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Name	Class				Index Number			
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BROADRICK SECONDARY SCHOOL

SECONDARY 4 NORMAL (ACADEMIC)

PRELIMINARY EXAMINATION 2023

MATHEMATICS SYLLABUS A

4045/01

Paper 1

August 2023

Candidates answer on the Question Paper

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name, class and index 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 70.

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.

For Examiner's Use		
Error in	Question Number	Marks Deducted
Rounding-off		
Reasoning		
Presentation		

For Examiner's Use
70

This document consists of **17** printed pages.

Setter(s) : Ms Yeo Li Shan

[Turn Over

Mathematical Formulae*Compound interest*

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

Mensuration

$$\text{Curved Surface area of a cone} = \pi r l$$

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1

$$0.25 \quad \frac{3}{11} \quad 0.\dot{2} \quad \sqrt[3]{0.02}$$

Write these numbers in order of size, starting with the largest.

Answer , , [2]
largest smallest

2 (a) A box contains red and black discs only.

$\frac{2}{7}$ of the discs are red.

Write the ratio red discs : black discs.

Answer : [1]

(b) Express 1.2 litres as a percentage of 150 ml.

Answer % [2]

3 Find the smallest prime number satisfying $-2x < -8$.

Answer [2]

- 4 P is inversely proportional to x^2 .

When $x = 2.5$, $P = 20$.

Find the value of P when x is 5.

Answer $P = \dots\dots\dots$ [2]

- 5 (a) $\sin x^\circ = 0.7$

Given that x is an obtuse angle, find x .

Answer $x = \dots\dots\dots$ [1]

- (b) $\cos 123^\circ = -\cos y^\circ$

Given that y is an acute angle, find y .

Answer $y = \dots\dots\dots$ [1]

6 $m = 4a^2 - 5$

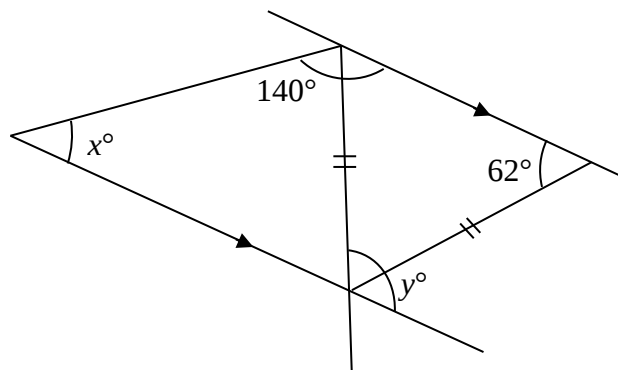
(a) Find m where $a = -5$.

Answer $m = \dots\dots\dots$ [1]

(b) Rearrange the formula to make a the subject.

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

7



(a) Explain why $x = 40^\circ$.

Answer

.....

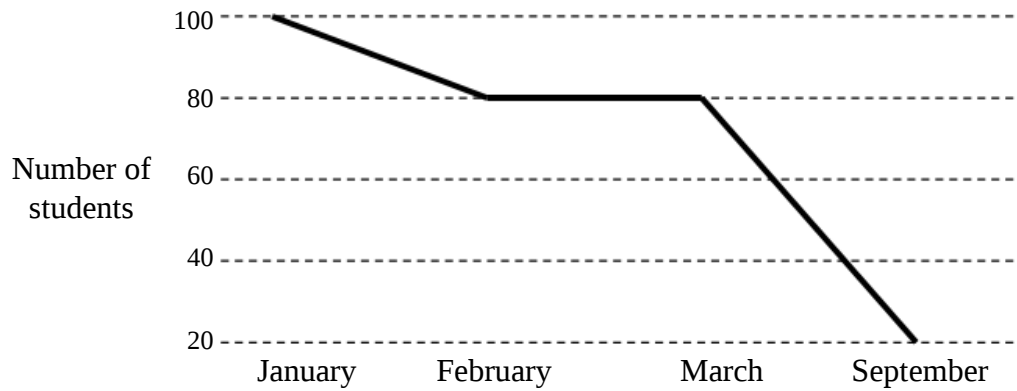
..... [1]

(b) Find y , stating your reasons.

Answer $y = \dots\dots\dots$ [2]

- 8 The graph shows the number of students who borrowed books from the school library.

Kerry claims that the number of students who borrowed books has been decreasing from January to September.



State one feature of the chart that may be misleading and explain why.

Answer

.....

.....

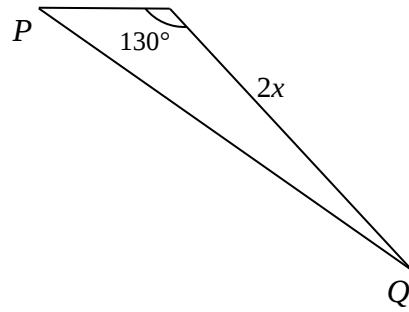
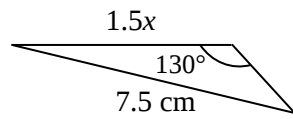
.....

.....

.....

[2]

9



These triangles are similar.
All the lengths are in centimetres.

Find the length of PQ .

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

10 Solve $x = 2(x + 3)$.

Answer $x = \dots\dots\dots$ [2]

- 11** \$1500 is placed in an account earning compound interest of $r\%$ per year.

At the end of 5 years, the total amount in the account is \$1592.19.

Calculate r .

Answer $r = \dots\dots\dots$ [3]

- 12 (a)** It is given that $1575 = 3^2 \times 5^2 \times 7$.

(i) Express 405 as a product of its prime factors.

Answer $\dots\dots\dots$ [1]

(ii) Find the highest common factor of 1575 and 405.

Answer $\dots\dots\dots$ [1]

- (b)** Q^3 is equal to the square of $2^3 \times 5^{6n}$, where n is a positive integer.

