begin{pmatrix} 3360 \\ 6200 \\ 4120 \end{pmatrix}$	M1 A1
	(d)	It represents the total selling price / revenue of cakes and drinks on Friday, Saturday and Sunday for 4 weekends respectively.	B1
21	(a)	[redacted]	B1 B1
	(b)		B1 B1

End of Paper

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Bendemeer 2021 Prelim 4E5N EM Paper 2 Marking Scheme

1 (a) Given that $= \frac{3x-2z}{5-x}$,

(i) Evaluate y when $x = -6$ and $z = 4$. [1]

$$y = \frac{3(-6)-2(4)}{5-(-6)}$$
$$= -\frac{26}{11}$$
$$= -2\frac{4}{11} \text{- B1}$$

(ii) Express x in terms of y and z. [2]

$$5y - xy = 3x - 2z$$
$5y + 2z = x(3 + y)$ - M1

$x = \frac{5y+2z}{3+y}$ - A1

(b) Simplify $\left(\frac{28a^{-8}}{16b^{10}}\right)^{-\frac{1}{2}}$ expressing your answer in positive index. [2]

$\left(\frac{16a^8b^{10}}{25}\right)^{\frac{1}{2}}$ - M1

$= \frac{4a^4b^5}{5}$ - A1

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(c) $\frac{3x-1}{3} < \frac{6+x}{2}$ [2]

$6x - 2 < 18 + 3x$ - M1

$3x < 20$

$x < 6\frac{2}{3}$ - A1

(d) Simplify $\frac{1-4x^2}{8x^2-10x+3}$. [3]

$\frac{(1+2x)(1-2x)}{(4x-3)(2x-1)}$ - M2 for factorizing the numerator & denominator

$= -\frac{(1+2x)}{(4x-3)}$ - A1

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2 Mr Lim used to drive to Johor Bahru, Malaysia, over the weekend for staycation and he would fill up the petrol tank of his car before coming back. In Malaysia, he would pay Malaysia Ringgit, MYR$125 for x litres of petrol. Due to the current COVID-19 situation, Mr Lim no longer travels to Malaysia. He found that he will be getting 28 litres of petrol less for Singapore dollars S$40 which is equivalent to MYR$125 in Singapore.

(a) Calculate the currency exchange rate from Singapore dollars to Malaysia Ringgit. [1]

S$40 = MYR $125
S$1 = MYR $3.125 - B1

(b) Write down an expression, in terms of x, the cost of 1 litre of petrol in Singapore. [1]

$\frac{40}{x-28}$ - B1

(c) Given that the petrol cost more in Singapore by S$1.20 per litre than the petrol in Malaysia, form an expression in terms of x and show that it simplifies to $3x^2 - 84x - 2800 = 0$. [3]

$\frac{40}{x-28} - \frac{40}{x} = 1.20$

$40x - 40x + 1120 = 1.2x^2 - 33.6x$ - M1

$1.2x^2 - 33.6x - 1120 = 0$ - M1

$3x^2 - 84x - 2800 = 0$ - A1

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(d) Solve the equation $3x^2 - 84x - 2800 = 0$. [3]

$x = \frac{-(-84) \pm \sqrt{(-84)^2 - 4(3)(-2800)}}{2(3)}$ - M1

$x = \frac{-(-84) \pm \sqrt{40656}}{6}$ - M1

$= 47.6$ or -19.6 - A1

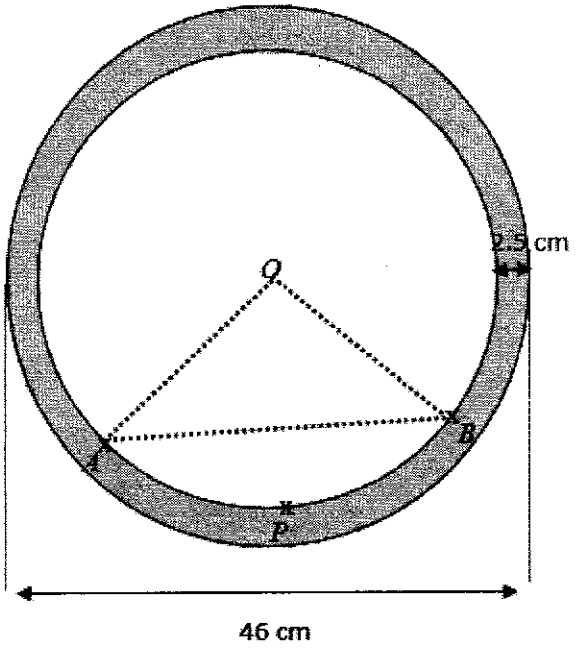
(e) Find the price of petrol per litre in Singapore. [1]

$\frac{40}{47.6 - 28}$

= \$2.04 / litre - B1

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3 (a) A dartboard below consists of two concentric circles with centre O. The difference between the radii of the two circles is 2.5 cm. The diameter of the dartboard is 46 cm.



