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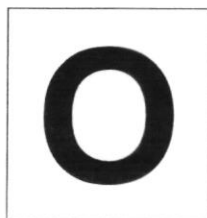
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NORTHBROOKS SECONDARY SCHOOL
End-of-Year Examination 2022
Secondary 3 Express



CANDIDATE NAME			
CLASS		REGISTER NUMBER	

MATHEMATICS**4052/01**

Paper 1

3 October 2022**2 hours**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

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

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

Answer **all** the questions.

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

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 total of the marks for this paper is 80.

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 .

FOR EXAMINER'S USE											
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	

80

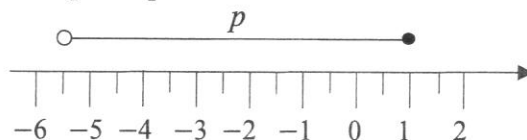
DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

This document consists of 17 printed pages.

Setter: Audrey Chong

Answer **all** the questions.

- 1 A range of values for p is represented on the number line below.



Write down the inequality that represents this range of values for p .

Answer [1]

- 2 Expand and simplify $2 - (3p - 5)^2$.

Answer [2]

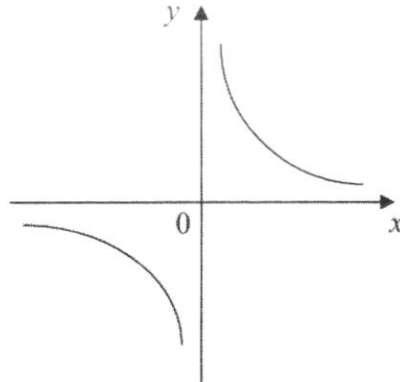
- 3 Simplify $\frac{8b^2c}{5} \div \frac{16bc^2}{15}$.

Answer [2]

- 4 Simplify $\left(\frac{27x^9}{y^6}\right)^{-\frac{2}{3}}$, leaving your answer in positive index form.

Answer [2]

- 5 The graphical representation of $y = ax^n$ is shown below.
Write down a suitable value of a and of n .



Answer $a = \dots\dots\dots$, $n = \dots\dots\dots$ [2]

- 6 Solve $(2x-15)^2 = 9$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- 7 The area of triangle PQR is 13.65 cm^2 .
 $PQ = 6.24 \text{ cm}$ and $QR = 7.03 \text{ cm}$.

Find the two possible sizes of the angle PQR .

Answer $\dots\dots\dots$ or $\dots\dots\dots$ [2]

- 8 A bell rings every 25 minutes and another bell rings every 45 minutes.

If the two bells rang together at 7.00 am, when will they next ring together next?

Answer [3]

- 9 Terry deposited \$2000 in a bank account that pays a compound interest of $r\%$ per annum. He received a **total interest** of \$250 at the end of 5 years.

Calculate the value of r .

Answer $r =$ [3]

- 10 (a) Find the HCF of 126 and 600.

Answer [2]

- (b) Find the smallest positive integer value of k such that $600k$ is a perfect cube.

Answer $k =$ [1]

- 11 One solution of the equation $5x^2 - px + 40 = 0$ is $x = 2$.
Find

- (a) the value of p ,

Answer $p =$ [2]

- (b) the second possible value of x .

Answer $x =$ [1]

12 Aniq is 5 years younger than Marie and the sum of their current ages is at most 31.

- (a) If x is the current age of Aniq, form an inequality in terms of x to represent this information.

Answer [1]

- (b) The minimum age to watch an NC16 movie at the cinema is 16 years old.

Solve the inequality in (a) to justify if Aniq is able to watch an NC16 movie at the cinema in two years' time.

Answer

.....
[2]

13 Factorise completely

- (a) $3x^2 - 75$,

Answer [2]

- (b) $6p^2q - 2pq + 3p - 1$.

Answer [2]

- 14** A reservoir contains 180 million litres of water.
On days with no rainfall, the water in the reservoir reduces by 1.2×10^6 litres per day.
[million = 10^6]

(a) Express 180 million litres in standard form.

Answer litres [1]

(b) Find the number of consecutive days with no rainfall it will take for the reservoir to be completely emptied.

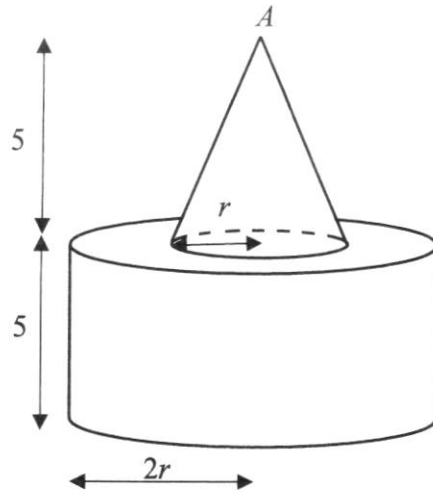
Answer [1]

(c) At the start of April, the reservoir was 90% filled.
This was followed by 5 days with no rainfall.

Calculate the amount of water left in the reservoir.

Answer litres [2]

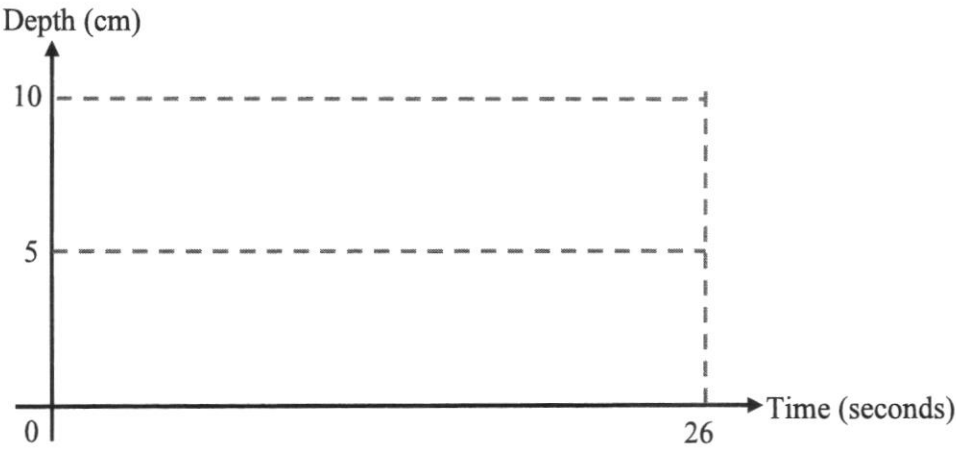
- 15 A container consists of a cylinder of radius $2r$ cm and a cone of radius r cm. The cylinder and the cone each have the same height of 5 cm. Water enters the empty container at a constant rate from the vertex A . It takes 26 seconds to fill the container completely.



