Calculator Model: _____

NAME:	CLASS:	INDEX NO:

QUEENSWAY SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2021

SECONDARY 3 EXPRESS

Parent's Signature:

MATHEMATICS

Paper 1

4048/01

4th Oct 2021

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue 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 bracket [ ] at the end of each question or part question.

The total number of marks for this paper is 80.

This document consists of 19 printed pages.

Setter: Ms Philynn Tan

[Turn over

Mathematical Formulae

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

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

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

1. Evaluate $\frac{\sqrt[3]{3589}}{1.81\times35}$.

(a) Write down the first five digits shown on the calculator display.

Answer: ..... [1]

(b) Write your answer to part (a), correct to 2 significant figures.

Answer: ..... [1]

2. Written as the product of its prime factors, $126 = 2\times3^2\times7$.

(a) (i) Express 600 as the product of its prime factors.

Answer: ..... [1]

(ii) Hence, find the LCM of 126 and 600.

Answer: ..... [1]

(b) Find the smallest positive integer k such that $\frac{126}{k}$ is a perfect square.

Answer: ..... [1]

3. Given that x is an integer such that $-2 \leq x \leq 4$ and y is a prime number such that $3 \leq y < 20$, find

(a) the smallest possible value of $x^2 - y^2$,

Answer: ..... [1]

(b) the greatest possible value of $\frac{x}{y}$.

Answer: ..... [1]

(c) the smallest possible value of x^2y .

Answer: ..... [1]

4. (a) Simplify $\left(\frac{p}{q}\right)^2 \times \left(\frac{27}{125p^3}\right)^{\frac{1}{3}} \div \left(\frac{9q^9}{7}\right)^0$.

Answer: ..... [2]

(b) Solve $2^x + 2^x = 32$.

Answer: ..... [2]

5. (a) Solve $\frac{4x-7}{2} < 3x - 1 \leq x + 21$.

Answer: ..... [3]

(b) Hence, write down the number of positive even numbers which satisfy $\frac{4x-7}{2} < 3x - 1 \leq x + 21$.

Answer: ..... [1]

6. Annie can clean 3 cabinets in 2 hours.
Betty can clean 5 cabinets in 3 hours.
Annie and Betty are to work together to clean 50 cabinets.
If they continue to work at the same rate, how long will it take for them to clean 50 cabinets? Give your answer in hours and minutes, correct to the nearest minute.

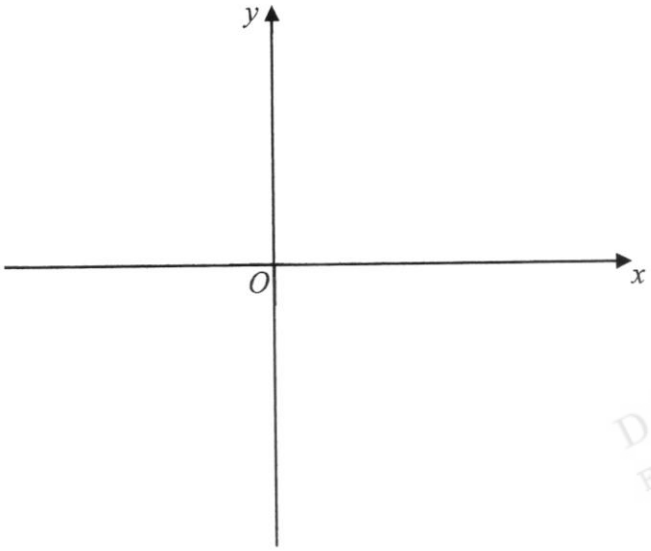
Answer: .....hours .....minutes [3]

7. (a) Express $x^2 - 6x + 5$ in the form of $(x - p)^2 - q$.

Answer: ..... [2]

(b) Hence, sketch the graph of $y = x^2 - 6x + 5$, indicating clearly the y-intercept and the coordinates of the turning point.

[2]



(c) Write down the equation of the line of symmetry of the graph of $y = x^2 - 6x + 5$.

Answer: ..... [1]

(d) Explain why the equation $x^2 - 6x + 5 = k$ does not have solution for $k < -7$.

Answer: .....

.....

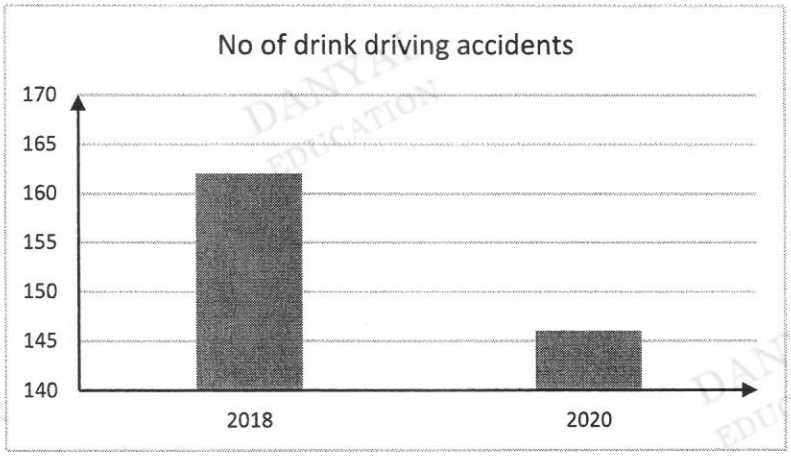
.....[1]

8. Under drink-driving laws in Singapore, the legal alcohol limit is 35 micrograms of alcohol in 100 millilitres of breath. Police officers could request for a preliminary breath test on the spot.

(a) Find the limit amount of alcohol in grams in 0.5 litres of breath, giving your answer in standard form. [1 microgram = 10^{-6} gram]

Answer: ..... grams [2]

(b) CNA news reported on 10 Feb 2021 that the number of drink driving accidents dipped by about 10 per cent - from 162 in 2018 to 146 in 2020.
Jason decided to present this information using a bar chart shown below.
State the reason why this bar chart may be misleading and explain how this may lead to a misinterpretation of the graph.



Answer: .....

.....

.....[2]

9. (a) Factorise completely $(2x + 3)^2 - 25$.

Answer: ..... [2]

(b) Show that $(7n + 1)^2 + 6$ is a multiple of 7 for all integer values of n. [2]

10. Solve the equation $\frac{5}{(x-3)^2} - \frac{2}{3-x} = 1$.

Answer: ..... [4]

11. Mr Lim borrowed \$50000 from a bank that charges compound interest of x % per annum, compounded half-yearly. If he owed a total of \$54900 after 3 years, find the value of x.