(i) Given that A , P and B are three points on the smaller circle and the arc length of $APB = 11\frac{7}{18}\pi$ cm. Find angle AOB in terms of π. [2]

$11\frac{7}{18}\pi = (20.5)(\theta)$ - M1

$\theta = \frac{5}{9}\pi$ - A1

(ii) A dart is thrown, find the probability that it will land in the segment APB. Correct your answer to 2 decimal places. [3]

Area of segment $= \frac{1}{2}(20.5^2)\left[\frac{5}{9}\pi - \sin\left(\frac{5}{9}\pi\right)\right]$

$= 159.80$ - M1

Area of circle $= \pi(23^2)$

$= 1661.90$ - M1

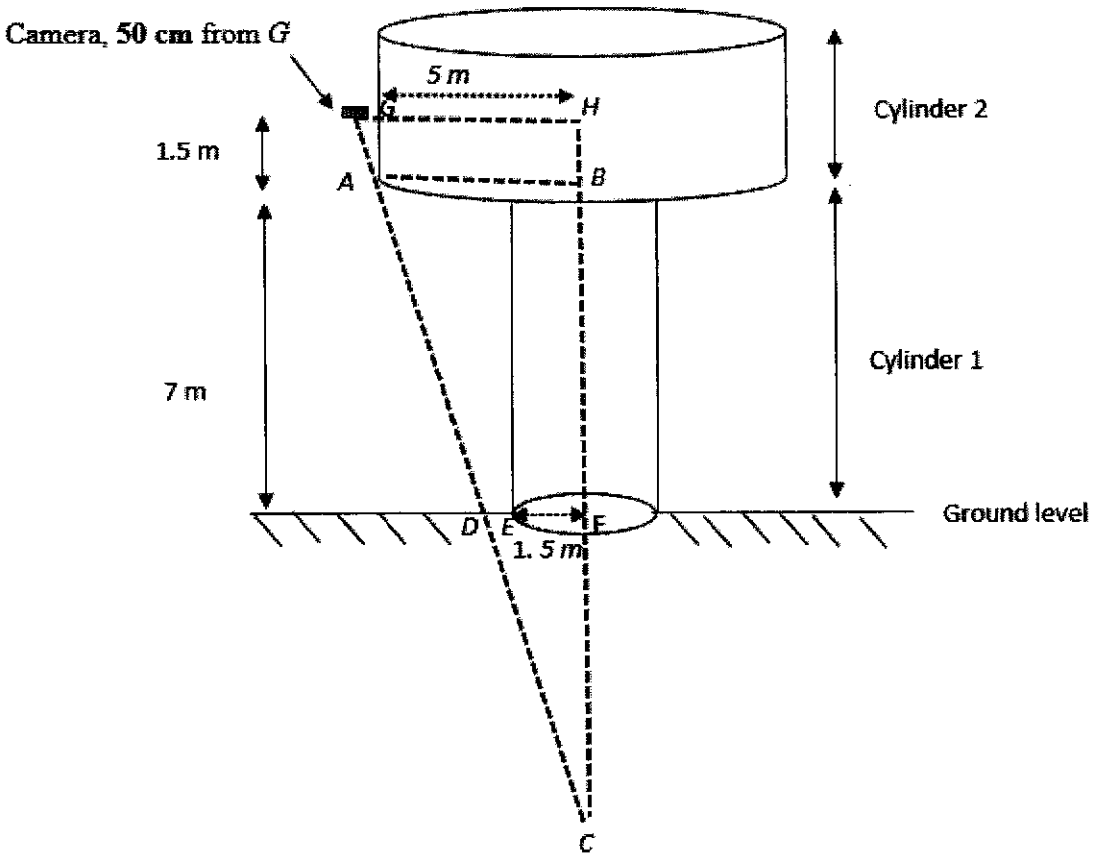
Probability $= \frac{159.80}{1661.90}$

$= 0.10$ - A1

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(b) The diagram below shows a watch tower. It is made up of 2 parts, cylinder 1 and cylinder 2 with radius $EF = 1.5$ m and $GH = 5$ m respectively. Cylinder 1 has a height of $BF = 7$ m from the ground level. A camera is fixed at 1.5 m above from the base of cylinder 2 and 50 cm horizontally away from G.



(i) Show that FC is 8 m. [2]

$\frac{5.5}{5} = \frac{8.5+FC}{7+FC}$ - M1

$38.5 + 5.5FC = 42.5 + 5FC$

$FC = \frac{4}{0.5}$

$FC = 8$ m - A1

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(ii) If an intruder is hiding between *DE*, he cannot be captured by the camera and *DE* is referred as the blind spot. How high should the tower be raised so that there will not be any blind spot? [3]

Let x be the height that the tower should be raised

$\frac{5}{1.5} = \frac{15}{8-x}$ - M1

$40 - 5x = 22.5$ - M1

$x = \frac{17.5}{5}$

$x = 3.5\ m$ - A1

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4 (a) During the Home Base Learning (HBL) period, the times taken by a group 30 students in Class A to complete an assignment were recorded and represented in the Stem-and-Leaf diagram below.

2	3	5	5	7	7	8	8	9	
3	2	2	3	4	5	6	6	7	9
4	0	1	1	2	4	6	6	7	
5	2	2	4	5					
6									
7	2								

Key : 2 | 3 means 23 minutes

(i) 40% of the students took more than x minutes to complete their assignment. Find x. [1]

(ii) $\frac{40}{100} \times 30 = 12$

$x = 40\ min$ - B1

(iii) Find the median time. [1]

Median = 36.5 min - B1

(iv) Is the median or the mean a better measure of central tendency in this distribution? Explain. [2]

The median will be a better measure. – B1
There are outliers in the data. Or There is an extreme value. – B1

(v) Find the standard deviation of the times taken. [2]

Standard deviation $= \sqrt{\frac{46707}{30} - \left(\frac{1141}{30}\right)^2}$
$= 10.5$

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(vi) The standard deviation of the times taken by students in Class B was 9.02. Compare and comment on one difference between the two distributions. [1]

The standard deviation in class B is lower, hence the times taken by students in class are more consistent. – B1

(b) The table summarises the age of 235 employees in a company who went for vaccination.

