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Answer all the questions.

- 1 (a) Calculate $\frac{12.603 + \sqrt[3]{8 - 5 \times (-6.1)}}{2^3}$
Write down the first five digits on your calculator display.

Answer (a) [1]

- (b) Write your answer to part (a) correct to 3 significant figures.

Answer (b) [1]

- 2 Arrange the following in order of size, largest first.

$$\frac{33}{41}, \quad 0.803, \quad \sqrt{0.64}, \quad 0.52^{\frac{2}{7}}$$

Answer [2]
largest smallest

- 3 Factorise fully $\frac{4}{5}x^3 - \frac{1}{5}xy^2$

Answer [2]

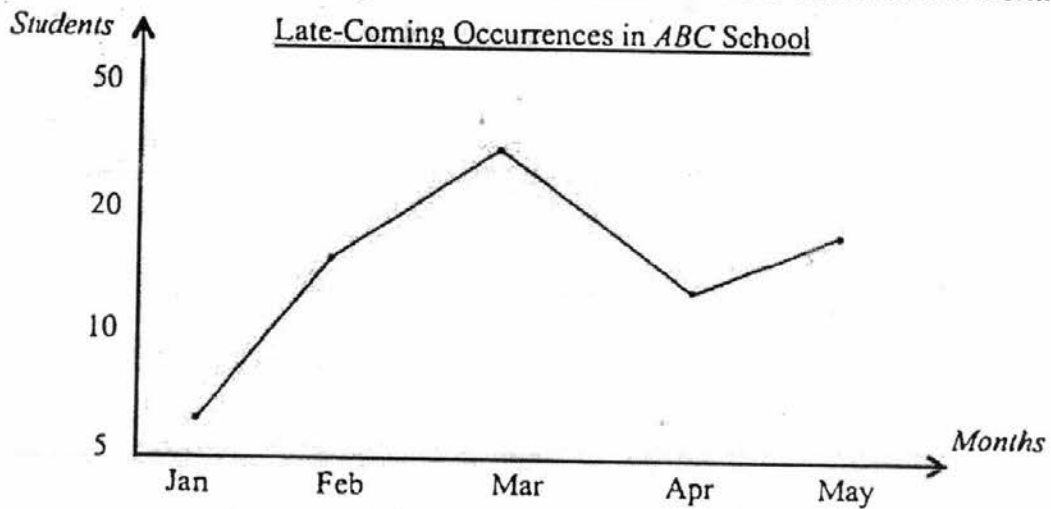
4 (a) Simplify $\left(\frac{y^{18}}{125}\right)^{-\frac{1}{3}}$.

Answer (a) [1]

(b) Given that $729^{\frac{1}{3}} \times 9 = 3^k$, find the value of k .

Answer (b) $k =$ [1]

- 5 The line graph shows the late coming occurrences of students in ABC School over 5 months.



Write down two statistical misrepresentations of this line graph.

Answer

1

2 [2]

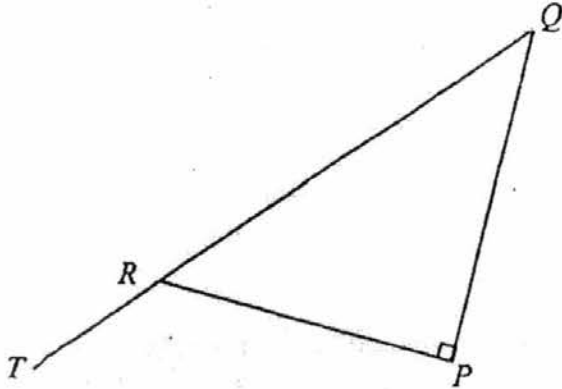
- 6 April, Bella and Chad shared a sum of money between them in the ratio 3 : 5 : 9.
If Chad gives Bella \$30, both of them will have an equal share.
What was the total sum of money that was shared amongst the three?

Answer \$ [2]

- 7 Simplify $4(x^2 + 3xy) - (2x - y)^2$.

Answer [2]

- 8 PQR is a right-angled triangle.
 QRT is a straight line. $PR = 12$ cm and $QR = 19$ cm.



Find the values of the following, giving your answer to 2 decimal places where necessary.

- (a) $\tan \angle PQR$

Answer (a) $\tan \angle PQR = \dots\dots\dots$ [2]

- (b) $\cos \angle TRP$

Answer (b) $\cos \angle TRP = \dots\dots\dots$ [1]

- 9 (a) Express 660 as the product of its prime factors.

Answer (a) $660 = \dots\dots\dots$ [1]

- (b) The lowest common multiple of 6, 12 and k is 660.
 Given that $k < 150$, find two possible values of k .

Answer (b) $k = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- 10 (a) $\xi = \{\text{integers } x : 1 \leq x < 18\}$
 $A = \{\text{prime numbers}\}$
 $B = \{\text{divisible by } 3\}$

(i) List the elements in A' .

Answer (a) $A' = \{\dots\dots\dots\}$ [1]

(ii) Find $n(A \cup B)$.

Answer (b) $n(A \cup B) = \dots\dots\dots$ [1]

- (b) Given that $P = \{\text{girls who play the guitar}\}$ and $Q = \{\text{girls who play the drums}\}$, describe what $P \cap Q = \{\}$ means.

Answer (b) $\dots\dots\dots$ [1]

- 11 Melissa jogs at a speed of 9 km/h.
 One evening she jogged around her neighbourhood for 1 hour 20 minutes.

(a) Given that the scale of the map of the neighbourhood is 1 : 25000, find, in cm, the map distance that she covered.

Answer (a) $\dots\dots\dots$ cm [2]

(b) A reservoir located in her neighbourhood occupies a total area of 1.68 cm² on the map. What is the actual area, in m², of the reservoir?