Answer: ..... [3]

12. (a) A limited edition K-pop themed set meal costed \$8.90, including 7% GST. Calculate the cost of the set meal before GST.

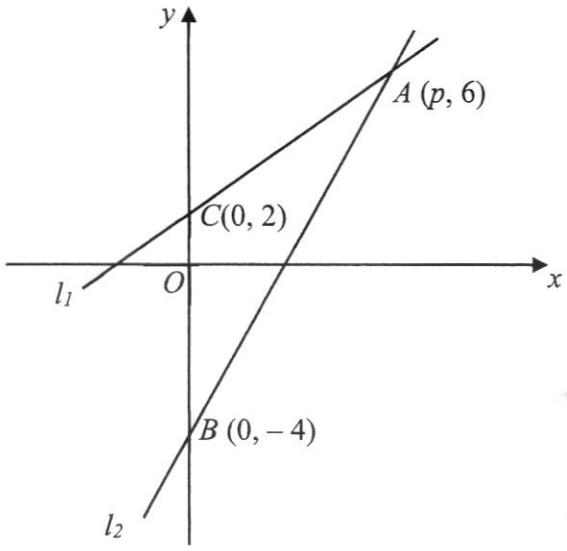
Answer: \$..... [2]

(b) Due to the Covid-19 situation, the K-pop themed set meal was only available on food delivery platform, 'Take-Away'. For every set meal, 'Take-Away' charged the customer a convenience fee, 27% of the selling price. 'Take-Away' also charged each customer a delivery fee of $3.

Given that 'Take-Away' earned a total of $17.42 from an order, find the number of set meals purchased by the customer.

Answer: ..... [3]

13. The diagram shows two lines, l_1 and l_2.
$l_1 : 5y - 4x - 10 = 0$ cuts the y-axis and $C\ (0, 2)$. The lines l_1 and l_2 intersects at the point A.



(a) Find the coordinates of A.

Answer: ..... [1]

(b) Find the equation of l_2.

Answer: ..... [2]

(c) Calculate the perpendicular distance from C to the line AB.

Answer: .....units [3]

(d) Given that $ADBC$ is a parallelogram with BC parallel to DA, find the coordinates of D.

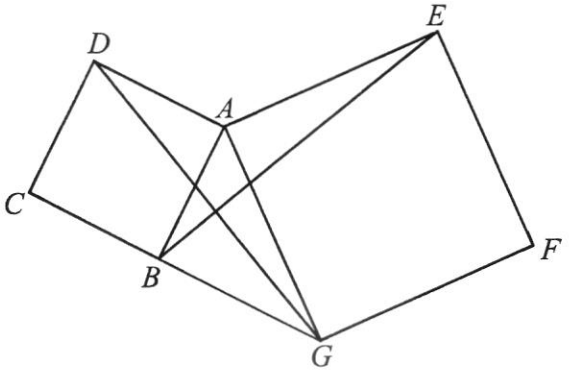
Answer: ..... [1]

(e) The point E lies on the line l_1.
Find the coordinates of E, given that it is equidistant from both axes.

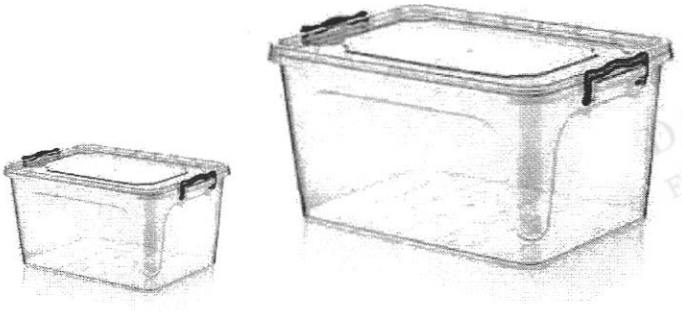
Answer: ..... units [2]

14. In the diagram below, $ABCD$ and $AEFG$ are squares.
Show that ΔADG and ΔABE are congruent.

[3]



15. Two similar storage boxes have base areas of 841 cm^2 and 2025 cm^2.



(a) Find the ratio of the height of the smaller box to the height of the large box.

Answer: ..... [2]

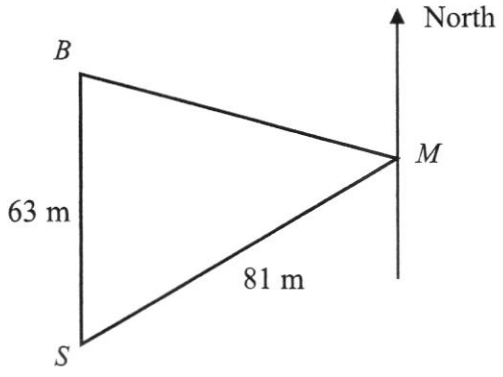
(b) The capacity of the larger box is 65 litres.
Find the capacity of the smaller box.

Answer: ..... litres [2]

(c) James filled both storage boxes completely with water.
Will the numerical value of $\frac{\text{total mass of small storage box and water}}{\text{total mass of large storage box and water}}$ be equal to $\left(\frac{29}{45}\right)^3$?
Show calculations to explain your answer.

[2]

16. The diagram shows three points, B, S and M, on the level ground, which represent the bus-stop, the school and the MRT station respectively.



S is due south of B. The bearing of S from M is 245°. $SB = 63$ m and $MS = 81$ m

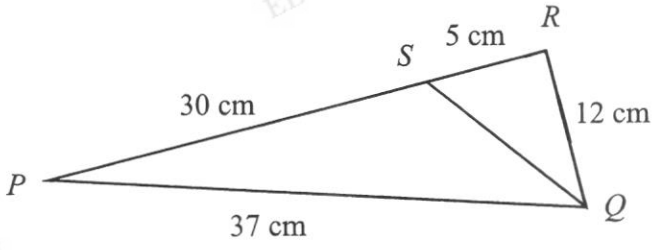
(a) Find the distance of BM.

Answer: .....m [3]

(b) David has to walk to the library, L, from S. The bearing of L from S is 094° and $ML = 45$ m.
Given that there are two possible locations for L, find the two possible values of $\angle SLM$.

