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MANJUSRI SECONDARY SCHOOL

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PRELIMINARY EXAMINATION 2017

Subject: Mathematics
Paper: 4048/01
Level: Secondary 4 Express / 5 Normal (Academic)
Date: 7 August 2017
Duration: 2 hours
Setter: Mr Lee Beng Huat

Candidates answer on the Question Paper
Additional materials: Geometrical Instruments

READ THESE INSTRUCTIONS FIRST

Write your Name, Register Number and Class on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, 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.

Calculators should be used 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.

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 brackets [] at the end of each question or part question.

The total number of marks for this paper is **80**.

Marks Obtained
80

This paper consists of 15 printed pages including this cover page.

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 (a) Estimate, correct to the nearest whole number, the value of $\frac{4.97^2 - \sqrt{15}}{\sqrt[3]{30}}$ without the use of a calculator.

Answer [1]

- (b) Write down the following in order of size, smallest first.

$$\sqrt{0.35} \quad 35\% \quad 3.5 \quad \frac{35}{53}$$

Answer [2]

- 2 (a) Solve $\frac{x}{3} + 15 = 9$.

Answer $x =$ [1]

- (b) Simplify $15(x-13) + 14(13-x)$.

Answer [2]

- 3 During a sale, there is a discount of 15% on all items selling in a shop. If the discounted price of a watch is \$182.75, find the original price of the watch before the discount.

Answer \$ [2]

- 4 (a) Simplify $18a^3b \div 6ab^{-3}$.

Answer [1]

- (b) Given that $\sqrt{2} \times 4^n = 1$, find the value of n .

Answer $n =$ [2]

- 5 $\xi = \{\text{integers } x : 11 \leq x < 19\}$
 $A = \{\text{multiples of } 3\}$
 $B = \{\text{prime numbers}\}$

List the elements in

- (a) A' ,

Answer [1]

- (b) $A' \cap B$,

Answer [1]

- (c) $(A \cup B)'$.

Answer [1]

- 6 Factorise completely $3ap + 8bq - 12aq - 2bp$.

Answer [2]

- 7 The plan of a museum is drawn to a scale of 1 : 500.

- (a) Find the length, in metres, of a corridor which is represented by a line 10.5 cm long on the plan.

Answer m [1]

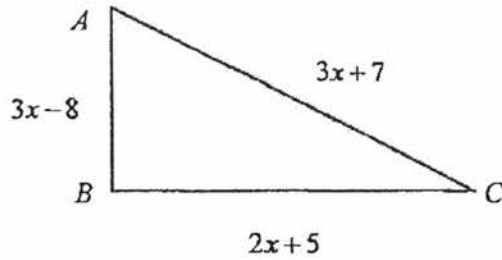
- (b) The area of the floor of a bookshop is 500 m^2 . Find, in square centimeters, its area on the plan.

Answer cm^2 [2]

- 8 After Pluto is no longer considered a planet, Mercury is now the smallest planet while Jupiter is still the biggest planet in our solar system.
Planet Mercury has a mass of $3.3 \times 10^{23} \text{ kg}$ and Jupiter has a mass of $1.898 \times 10^{27} \text{ kg}$.
How many times is the mass of Jupiter compare to the mass of Mercury?
Give your answer in standard form, correct to 3 significant figures.

Answer [2]

- 9 The diagram shows a triangle ABC .



- (a) One property of a triangle is that the length of the longest side must be less than the sum of the lengths of the two shorter sides.
Form an inequality in x and solve it.

Answer [2]

- (b) Given also that the perimeter of the triangle is no more than 85 cm.
Find the largest possible length of the longest side, given x is a prime number.

Answer cm [3]

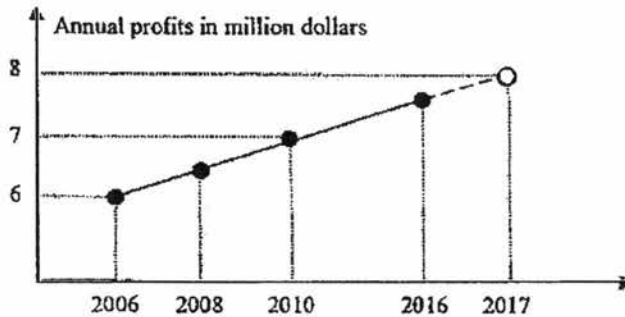
10 Write as a single fraction in its simplest form $\frac{x}{x^2 - 4} - \frac{2}{2 - x}$.

Answer [2]

11 Given that n is a positive integer and $n - \frac{1}{n} = 5$. Find the value of $n^2 + \frac{1}{n^2}$.

Answer [2]

12 The CEO used the following line graph to show the annual profits made by the company over a number years.



State one aspect of the graph that may be misleading and explain how the annual profits in 2017 can be projected wrongly.