Answer (b) $\dots\dots\dots$ m² [2]

- 12 (a) Express $x^2 - 5x - 3$ in the form $(x - a)^2 + b$.

Answer (a) [2]

- (b) Hence solve $x^2 - 5x - 3 = 0$, giving your answers correct to two decimal places.

Answer (b) $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

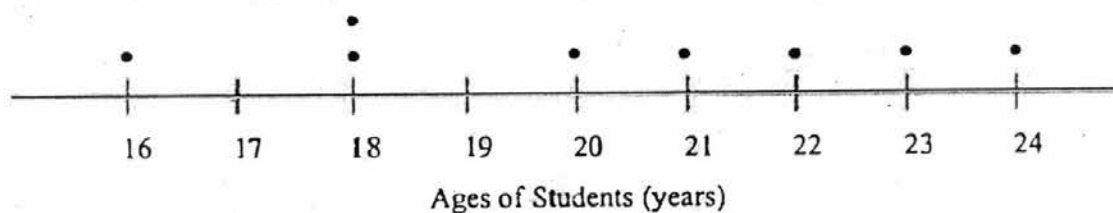
- 13 The table below shows the ages of 16 students who work part-time at a book shop.

20	21	16	18
22	17	19	24
23	22	17	22
24	19	19	18

- (a) Complete the dot diagram to show the distribution of the ages of the employees.

Answer (a)

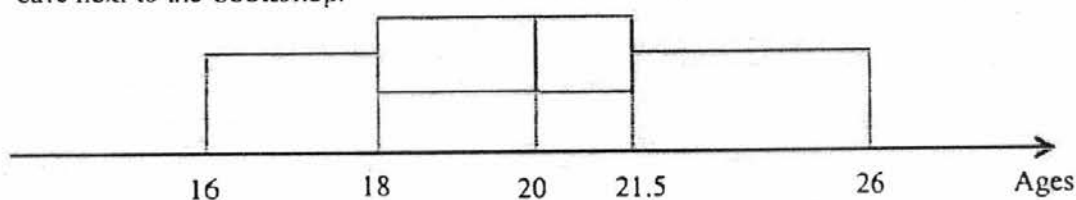
[1]



- (b) Find the median of the distribution of the ages.

Answer (b) Median = years [1]

- (c) The box-and-whisker diagram below shows the ages of another 16 students who work at a café next to the bookshop.



Explain, with statistical evidence, whether the following statement is TRUE or FALSE.
 "The ages of the 4 youngest students who work at the café are closer together than the ages of the 4 youngest students who work at the bookshop."

Answer (c)

[2]

The statement is because

.....

14 (a) The line l has equation $4x + 2y + 7 = 0$.

(i) Find the gradient of line l .

Answer (a)(i) gradient = [1]

(ii) Find the coordinates of the point where l cuts the y -axis.

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

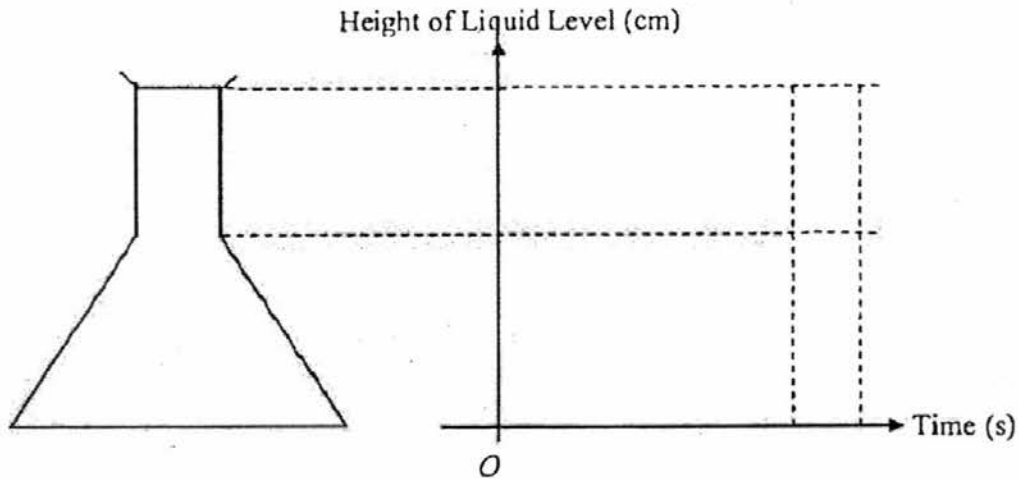
(b) Another line k is parallel to $y = \frac{1}{2}x + 5$ and it passes through the point $(8, 3)$.
Find the equation of line k .

Answer (b) [2]

- 15 (a) Mrs Ong pours water into a conical flask at a constant rate. She stops once the flask is filled to the brim as shown in the diagram below. Sketch a graph to show how the height of the water level changes with time.

Answer (a)

[2]



- (b) Electric power, P , in watt (W) is proportional to the square of the current, I , in amps (A). If $P = 0.8$ W when $I = 0.02$ A, find an equation for P in terms of I .

Answer (b) [2]

16 Given that $A = \begin{pmatrix} 7 & 5 \\ -2 & 3 \end{pmatrix}$, find

(a) A^2 ,

Answer (a) $A^2 = \dots\dots\dots$ [2]

(b) the value of x and of y if $3A - \begin{pmatrix} 15 & x \\ 2 & 0 \end{pmatrix} = \begin{pmatrix} 6 & 16 \\ y & 9 \end{pmatrix}$.