Answer: .....or..... [3]

17. In the diagram below, $PQ = 37$ cm and $QR = 12$ cm.
S lies between P and R such that $RS = 5$ cm and $PS = 30$ cm.



(a) Prove that $\angle PRQ$ is a right angle. [2]

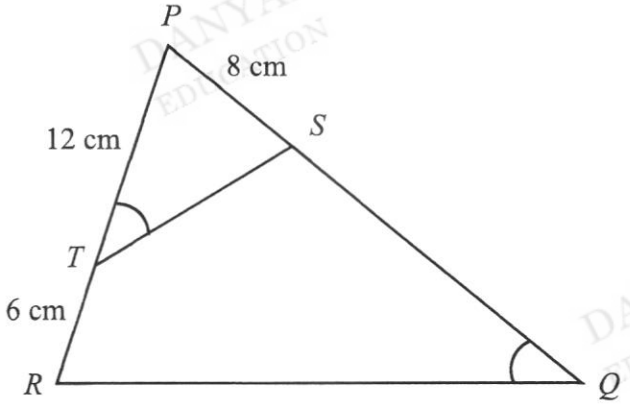
(b) Leaving your answers as fractions in the simplest form, find
(i) tan $\angle RQS$,

Answer: ..... [1]

(ii) cos $\angle PSQ$.

Answer: ..... [2]

18. In the diagram below, $\angle PQR = \angle PTS$, $PS = 8$ cm, $PT = 12$ cm and $TR = 6$ cm.



(a) Show that ΔPQR is similar to ΔPTS. [2]

(b) Find SQ.

Answer: .....cm [2]

(c) Find the value of $\frac{\text{Area of } \Delta PST}{\text{Area of quadrilateral } SQRT}$.

Answer: ..... [2]

END OF PAPER

Calculator Model: _____

NAME:	CLASS:	INDEX NO:

QUEENSWAY SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2021

SECONDARY 3 EXPRESS

Parent's Signature:

MATHEMATICS

4048/02

Paper 2

7 October 2021

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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Write in dark blue or black pen.
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For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in bracket [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of 16 printed pages.

Setter: Mrs Sheryl Soh

[Turn over

Mathematical Formulae

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

Mensuration

Curved Surface area of a cone = πrl

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

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

Arc length = $r\theta$, where θ is in radians

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Statistics

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

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

1. (a) Evaluate $(1.3 \times 10^2)^3 - \sqrt{1.96 \times 10^{10}}$, expressing your answer in standard form.

Answer: ..... [2]

(b) Solve $\frac{}{3} - \frac{x-1}{2} = 4$.

Answer: ..... [2]

(c) Simplify $\frac{4x^2-25}{2x^2-x-10}$.

Answer: ..... [2]

(d) Petrol costs x cents per litre. Amy bought some petrol and it costed her y dollars.
Find an expression, in terms of x and y, for the number of litres that Amy bought.

Answer: ..... [2]

2. (a) Consider the pattern

$$\begin{aligned} 2 \times 2 &= 1 \times 5 - 1 \\ 3 \times 3 &= 2 \times 6 - 3 \\ 4 \times 4 &= 3 \times 7 - 5 \\ 5 \times 5 &= 4 \times 8 - 7 \\ &\vdots \\ a \times a &= 13 \times 17 - 25 \end{aligned}$$

(i) From the above number pattern, find the value of a.

Answer: ..... [1]

(ii) Write down the 234^{th} line in the pattern.

Answer: ..... [2]

(b) It is given that $V = \pi(x - y)^2 h$.

(i) Express x in terms of V, π, y and h.

Answer: ..... [2]

(ii) Rix suggests that V could represent the volume of a cylindrical solid, with radius x, that has a cylindrical-shaped cavity of radius y at its centre. Explain if you agree with him.

Answer: ..... [1]

.....

(c) Solve the following equation $5x^2 + 3x = 13 - x$.

Answer: ..... [3]

3. (a) Simplify $\frac{6p^5q^{-6}}{14} \times \left(\frac{pq}{-2}\right)^3$ and express your answer in positive indices.

Answer: ..... [2]

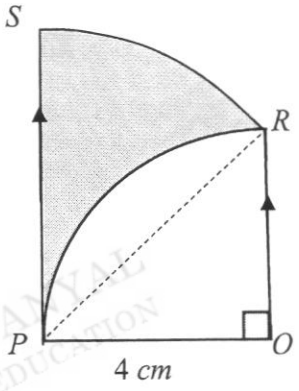
3. (b) The diameter of a certain molecule is measured as 0.16552 mm. Assume that it is spherical in shape, express its volume in standard form, giving your answer correct to 3 significant figures.

Answer: ..... mm^3 [2]

(c) Given that $\frac{2^{y-1}}{4^y} = 8^{2-y}$, find the value of y.

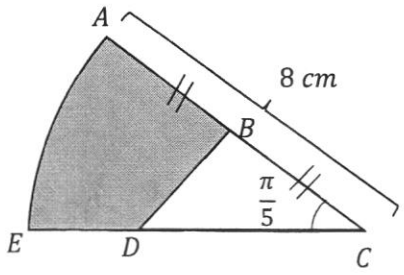
Answer: ..... [3]

4. (a) In the diagram below, $\angle POR = 90°$, PS is parallel to OR and $OP = OR = 4\ cm$. PR is an arc of a circle with centre O. RS is an arc of a circle with centre P. Find the area of the shaded region.



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

4. (b) A cake, cylindrical in shape, has a radius of 8 cm and a thickness of 6 cm. It is cut into pieces with centre C. The cross section of each piece is a sector of a circle making an angle of $\frac{\pi}{5}$ radians, as shown in the diagram. B is the midpoint of AC and D is a point on CE such that $CD = 2DE$. Calculate



(i) the length of the arc AE,

Answer: .....cm [1]

(ii) the length of the line BD,

Answer: ..... cm [3]

(iii) the volume of the shaded region.

Answer: ..... cm^3 [4]

5. Mrs Tan planned to spend \$30 buying fruit at \$$x$ per kilogram.

(a) Write down an expression in terms of x for the number of kilograms she expected to buy.

Answer: .....*kg* [1]

She found, however, that the price had increased by \$0.30 per kilogram.

(b) Write down an expression in terms of x for the number of kilograms she actually bought for \$30.

Answer: .....*kg* [1]

(c) Given that she actually bought 5 kg less than she had expected, form an equation in x and show that it reduces to $10x^2 + 3x - 18 = 0$.

Answer: [3]

(d) Solve this equation and use your answer to find the number of kilograms she actually bought.

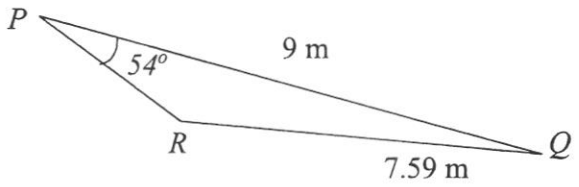
Answer: .....*kg* [3]

5. In the following week, Mrs Tan spent the same amount of money and was able to buy 4 kg more of the same fruit.

   (e) Show that the price of the fruit per kilogram had fallen by \$0.25.