- (a) Find the time taken to fill the cylinder completely.

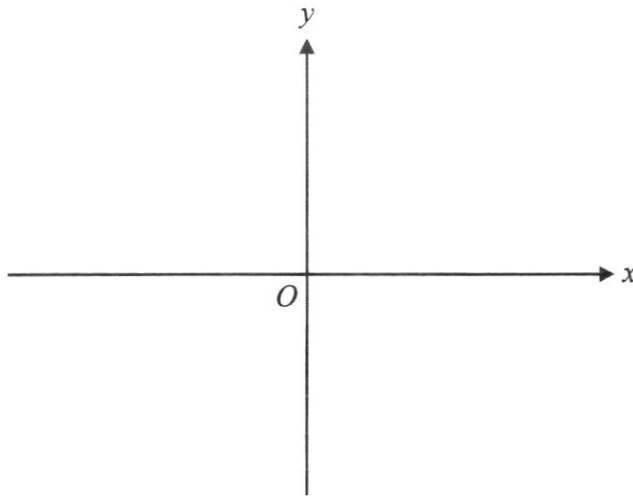
Answer seconds [2]

- (b) On the axes in the grid below, sketch the graph showing how the depth varies during the 26 seconds.



[2]

- 16 (a) **Sketch** the graph of $y = -(x-9)(x+3)$ on the axes below.
Indicate clearly the values where the graph crosses the x - and the y -axes.



[2]

- (b) Find the equation of the line of symmetry for the graph of $y = -(x-9)(x+3)$.

Answer [1]

- (c) Find the coordinates of the maximum point of the graph of $y = -(x-9)(x+3)$.

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

17 It is given that $y = \frac{3x+5b^2}{x-2c}$.

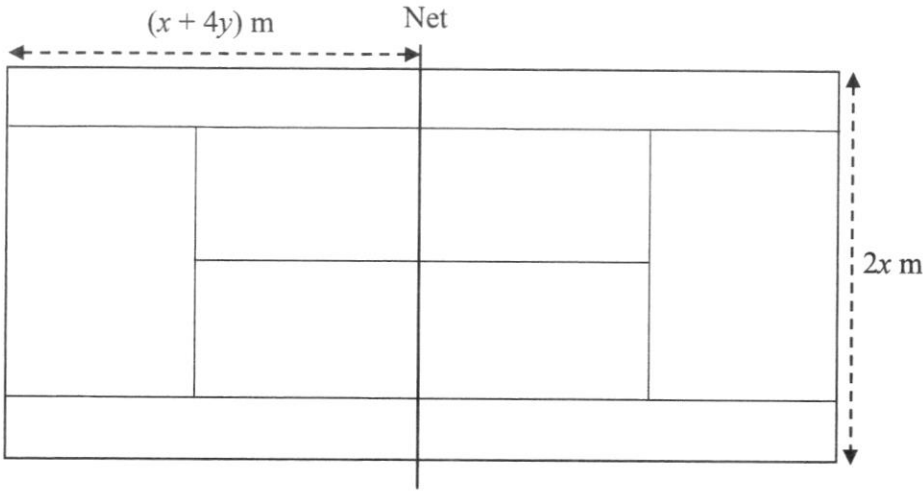
- (a) Find the value of y when $x=1$, $b=-2$ and $c=3$.

Answer $y=.....$ [1]

- (b) Express x in terms of y , b and c .

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

- 18 The diagram shows a tennis court.
The net divides the court equally into two.
The half-length of the court is $(x + 4y)$ m and the breadth is $2x$ m.

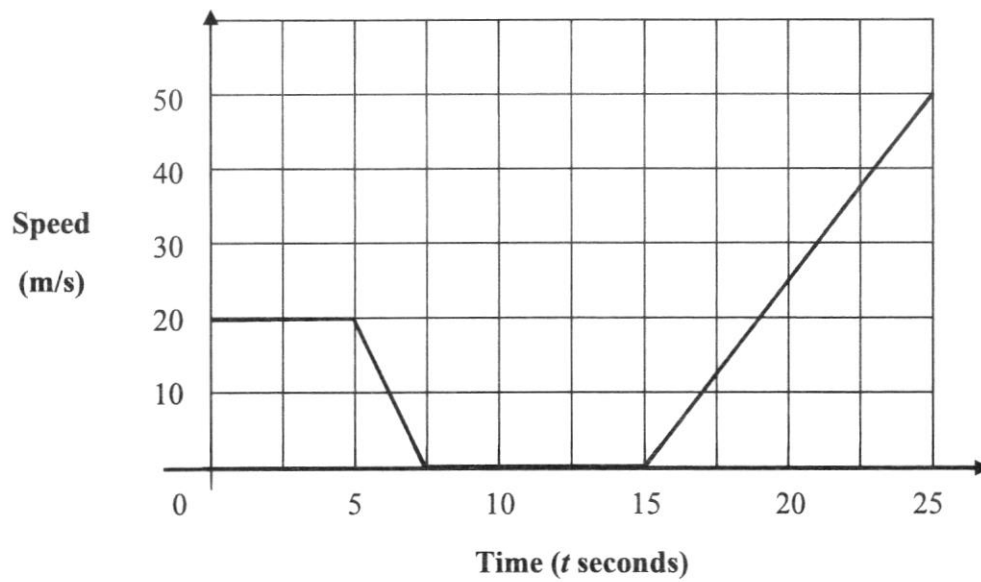


Given that the perimeter and length of the court are 69.6 m and 23.8 m respectively, find the value of x and of y .

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [4]

- 19 The diagram below is the speed-time graph of an object for the first 25 seconds of its journey.