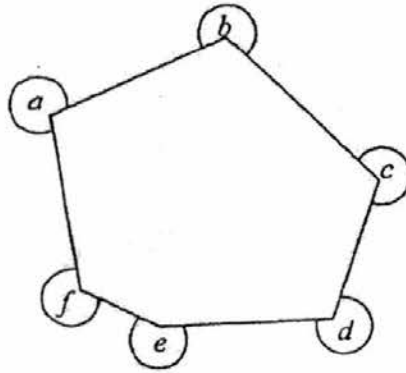
Answer (b) $x = \dots\dots\dots$ [1]

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

- 17 (a) Calculate the sum of the interior angles of a hexagon. Show your working clearly.

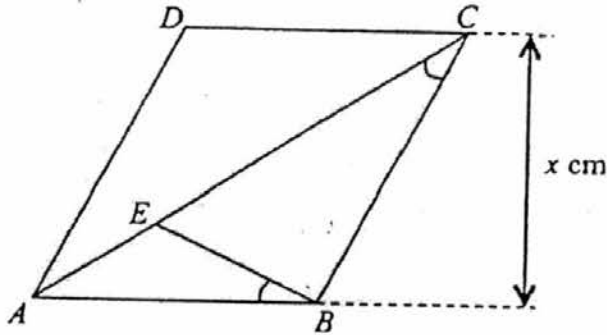
Answer (a) ° [2]

- (b) The diagram below shows a hexagon. Calculate the value of $a + b + c + d + e + f$.



Answer (b) ° [2]

- 18 In the diagram, $ABCD$ is a parallelogram. E is the point on AC such that angle $ACB =$ angle ABE . The vertical height of the parallelogram is x cm.



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

Answer (a)

.....

.....

..... [1]

- (b) Given that $AE = 4$ cm and $EC = 5$ cm, find the length of AB .

Answer (b) cm [2]

- (c) Parallelogram $ABCD$ is the cross-sectional face of a right prism with height 12 cm. Find the volume of the prism if $x = 9$.

Answer (c) cm^3 [2]

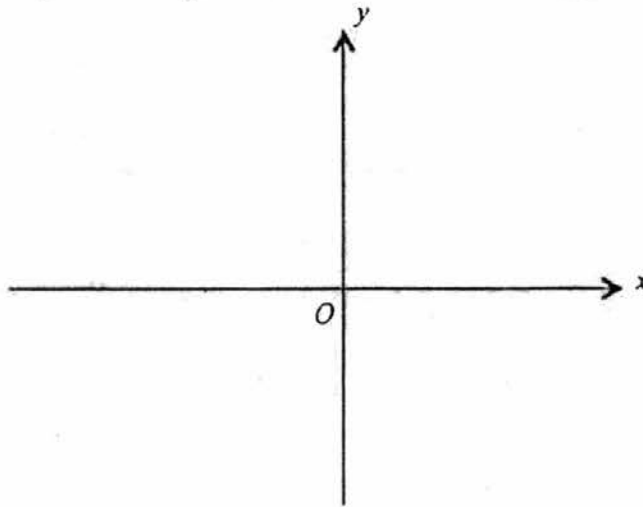
19 (a) (i) Solve $-(x-1)(x+3) = 0$.

Answer (a)(i) $x = \dots\dots\dots$ or $\dots\dots\dots$ [1]

- (ii) Sketch the graph of $y = -(x-1)(x+3)$.
Label clearly the intercepts with the axes and the turning point.

Answer (a)(ii)

[2]



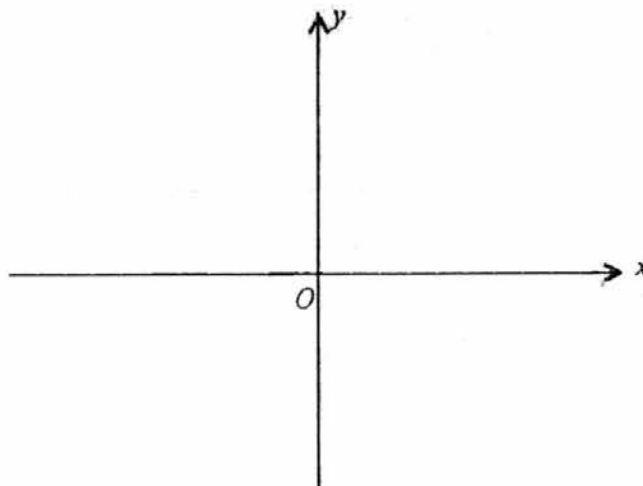
- (iii) State the equation of the line of symmetry of $y = -(x-1)(x+3)$.

Answer (a)(iii) $\dots\dots\dots$ [1]

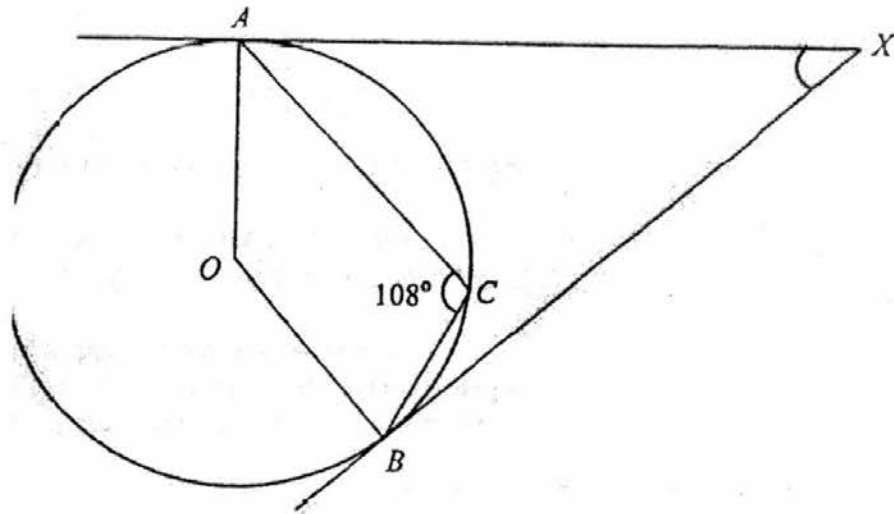
- (b) Sketch the graph of $y = -\frac{2}{x}$.