Age (years)	$20 \leq x < 30$	$30 \leq x < 40$	$40 \leq x < 50$	$50 \leq x < 60$
Male	37	46	20	15
Female	30	35	32	20

(i) If one employee is selected at random, find, as a fraction in its lowest term, the probability that this person is less than 30 years of age or at least 50 years of age. [2]

$\frac{67}{235} + \frac{35}{235}$ - M1

$= \frac{102}{235}$ - A1

(ii) When two employees are selected at random, Randy claimed that the chances of selecting one male and one female under the age of 30 is at least 0.04. Justify if he is correct. [2]

$2[\frac{37}{235} \times \frac{30}{234}]$

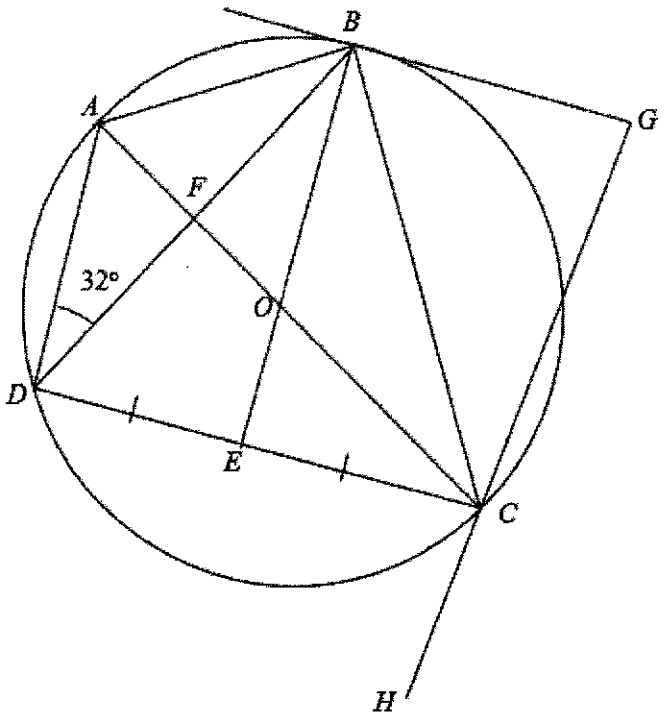
$= 0.0404$ - M1

He is correct - A1

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5 In the diagram shown below, $ABCD$ are points on the circle with centre O and diameter AC. BE passes through O and the ratio of $DE : CE$ is 1:1. F is the intersection of BD and AC. BG is a tangent to the circle and HCG is a straight line. Angle $ADB = 32°$.



(a) Find, stating your reasons,

(i) angle BCA. [1]

angle $BCA = 32^0$ (angles in the same segment) - B1

(ii) angle BAC [2]

angle $ABC = 90^0$ (angle in a semi-circle is 90^0) - M1

angle $BAC = 180^0 - 90^0 - 32^0$ -A1
$= 58^0$

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(iii) angle BOC [2]

angle BDC = angle BAC (angles in the same segment)
$= 58^0$ - M1

angle BOC = 2 angle BDC (angles at the centre is 2 times the angle at circumference)
$= 2 \times 58°$
$= 116°$ - A1

(iv) angle BFO [2]

angle $CBD = 180^0 - 2(58^0)$ (perpendicular from ctr bisects, chord, ΔDBC is an isosceles Δ)
$= 64^0$

angle $FBO = 64° \div 2$
$= 32^0$ - M1

angle BFO + angle $FBO = 116^0$ (sum of interior angle = ext. angle)
angle $BFO + 32^0 = 116^0$

angle $BFO = 84^0$ - A1

(b) Given that angle $HCE = \alpha$, Show that angle $BGH = \alpha$. [3]

angle $EBG = 90^0$ (tangent perpendicular to radius) – M1

angle $GBC = 90^0 - 32^0$
$= 58^0$

angle BCD = angle $BDC = 58^0$

angle $BGH + 58^0$ = angle BCD + angle HCE - M1
angle $BGH + 58^0 = 58^0 + \alpha$
angle $BGH = \alpha$ - A1

Or
angle EBG = 90^0(tangent perpendicular to radius) M1

angle BEC = 90^0(perpendicular from the centre of circle bisects chord) M1

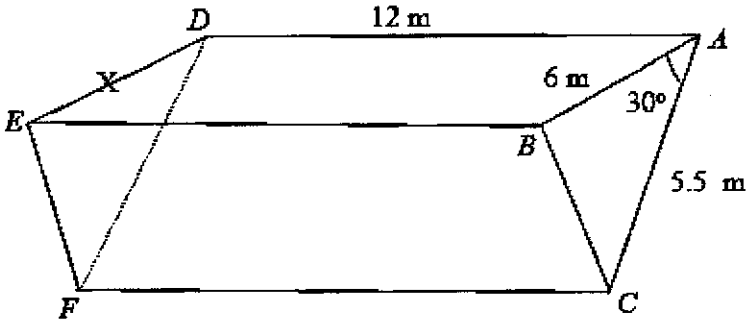
given HCG is a straight line, angle HCE and angle BGH are corresponding angles.