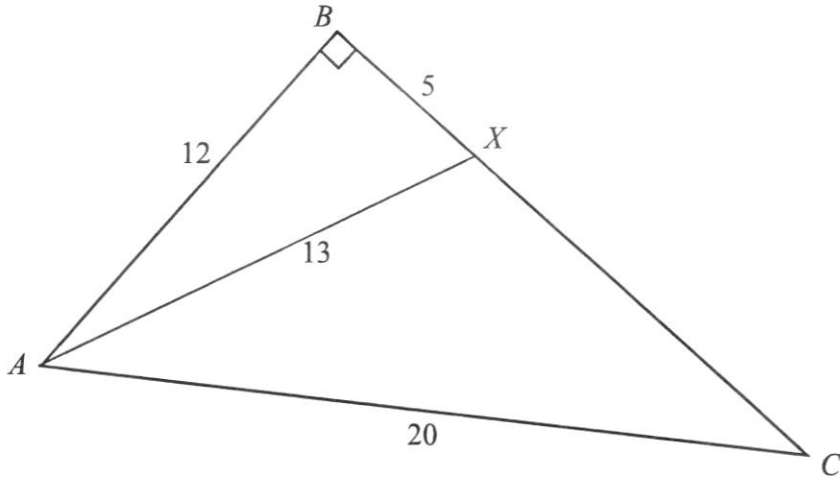
- (a) Find the acceleration of the object for the last 10 seconds of the journey.

Answerm/s² [2]

- (b) Calculate the average speed of the object for the first 25 seconds of the journey.

Answerm/s [3]

- 20** ABC is a right-angled triangle in which $AB = 12$ cm and $AC = 20$ cm.
 X is a point on BC where $AX = 13$ cm and $BX = 5$ cm.



- (a)** **Without using a calculator** and giving your answers in fraction in its lowest terms, find

(i) $\sin \angle ACB$,

Answer [1]

(ii) $\cos \angle AXC$.

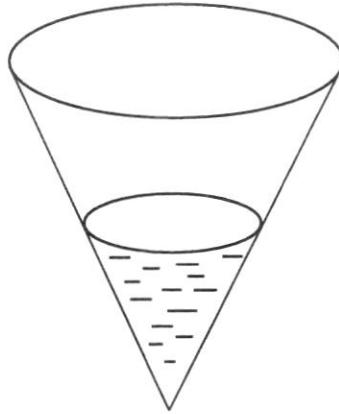
Answer [1]

- (b)** Find the shortest distance from X to AC .

Answercm [3]

- 21 A paper conical cup as shown in the diagram below is filled to $\frac{1}{2}$ of its maximum depth.

Aiken commented that the cup was half full.



- (a) Do you agree with Aiken?
Explain your answer by showing your working clearly.

Answer

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

- (b) A second conical cup, $1\frac{1}{2}$ times as tall, is geometrically similar to the cup above.
180 cm² of paper is required to make the second cup.
Calculate the difference in the amount of paper used to make the cups.

Answercm² [3]

- 22 A field is in the form of a quadrilateral $ABCD$ with $AB = 90$ m, angle $ABC = 70^\circ$, $BC = 33$ m, $AD = 70$ m and diagonal $BD = 85$ m.

- (a) Using a scale of 1 cm to represent 10 m, construct an accurate drawing of the field. AB has been drawn below.



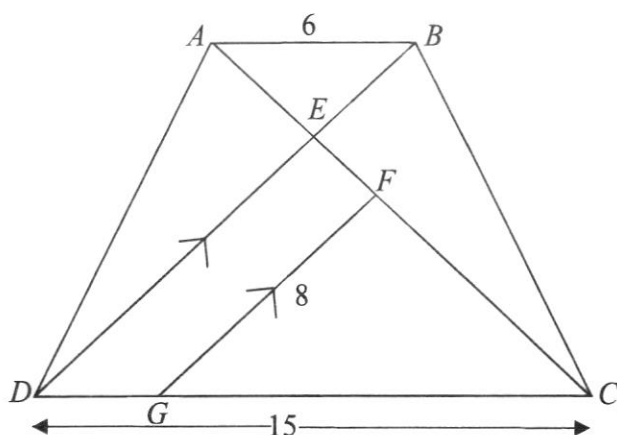
[2]

- (b) Construct the angle bisector of angle BAD . [1]

- (c) During a school carnival, a prize is hidden at a point in the field. It is 15 m from the side CD and equidistant from the sides AB and AD .

Mark clearly the position of the prize and label this point X . [2]

- 23 In the figure, $ABCD$ is a trapezium with AB parallel to DC . DB and GF are parallel lines. G lies on the line DC such that $DG : GC = 1 : 4$. $AB = 6$ cm, $GF = 8$ cm and $DC = 15$ cm.



- (a) Show that triangles ABE and CDE are similar.

Answer

[2]

- (b) Write down another pair of similar triangles.

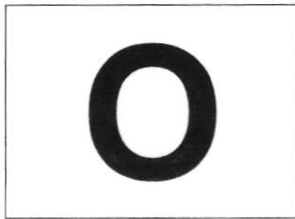
Answer $\Delta \dots\dots\dots$ and $\Delta \dots\dots\dots$ [1]

- (c) Find the length of BE .

Answer $\dots\dots\dots$ cm [2]

(d) If the area of triangle ABE is 10 cm^2 , calculate the area of triangle CFG .

Answer cm^2 [2]



NORTHBROOKS SECONDARY SCHOOL
End-of-Year Examination 2022
Secondary 3 Express



CANDIDATE NAME			
CLASS		REGISTER NUMBER	

MATHEMATICS

4052/02

Paper 2

4 October 2022

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

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

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

Answer **all** questions.

If working is needed for any question it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

The total of the marks for this paper is 80.

FOR EXAMINER'S USE							
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
							80

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

This document consists of 18 printed pages.

Setter: Yong Kenneth

1 (a) Write as a single fraction in its simplest form

(i) $-\frac{1}{x+2} + \frac{3}{(x+2)^2}$

Answer [2]

(ii) $\frac{1}{x^2-4} \times \frac{x^2-x-6}{3-x}$

Answer [3]

(b) Solve $\frac{x^2}{8} = -\frac{7x}{4} + x^2$

Answer $x =$ or [3]

2 (a) Simplify $\left(p^{\frac{1}{3}}\right)^{-5} \times \sqrt[3]{27p^{-31}}$.

Answer [3]

(b) Solve $\sqrt{4^{2y-1}} = \left(\frac{1}{16}\right)^y$.

Answer $y =$ [3]

(c) 2^{10} is greater than 5^5 .

Without working out the values of the terms, state if you agree with the statement above.
Explain your answer.

Answer

.....

.....

..... [2]

- (d) (i) Solve the inequalities $-\frac{5}{2} < \frac{5x+2}{6} < \frac{21}{2}$.

Answer [3]

- (ii) Hence write down the smallest integer value for x .

Answer $x =$ [1]

- 3 Mr Wong drove from Singapore to Penang and then back to Singapore.