Write Q , in terms of n , as the product of its prime factors.

Answer $Q = \dots\dots\dots$ [2]

13 Tan spent a total of \$3000 for his holiday.

He spent:

$\frac{9}{20}$ on flight tickets and accommodations, and

40% **of the remainder** on entertainment and transport.

The rest of the money was spent on food and shopping.

Find the percentage of the money he spent on food and shopping.

Answer % [3]

- 14** The following table shows the exchange rates of some currencies displayed in a bank against Singapore Dollars (SGD).

Code	Foreign Currency	Unit	Selling (SGD)	Buying (SGD)
CAD	Canadian Dollar	1	1.0278	1.0028
JPY	Japanese Yen	100	0.9447	0.9297

- (a)** Kate has 250 CAD.

By using the “Buying” rate, calculate the amount in SGD Kate will receive if she exchanges 250 CAD to SGD?

Answer SGD [2]

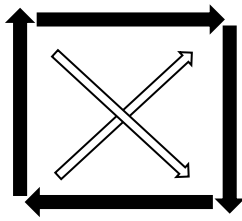
- (b)** Lim has 500 SGD.

By using the “Selling” rate, calculate the amount in JPY Lim will receive if he exchanges 500 SGD to JPY?

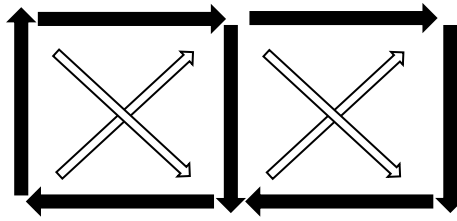
Give your answer correct to the nearest Yen.

Answer JPY [2]

15 The diagram shows some patterns made from two types of arrows.



Pattern 1



Pattern 2

(a) Complete the table.

Pattern number	Black arrows	White arrows	Total
1	4	2	6
2	7	4	11
3	10	6	16
4	13	8	21
5			

[1]

(b) Find an expression in terms of n , for

(i) the number of white arrows in Pattern n ,

Answer [1]

(ii) the total number of arrows in Pattern n .

Answer [1]

(c) Tina says that it is possible to have a total of 615 arrows in the pattern.

Is he correct? Explain your answer.

Answer

[2]

16 P is the point $(k, -1)$ and Q is the point $(3, k)$.

The gradient of the line PQ is 3.

(a) Form an equation in k and solve it to find the coordinates of P .

Answer $P = (\dots\dots\dots, \dots\dots\dots)$ [3]

(b) Another line L is parallel to PQ and passes through $(5, -3)$.

Find the equation of the line L .

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

17 Two six-sided dice are rolled and the product of the two numbers is recorded.

The table shows some of the possible products.

$\times$	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12			
5	5	10	15			
6	6	12	18			

(a) Complete the table above to show all the possible outcomes. [2]

(b) Find the probability that, when the two dice are rolled, the product is

(i) a prime number,

Answer [1]

(ii) at most 20,

Answer [1]

(iii) an irrational number.

Answer [1]

18 $x^2 - 6x - 16 = (x + a)^2 + b$

(a) Find a and b .

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

(b) **Hence**, for the graph $y = x^2 - 6x - 16$,

(i) state the equation of the line of symmetry,

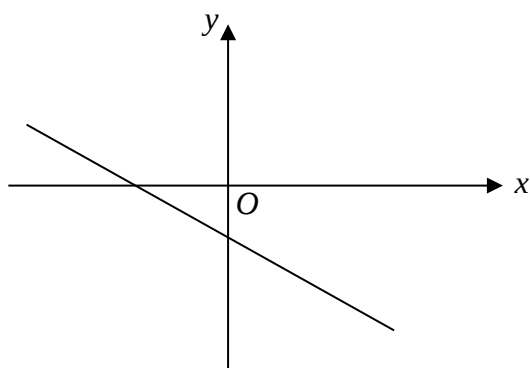
Answer $\dots\dots\dots$ [1]

(ii) find the values of the x -intercepts of the graph.

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

- 19 (a)** The equation of the line AB is $y = 2x - 8$.

Seng says that the graph of the line AB is shown below.

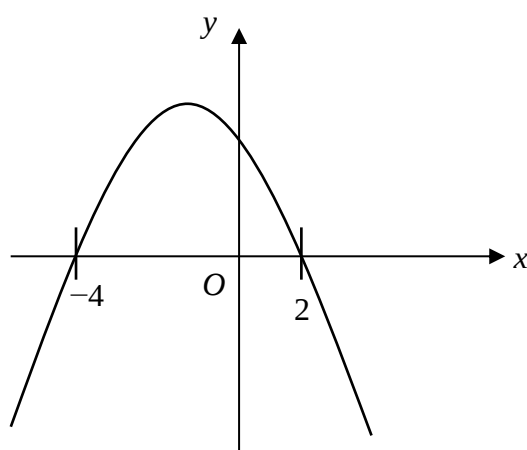


Is he correct? Explain your answer.

Answer

 [2]

- (b)** The sketch shows a quadratic curve with an equation $y = -(x + 4)(x - 2)$.

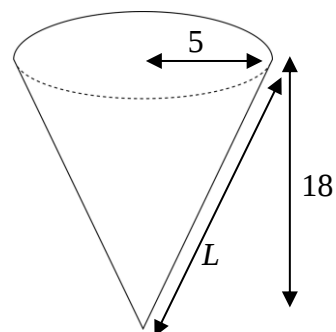


Find the coordinates of the maximum point.

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

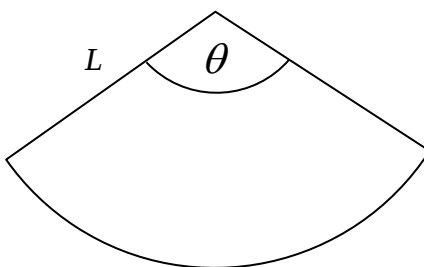
20 A paper cone has a circular base of radius 5 cm and a perpendicular height of 18 cm.