Hence if angle $HCE = \alpha$, $BGH = \alpha$.

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6 The diagram shows an empty triangular prism with three rectangular faces and two congruent triangular faces. $AB = 6$ m, $AC = 5.5$ m and $AD = 12$ m. Angle $CAB = 30°$. FX is the shortest distance from F to DE.



(a) Show that FX is 2.75m. [1]

$\sin 30° = \frac{FX}{5.5}$ - B1

FX = 2.75 m

(b) Calculate the length of AX. [2]

$\cos 30° = \frac{DX}{5.5}$

DX = 4.76 - M1

$(AX)^2 = 12^2 + 4.76^2$

AX = 12.9 m - A1

(c) Calculate the length from A to F. [2]

$(AF)^2 = (AX)^2 + (FX)^2$

$(AF)^2 = (12.9)^2 + (2.75)^2$ - M1

AF = 13.2 m - A1

OR

$(AF)^2 = (DA)^2 + (DF)^2$

$(AF)^2 = (12)^2 + (5.5)^2$ - M1

AF = 13.2 m - A1

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(d) Calculate the length of BC, hence or otherwise find surface area of the prism. [3]

$BC = \sqrt{6^2 + 5.5^2 - 2(6)(5.5)\cos 30}$
$= 3.0153$ m - M1

Surface area $= 2[\left(\frac{1}{2}\right)(6)(5.5)\sin 30] + (12 \times 6) + (12 \times 3.0153) + (12 \times 5.5)$ - M1
$= 191$ m^2 (3 s.f) - A1

(e) Calculate the amount of water, in litres, that can be filled into this prism.
[1 l = 1000 cm^3] [2]

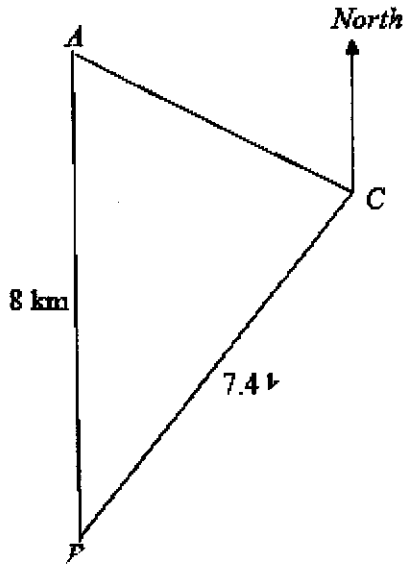
Volume $= \frac{1}{2}(6)(5.5)\sin 30° \times 12$
$=$ 99m^3 - M1

1000000 cm^3= 1m^3
99 000000cm^3 = 99 000 l - A1

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7 In the diagram below, A, B and C are points on level ground where A is due north of B. $AB = 8$ m and $BC = 7.4$ m. The bearing of B from C is 223°.



(a) Find angle ABC. [1]

angle $ABC = 223^0 - 180^0$
$= 43^0$ - B1

(b) Calculate the distance of AC. [2]

$AC = \sqrt{8^2 + 7.4^2 - 2(8)(7.4)\cos 43°}$ - M1
$= 5.67$ m - A1

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(c) A 6 m high flag pole is placed at C.
Find the greatest angle of elevation of the top of the flag pole along the path AB. [3]

Let the shortest distance from C to BA be x

$\sin 43° = \frac{x}{7.4}$
$x = 5.04678$ - M1

Let the greatest angle of elevation be θ
$\tan\theta = \frac{6}{5.04678}$ - M1
$\theta = 49.9°$ - A1

(d) Given an object X is 5 m away from C and the bearing of X from B is 080^0.
Find the two possible values of angle BXC. [3]

angle CBX $= 80^0 - 43^0$
$= 37^0$

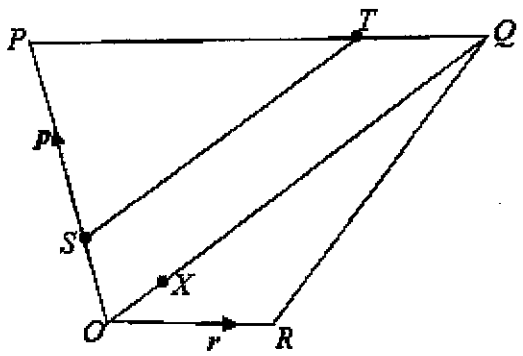
$\frac{\sin BXC}{7.4} = \frac{\sin 37°}{5}$

$sinBXC = \frac{\sin 37° \times 7.4}{5}$
$BXC = 63.0° \; or \; 180° - 63.0°$
$= 63.0°$ or 117.0^0

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8 In the diagram, $OPQR$ is a trapezium. Given that $2OR = PQ$, $OX = \frac{1}{5}OQ$ and $OS = \frac{1}{2}P$. T is a point on PQ such that ST is parallel to OQ.