Answer (b)

[1]



- 20 (a) In the diagram, A , B and C are points on the circumference of the circle with centre O . AX and BX are tangents to the circle. Angle $ACB = 108^\circ$.



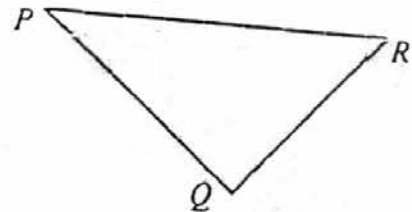
- (i) Find reflex angle AOB . Give a reason for your answer.

Answer (a)(i) Reflex angle $AOB = \dots\dots\dots^\circ$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (ii) Find angle AXB .

Answer (a)(ii) $\dots\dots\dots^\circ$ [2]

- (b) The diagram, not drawn to scale, shows a triangle with vertices P , Q and R . $PQ = 15$ cm, $QR = 8$ cm and $PR = 17$ cm.



Explain why P , Q and R lie on the circumference of a circle with diameter 17 cm.

Answer (b) $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$ [3]

21 The first four terms in a sequence of numbers, $T_1, T_2, T_3, T_4, \dots$, are given below.

$$T_1 = 3\left(\frac{4}{3}\right) - 1 = 3$$

$$T_2 = 3\left(\frac{4}{3}\right)^2 - 3 = \frac{7}{3}$$

$$T_3 = 3\left(\frac{4}{3}\right)^3 - 5 = \frac{19}{9}$$

$$T_4 = 3\left(\frac{4}{3}\right)^4 - 7 = \frac{67}{27}$$

(a) Write down an expression for T_5 and show that $T_5 = \frac{295}{81}$.

Answer (a) [1]

(b) Write down an expression for T_7 and evaluate it.

Answer (b) [1]

(c) Find an expression, in terms of n , for the n th term, T_n , of the sequence.

Answer (c) $T_n = \dots\dots\dots$ [2]

(d) Alvin claims that the value of the k th term, T_k , has a denominator of 1458.
Explain why Alvin is incorrect.

Answer (d) [1]

.....

.....

.....

- 22 You are out at sea in your sail boat Q searching for a precious treasure. You have to determine the location of the treasure quickly so that you can get hold of it before the other treasure hunters.



- (a) Boat A and boat B are closest to the buried treasure. The treasure lies on a point that is equidistant from boat A and boat B . Construct the line that the treasure is lying on. [1]
- (b) The treasure is located on a bearing of 30° from boat D . Mark the location of the treasure with a cross 'X'. [1]
- (c) You discover the treasure box and a note tells you that more treasure can be found within 10 m from 'X'. Draw and shade the area where additional treasure may be found. [1]

22 (continued from previous page)

- (d) In the treasure box that you discovered at point X , you found US\$ 12 000.
 The current exchange rate is S\$ 1 = US\$ 0.75.
 How much Singapore Dollars will you receive?

Answer (d) S\$ [1]

- (e) You decide to save the Singapore Dollars that you received, from (d), in a bank for 5 years.
 The following shows the savings plan from two different banks.
 Determine which bank you should choose to deposit your money in if you aim to receive as much money as possible at the end of 5 years.
 Support your answer with numerical evidence.

Bank Flourish	Bank Prosper
Plan: Simple Interest	Plan: Compound Interest
0.8% per annum	0.9% per annum
No bank fee	Bank fee to be deducted from account after 5 years = S\$ 88

Answer (e) I will choose Bank because

.....

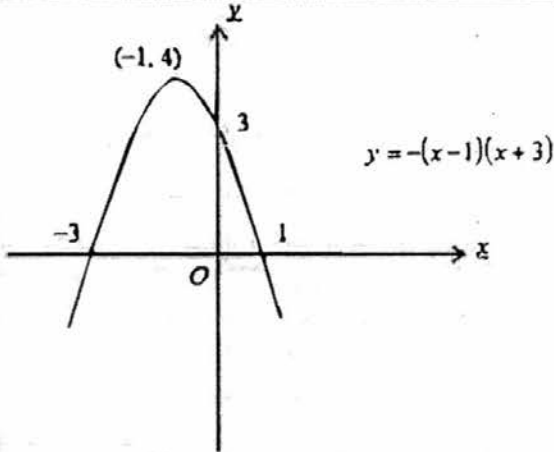
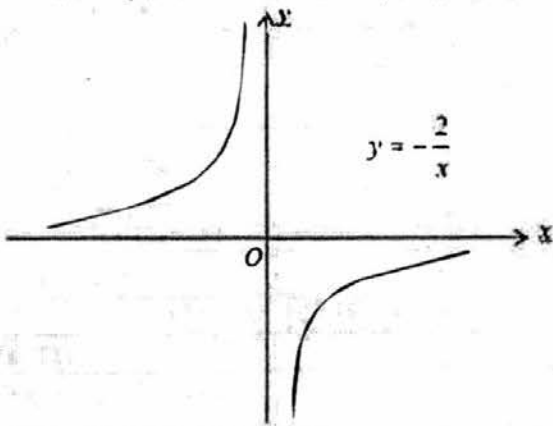
..... [3]