   Answer: [2]

6. The diagram shows a horizontal field with three points marked on it, P, Q and R. $PQ = 9\ m, RQ = 7.59\ m$ and $\angle QPR = 54°$. A rope is used to join the three points to form a triangle PQR.



   (a) Show that $\angle PRQ = 106.4°$.

   Answer: [3]

   (b) Find the area of triangle PQR.

   Answer: .....m^2 [2]

(c) A marking, S, is made along PQ such that RS is the shortest distance from R to PQ. Find the length of RS.

Answer: .....m [2]

(d) June is standing at R, flying a drone. The drone, T, is vertically above S and $ST = 7.2\ m$.

(i) Find the angle of elevation of T when viewed from R.

Answer: ..... [2]

(ii) June's mother would like to watch her fly the drone. She wants to stand at a point where she can use the least effort to view the drone. Suggest one point, either P or Q, that she should stand at. Justify your suggestion and show your calculations clearly.

Answer: [4]

7. Match the following equations with its graph.

(a) $y = \frac{-4}{x}$

(b) $y = x^3 + 8$

(c) $y = -x^2 - 4x$

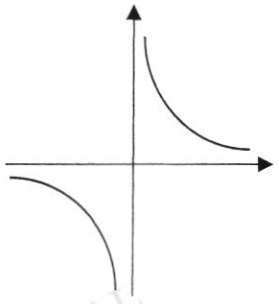
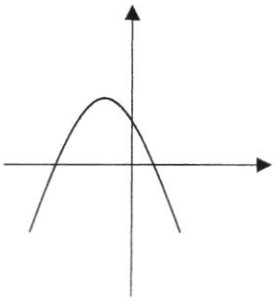
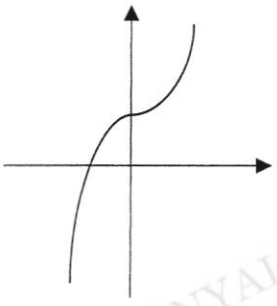
		

Figure 1	Figure 2	Figure 3

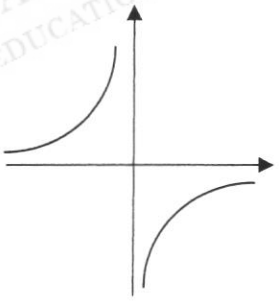
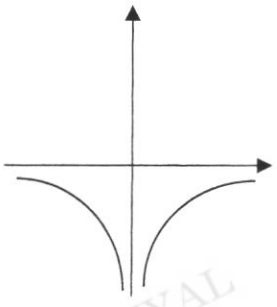
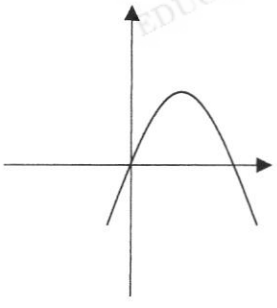

		

Figure 4	Figure 5	Figure 6

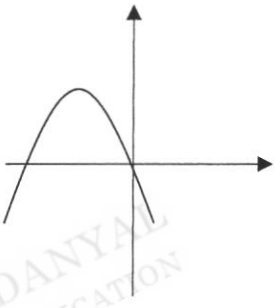
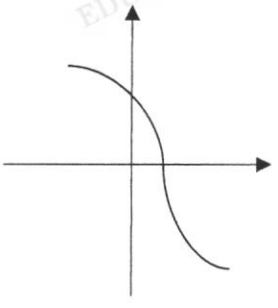
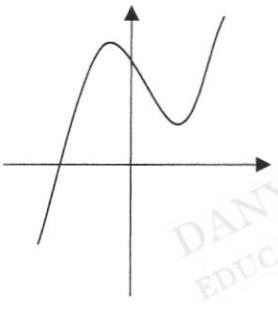

		

Figure 7	Figure 8	Figure 9

Answer: (a) Figure ..... [1]

(b) Figure ..... [1]

(c) Figure ..... [1]

8. When x number of handphones are produced, the cost \$$y$ of each handphone is given by the formula $y = 40 + \frac{825}{x}$.

The table below shows some values of x and the corresponding values of y, correct to one decimal place.

x	20	50	80	100	150	200	250	300	350
y	81.3	56.5	p	48.3	45.5	44.1	43.3	42.8	42.4

(a) Find the value of p.

Answer: ..... [1]

(b) On the graph provided, using a scale of 2 cm to represent 50 handphones, draw a horizontal x-axis for $0 \leq x \leq 350$. Using a scale of 2 cm to represent \$10, draw a vertical y-axis for $0 \leq y \leq 100$. On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the number of handphones to be produced if the cost of producing one handphone is \$60.

Answer: ..... [1]

(d) By drawing a tangent, find the change in the cost of producing each handphone when the number of handphones produced is 80.

Answer: ..... [2]