- (a)** By finding the slant height, L , of the cone, calculate the curved surface area of the cone.



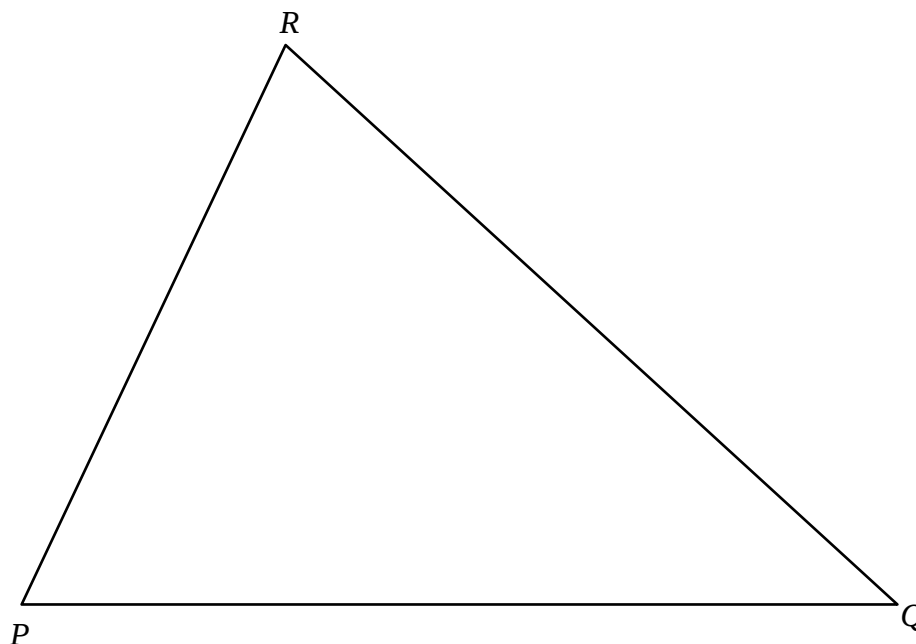
Answer cm^2 [3]

- (b)** The paper cone is cut along its slant height, L , to form a sector.
Find θ , in degrees.



Answer $\theta = \dots\dots\dots^\circ$ [2]

21 The diagram below shows a field PQR .



- (a) A point, M , is situated in the field.
 It lies on the perpendicular bisector of PQ and on the bisector of angle RPQ .
 Construct and label the position of M . [2]
- (b) A fence is built around a garden in the field PQR such that it is 4 cm from R in the diagram above.
 Shade the garden area and determine whether M lies inside the garden.
 Circle the correct word(s) in the statement below.

Answer

The point M (does / does not) lie inside the garden. [2]

End of Paper

Name	Class				Index Number			
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BROADRICK SECONDARY SCHOOL

SECONDARY 4 NORMAL (ACADEMIC)

PRELIMINARY EXAMINATION 2023

MATHEMATICS

4045/02

Paper 2

August 2023

Candidates answer on the Question Paper.

2 hours

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Section A

Answer **all** the questions.

Section B

Answer **one** question.

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For Examiner's Use		
Error in	Question Number	Marks Deducted
Rounding-off		
Reasoning		
Presentation		

For Candidate's Use	For Examiner's Use
Question Number	Marks Obtained
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11 or 12	
Total Marks	/ 70

This document consists of **19** printed pages.

Setter(s) : Ms Yeo Li Shan

[Turn Over

Mathematical Formulae*Compound interest*

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

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

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Trigonometry

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

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

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

Section A (62 marks)

Answer **all** the questions in this section.

- 1 (a)** Work out $\sqrt{5.2^2 - (-2) \times 3}$.

Answer [1]

- (b)** Write 87.1 million in standard form.

Answer [1]

- (c)** Write 0.054321 correct to 3 significant figures.

Answer [1]

- (d)** Express $\frac{4x-1}{3} - \frac{3+x}{6}$ as a single fraction.

Answer [2]

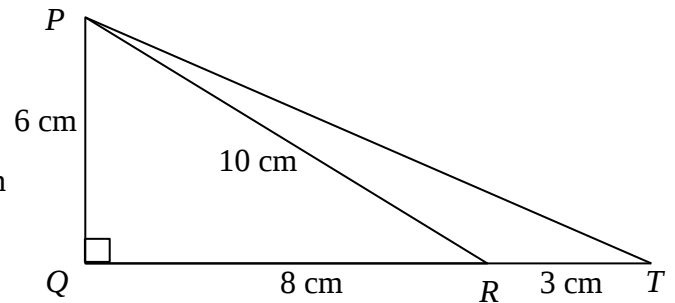
- 2 (a) $49 \div 7^n = 7^5$
Find the value of n .

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

- (b) Simplify $\left(\frac{8}{x^3}\right)^{-\frac{1}{3}}$.

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

- 3 In the diagram below, angle $PQR = 90^\circ$.
 QRT is a straight line.



- (a) Expressing your answers as a fraction
in the simplest form, find
(i) $\cos \angle QPR$,

Answer $\dots\dots\dots$ [1]

- (ii) $\sin \angle PRT$.

Answer $\dots\dots\dots$ [1]

- (b) Find the area of triangle PRT .

Answer $\dots\dots\dots \text{cm}^2$ [1]

- 4 An advertisement on the sale of a particular type of Headphones is shown below.

Sale



~~\$504.00~~

NOW \$399.00

- (a) Calculate the percentage discount of the Headphones during the sale.

Answer % [2]

- (b) Mr Kay intends to buy the Headphones on hire-purchase during the sale.
 He pays a deposit of 10% of the discounted price and then 12 monthly instalments at 5% simple interest per annum.
 Calculate the **extra** amount he pays as a percentage of the discounted price.