(a) Express in terms of p and r where $\overrightarrow{OP} = \boldsymbol{p}$ and $\overrightarrow{OR} = \boldsymbol{r}$,

(i) $\overrightarrow{RS}$ [1]

$\overrightarrow{RS} = \overrightarrow{RO} + \overrightarrow{OS}$
$= -\boldsymbol{r} + \frac{1}{2}\boldsymbol{p}$ -B1

(ii) $\overrightarrow{OQ}$ [1]

$\overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ}$
$= \boldsymbol{p} + 2\boldsymbol{r}$ -B1

(iii) $\overrightarrow{RX}$ [2]

$\overrightarrow{RX} = \overrightarrow{RO} + \overrightarrow{OX}$
$= -\boldsymbol{r} + \frac{1}{5}(\boldsymbol{p} + 2\boldsymbol{r})$ -M1
$= \frac{1}{5}\boldsymbol{p} - \frac{3}{5}\boldsymbol{r}$ -A1

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(b) Show that R, X and S lie on a straight line. [2]

$\overrightarrow{RX} = \frac{1}{5}\underset{\sim}{p} - \frac{3}{5}\underset{\sim}{r}$

$= \frac{3}{5}(-\underset{\sim}{r} + \frac{1}{3}\underset{\sim}{p})$ - M1

$= \frac{3}{5}\overrightarrow{RS}$ - A1

$\overrightarrow{RX}$ and $\overrightarrow{RS}$ are parallel vectors, since they have a common point R, R, X and S lie on a straight line.

(c) Find the value of

(i) $\frac{Area\ of\ \Delta\ ORQ}{Area\ of\ \Delta OPQ}$, [1]

$\frac{Area\ of\ \Delta\ ORQ}{Area\ of\ \Delta OPQ} = \frac{1}{2}$ -B1

(ii) $\frac{Area\ of\ \Delta\ PST}{Area\ of\ \Delta\ POQ}$ [1]

$\frac{Area\ of\ \Delta\ PST}{Area\ of\ \Delta\ POQ} = \left(\frac{2}{3}\right)^2$

$= \frac{4}{9}$ - B1

(iii) $\frac{Area\ of\ \Delta\ OXR}{Area\ of\ trapezium\ ORPQ}$ [2]

$\frac{Area\ of\ \Delta\ OXR}{Area\ of\ trapezium\ ORPQ} = \frac{1}{15}$ - B2

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9 An electrical company wants to launch a new air purifier. After calculating the material, production and marketing costs, if the new air purifier is to be priced at \$$x$ (in hundreds), the estimated profit \$y (in thousands) per month is given by the formula $\boldsymbol{y = 5(25x - 5x^2 - 10)}$.

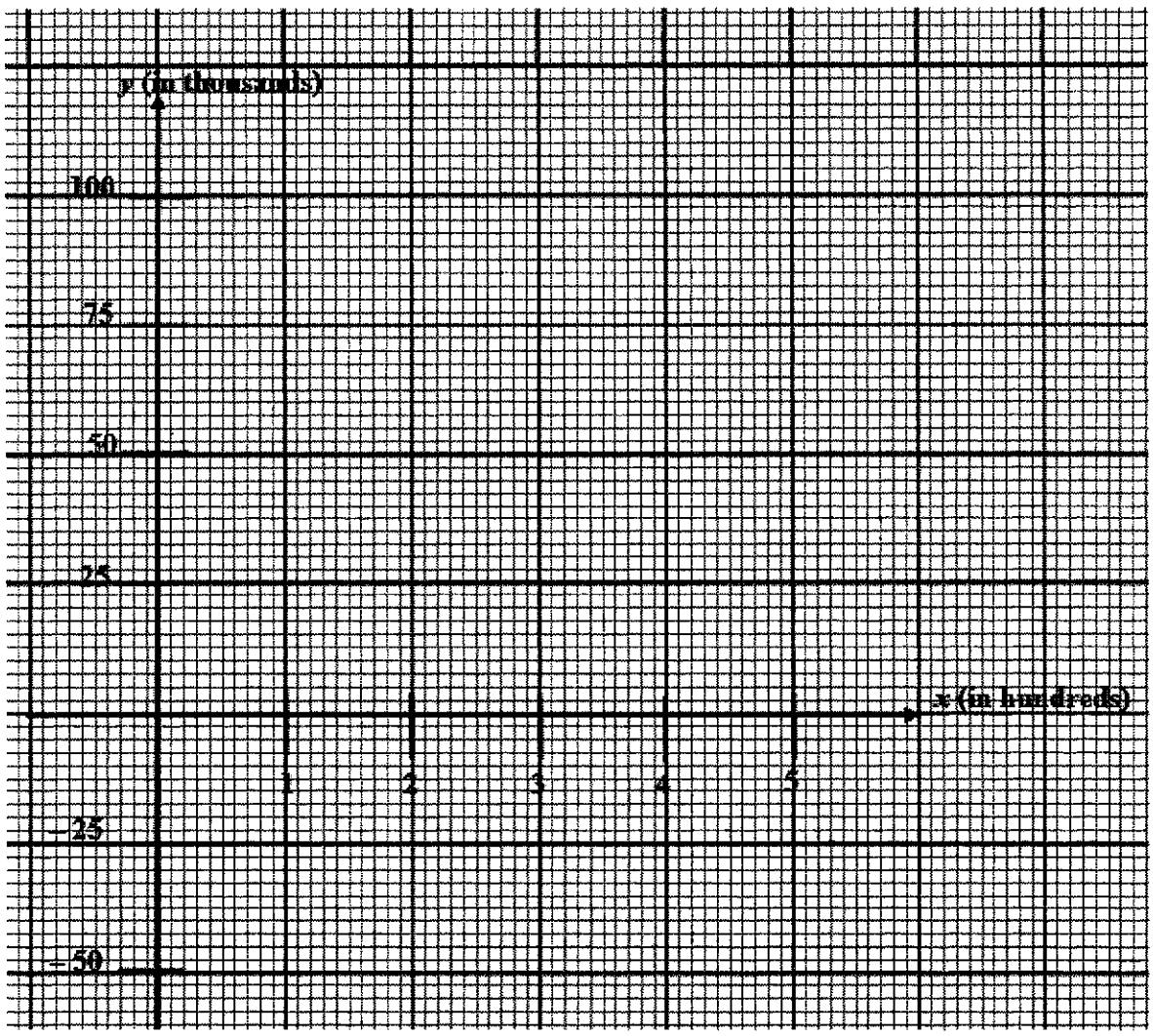
Some corresponding values of x and y, correct to two decimal places, are given in the table below.