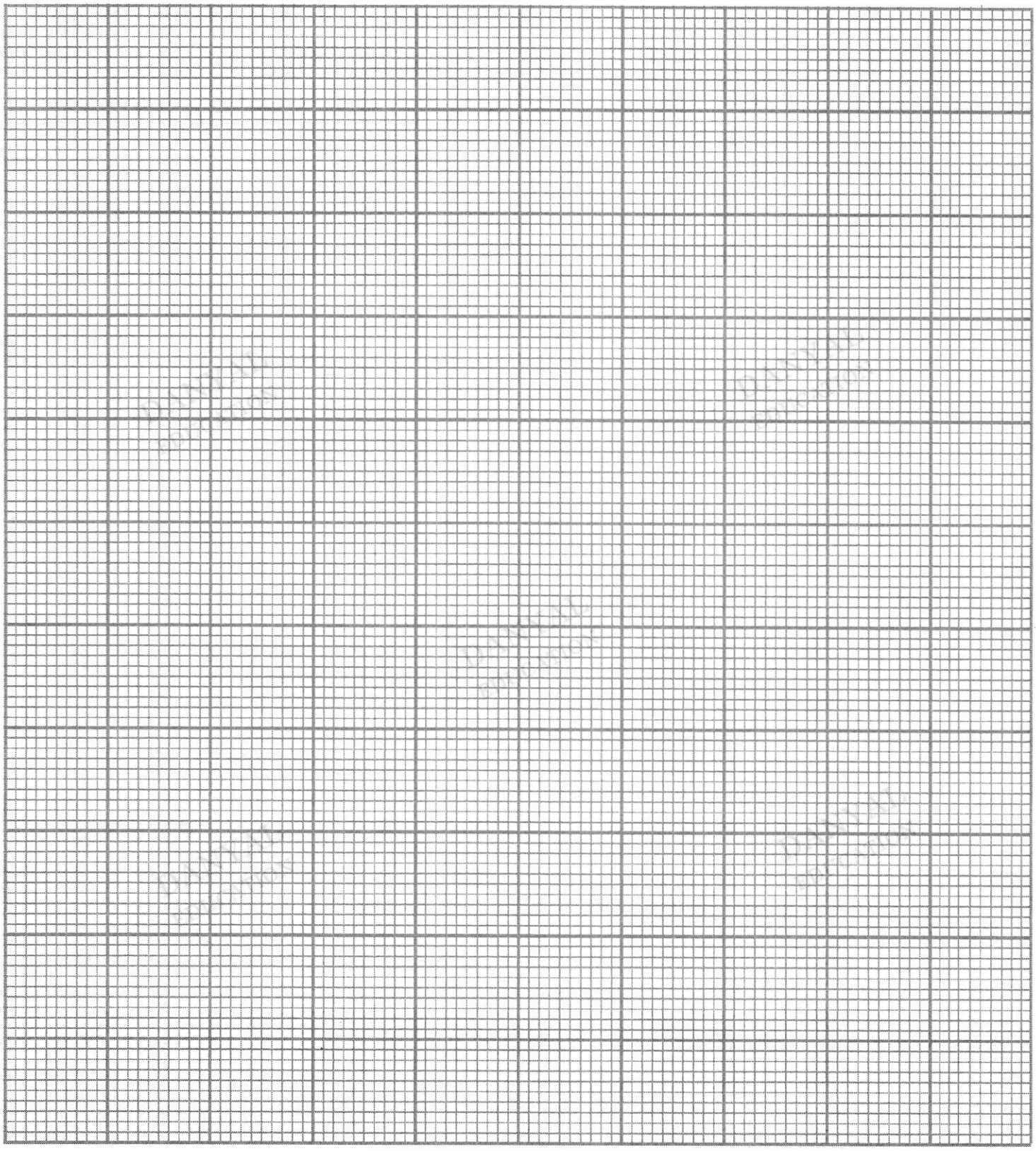
(e) The selling price of each handphone is $\$\left(70 - \frac{x}{10}\right)$.

(i) On the same axes, draw the graph of $y = 70 - \frac{x}{10}$. [1]

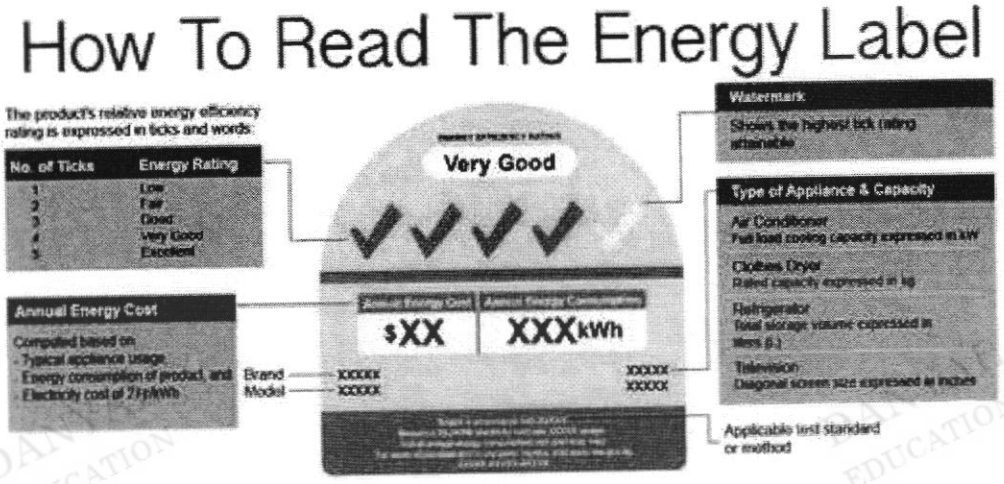
(ii) Use your graph to find the range of the number of handphones that should be produced if no loss is to be suffered, assuming that all handphones would be sold.

Answer: ..... [1]

Answer for 8(b), (d), (e(i))



9. Mandatory Energy Labelling Scheme (MELS) was introduced for air-conditioners to help consumers compare the energy efficiency and make more informed purchasing decision. A sample of the Energy Label is shown below:



Picture taken from https://www.visionair.com.sg/blogs/news/how-to-read-the-mandatory-nea-energy-efficiency-label-and-what-does-it-have-to-do-with-aircons

Generally, when comparing 2 different air-conditioner models of similar capacities, the model with the lower energy consumption is more efficient. A higher number of ticks indicate that the appliance is more energy efficient and consume less electricity.

The monthly electricity consumption and monthly electricity cost of running a particular home appliance can be calculated as follows:

$$\text{Electricity consumption per home appliance} = \left[\frac{\text{power rating (watts)} \times \text{number of hours} \times \text{number of days}}{1000}\right] kWh$$

Monthly electricity cost per home appliance
= electricity consumption x electricity tariff per kWh

(i) Calculate the monthly electricity consumption in kWh of an air-conditioner which is rated at 3500 watts if it is switched on for 7 hours each day for 30 days.

Answer: .....kWh [1]

9 (ii) Calculate the electricity tariff per kWh in cents if the monthly electricity cost for the air-conditioner was $143.91, correct your answer to 2 decimal places.

Answer: .....¢ [2]

(iii) The specifications of three models of air-conditioner are given below.

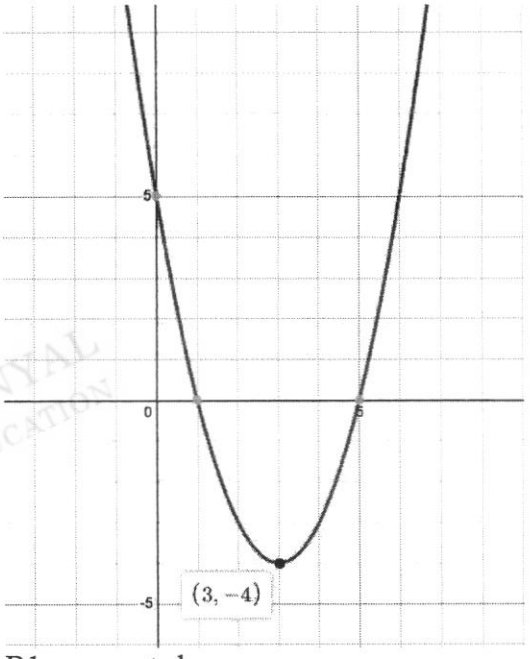
Air-conditioner	Brand X	Brand Y	Brand Z
Energy Efficiency Rating	✓✓✓✓	✓✓✓✓	✓✓✓✓✓
Power Rating	3800 W	3500 W	3750 W
Voltage	230 V	230 V	230 V
Estimated life span	10 years	10 years	10 years
Electricity tariff per kWh in cents including GST	22.55	22.55	22.55
Purchase cost exclude GST	$2000	$3000	$2500

David, who is working from home, switches on the air-conditioner in his room from 8.00 am to 4.00 pm daily for the whole year. By considering the purchase cost and electricity cost of the air-conditioner over its estimated life span, which air-conditioner should he buy in order to maximise his purchase? Justify the decision that you make and show your calculations clearly.
[Assume that the electricity tariff remains the same for 10 years and the efficiency of the air-conditioner is consistent throughout for the 10 years.]