End of Paper

2016 Sec 4 Prelims Mathematics P1 (Answer Key)

Question	Solution
1(a)	1.9974
1(b)	2.00
2	$0.52^{\frac{2}{7}}, \frac{33}{41}, 0.803, \sqrt{0.64}$
3	$\frac{1}{5}x(2x + y)(2x - y)$
4(a)	$\frac{5}{y^6}$
4(b)	$k = 4$
5	<ul style="list-style-type: none"> It is not clear whether the vertical axis represents the number of students or the percentage of the students. The intervals between the values on the vertical axis are not equal. The vertical axis is truncated and does not start from zero.
6	\$255
7	$16xy - y^2$
8(a)	$\tan \angle PQR = 0.81$ (2 dp)
8(b)	$\cos \angle TRP = -\frac{12}{19}$
9(a)	$660 = 2^2 \times 3 \times 5 \times 11$
9(b)	55, 110
10(a)(i)	$A' = \{1, 4, 6, 8, 9, 10, 12, 14, 15, 16\}$
10(a)(ii)	$n(A \cup B) = 11$
10(b)	$P \cap Q = \{\}$ means that none of the girls play both the guitar and the drums.
11(a)	48 cm
11(b)	105000 m^2
12(a)	$\left(x - \frac{5}{2}\right)^2 - \frac{37}{4}$ or $(x - 2.5)^2 - 9.25$
12(b)	$x = \sqrt{\frac{37}{4}} + \frac{5}{2}$ or $x = -\sqrt{\frac{37}{4}} + \frac{5}{2}$ $= 5.54$ (2 dp) $= -0.54$ (2 dp)
13(a)	
13(b)	Median = $0.5(19 + 20) = 19.5$
13(c)	Lower quartile of ages (book shop) = 18 years Lower quartile of ages (café) = 18 years

Question	Solution
	The statement is <u>not true</u> because the lower quartiles are the same therefore <u>the ages of the 4 youngest students are equally close</u> for both the café and the book shop.
14(a)(i)	Gradient = - 2
14(a)(ii)	$\left(0, -\frac{7}{2}\right)$ or $\left(0, -3\frac{1}{2}\right)$ or $(0, -3.5)$
14(b)	equation of line k is $y = \frac{1}{2}x - 1$.
15a	<p style="text-align: center;">Height of Liquid Level (cm)</p> <p style="text-align: center;">Time (s)</p>
15(b)	$P = 2000J^2$
16(a)	$\begin{pmatrix} 39 & 50 \\ -20 & -1 \end{pmatrix}$
16(b)	$x = -1, y = -8$
17(a)	720°
17(b)	1440°
18(a)	$\angle ACB = \angle ABE$ (given) $\angle BAC = \angle EAB$ (common angle) Triangles ACB and ABE are similar.
18(b)	$AB = 6$ cm
18(c)	648 cm ³
19(a)(i)	$x = 1$ or -3

Question	Solution
19a(ii)	
19(a)(iii)	$x = -1$
19(b)	
20(a)(i)	<p>Reflex angle $AOB = 216^\circ$ because <u>angle at centre is twice angle at the circumference.</u></p>
20(a)(ii)	$\angle AXB = 36^\circ$
21(a)	$T_3 = 3\left(\frac{4}{3}\right)^3 - 9 = \frac{295}{81}$
21(b)	$T_7 = 3\left(\frac{4}{3}\right)^7 - 13 = \frac{6907}{729}$
21(c)	$T_n = 3\left(\frac{4}{3}\right)^n - (2n-1)$ or $T_n = 3\left(\frac{4}{3}\right)^n - 2n + 1$
21(d)	Alvin is incorrect because the denominator are all <u>powers of 3</u> , but 1458 is not a power of 3.

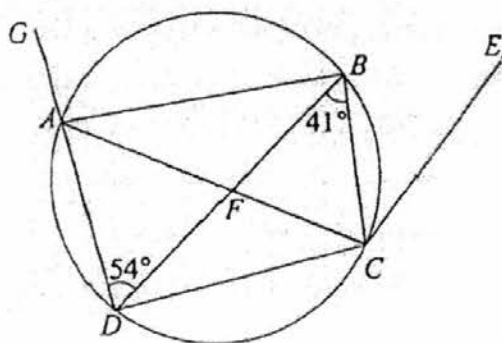
Question	Solution
22	<p>22. You are on the tiny, deserted boat <i>O</i> searching for a precious treasure. You have to determine the location of the treasure quickly so that you can get hold of it before the other treasure hunter.</p>  <p>(a) Boat <i>A</i> and boat <i>B</i> are closest to the buried treasure. The treasure lies on a point that is equidistant from boat <i>A</i> and boat <i>B</i>. Construct the line that the treasure lies on.</p> <p>(b) The treasure is located on a bearing of 30° from boat <i>B</i>. Mark the location of the treasure with a cross (X).</p> <p>(c) You discover the treasure box and a note tells you that there are three more buried around in an area that can be covered if you walk 10 m in all directions from where you have marked with a cross (X). Draw and shade this area where the additional treasure may be found.</p>
22(d)	S\$ 16 000
22(e)	I will choose Bank <u>Prosper</u> because <u>there is a greater amount of interest received/ the savings yield higher returns/ I will receive more money from Bank Flourish.</u>

Answer **all** the questions.

1 A path along Pasir Ris Park is 12 km long.

- (a) Darryl walks at an average speed of x km/h. Write down an expression, in terms of x , for the number of hours he takes to walk the entire path. [1]
- (b) Oliver walks at an average speed of $(x + 0.5)$ km/h. Write down an expression, in terms of x , for the number of hours he takes to walk the entire path. [1]
- (c) Darryl takes 10 minutes longer than Oliver to walk the entire path. Write down an equation in x , and show that it simplifies to $2x^2 + x - 72 = 0$. [2]
- (d) Solve the equation $2x^2 + x - 72 = 0$, giving the solutions correct to 3 decimal places. [3]
- (e) Oliver and Darryl took part in a 30 km relay walkathon, where each of them walked half the distance at the average speed stated in (a) and (b). Find the total time taken by them to complete the walkathon. [2]

- 2 In the diagram, AC is a diameter of the circle $ABCD$. AC and BD cut at F . DAG is a straight line. Angle $ADB = 54^\circ$ and angle $DBC = 41^\circ$.