x (in hundreds)	0	1	1.5	2	2.5	3	3.5	4
y (in thousands)	- 50	50	81.25	100	p	100	81.25	50

(a) Calculate the value of p. [1]

$p = 106.25$ - B1

(b) On the grid given, draw the graph of $\boldsymbol{y = 5(25x - 5x^2 - 10)}$ for $0 \leq x \leq 4$ where x is in hundreds. [3]



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(c) Use your graph, find

(i) the profit if the air purifier is to be priced at \$120. [1]

\$63750 B1 (Award marks based on graph)

(ii) the amount that the air purifier should be priced in order to earn the maximum profit. [1]

\$250

(d) Write down an inequality to describe the range of values of x in order to make a profit. [1]

$0.45 < x < 4.55$

(e) What could be a possible reason for the loss of profit if the air purifier is priced at a higher price. [1]

There may be less people buying due to the high cost.
Or
More money needs to be spent at marketing.
Or any other logical reason

(f) By drawing a tangent, find the gradient of the curve at $x = 4$. [2]

$\text{tangent} = \frac{100-10}{3.3-4.5}$
$= -75$ - A1 accept $(-65) - (-85)$

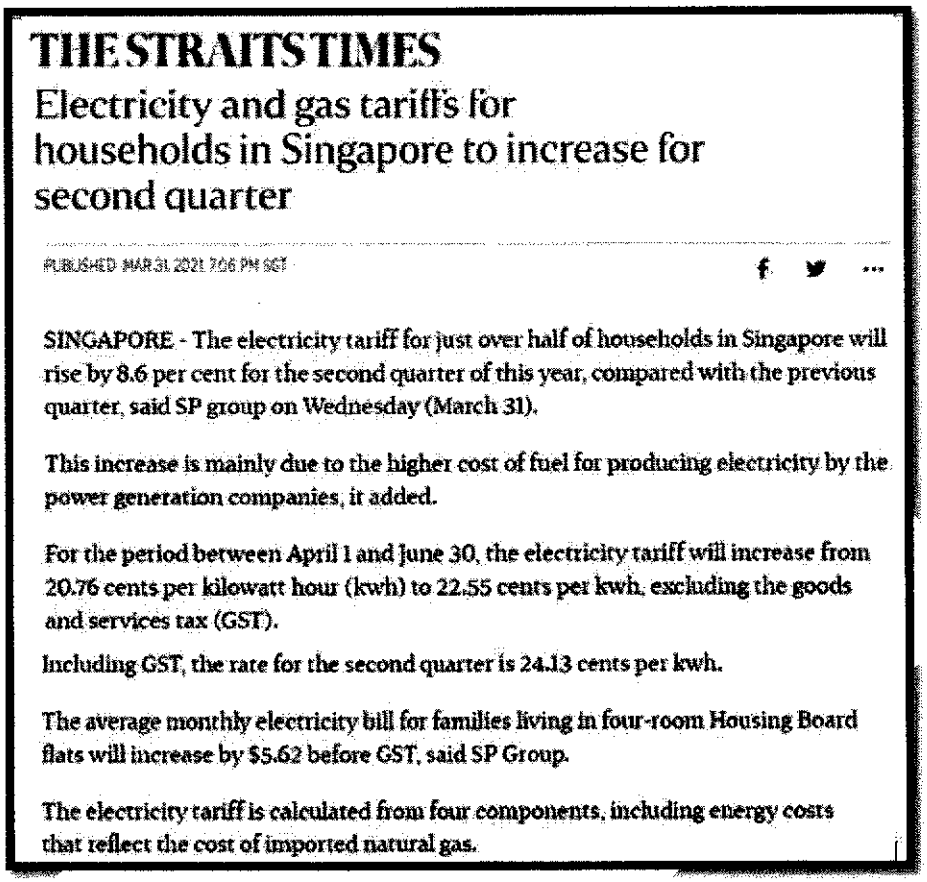
(g) By adding a suitable straight line on the same axis, find the solution of the $5(5x^2 - 25x + 25) = 0$ [2]

$25x^2 - 125x + 125 = 0$
$125x - 25x^2 - 125 = 0$
$125x - 25x^2 - 125 + 75 = 75$
$125x - 25x^2 - 50 = 75$ - M1
$x = 1.4\ , x = 3.6$ - A1

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10 In March, The Straits Times reported on the increase in electricity and gas tariffs for household in Singapore.