The distance between Singapore and Penang is approximately 720 km via the North-South Highway.

- (a) During his trip from Singapore to Penang, he drove at an average speed of x km/h.
Write down an expression, in terms of x , for the time taken by Mr Wong to travel from Singapore to Penang.

Answer hours [1]

- (b) On his return trip, Mr Wong's average speed was reduced by 10 km/h.
Write down an expression, in terms of x , the time taken for Mr Wong to make the return journey.

Answer hours [1]

- (c) It is given that the difference in times taken for the two trips was 45 minutes.
Write down an equation in x to represent this information, and show that it reduces to

$$x^2 - 10x - 9600 = 0.$$

Answer

[3]

- (d) Solve the equation $x^2 - 10x - 9600 = 0$, giving your solutions correct to one decimal place.

Answer $x =$ or [3]

- (e) Find the time taken for the entire journey, giving your answer in hours, minutes and seconds, correct to the nearest second.

Answer hours minutes seconds [2]

4 P is the point $(-4, 10)$ and Q is the point $(5, -8)$.

(a) Find the length of line PQ .

Answer [2]

(b) Find the equation of line PQ .

Answer [2]

(c) R is the point where the line PQ cuts the x -axis.

Find the coordinates of R .

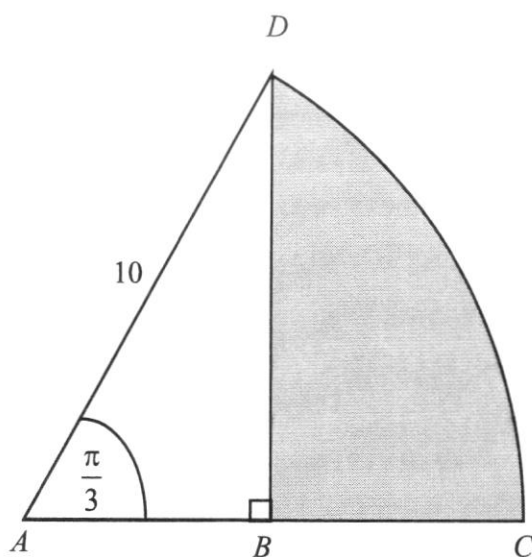
Answer R (.....,) [1]

- (d) The equation of line k is $3x + 2y = 7$.

Find the coordinates of the point of intersection of the line PQ and line k .

Answer (.....,) [3]

- 5 The following diagram shows a sector ACD with radius 10 cm and angle $DAC = \frac{\pi}{3}$ radian. B is a point on AC such that DB is perpendicular to AC .



- (a) Convert $\frac{\pi}{3}$ radians to degrees.

Answer [1]

- (b) Calculate the area of sector ACD .

Answer cm^2 [2]

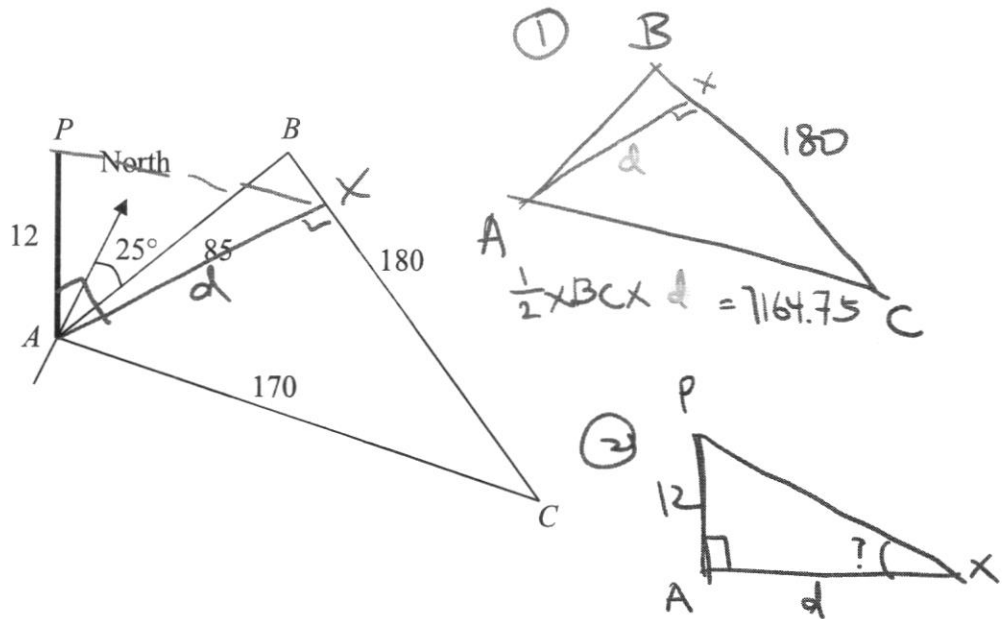
- (c) Calculate the length AB .

Answer cm [2]

- (d) Find the perimeter of the shaded region BCD .

Answer cm [5]

- 6 In the diagram, ABC represents a triangular field on horizontal ground and AP represents a vertical flagpole. B is 85 m from A on a bearing of 025° and C is 170 m from A . The length of BC is 180 m and the height of the flagpole is 12 m.



(a) Calculate

(i) the bearing of A from B ,

Answer [1]

(ii) angle ABC ,

Answer angle ABC = [3]

(iii) angle BCA .

Answer angle BCA = [2]

- (b) Find the area of the triangular field ABC .

Answer m^2 [2]

- (c) An ant moves along BC .

Calculate the greatest angle of elevation of the top of the flagpole when viewed by the ant as it moves from B to C .

Answer [4]

7 The variables x and y are connected by the equation

$$y = \frac{50}{x} + 4x - 36.$$

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

x	1	1.5	2	3	4	5	6	7	8
y	18.0	p	-3.0	-7.3	-7.5	-6.0	-3.7	-0.9	2.3

(a) Calculate the value of p .

Answer $p =$ [1]

(b) Using a scale of 2 cm to represent 1 unit on the horizontal x -axis and 2 cm to represent 5 units on the vertical y -axis, draw the graph of $y = \frac{50}{x} + 4x - 36$ for $1 \leq x \leq 8$ on the grid provided on page 15. [3]

(c) Using your graph,

(i) solve the equation $\frac{50}{x} + 4x - 36 = 0$,

Answer $x =$ or [2]

(ii) find the range of values of x when $y < -5$.