Answer % [3]

5 (a) Factorise

(i) $25x^2 - 1$,

Answer [1]

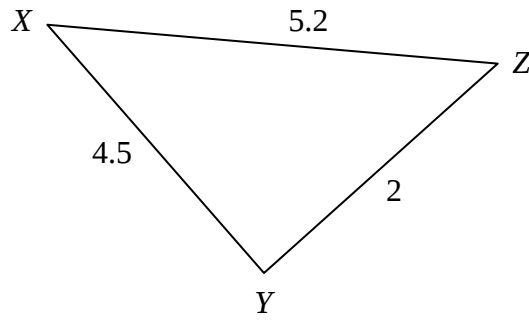
(ii) $4ax - 10x + 6ay - 15y$.

Answer [2]

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

Answer $x =$ [4]

6



- (a) Determine if triangle XYZ is a right-angled triangle.

Answer

[2]

- (b) Calculate angle XZY .

Answer° [3]

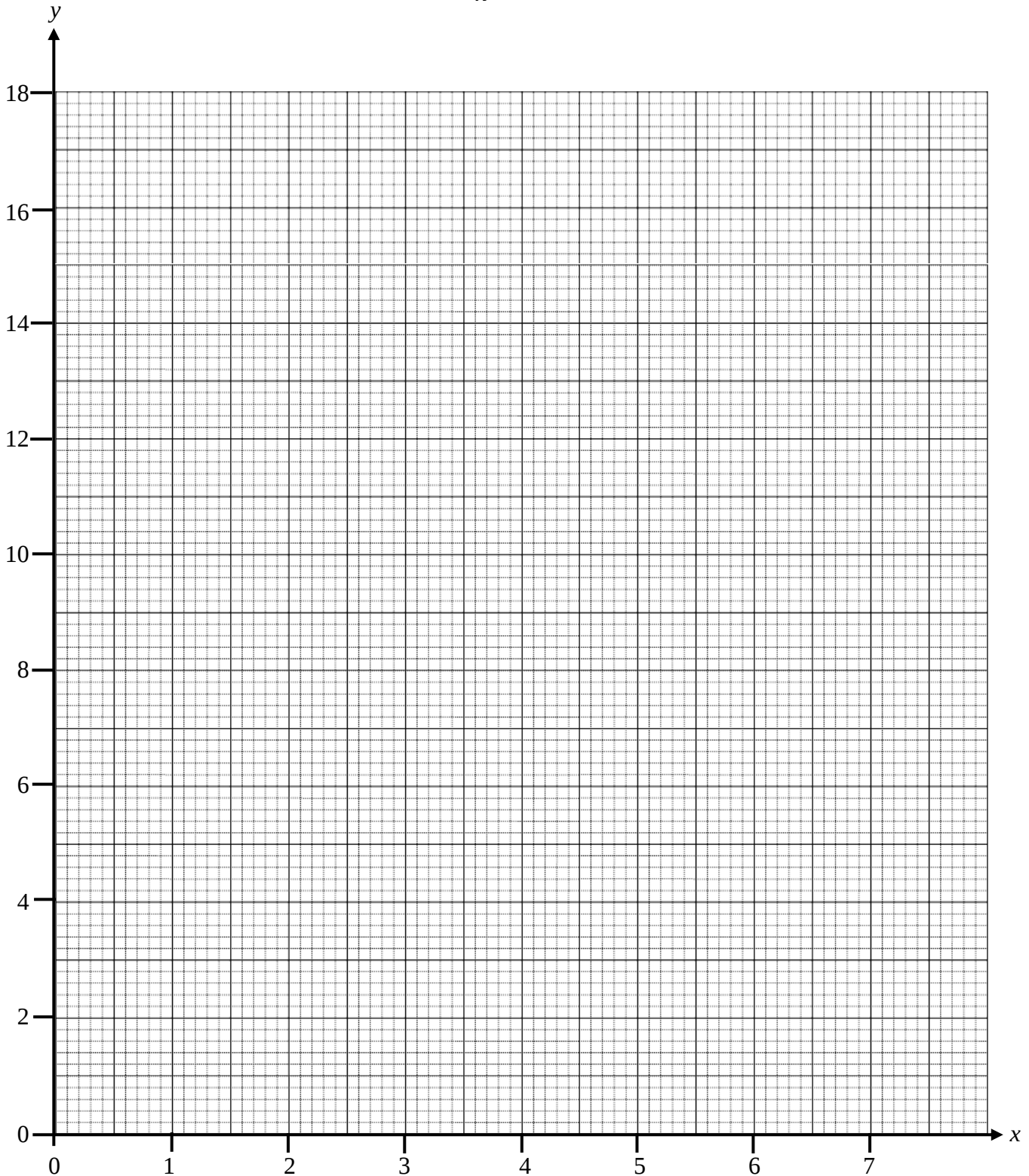
- 7 (a) Complete the table of values for $y = 2x + \frac{8}{x}$.

x	0.5	1	2	3	4	5	6	7
y	17	10	8	8.7		11.6	13.3	

[2]

- (b) Draw the graph of $y = 2x + \frac{8}{x}$ for $0.5 \leq x \leq 7$.

[3]



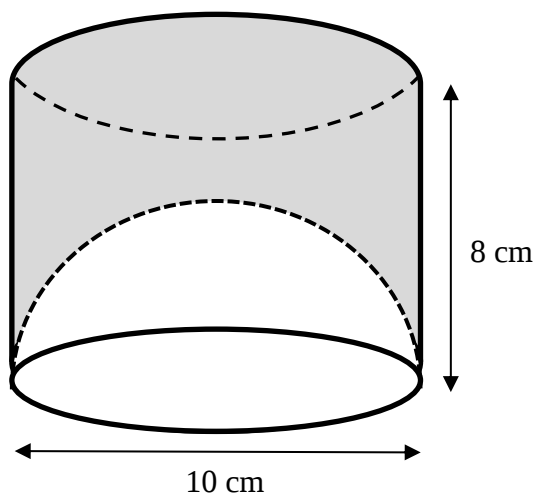
- (c) Using your graph, solve the equation $2x + \frac{8}{x} = 11$.