THE STRAITS TIMES

Electricity and gas tariffs for households in Singapore to increase for second quarter

PUBLISHED MAR 31, 2021, 7:06 PM SGT

SINGAPORE - The electricity tariff for just over half of households in Singapore will rise by 8.6 per cent for the second quarter of this year, compared with the previous quarter, said SP group on Wednesday (March 31).

This increase is mainly due to the higher cost of fuel for producing electricity by the power generation companies, it added.

For the period between April 1 and June 30, the electricity tariff will increase from 20.76 cents per kilowatt hour (kwh) to 22.55 cents per kwh, excluding the goods and services tax (GST).

Including GST, the rate for the second quarter is 24.13 cents per kwh.

The average monthly electricity bill for families living in four-room Housing Board flats will increase by $5.62 before GST, said SP Group.

The electricity tariff is calculated from four components, including energy costs that reflect the cost of imported natural gas.

Source : https://www.straitstimes.com/singapore

(a) Based on the newspaper report, what is the average monthly electricity usage in kwh for a four –room Housing Board flat? [2]

$\frac{562}{22.55-20.76}$ - M1

$= 314$ kwh - A1

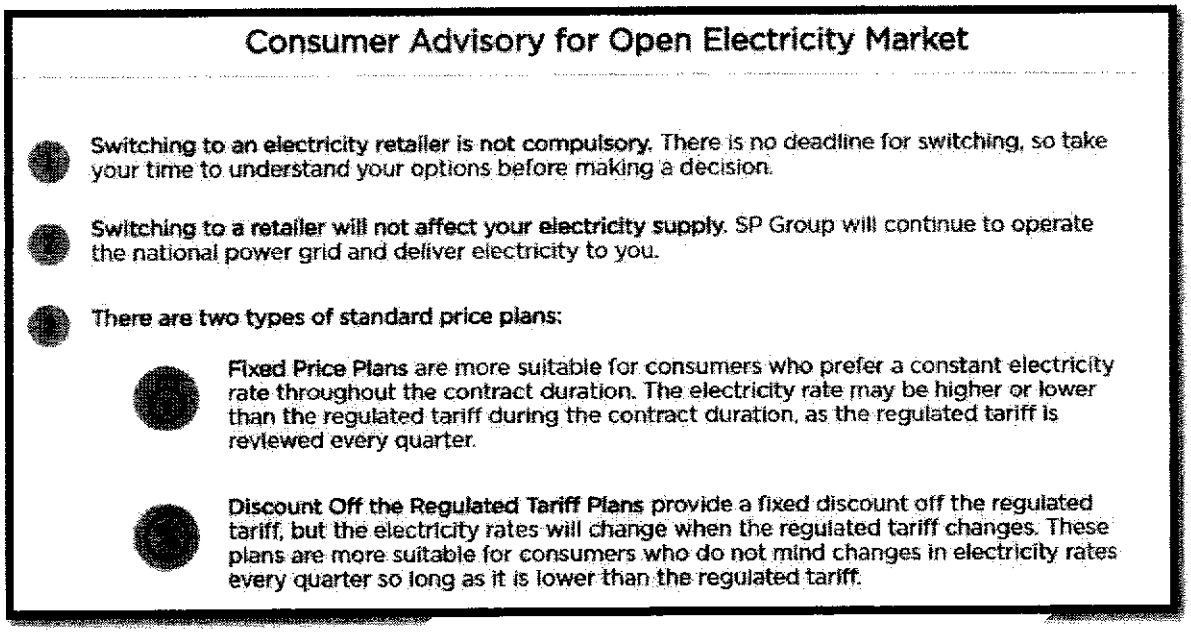
(b) What is the monthly average electricity bill, including GST, after the price increase for a four-room Housing Board flat? [2]