- (a) Calculate, stating your reasons clearly,
- (i) $\angle BCF$, [1]
- (ii) $\angle BFC$, [1]
- (iii) $\angle BAC$, [1]
- (iv) $\angle BAG$. [2]
- (b) It is given that BD is parallel to CE . Lily says that CE is a tangent to the circle at point C . Explain, with calculations, why Lily is not correct. [1]

- 3 (a) The number of hours of sleep per night of a group of girls is recorded in the table shown below.

Number of hours	4	5	6	7	8	9
Frequency	5	6	7	2	x	6

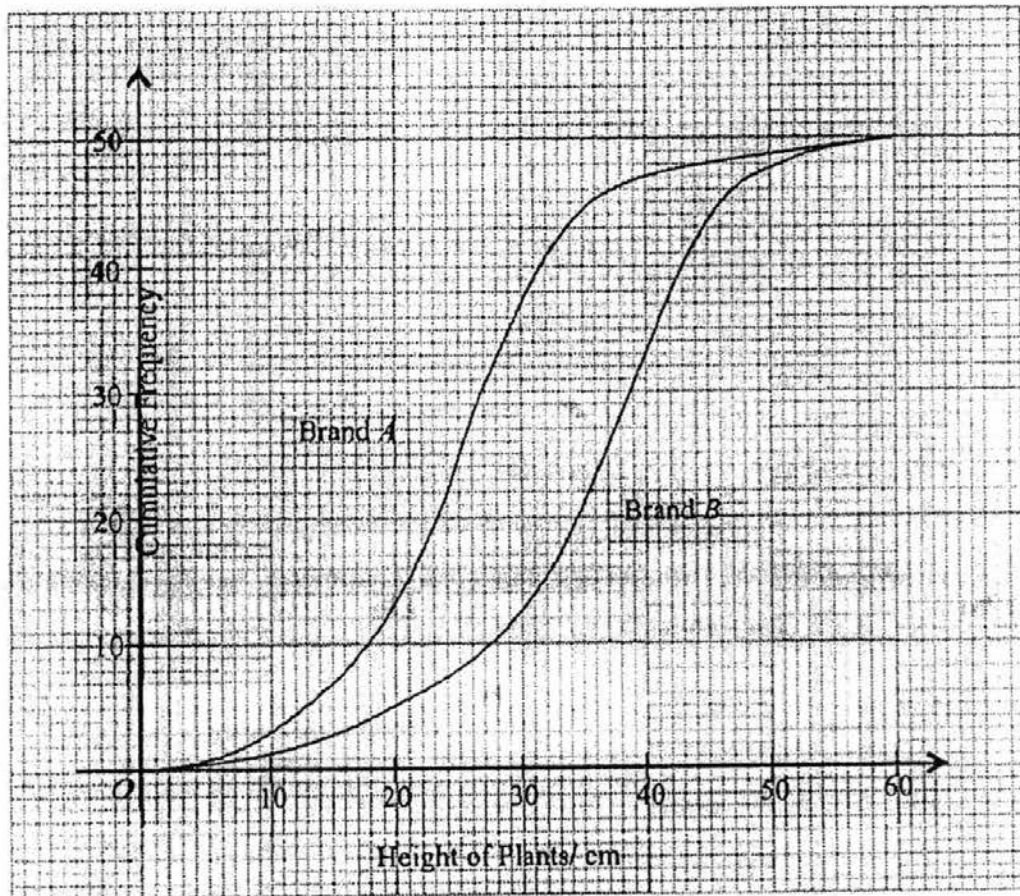
- (i) Given that the median is 6, find the largest possible value of x . [1]
- (ii) With the value of x found in (i), calculate
- (a) the mean number of hours of sleep, [1]
- (b) the standard deviation. [1]
- (iii) The number of hours of sleep per night of a group of boys is summarised below.

Mean	5.75
Standard Deviation	2.31

Make two comparisons between the number of hours of sleep per night by the two groups, using your answer found in (ii). [2]

- (b) A basket contains identical Easter eggs which are painted either blue or red in colour. There are 8 blue eggs and 3 red eggs.
- An egg is picked out at random and not replaced.
- A second egg is picked out at random and not replaced.
- (i) Find, as a fraction in its simplest form, the probability that
- (a) the first egg taken is red, [1]
- (b) the second egg is blue, given that the first egg is blue, [1]
- (c) one egg is red and the other is blue. [2]
- (ii) Some green eggs are added to the basket and two eggs are picked out at random. Given that the probability that no green eggs are picked is $\frac{11}{21}$, calculate the number of green eggs added. [3]

- 4 The diagram below is the cumulative frequency curve for the heights, in cm, of two batches of plants each of which was given Brand *A* and Brand *B* fertilizer respectively.



- (a) Use the graph for Brand *A* to estimate
- the median, [1]
 - the interquartile range, [2]
 - the number of plants whose heights are more than 36 cm. [1]
- (b) A plant is measured to be 24 cm tall with Brand *A* fertilizer. Use the two graphs to estimate this plant's height if it had been given Brand *B* fertilizer. [1]
- (c) State, with a reason, which you think is the better fertilizer. [1]

- 5 (a) A is the point $(3, -2)$, B is the point $(9, 6)$.
- (i) Write down the column vector \overrightarrow{AB} . [1]
- (ii) Calculate the value of $|\overrightarrow{AB}|$. [2]
- (iii) D is a point such that $\overrightarrow{AD} = 5\overrightarrow{BA}$. Find the coordinates of D . [2]

- (b) The table below shows the number of tubs of ice-cream of three flavours, sold at three shops.

	Vanilla	Chocolate	Strawberry
Moo	5	3	2
Cool	11	8	6
Icez	8	5	4

The cost price of a tub of Vanilla, Chocolate and Strawberry ice-cream is \$20, \$18 and \$15 respectively.