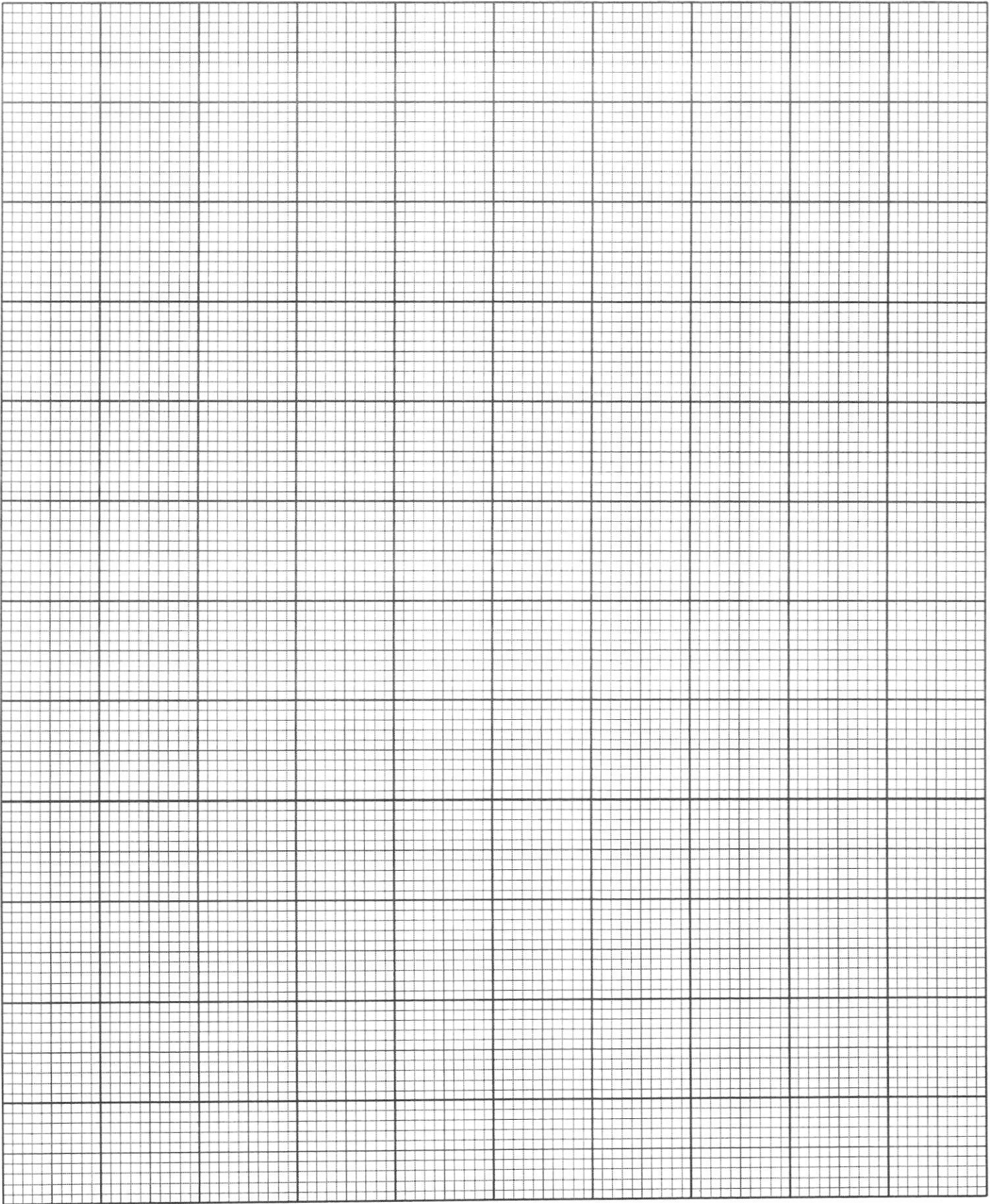
Answer [1]

(d) By drawing a tangent, find the gradient of the curve at $x = 2$.

Answer [2]

(e) Explain why there is no solution for $\frac{50}{x} + 4x - 36 = -8.5$.

Answer [1]



8 Mr Tan lives with his family in a HDB flat.

For the month of March, the family consumed 824 kWh of electricity, 26.0 Cu M of water and required refuse removal.

The following shows the breakdown of utilities charges for the month of March for Mr Tan.

Breakdown of Charges	Usage	Rate (\$)	Amount (\$)	Total (\$)
Electricity Services				
Cost for amount of electricity used	824 kWh	0.2156	177.65	177.65
Water Services				
Base cost for amount of water used	26.0 Cu M	1.1900	30.94	
Waterborne Fee	26.0 Cu M	0.7800	20.28	
Water Conservation Tax	\$30.94	35%	10.83	62.05
Refuse Removal	1 Qty	7.71	7.71	7.71
Subtotal			247.41	247.41
GST	\$247.41	7%	17.32	17.32
Total Charges: (inclusive of GST)				\$264.73

kWh: kilowatt hour

Cu M: cubic metre

Note: The water conversation tax is a tax of 35% on base cost of the amount of water used.

- (a) Calculate the total utilities charges for Mr Tan for the month of January when the family consumed 579 kWh of electricity, 19.3 Cu M of water and required refuse removal. Assume that the same rates apply.

Answer \$ [3]

- (b) A survey established that the air-conditioner used in Mr Tan's home accounts for 36% of the total electricity consumption in a household.

Calculate the electricity consumed by the air-conditioner in Mr Tan's home for the month of March.

AnswerkWh [1]

- (c) Mr Tan wants to reduce his monthly utilities bill by 15% from April onwards by switching to an energy-saving air conditioner. He found the following information on the internet.

Energy-Saving Air-Conditioner	
Green Ticks	Annual Energy Consumption (kWh)
5	1492
4	2282
3	2646
2	3368

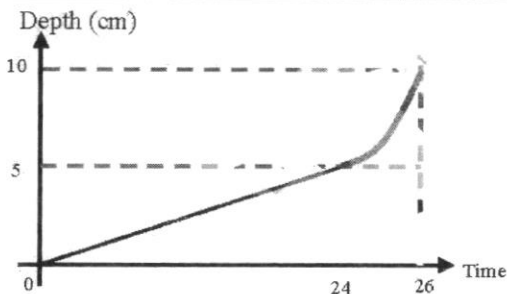
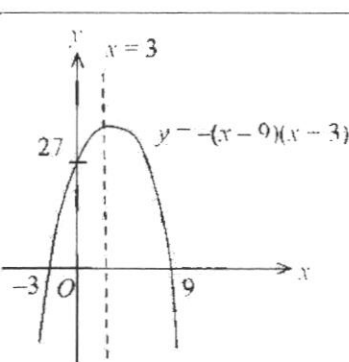
What is the minimum number of green ticks Mr Tan should look for on the air-conditioner in order to achieve the 15% reduction in his monthly utilities bill?