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

- (d) By drawing a suitable tangent, find the gradient of the graph when $x = 1$.

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

- 8** A paper weight is made by removing a hemisphere with diameter 10 cm from the bottom of a solid wooden cylinder with base diameter 10 cm and vertical height 8 cm.



- (a)** For the paper weight, calculate its

(i) volume,

Answer cm^3 [2]

(ii) total surface area.

Answer cm^2 [3]

- (b) A rectangular box measures 85 cm by 50 cm by 8 cm.

Find the maximum number of such paper weights which can be placed in the box.

Answer [1]

- 9 (a) Solve the simultaneous equations.

$$2x + 3y = 14$$

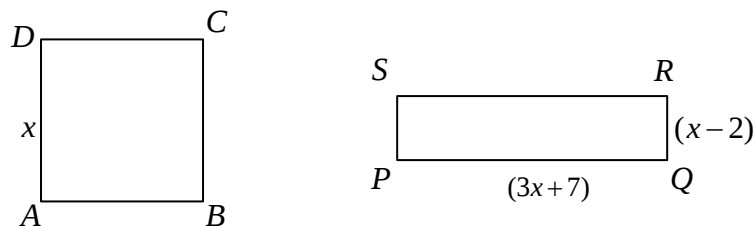
$$4x - y = 7$$

Answer $x =$

$y =$ [3]

- (b) $ABCD$ is a square of side x cm.

$PQRS$ is a rectangle with $PQ = (3x + 7)$ cm and $QR = (x - 2)$ cm.



Given that $ABCD$ and $PQRS$ have the same area,

- (i) Write down an equation to represent the information and show that it simplifies to $2x^2 + x - 14 = 0$.

Answer

[3]

- (ii) Solve $2x^2 + x - 14 = 0$.

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

- (iii) Explain why one of the answers in (b)(ii) needs to be rejected.

Answer

[1]

- 10 (a) The table below shows the utilities bill of the Lim family for a particular month.

Breakdown of Charges	Rate (\$)	Usage (per month)	Total cost (\$ per month)
Electricity Services	0.2794 / kWh	793 kWh	221.5642
Gas Services	0.2166 / kWh	70 kWh	
Water Services	1.21 / m ³	36.5 m ³	
Waterborne Fee	0.92 / m ³		
Water Conservation Tax	50% of charges for water service.		
Refuse Removal Fee	9 / Qty	1 Qty	

By completing the table above, calculate the total amount to be paid, after 8% GST, by the Lim family.

Answer \$..... [3]

- (b) The table below shows the electricity plan by various retailers per month. The Lim family is looking at getting a no contract or 12 months plan, comparing between SPgroup, Sembcorp and Senoko.

CHEAPEST ELECTRICITY RETAILERS (Per Month)			
RETAILERS	NO CONTRACT	6 MONTHS	12 MONTHS
 SPgroup	29.62¢/kWh	—	—
 Geneco Powered by YTL PowerSeraya	—	29.30¢/kWh	28.98¢/kWh
 Keppel Electric	—	—	31.10¢/kWh
 PacificLight	30.56¢/kWh + 55¢ daily fee	—	30.86¢/kWh
 sembcorp	—	—	29.61¢/kWh
 Senoko	—	29.30¢/kWh	28.98¢/kWh
 SUNSEAP	—	42.12¢/kWh	—
 TUEAS POWER	—	—	29.52¢/kWh

<https://blog.seedly.sg/electricity-retailer-comparison-cheapest-in-singapore/>

The table below also shows available deals for SPgroup, Sembcorp and Senoko.

Plan Retailer	No contract	12 months	Credit Card Deal
SPgroup			One time Cash Rebate of \$50
Sembcorp		22.5% off Additional One-time \$50 bill rebate	One time Cash Rebate of \$50
Senoko		19% off	One time Cash Rebate of \$50

Assuming the monthly electricity services usage is the same as **(a)**, determine which plan from which retailer would be the lowest cost for the Lim family if they use credit card to pay.

Show all your calculations and explain your answer clearly.

Answer

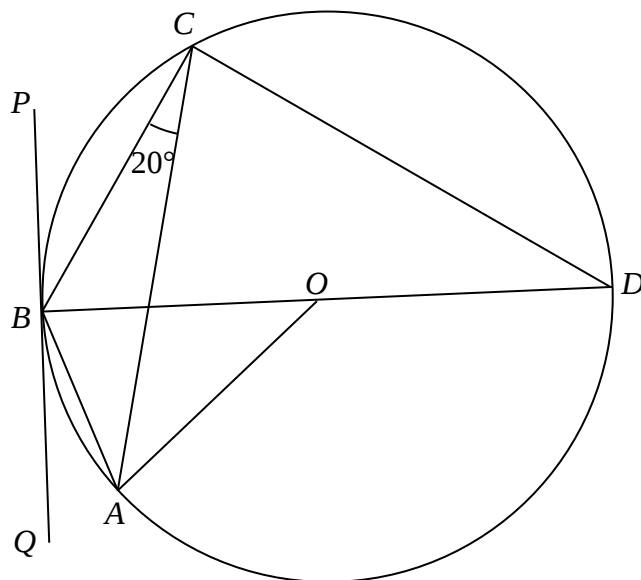
[Continue your Answer for Q10(c) on this page]

The Lim family should get the contract from [5]
(plan) (retailer)

Section B (8 marks)

Answer any **one** question from this section. Each question carries 8 marks.

11 (a)



A, B, C and D are points on a circle with centre O .

PQ is a tangent to the circle at B .