Answer: [7]

END OF PAPER

1.	(a)	0.2416	B1
	(b)	0.24	B1
2.	(a)	(i) $600 = 2^3 \times 3 \times 5^2$	B1
		(ii) $LCM = 2^3 \times 3^2 \times 5^2 \times 7$ $= 12600$	A1
	(b)	$2 \times 7 = 14$	A1
3.	(a)	$x^2 - y^2 = 0 - 19^2$ $= -361$	A1
	(b)	$\frac{x}{y} = \frac{4}{3}$ $= 1\frac{1}{3}$	A1
	(c)	$x^2y = 0$	A1
4.	(a)	$\left(\frac{p}{q}\right)^2 \times \left(\frac{27}{125p^3}\right)^{\frac{1}{3}} \div \left(\frac{9q^9}{7}\right)^0$ $= \frac{p^2}{q^2} \times \frac{3}{5p} \div 1$ $= \frac{3p}{5q^2}$	M1 A1
	(b)	$2^x + 2^x = 32$ $2(2^x) = 32$ $2^x = 16$ $x = 4$	M1 A1
5.	(a)	$\frac{4x-7}{2} < 3x - 1$ $4x - 7 < 6x - 2$ $-5 < 2x$ $x > -2.5$ $\therefore -2.5 < x \leq 11$ $3x - 1 \leq x + 21$ $2x \leq 22$ $x \leq 11$	M2 A1
	(b)	5	B1
6.		In 1 hr, Annie cleans $\frac{3}{2}$ cabinets, Betty cleans $\frac{5}{3}$ cabinets In 1 hr, both can clean $\frac{3}{2} + \frac{5}{3} = \frac{19}{6}$ cabinets Time taken = $50 \div \frac{19}{6}$ $= 15\frac{15}{19} hr$ $\approx 15\ hr\ 47\ mins$	M1 M1 A1

7.	(a)	$x^2 - 6x + 5$ $= x^2 - 6x + \left(-\frac{6}{2}\right)^2 - \left(-\frac{6}{2}\right)^2 + 5$ $= (x-3)^2 - 4$	M1 A1
	(b)	 B1 – correct shape B1 – correct y-intercept and turning point	
	(c)	$x = 3$	B1
	(d)	Since the minimum value of y is -4, the curve will not intersect the line $y = k$ when $k < -7$.	B1
8.	(a)	$35 \times 10^{-6} \times 5 = 1.75 \times 10^{-4}$	M1, A1
	(b)	The vertical axis does not start from zero. This causes the decrease in number of accidents to appear to be more than 50%.	B1 B1
9.	(a)	$(2x+3)^2 - 25$ $= [(2x+3) - 5][(2x+3) + 5]$ $= (2x-2)(2x+8)$ $= 4(x-1)(x+4)$	 M1 A1
	(b)	$(7n+1)^2 + 6 = 49n^2 + 14n - 7$ $= 7(7n^2 + 2n + 1)$ (shown)	M1 A1
10.		$\frac{5}{(x-3)^2} - \frac{2}{3-x} = 1$ $\frac{5}{(x-3)^2} + \frac{2}{x-3} = 1$ $\frac{5 + 2(x-3)}{(x-3)^2} = 1$ $2x - 1 = (x-3)^2$ $x^2 - 8x + 10 = 0$	 M1 M1

		$x = \dfrac{-(-8) \pm \sqrt{(-8)^2 - 4(1)(10)}}{2(1)}$ $x = 1.55$ or $x = 6.45$	M1 A1
11.		$54900 = 50000\left(1 + \dfrac{\frac{x}{2}}{100}\right)^6$ $\left(1 + \dfrac{\frac{x}{2}}{100}\right)^6 = \dfrac{54900}{50000}$ $1 + \dfrac{\frac{x}{2}}{100} = \sqrt[6]{\dfrac{54900}{50000}}$ $x = 3.14$	M1 M1 A1
12.	(a)	$\dfrac{\$8.90}{1.07} \times 100 = \$8.32$	M1 A1
	(b)	Convenience fee $= \$8.90 \times 27\%$ $= \$2.403$ No of meals $= \frac{17.42-3}{2.403}$ $= 6$	M1 M1 A1
13.	(a)	When $y = 6$, $5(6) - 4p - 10 = 0$ $p = 5$ $A = (5, 6)$	A1
	(b)	Gradient $= \frac{6-(-4)}{5-0}$ $= 2$ $\therefore y = 2x - 4$	M1 A1
	(c)	$AB = \sqrt{(0-5)^2 + (-4-6)^2}$ $= \sqrt{125}$ $\frac{1}{2} \times d \times \sqrt{125} = \frac{1}{2} \times 6 \times 5$ $d = 2.68$ units	M1 M1 A1
	(d)	$(5, 0)$	A1
	(e)	$y = x \ -(1)$ $5y - 4x - 10 = 0 - (2)$ sub (1) into (2) $x = 10$ $y = 10$ $\therefore E = (10, 10)$	M1 A1
14.		$AD = AB$ (given) $AG = AE$ (given) $\angle DAG = 90° + \angle BAG$ $\angle BAE = 90° + \angle BAG$ $\therefore \angle DAG = \angle BAE$ ΔADG and ΔABE are congruent (SAS)	M1 M1 A1