$314 \times 22.55 \times 1.07$ - M1

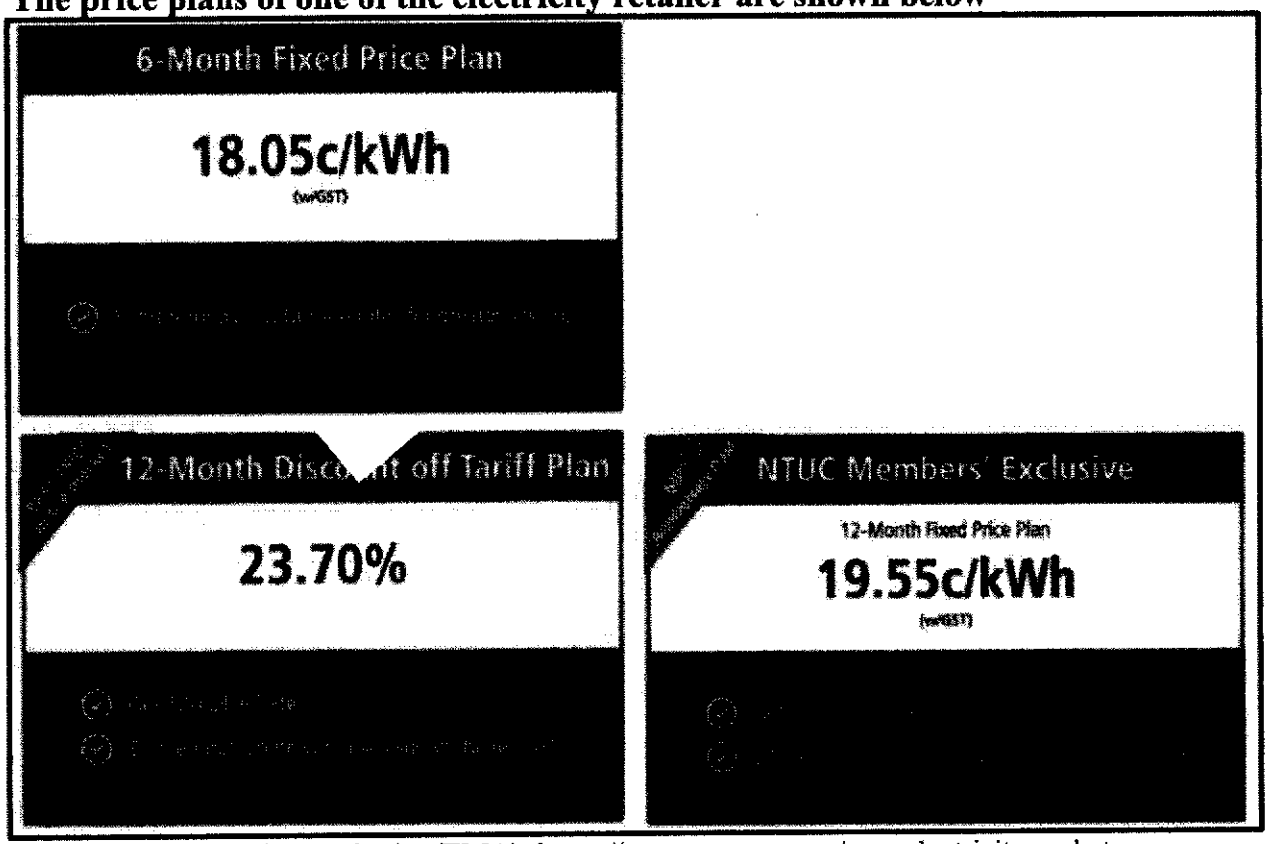
$= \$75.76$ - A1

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Since 1 November 2018, consumers of electricity can choose to buy electricity from a retailer of their choice, or continue to buy from Singapore Power (SP) Group at the regulated tariff.



The price plans of one of the electricity retailer are shown below



Source: Energy Market Authority (EMA), https://www.ema.gov.sg/openelectricitymarket.aspx

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(c) Mr Lim stays in a four-room Housing Board flat.
Based on the average usage of electricity of a typical a four-room Housing Board flat, calculate the difference in the total amount Mr Lim will have to pay for electricity if he chooses between the **" 12-Month Discount Off Tariff Plan"** or **" NTUC Members' Exclusive Plan."** [Also consider all rebate in the calculation] [3]

$\frac{76.3}{100} \times 22.55 \times 314$
$= \$54.03$
$= \$57.80\ (w\ gst)$
Total for the year $= (57.80 \times 12) - 20 = \$673.69$ - M1

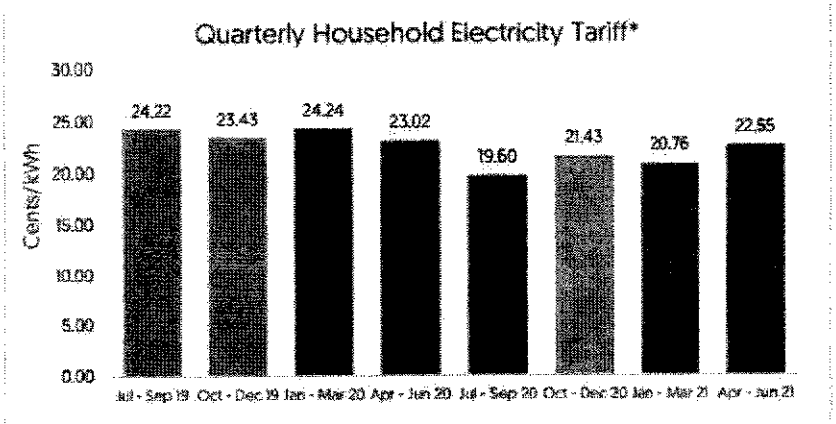
19.55×314
$= \$61.387$

Total for the year $= (61.387 \times 12) - 30 = \$706.64$ - M1

$\$706.64 - \$673.60 = \$32.95$ - A1

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(d) Mr Lim wants to choose the most cost effective plan. He will not be referring any of his friends to get rebate. Given the additional information given below, suggest a suitable plan for Mr Lim. Justify any decisions you made and show your calculations clearly. [2]



Source https://www.ema.gov.sg/Residential_Electricity_Tariffs.aspx

Using the 4-room flat usage and the year's tariff rate for estimation

$(100\% - 23.7\%) \times x < 18.05$
$x < 23.66$ cents - M1

If the tariff is less than 23.66, it will be more cost effective for Mr Lim to choose the " 12-Month Discount Off Tariff Plan".

Based on the charts, there are two months where the tariff is more than 23.66 cents. Hence at this point of time, " 12-Month Discount Off Tariff Plan" is a better choice. – A1

~END OF PAPER~

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