Justify your answer with calculations.

Assume that the rates and all other charges (water consumption, other electrical appliances usage and refuse removal) for the family remain unchanged.

Answer [6]

8	$25 = 5^2$ $45 = 3^2 \times 5$ $LCM = 3^2 \times 5^2$ $= 225$ $= 3\text{h } 45\text{min}$ Time = 10.45 a.m.	M1 M1 for LCM A1	
9	$2250 = 2000 \left(1 + \frac{r}{100}\right)^5$ $\left(1 + \frac{r}{100}\right)^5 = \frac{2250}{2000}$ $1 + \frac{r}{100} = \sqrt[5]{\frac{2250}{2000}}$ $\frac{r}{100} = \sqrt[5]{\frac{2250}{2000}} - 1$ $r = \left(\sqrt[5]{\frac{2250}{2000}} - 1\right) \times 100$ $r \approx 2.38$	M1 M1 A1	
10(a)	$126 = 2 \times 3^2 \times 7$ $600 = 2^3 \times 3 \times 5^2$ HCF = 6	M1 A1	
(b)	$3^2 \times 5 = 45$	B1	ecf from (a)
11(a)	$5(2)^2 - p(2) + 40 = 0$ $60 - 2p = 0$ $2p = 60$ $p = 30$	M1 A1	
11(b)	$5x^2 - 30x + 40 = 0$ $x - 6x + 8 = 0$ $(x - 2)(x - 4) = 0$ $x = 2$ or $x = 4$ Hence, the second possible value of <u>$x = 4$</u> .	 B1	or quadratic formula
12(a)	$x + x + 5 \leq 31$ $2x + 5 \leq 31$	B1	
12(b)	$2x + 5 \leq 31$ $2x \leq 26$ $x \leq 13$ In 2 years' time, Aniq is at most 15 years old, thus he cannot watch an NC16 movie.	 M1 A1	
13(a)	$3x^2 - 75$ $= 3(x^2 - 25)$ $= 3(x + 5)(x - 5)$	 M1 A1	

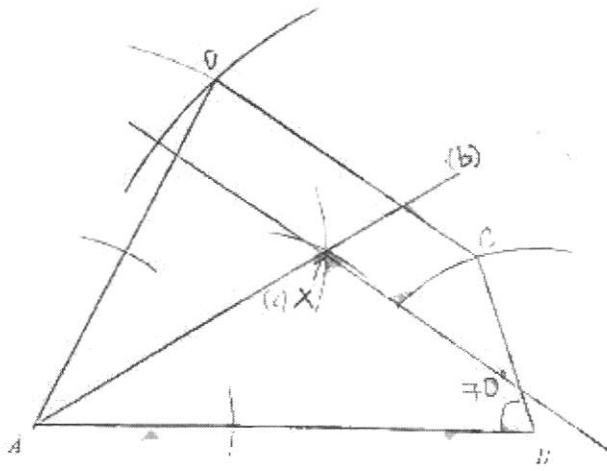
13(b)	$6p^2q - 2pq + 3p - 1$ $= 2pq(3p - 1) + (3p - 1)$ $= (3p - 1)(2pq + 1)$	M1 A1	
14(a)	1.8×10^8 litres	B1	
14(b)	$\frac{1.8 \times 10^8}{1.2 \times 10^6} = 150$ days	B1	
14(c)	$\left(\frac{90}{100} \times 1.8 \times 10^8 \right) - (5 \times 1.2 \times 10^6)$ $= 1.56 \times 10^8 \text{ litres}$	M1 A1	ecf from (a)
15(a)	$\text{Vol}_{\text{cylinder}} = \pi(2r)^2(5)$ $= 4(5\pi r^2)$ $\text{Vol}_{\text{cone}} = \frac{1}{3}(5\pi r^2)$ 13 parts ----- 26 s 12 parts ----- 24 s	M1 A1	
15(b)		B1 B1	ecf from (a) Straight line Curve *students will not be penalised for wrong labelling of the timing
16(a)		B1 for the correct curve B1 for the correct label of x-intercepts and y-intercept	
16(b)	$x = 3$	B1	
16(c)	$(3, 36)$	B1	
17(a)	$y = -4\frac{3}{5}$ or -4.6 or $-\frac{23}{5}$	B1	

17(b)	$y = \frac{3x+5b^2}{x-2c}$ $y(x-2c) = 3x+5b^2$ $yx-2yc = 3x+5b^2$ $yx-3x = 5b^2+2yc$ $x(y-3) = 5b^2+2yc$ $x = \frac{5b^2+2yc}{y-3}$ or $y = \frac{3x+5b^2}{x-2c}$ $y(x-2c) = 3x+5b^2$ $yx-2yc = 3x+5b^2$ $3x-yx = -2yc-5b^2$ $x(3-y) = -2yc-5b^2$ $x = \frac{-2yc-5b^2}{3-y}$	M1 M1 A1 M1 M1 A1	cross multiplication factorisation
18	$2x+8y = 23.8$ or $x+4y = 11.9$ $4x+16y+4x = 69.6$ or $8x+16y = 69.6$ By elimination or substitution method, $x = 5.5$ $y = 1.6$	B1 B1 M1 A1 for both x and y	
19(a)	$\frac{50}{10} = 5 \text{ m/s}^2$	M1, A1	
19(b)	Avg speed $= \frac{\left(\frac{1}{2} \times 20 \times (5+7.5)\right) + \left(\frac{1}{2} \times 10 \times 50\right)}{25}$ $= \frac{375}{25}$ $= 15 \text{ m/s}$	M1, M1 A1	1 mark for area of trapezium, 1 mark for area of triangle
20(ai)	$\frac{12}{20} = \frac{3}{5}$	B1	
20(aii)	$\frac{5}{13}$	B1	
20(b)	$XC = \left(\sqrt{20^2 - 12^2}\right) - 5$ $= 11$	M1	