The cost is represented by the matrix $B = \begin{pmatrix} 20 \\ 18 \\ 15 \end{pmatrix}$.

- (i) Write down a 3×3 matrix A that represents the data in the table above. [1]
- (ii) Given that $P = AB$, evaluate P . [1]
- (iii) Explain what the elements in P represent. [1]

Moo makes a profit of 10%, Cool makes a profit of 15% and Icez makes a profit of 20%.

- (iv) Write down a matrix C given that the product CP gives the profit that each shop earns. [1]
- (v) Evaluate the matrix CP . [1]

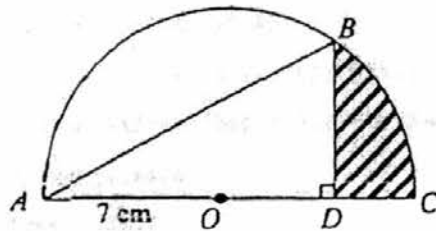
6 (a) Solve the inequality $\frac{x-1}{5} \geq \frac{3-x}{2}$. [2]

- (b) Express as a single fraction in its simplest form

$$\frac{3}{2x-1} + \frac{1}{1-3x} + \frac{1}{6x^2-5x+1}$$
 [4]

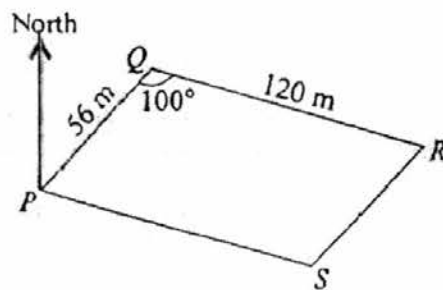
- (c) Given that $xy^2 + x^2 - 1 = x^2y^2 + 3y^2 - 3xy^2$, express y in terms of x . [4]

- 7 In the diagram, $OABC$ is a semi-circle, with centre O and radius 7 cm. The length of the arc BC is 5.24 cm.



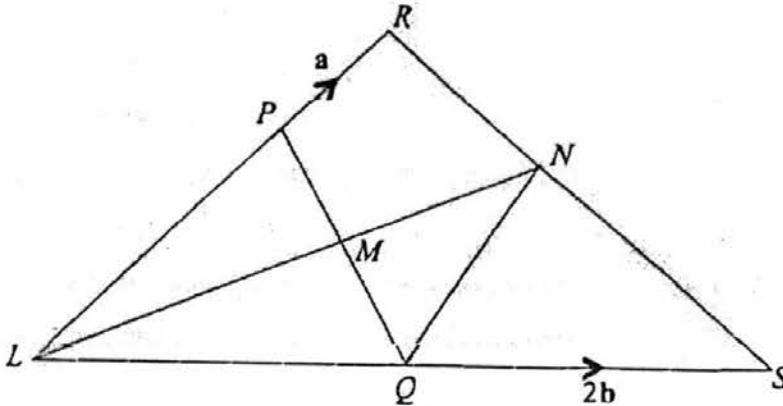
B is a point on the arc AC . The perpendicular from B to AC meets AC at D .

- (i) Find angle BOC in radians, giving your answer correct to 3 significant figures. [2]
 - (ii) Find the length of BD . [2]
 - (iii) Show that the length OD is approximately 5.13 cm. [1]
 - (iv) Find the area of the shaded region. [2]
- 8 The diagram shows P, Q, R and S , the four corners of a horizontal field $PQRS$. $PQRS$ is a parallelogram. The corner Q is 56 metres from P on a bearing of 034° , angle PQR is 100° and R is 120 metres from Q .



- (a) Calculate
 - (i) the bearing of R from Q , [2]
 - (ii) the length PR , [2]
 - (iii) the area of the field $PQRS$, [2]
 - (iv) angle QPR . [2]
- (b) An eagle was hovering at a height of 35 metres above the field. It spots its prey on the ground at an angle of depression of 58° . Calculate the distance that the eagle must fly to catch its prey. [2]

- 9 In the triangle LRS , the point P on LR is such that $RL = 3RP$. Q is the midpoint of LS and M is the midpoint of PQ . LM produced meets RS at N and $5LM = 7MN$.
 $\overrightarrow{PR} = \mathbf{a}$ and $\overrightarrow{QS} = 2\mathbf{b}$.



- (a) Express each of the following, as simply as possible, in terms of \mathbf{a} and /or \mathbf{b} ,
- \overrightarrow{PQ} , [1]
 - \overrightarrow{RS} , [1]
 - \overrightarrow{LM} . [2]
- (b) Show that $\overrightarrow{RN} = \frac{1}{7}(-9\mathbf{a} + 12\mathbf{b})$. [1]
- (c) Calculate the value of
- $\frac{RN}{NS}$, [1]
 - $\frac{\text{area of } \triangle LNQ}{\text{area of } \triangle QNS}$, [1]
 - $\frac{\text{area of } \triangle RLM}{\text{area of } \triangle NLS}$. [2]

10 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation $y = \frac{x^2}{4} + \frac{1}{x} - 3$.

The table below shows some values of x and the corresponding values of y , correct to 1 decimal place.

x	0.2	1	2	3	4	5	6.5	8
y	2.0	-1.8	k	-0.4	1.3	3.5	7.7	13.1

- (a) Find the value of k . [1]
- (b) Using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $0.2 \leq x \leq 8$.
Using a scale of 1 cm to 1 unit, draw a vertical y -axis for $-2 \leq y \leq 14$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) Use your graph to solve the equation $\frac{x^2}{4} + \frac{1}{x} = 3$. [2]
- (d) By drawing a tangent, find the gradient of the curve at the point (5, 3.5). [2]
- (e) By drawing a suitable straight line on your graph, solve $x^3 - 4x^2 - 16x + 4 = 0$. [3]

11



Diagram I

In the question, the hut can be modelled as a cylinder with a cone on top, as shown in Diagram I. The roof is the curved surface of a cone and is supported by a central vertical pole.