Angle $ACB = 20^\circ$.

Find

(i) angle ACD ,

Answer Angle $ACD = \dots\dots\dots^\circ$ [1]

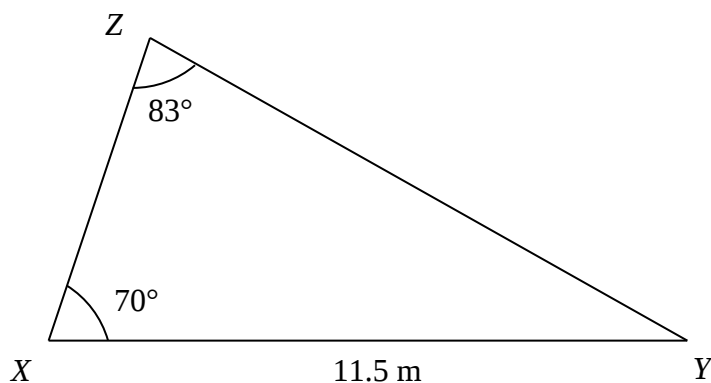
(ii) angle AOB ,

Answer Angle $AOB = \dots\dots\dots^\circ$ [1]

(iii) angle ABQ .

Answer Angle $ABQ = \dots\dots\dots^\circ$ [2]

- (b) The diagram shows three points, X, Y and Z on horizontal ground. $XY = 11.5$ m, angle $YXZ = 70^\circ$ and angle $XZY = 83^\circ$.



- (i) Find YZ.

Answer YZ = m [2]

- (ii) A bird is hovering 8 m vertically above Y.
Find the angle of elevation of the bird from X.

Answer $^\circ$ [2]

- 12 (a)** The stem-and-leaf diagram shows the time taken to travel to school every week by each student in a class of 12 students.

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

Key: 4 | 2 means 42 minutes

Find the

(i) median,

Answer min [1]

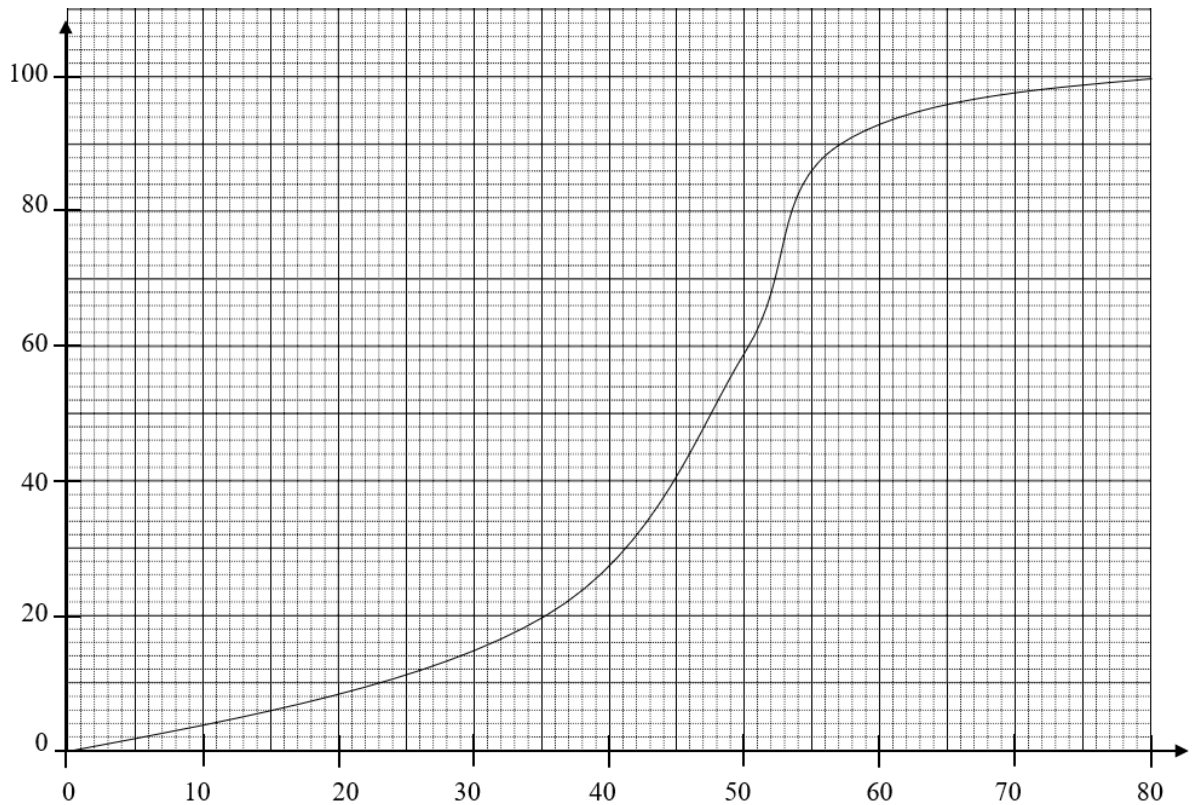
(ii) mean,

Answer min [1]

(iii) standard deviation.

Answer min [1]

- (b) The cumulative frequency graph shows the number of hours a group of 100 students spent on watching Youtube in June.



- (i) Use the diagram to estimate the median.

Answer h [1]

- (ii) Use the diagram to estimate the interquartile range.

Answer h [2]

- (iii) Two students are selected at random.
Find the probability that both students spent more than 55 hours watching Youtube.
Give your answer as a fraction in simplest form.