15.	(a)	$\frac{\text{Height}_S}{\text{Height}_L} = \sqrt{\frac{841}{2025}}$ $= \frac{29}{45}$ Ratio = 29 : 45	M1 A1
		$\frac{\text{Capacity of small box}}{65} = \left(\frac{29}{45}\right)^3$ Capacity of small box$= 65 \times \left(\frac{29}{45}\right)^3$ $= 17.4$ litres	M1 A1
	(b)	Yes $\frac{\text{total mass of small storage box and water}}{\text{total mass of large storage box and water}}$ $= \frac{m_{small} + m_{water\ (small)}}{m_{large} + m_{water(large)}}$ $= \frac{m_{small} + m_{water\ (small)}}{\left(\frac{45}{29}\right)^3 m_{small} + \left(\frac{45}{29}\right)^3 m_{water\ (small)}}$ $= \frac{m_{small} + m_{water\ (small)}}{\left(\frac{45}{29}\right)^3 (m_{small} + m_{water\ (small)})}$ $= \left(\frac{29}{45}\right)^3$	B1 A1
16.	(a)	$\angle BSM = 245° - 180°$ $= 65°$ $BM = \sqrt{63^2 + 81^2 - 2(63)(81)\cos 65°}$ $= 78.846$ $= 78.8$m	M1 M1 A1
	(b)	$\angle MSL = 94° - 65°$ $= 29°$ $\frac{81}{\sin \angle SLM} = \frac{45}{\sin 29°}$ $\sin \angle SLM = \frac{81 \sin 29°}{45}$ $\sin \angle SLM = 0.87265$ $\angle SLM = \sin^{-1} 0.87265$ or $\angle SLM = 180° - \sin^{-1} 0.87265$ $= 60.76°$ $= 119.23°$ $= 60.8°$ $= 119.2°$	 M1 A2
17.	(a)	$PR^2 + QR^2 = 35^2 + 12^2$ $= 1369$ $PQ^2 = 37^2$ $= 1369$ Since $PR^2 + QR^2 = PQ^2$, by converse of Pythagoras' Theorem, $\angle PRQ$ is a right angle.	M1 A1
	(b)	(i) $\tan \angle RQS = \frac{5}{12}$	A1
		(ii) $\cos \angle PSQ = -\cos \angle RSQ$ $= -\frac{5}{13}$	M1 A1

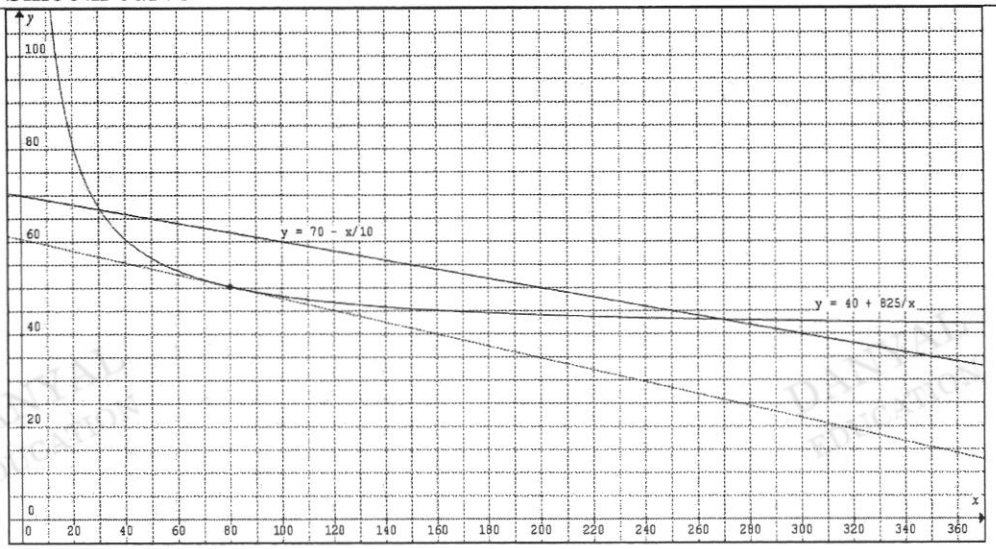
18.	(a)	$\angle PQR = \angle PTS$ (given) $\angle QPR = \angle TPS$ (common angle) ΔPQR is similar to ΔPTS. (AA test)	M1 A1
	(b)	$\frac{PQ}{PT} = \frac{PR}{PS}$ $\frac{8 + SQ}{12} = \frac{12 + 6}{8}$ $SQ = 19$ cm	M1 A1
	(c)	$\frac{\text{Area of } \Delta PST}{\text{Area of } \Delta PQR} = \left(\frac{8}{18}\right)^2$ $= \frac{16}{81}$ $\frac{\text{Area of } \Delta PST}{\text{Area of quadrilateral } SQRT} = \frac{16}{81-16}$ $= \frac{16}{65}$	M1 A1

1a)	$(1.3 \times 10^2)^3 - \sqrt{1.96 \times 10^{10}} = 2057\,000$ $= 2.057 \times 10^6$	M1 A1
1b)	$\frac{3x-1}{3} - \frac{x-1}{2} = 4$ $2(3x-1) - 3(x-1) = 24$ $6x - 2 - 3x + 3 = 24$ $x = \frac{23}{3} = 7\frac{2}{3}$	 M1 A1
1c)	$\frac{4x^2-25}{2x^2-x-10} = \frac{(2x-5)(2x+5)}{(2x-5)(x+2)}$ $= \frac{2x+5}{x+2}$	M1 A1
	Page 3	**6M**
1d)	$\$\frac{x}{100} \rightarrow 1$ litre $\$y \rightarrow \frac{1}{\frac{x}{100}} \times y$ $= \frac{100y}{x}$ litres	 M1 A1
2a(i)	$a = 14$	A1
2a(ii)	$n \times n = (n-1) \times (n+3) - (2n-3)$ 234^{th} line: $235 \times 235 = 234 \times 238 - 467$ Note: 234×238 (A1) -467 (A1)	 A2
2b(i)	$V = \pi(x-y)^2 h$ $(x-y)^2 = \frac{V}{\pi h}$ $x = y \pm \sqrt{\frac{V}{\pi h}}$	 M1 A1
	Page 4	**7M**