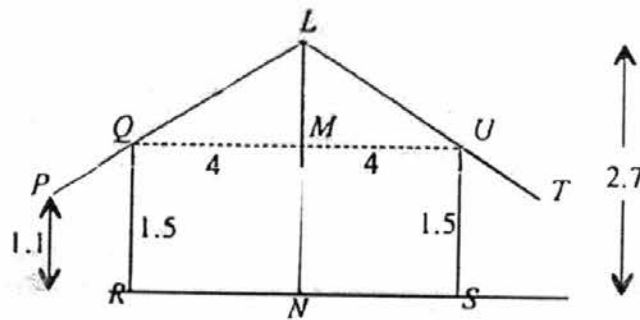


Diagram II

Diagram II shows a vertical cross-section of the hut. QU and RS are horizontal. Both P and T are 1.1 m vertically above the ground level. $LN = 2.7$ m, $QM = MU = 4$ m and $QR = US = 1.5$ m.

- (a) Calculate
- the volume of the interior of the hut, [3]
 - the surface area of the roof. [4]
- (b) At noon, the sun is directly above the hut. The shadow of the overhanging section of the roof on the ground is a circular ring around the hut. At this time of the day, a minimum shadow of 50 m^2 is needed to keep the family cool. The central vertical pole LN can be adjusted in height to change the area of the shadow formed by the roof. Explain why it is not possible to provide the family with the required 50 m^2 of shadow. [3]

END OF PAPER

2016 Secondary 4 Prelims Mathematics Paper 2 (Answer Key)

1a	$\frac{12}{x}$
1b	$\frac{24}{2x+1}$
1d	$x = 5.755$ or -6.255
1e	5.00 hours (3sf)
2ai	$\angle BCF = 54^\circ$ (\angle s in the same segment)
2aii	$\angle BFC = 85^\circ$ (\angle sum of Δ)
2aiii	$\angle BAC = 36^\circ$ (\angle in semi-circle)
2aiv	$\angle BAG = 103^\circ$ (ext \angle of cyclic quad)
2b	$\angle BCE = 41^\circ$ (alt \angle s) $\angle ACE = 54^\circ + 41^\circ = 95^\circ$ AC is not perpendicular to CE , hence CE is not tangent to the circle at C . (tan \perp rad)
3ai	9
3aiia	6.63 h
3aiib	1.73 h
3aiii	The girls sleep longer hours with a higher mean number of hours. The girls are also more consistent with a smaller standard deviation
3bia	$\frac{3}{11}$
3bib	$\frac{7}{10}$
3bic	$\frac{24}{55}$
3bii	4 green eggs added.
4ai	25 cm
4aii	10 cm (accept $30.5 - 19.5 = 11$)
4aiii	5
4b	35.5 cm (accept 36 cm)
4c	Brand B fertilizer is better as it has a higher median. Plants grow taller with Brand B.
5ai	$\begin{pmatrix} 6 \\ 8 \end{pmatrix}$
5aii	10 units
5aiii	$D(-27, -42)$

5bi	$\begin{pmatrix} 5 & 3 & 2 \\ 11 & 8 & 6 \\ 8 & 5 & 4 \end{pmatrix}$
5bii	$\begin{pmatrix} 184 \\ 454 \\ 310 \end{pmatrix}$
5biii	The total cost price incurred by each shop.
5biv	$\begin{pmatrix} 0.1 & 0 & 0 \\ 0 & 0.15 & 0 \\ 0 & 0 & 0.2 \end{pmatrix}$
5bv	$\begin{pmatrix} 18.4 \\ 68.1 \\ 62 \end{pmatrix}$
6a	$x \geq 2\frac{3}{7}$
6b	$\frac{3}{2x-1} - \frac{1}{3x-1} + \frac{1}{(3x-1)(2x-1)}$ $= \frac{3(3x-1) - (2x-1) + 1}{(3x-1)(2x-1)}$ $= \frac{9x-3-2x+1+1}{(3x-1)(2x-1)}$ $= \frac{7x-1}{(3x-1)(2x-1)}$
6c	$y = \pm \sqrt{\frac{x+1}{x-3}}$
7i	$\angle BOC = 0.749 \text{ rad (3sf)}$
7ii	$BD = 4.76 \text{ cm (3sf)}$
7iii	$OD = 5.13 \text{ cm (3sf)}$
7iv	Area of shaded region $= 6.12 \text{ sq cm (3sf)}$
8ai	Bearing of R from Q = 114°
8aii	$PR = 141 \text{ m (3sf)}$
8aiii	Area of field PQRS $= 6620 \text{ sq m (3sf)}$
8aiv	$\angle QPR = 57.0^\circ \text{ (1dp)}$
8b	41.3 m (3sf)

9ai	$-2a + 2b$
9aii	$-3a + 4b$
9aiii	\overline{LM} $= a + b$
9ci	$\frac{3}{4}$
9cii	1
9ciii	$\frac{\Delta RLM}{\Delta NLS} = \frac{7}{16}$
10a	-1.5
10b	See attached graph
10c	$x = 3.25$ (accept 3.2 – 3.3) or 0.4 (accept 0.3 – 0.5)
10d	Draws tangent at $x = 5$ and estimates (change in y)/(change in x) 2.3 – 2.6
10e	Add $y = x + 1$ $x = 0.25$ or 6.35
11ai	Volume of hut = 95.5 m^3 (3sf)
11aii	93.3 m^2 (3sf)
11b	It is not possible to have a shadow of 50 m^2 at noon.