Answer [2]

End of Paper

2023 4N Prelim P1 MS

1	$\frac{3}{11}$ $\sqrt[3]{0.02}$ 0.25 $0.\dot{2}$	B2 Deduct 1 mark for each error
2a	$2 : 5$	B1
2b	$\frac{1200}{150} \times 100\%$ $= 800\%$	M1 A1
3	$-2x < -8$ $x > 4$ Smallest prime = 5	M1 A1
4	$P = \frac{k}{x^2}$ $20 = \frac{k}{(2.5)^2}$ $k = 125$ $P = \frac{125}{5^2}$ $= 5$	M1 A1
5a	Acute $x = \sin^{-1}(0.7) = 44.4$ Obtuse $x = 180 - 44.4 = 135.6^\circ$	B1
5b	$y = 180 - 123 = 57^\circ$	B1
6a	$m = 4(-5)^2 - 5$ $= 95$	B1
6b	$m = 4a^2 - 5$ $m + 5 = 4a^2$ $\frac{m+5}{4} = a^2$ $\pm \sqrt{\frac{m+5}{4}} = a$ $a = \pm \sqrt{\frac{m+5}{4}}$	M1 (isolate a^2) A1

7a	$x = 180 - 140 = 40$ They are interior angles between 2 parallel lines	B1 (mention interior and parallel)
7b	Angle a = 62 (base angles of isos tri) $Y = 180 - 62$ (interior angles, // lines) = 118	M1 A1 Deduct 1 mark if missing/ no reason
8	The trend may not be decreasing There are missing data for the months of March to June and August.	B2
9	$\frac{PQ}{7.5} = \frac{2x}{1.5x}$ $\frac{PQ}{7.5} = \frac{4}{3}$ PQ = 10 cm	M1 (or find scale factor = 4/3) A1
10	$x = 2(x + 3)$ $x = 2x + 6$ $-6 = x$ $x = -6$	M1 (expand) A1
11	$1592.19 = 1500(1 + \frac{r}{100})^5$ $1.06146 = (1 + \frac{r}{100})^5$ $1.06146^{\frac{1}{5}} = 1 + \frac{r}{100}$ $1.06146^{\frac{1}{5}} - 1 = \frac{r}{100}$ R = 1.20% (3sf)	M1 M1 (remove power 5) or attempt to solve A1
12ai	$405 = 3^4 \times 5$	B1
12aii	$HCF = 3^2 \times 5 = 45$	B1
12b	$Q^3 = (2^3 \times 5^{6n})^2$ $Q^3 = 2^6 \times 5^{12n}$ $Q = 2^2 \times 5^{4n}$	M1 A1
13	Remainder = 11/20 Food and shopping = 60% of (11/20) * 100% = 33%	M1 (find remainder) M1 (or find 40%) A1

14a	See BUY rate as bank is buying CAD 1 CAD = 1.0028 SGD 250 CAD = 250 x 1.0028 = 250.70 SGD	M1, A1																								
14b	See SELL rate as bank is selling JYP 100 JPY = 0.9447 SGD 500 SGD = 500/0.9447 X 100 = 52926.855 = 52927 JYP	M1 A1																								
15a	<table><tr><td>Pattern number</td><td>Black arrows</td><td>White arrows</td><td>Total</td></tr><tr><td>1</td><td>4</td><td>2</td><td>6</td></tr><tr><td>2</td><td>7</td><td>4</td><td>11</td></tr><tr><td>3</td><td>10</td><td>6</td><td>16</td></tr><tr><td>4</td><td>13</td><td>8</td><td>21</td></tr><tr><td>5</td><td>16</td><td>10</td><td>26</td></tr></table>	Pattern number	Black arrows	White arrows	Total	1	4	2	6	2	7	4	11	3	10	6	16	4	13	8	21	5	16	10	26	B1
Pattern number	Black arrows	White arrows	Total																							
1	4	2	6																							
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3	10	6	16																							
4	13	8	21																							
5	16	10	26																							
15bi	2n	B1																								
15bii	5n+1	B1																								
15c	5n + 1 = 615 5n = 614 n = 122.8 He is not correct as n is not a whole number when total has 615 arrows.	M1 A1																								
16a	$\frac{k - (-1)}{3 - k} = 3$ $\frac{k + 1}{3 - k} = 3$ $k + 1 = 9 - 3k$ $4k = 8$ $k = 2$ P is (2, -1)	M1 M1 or (attempt) to solve A1																								
16b	y = mx + c -3 = 3(5) + c -3 = 15 + c -18 = c y = 3x - 18	M1 A1																								

17a	<table border="1"> <tr> <td>16</td><td>20</td><td>24</td></tr> <tr> <td>20</td><td>25</td><td>30</td></tr> <tr> <td>24</td><td>30</td><td>36</td></tr> </table>	16	20	24	20	25	30	24	30	36	B2 Deduct 1 for each error
16	20	24									
20	25	30									
24	30	36									
17bi	P (prime) = $6/36 = 1/6$	B1									
17bii	P(at most 20) = $1-6/36 = 5/6$	B1									
17biii	P(irrational) = 0	B1									
18a	$x^2 - 6x - 16$ $= x^2 - 6x + \left(\frac{-6}{2}\right)^2 - 16 - \left(\frac{-6}{2}\right)^2$ $= (x-3)^2 - 25$ a = -3 and b = -25	M1 A1 OR B2									
18bi	x = 3	B1									
18bii	When y = 0, $(x-3)^2 - 25 = 0$ $(x-3)^2 = 25$ $x-3 = \pm\sqrt{25}$ $x = \pm\sqrt{25} + 3$ X = 8 or -2	M1 (solve) A1									
19a	No he is not correct as the line AB has a positive gradient so it should be upward sloping.	M1 (positive m) A1 (upward slope)									
19b	$x = \frac{-4+2}{2} = -1$ $y = -(-1+4)(-1-2) = 9$ Max pt (-1, 9)	M1 (find x coord) or any other method A1									
20a	$L = \sqrt{5^2 + 18^2} = \sqrt{349}$ Curved area = $\pi r L = \pi(5)(\sqrt{349})$ $= 293.4489707$ $= 293 \text{ cm}^2$	M1 M1 A1									
20b	$293.4489707 = \frac{\theta}{360} \times \pi(\sqrt{349})^2$ $\theta = 96.4 \text{ (1dp)}$	M1 A1									