2b(ii)	No. The volume suggested by Rix should be $\pi(x^2 - y^2)h$.	A1
2c)	$5x^2 + 3x - 13 + x = 0$ $5x^2 + 4x - 13 = 0$ $x = \frac{-4 \pm \sqrt{16-4(5)(-13)}}{10}$ $x = 1.26 \quad or\ x = -2.06$	M1 A2
3a)	$\frac{6p^5q^{-6}}{14} \times \left(\frac{pq}{-2}\right)^3 = \frac{6p^5}{14q^6} \times \frac{p^3q^3}{-8}$ [M1 for expanding correctly] $= \frac{-3p^8}{56q^3}$	M1 A1
	Page 5	**6M**
3b)	$v = \frac{4}{3}\pi\left(\frac{0.16552}{2}\right)^3$ $= 0.002374$ $= 2.37 \times 10^{-3}$ mm^3	M1 A1
3c)	$\frac{2^{y-1}}{4^y} = 8^{2-y}$ $\frac{2^{y-1}}{2^{2y}} = 2^{3(2-y)}$ $2^{y-1-2y} = 2^{6-3y}$ $-y - 1 = 6 - 3y$ $y = 3.5$ [Accept $y = 3\frac{1}{2}$]	M1 M1 A1
4a)	$\angle SPR = 45°$ Area of sector $= \frac{45}{360} \times \pi\left(\sqrt{4^2 + 4^2}\right)^2$ $= 4\pi$ cm^2 Area of segment $= \frac{1}{4}\pi(4)^2 - \frac{1}{2}(4)^2$ $= (4\pi - 8)$ cm^2 Area of shaded region $= 4\pi - (4\pi - 8)$ $= 8$ cm^2	M1 M1 A1
	Page 6	**8M**

4bi)	Arc length AE= $8\left(\frac{\pi}{5}\right) = 1.6\pi$ cm [Accept 5.03 cm]	A1
4bii)	$CD = \frac{16}{3} cm$ $BD^2 = 4^2 + \left(\frac{16}{3}\right)^2 - 2(4)\left(\frac{16}{3}\right)\cos\frac{\pi}{5}$ $BD = 3.1506$ $= 3.15\ cm\ (3s.f)$	M1 M1 A1
4biii)	Area of sector ACE $= \frac{1}{2} \times 8^2 \times \frac{\pi}{5} = \frac{32\pi}{5}\ cm^2$ Area of triangle BCD $= \frac{1}{2} \times 4 \times \left(\frac{16}{3}\right)\sin\frac{\pi}{5} = 6.2697\ cm^2$ Volume $= \left(\frac{32\pi}{5} - 6.2697\right) \times 6$ $= 83.018$ $= 83.0\ cm^3 (3s.f)$	M1 M1 M1 A1
	Page 7	**8M**
5a)	No of kg expected to buy $= \frac{30}{x}$	A1
5b)	No of kg actually bought $= \frac{30}{x+0.3}$	A1
5c)	$\frac{30}{x} - \frac{30}{x+0.3} = 5$ $30x + 9 - 30x = 5x^2 + 1.5x$ $5x^2 + 1.5x - 9 = 0$ $10x^2 + 3x - 18 = 0$ (shown)	M1 M1 A1
5d)	$10x^2 + 3x - 18 = 0$ $(5x - 6)(2x + 3) = 0$ $x = 1.2 \ \ or \ \ -1.5\ (rejected)$ [Note: only award A1 when rejected] No of kg actually bought $= \frac{30}{1.2+0.3} = 20$	A2 A1
	Page 8	**8M**

5e)	Following week: $\frac{30}{24} = \$1.25\ per\ kg$ Previous week: \$1.50 per kg Price difference = \$1.50 - \$1.25 = \$0.25 per kg (shown)	M1 A1
6a)	$\frac{\sin \angle PRQ}{9} = \frac{\sin 54}{7.59}$ $\angle PRQ = 73.598\ (rejected) or\ 106.401$ $\angle PRQ = 106.4°$ (shown)	M1 M1 A1
6b)	$\angle PQR = 180 - 54 - 106.401 = 19.599°$ Area $= \frac{1}{2} \times 9 \times 7.59 \times \sin 19.599$ $= 11.456$ $= 11.5\ m^2\ (3s.f)$	M1 A1
	Page 9	**7M**
6c)	$\frac{1}{2} \times RS \times 9 = 11.456$ $RS = 2.5457$ $= 2.55\ m\ (3s.f)$ OR $\sin 19.599 = \frac{RS}{7.59}$ (Alternative) $RS = 2.5457$ $= 2.55\ m\ (3s.f)$	M1 A1
6di)	$\tan \angle TRS = \frac{7.2}{2.5457}$ Angle of elevation = 70.5° (1d.p)	M1 A1
6dii)	$QS^2 = 7.59^2 - 2.5457^2$ $QS = 7.1503\ m$ $PS = 9 - 7.1503 = 1.8496\ m$ Angle of elevation when viewed from P $= tan^{-1}\left(\frac{7.2}{1.8496}\right)$ $= 75.6°$ Angle of elevation when viewed from Q $= tan^{-1}\left(\frac{7.2}{7.1503}\right)$ $= 45.2°$ She should stand at **Q** as the **distance is longer**, the **angle of elevation is smaller.** (Point Q – 1m, reason – 1m)	M1 M1 A2
	Page 10	**8M**
7a)	Figure 4	A1
7b)	Figure 3	A1
7c)	Figure 7	A1
	Page 11	**3M**

8a)	p = 50.3	A1
b)	Refer to graph Correct points Correct axes Smooth curve	 A1 A1 A1
		
8c)	When y = 60, x = 41 [Accept from 40 to 45]	A1
8d)	Draw tangent on graph at x = 80 Grad = -0.1289 [Accept from -0.115 to -0.145]	M1 A1
8ei)	Draw $y = 70 - \frac{x}{10}$	A1
8eii)	Range of handphone: $31 \leq x \leq 269$ [Accept from $30 \leq x \leq 270$]	A1
	Page 12 & 13	**9M**
9i)	Consumption $= \frac{3500 \times 7 \times 30}{1000} = 735\ kWh$	A1
	Page 14	**1M**
9ii)	Electricity tariff $= \frac{143.91}{735}$ $= \$0.19579$ $= 19.58$ cents	 M1 A1
	Page 15	**2M**

9iii)

	Brand X	Brand Y	Brand Z
Electricity consumption per year	$\frac{3800 \times 8 \times 365}{1000} = 11096\ kWh$	$\frac{3500 \times 8 \times 365}{1000} = 10220\ kWh$	$\frac{3750 \times 8 \times 365}{1000} = 10950\ kWh$
Total electricity cost over 10 years	11096 x \$0.2255 x 10 = \$25021.48	10220 x \$0.2255 x 10 =\$23046.10	10950 x \$0.2255 x 10 =\$24692.25
Purchase price including GST	\$2000 x 1.07 =\$2140	\$3000 x 1.07 = \$3210	\$2500 x 1.07 = \$2675
Total payment	\$25021.48+\$2140 = \$27161.48	\$23046.10+\$3210 =\$26256.10	\$24692.25+\$2675 =\$27367.25

A6

Every box – A0.5 (total 6m)

He should buy **Brand Y** as it costs the cheapest over 10 years. A1

Page 16 **7M**