	$\sin \angle ACB = \frac{d}{11}$ $\frac{3}{5} = \frac{d}{11}$ $d = \frac{3}{5} \times 11$ $d = 6.6$	M1 A1	ecf from (ai)
21(a)	$\left(\frac{h_1}{h_2}\right)^3 = \left(\frac{1}{2}\right)^3$ $= \frac{1}{8}$ <u>No, I do not agree</u> as the cup is only one-eighth full.	M1 A1	
21(b)	$\frac{A}{180} = \left(\frac{1}{1.5}\right)^2$ $A = \left(\frac{1}{1.5}\right)^2 \times 180$ $= 80$ $180 - 80 = 100 \text{ cm}^2$	M1 M1 A1	
22(a)	(Diagram is on the last page) Correct position of C and D.	B1, B1	arcs must be shown
22(b)	Angle bisector drawn with markings.	B1	
22(c)	For being along angle bisector For being 1.5 cm away from CD	B1 B1	
23(a)	$\angle ABE = \angle CDE$ (alt angles) $\angle BAE = \angle DCE$ (alt angles) $\angle AEB = \angle CED$ (vert. opp angles) By the <u>AA similarity test</u> , triangle ABE is similar to triangle CDE.	M1 (any 2) A1	
23(b)	$\triangle DEC$ and $\triangle GFC$	B1	
23(c)	$DE = 8 \times \frac{5}{4}$ $= 10$ $\frac{BE}{10} = \frac{6}{15}$ $BE = 4$	M1 A1	
23(d)	$\frac{\text{Area of } \triangle CFG}{\text{Area of } \triangle AEB} = \left(\frac{4}{8}\right)^2$ $\frac{\text{Area of } \triangle CFG}{10} = \frac{1}{4}$ $\text{Area of } \triangle CFG = \frac{1}{4} \times 10$ $= 40 \text{ cm}^2$ or	M1 A1	

$\frac{\text{Area of } \triangle ABE}{\text{Area of } \triangle CDE} = \left(\frac{6}{15}\right)^2$ $\frac{10}{\triangle CDE} = \frac{4}{25}$ $\text{Area of } \triangle CDE = 62.5 \text{ cm}^2$ $\frac{\text{Area of } \triangle CFG}{\text{Area of } \triangle CDE} = \left(\frac{4}{5}\right)^2$ $\frac{\text{Area of } \triangle CFG}{62.5} = \frac{16}{25}$ $\text{Area of } \triangle CFG = 40 \text{ cm}^2$			
		M1	
		A1	

Question 22



Sec 3 Express Mathematics
End of Year Examinations 2022
Mark Scheme

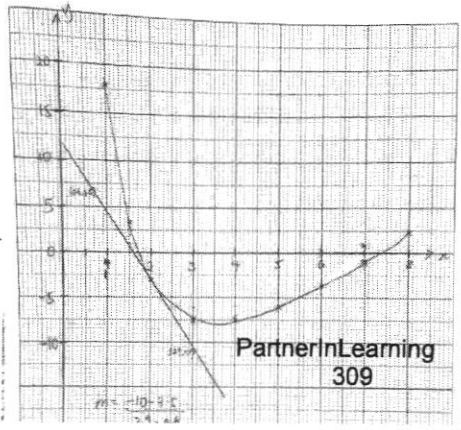
1	(a)(i)	$\frac{3}{(x+2)^2} - \frac{1}{x+2}$ $= \frac{3}{(x+2)^2} - \frac{1(x+2)}{(x+2)^2}$ $= \frac{3-x-2}{(x+2)^2}$ $= \frac{1-x}{(x+2)^2} \quad \text{or} \quad = -\frac{x-1}{(x+2)^2}$	M1 A1
	(a)(ii)	$\frac{1}{x^2-4} \times \frac{x^2-x-6}{3-x}$ $= \frac{1}{(x-2)(x+2)} \times \frac{x^2-x-6}{(3-x)}$ $= \frac{1}{(x-2)(x+2)} \times \frac{(x-3)(x+2)}{(3-x)}$ $= \frac{1}{(x-2)(x+2)} \times -\frac{(x-3)(x+2)}{(x-3)}$ $= \frac{-(x-3)(x+2)}{(x-2)(x+2)(x-3)}$ $= -\frac{1}{x-2} \quad \text{or} \quad \frac{1}{2-x}$	M1 (factorise denominator) M1 (factorise numerator) A1

	(b)	$\frac{x^2}{8} = -\frac{7x}{4} + x^2$ $x^2 - \frac{7x}{4} = \frac{x^2}{8}$ Multiply by 8 throughout, $8x^2 - 14x = x^2$ $7x^2 - 14x = 0$ $7x(x - 2) = 0$ Therefore $x = 0$ or $x = 2$	M1 – quadratic equation A1 for each answer
2	(a)	$\left(p^{\frac{1}{3}}\right)^{-5} \times \sqrt[3]{27p^{-31}}$ $= \left(p^{-\frac{5}{3}}\right) \times \sqrt[3]{27p^{-31}}$ $= \left(p^{-\frac{5}{3}}\right) \times 3p^{-\frac{31}{3}}$ $= 3p^{-\frac{36}{3}}$ $= 3p^{-12} \quad \text{or} \quad = \frac{3}{p^{12}}$	M1 M1 A1

	(b)	$\sqrt{4^{2y-1}} = \left(\frac{1}{16}\right)^y$ $\sqrt{2^{2(2y-1)}} = \left(\frac{1}{2^4}\right)^y \text{ change to base 2}$ $(2^{2(2y-1)})^{\frac{1}{2}} = (2^{-4})^y$ $2^{(2y-1)} = 2^{-4y} \text{ multiplying the power in}$ $2y-1 = -4y \text{ comparing the power}$ $6y = 1$ $y = \frac{1}{6}$	M1 M1 A1
	(c)	$2^{10} = (2)^{2 \times 5}$ $= (2^2)^5$ $= 4^5$ $4^5 < 5^5$ Therefore, <u>do not agree.</u>	M1 – show $2^{10} = 4^5$ A1
	(d)	$-\frac{5}{2} < \frac{5x+2}{6} < \frac{21}{2}$ $-\frac{5}{2} < \frac{5x+2}{6} \quad \text{and} \quad \frac{5x+2}{6} < \frac{21}{2}$ $-15 < 5x+2 \quad \text{and} \quad 5x+2 < 63$ $-17 < 5x \quad \text{and} \quad 5x < 61$ $-\frac{17}{5} < x \quad \text{and} \quad x < \frac{61}{5}$ $-3\frac{2}{5} < x \quad \text{and} \quad x < 12\frac{1}{5}$ $\therefore -3\frac{2}{5} < x < 12\frac{1}{5}$ Therefore, smallest integer value of x is -3.	M1 for each correct inequality M1 A1
3	(a)	$\frac{720}{x} \text{ hours}$	