	Or $\frac{1}{2}(\sqrt{349})^2 \theta = 293.4489707$ $\theta = 1.68\text{rad} = \frac{1.68}{\pi} \times 180^\circ$ $= 96.4^\circ$	
21	See construction	[4]

2023 4N Prelim P2 MS

1a	5.75 (3sf)	B1
1b	8.71×10^7	B1
1c	0.0543	B1
1d	$\frac{4x-1}{3} - \frac{3+x}{6}$ $= \frac{2(4x-1) - 3 - x}{6}$ $= \frac{8x-2-3-x}{6}$ $= \frac{7x-5}{6}$	M1 A1
2a	$49 \div 7^n = 7^5$ $7^2 \div 7^n = 7^5$ $7^{2-n} = 7^5$ $2-n=5$ $n=-3$	M1 (make all same base) A1
2b	$\left(\frac{8}{x^3}\right)^{-\frac{1}{3}} = \left(\frac{x^3}{8}\right)^{\frac{1}{3}}$ $= \frac{x}{2}$	M1 (make positive index or apply power of -1/3 into brackets) A1
3ai	$\cos \angle QPR = \frac{6}{10} = \frac{3}{5}$	B1
3aii	$\sin \angle PRT = \frac{6}{10} = \frac{3}{5}$	B1
3b	Area $= \frac{1}{2}(10)(3)\left(\frac{3}{5}\right) = 9 \text{ units}^2$ OR $\frac{1}{2}(3)(6) = 9$	B1
4a	$\frac{504-399}{504} \times 100\%$ $= 20\frac{5}{6}\%$	M1 A1
4b	Balance = 90% of 399 = 359.10 $\text{Int} = \frac{359.1(5)(1)}{100} = 17.955$	M1 M1

	$\text{Extra} = \frac{17.955}{399} \times 100\%$ $= 4.5\%$	A1
5ai	$25x^2 - 1 = (5x + 1)(5x - 1)$	B1
5aii	$4ax - 10x + 6ay - 15y$ $= 2x(2a - 5) + 3y(2a - 5)$ $= (2a - 5)(2x + 3y)$	M1 A1
5b	$\frac{1}{x+1} + \frac{1}{3-x} = 1$ $\frac{3-x+x+1}{(x+1)(3-x)} = 1$ $4 = 3x - x^2 + 3 - x$ $4 = -x^2 + 2x + 3$ $x^2 - 2x + 1 = 0$ $0 = (x-1)(x-1)$ $x = 1$	M1 (combine) M1 (obtain quad eqn/attempt) M1 (solve eqn) A1
6a	$XZ^2 = 5.2^2 = 27.04$ $XY^2 + YZ^2 = 4.5^2 + 2^2 = 24.25$ Since $XZ^2 \neq XY^2 + YZ^2$, the converse of Pythagoras' Theorem is not true. The triangle is not right angled triangle.	M1 (working) A1 (conclude stmt)
6b	$\cos \angle XZY = \frac{5.2^2 + 2^2 - 4.5^2}{2(5.2)(2)}$ $\angle XZY = \cos^{-1}(0.51875)$ $= 58.8^\circ \text{ (1dp)}$	M2 A1
7	See graph	[9]
8ai	Vol $= \pi(5)^2(8) - \frac{2}{3}\pi(5)^3$ $= 367 \text{ cm}^3 \text{ (3sf)}$	M1 (either formula) A1
8aii	Total area $= \pi(5)^2 + 2\pi(5)(8) + 2\pi(5)^2$ $= 487 \text{ cm}^2$	M1, M1 (cylinder & Hemis) A1
8b	Max = $8 \times 5 \times 1 = 40$	B1

10b	SP Group (no contract)	Total for a month = 29.62×793 = \$234.8866	Total over 12 mths = $234.8866 \times 12 - 50$ = 2768.6392	M1: SPgroup M1: Sembcorp M1: Senoko M1 A1
	Sembcorp (12 mth)	Total for a month = $\frac{100 - 22.5}{100} (29.61)(793)$ = 181.9757	Total over 12 mths = $181.9757 \times 12 - 100$ = 2083.7084	
	Senoko (12 mth)	Total for a month = $\frac{100 - 19}{100} (28.98)(793)$ = 186.1472	Total over 12 mths = $186.1472 \times 12 - 50$ = 2183.7664	
	Since the cost over 1 year is the cheapest for Sembcorp, Get the 12 months plan from Sembcorp.			
11ai	angle $ACD = 90^\circ - 20^\circ = 70^\circ$ (right angle in semicircle)			B1
11aii	Angle $AOB = 40^\circ$ (angle at centre = 2x angle at circumf)			B1
11aiii	Angle $OBA = (180-40)/2 = 70$ (base angles of isos tri) Angle $ABQ = 90-70 = 20$ (tan perp to rad)			M1 A1
11bi	$\frac{YZ}{\sin 70} = \frac{11.5}{\sin 83}$ $YZ = 10.8876 = 10.9 \text{ m (3sf)}$			M1 A1
11bii	$\tan \theta = \frac{8}{11.5}$ $\theta = 34.8 \text{ (1dp)}$			M1 A1
12ai	$\frac{36+38}{2} = 37$			B1
12aii	$\frac{448}{12} = 37\frac{1}{3}$			B1
12aiii	7.35 min			B1
12bi	47.5 h (also accept 48 h)			B1
12bii	$52.5 - 38.5 = 14 \text{ h}$ or $53 - 38.5 = 14.5 \text{ h}$			M1, A1
12biii	$>55 \text{ h} \rightarrow 100 - 86 = 14$ Prob = $\frac{14}{100} \times \frac{13}{99} = \frac{91}{4950}$			M1, A1