	(b)	$\frac{720}{x-10} \text{ hours}$	
	(c)	$\frac{720}{x-10} - \frac{720}{x} = \frac{45}{60}$ $\frac{720x - 720(x-10)}{x(x-10)} = \frac{3}{4}$ $\frac{7200}{x^2 - 10x} = \frac{3}{4}$ $3x^2 - 30x - 28800 = 0$ $x^2 - 10x - 9600 = 0$	M1 – Construct equation correctly M1 – linear equation A1 – shown
	(d)	$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(1)(-9600)}}{2(1)}$ $x = \frac{10 \pm \sqrt{38500}}{2}$ $x = 103.10708 \text{ or } x = -93.10708$ $x = 103.1 \quad x = -93.1$	M1 A1, A1
	(e)	$\frac{720}{103.10708 - 10} + \frac{720}{103.10708}$ $= 14.71606h$ $= 14 \text{ hours } 42 \text{ min } 58 \text{ sec or } 14 \text{ hours } 43 \text{ min } 2 \text{ sec}$	M1 A1
4	(a)	Length of PQ = $\sqrt{(-4-5)^2 + (10+8)^2}$ $= 20.1246$ $\approx 20.1 \text{ units (3sf)}$	M1 A1
	(b)	Gradient of PQ = $\frac{10 - (-8)}{-4 - 5}$ $= \frac{18}{-9}$ $= -2$ Equation of line PQ: $y = -2x + C$ Using $(-4, 10)$, $10 = -2(-4) + C$ $C = 2$	M1

		Equation of line PQ: $y = -2x + 2$	A1
	(c)	Coordinates of R will be $(1, 0)$.	B1
	(d)	$3x + 2y = 7 \dots (1)$ $y = -2x + 2 \dots (2)$ Sub (2) into (1): $3x + 2(-2x + 2) = 7$ $3x - 4x + 4 = 7$ $-x = 3$ $x = -3$ $y = 8$ Hence the coordinates of the point of intersection is $(-3, 8)$.	M1 – correct substitution M1 – $x = -3$ A1
5	(a)	$\pi \text{ radian} = 180^\circ$ $\frac{\pi}{3} = \frac{180}{3} = 60^\circ$	B1
	(b)	Area of sector = $\frac{1}{2}r^2\theta$ $= \frac{1}{2} \times 10^2 \times \frac{\pi}{3} \text{ or } \frac{60}{360} \times \pi(10)^2$ $= 52.3599 \text{ cm}^2 = 52.4 \text{ cm}^2 \text{ (3sf)}$	M1 A1
	(c)	$\cos \frac{\pi}{3} = \frac{AB}{10}$ $AB = 5 \text{ cm}$	M1 A1
	(d)	$\sin \frac{\pi}{3} = \frac{BD}{10}$	M1

		$BD = 8.6603 \text{ cm}$ $BC = 10 - 5 = 5 \text{ cm}$ $\text{arc length} = r\theta$ $= 10 \times \frac{\pi}{3}$ $= 10.4720 \text{ cm}$ $\text{Perimeter} = 8.6603 + 10.4720 + 5 = 24.1323$ $= 24.1 \text{ cm (3sf)}$	M1(ecf) M1 M1 A1
6	(a)(i)	$180 - 25 = 155$ $\text{Bearing} = 360 - 155 = 205^\circ$	B1
	(a)(ii)	$\cos^{-1} \left(\frac{170^2 - 85^2 - 180^2}{-2(85)(180)} \right)$ $= 69.4827$ $= 69.5^\circ \text{ (1 d p)}$	M1 – use of cosine rule M1 – substitute values A1
	(a)(iii)	$\frac{\sin 69.4827}{170} = \frac{\sin C}{85}$ (accept cosine rule as well) $\angle BCA = 27.9^\circ$	M1 A1
	(b)	$\text{Area} = \frac{1}{2}(85)(180)\sin 69.4827 = 7164.732963$ $\text{Cost: } 7164.732963 \times 85 = \$609002.30 \text{ (2 d p)}$	M1 – find area A1
	(c)	$\text{Shortest Dist} = \frac{2 \times 7164.732963}{180} = 79.64$ $\text{Angle of elevation} = \tan^{-1} \frac{12}{79.64} = 8.57^\circ$	M1, A1 (shortest distance) M1, A1
7	(a)	$p = 3.3$	B1
	(b)	Scale Plotted points Smooth curve 	B1 B1 B1

	(c)(i)	(1.65 to 1.75) and (7.25 to 7.35)	B1 each
	(c)(ii)	(2.25 to 2.45) < x < (5.35 to 5.45)	B1
	(d)	Draw a tangent at x=2 Gradient = -7.33 to -8.5	M1 A1
	(e)	because the lowest value is -8	B1
8	(a)	Electrical charges = 579×0.2156 = 124.8324 Water charges = $(19.3 \times 1.19) + (19.3 \times 0.78) + (0.35 \times 19.3 \times 1.19)$ = 546.05945 Total charges = $(124.8324 + 46.05945 + 7.71) \times 1.07$ = 5191.10	M1 M1 A1
	(b)	$0.36 \times 824 = 296.64 \text{ kWh}$	B1
	(c)	Reduction of 15% Reduced monthly bill = $\frac{85}{100} \times \$264.73$ = 5225.02 Before GST = $\frac{100}{107} \times \$225.02$ = 5210.30 Subtract Water Services & Refuse Removal = $5210.30 - 562.05 - 57.71$ = 5140.54	M1 M1

	$\text{Total energy consumption per month} = \frac{140.54}{0.2156}$ $= 651.855 \text{ kWh}$	M1
	Initial total monthly energy consumption Before change of airconditioner Initial total monthly energy consumption of all other electrical appliances excluding air conditioner maximum airconditioner electrical energy consumption in order to decrease total charges by 15%	M1
	- 824 kWh - 0.64 × 824 kWh - 527.46 kWh = 651.855 - 527.36 = 124.495 kWh	M1
	Total annual energy consumption From new airconditioner in order to decrease total charges by 15% = 124.495 × 12 = 1493.94 kWh	M1
	Based on the list of air-conditioners provided, Mr Tan should look for an air-conditioner with <u>5 ticks</u>.	A1