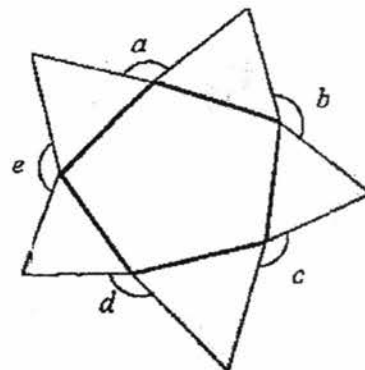
Answer

 [2]

- 13 Given that $x : y = 0.2 : 0.5$ and $y : z = \frac{1}{3} : \frac{1}{2}$, find $x : y : z$.

Answer [3]

- 14 The diagram shows a pentagon and five equilateral triangles. Calculate the sum of the angles a, b, c, d and e .



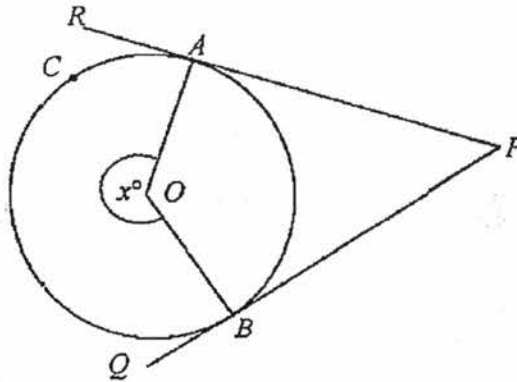
Answer [3]



- 15 Jane can make 8 dresses in 7 hours. Judy can make 7 dresses in 6 hours.
 If Jane and Judy continue to make dresses at the same rate, how long will it take them to make 20 dresses? Give your answer in hours and minutes, to the nearest minutes.

Answer hours minutes [3]

- 16 A, B and C are points on the circle centre O . PBQ and PAR are tangents to the circle. Reflex $\angle AOB = x^\circ$.



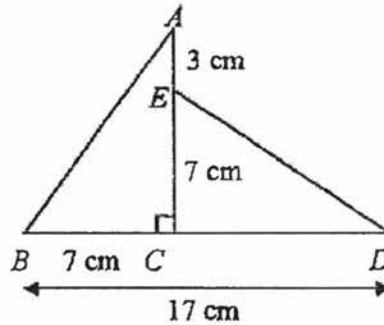
- (a) Given C is a point along the major arc AB , express $\angle ACB$ in terms of x .

Answer $\angle ACB =$ [2]

- (b) Express $\angle APB$ in terms of x .

Answer $\angle APB =$ [2]

- 17 In the diagram, $AE = 3$ cm, $EC = 7$ cm, $BC = 7$ cm and $BD = 17$ cm. Name a pair of congruent triangles, stating your case of congruency.



Answer

.....

.....

..... [3]

- 18 (a) Express 168 as a product of its prime factors.

Answer $168 = \dots\dots\dots$ [2]

- (b) Find the smallest positive integer m such that $\frac{168}{\sqrt{m}}$ is a perfect cube.

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

- (c) Alice uses all 168 cubes of side 1 unit to make a cuboid. Each of the sides of the cuboid is made up of more than 3 cubes. Find the number of cubes on each side of the cuboid.

Answer by by [2]

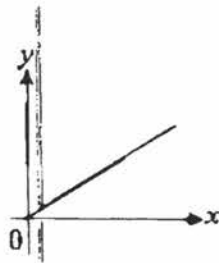


Figure 1

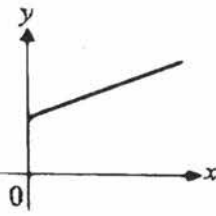


Figure 2

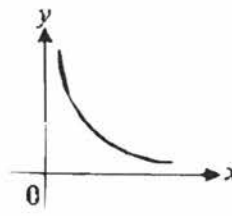


Figure 3

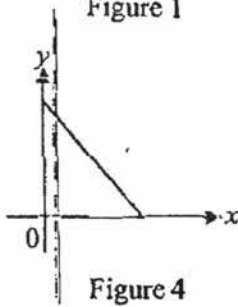


Figure 4

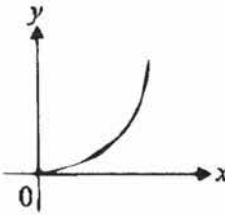


Figure 5

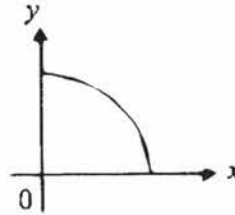


Figure 6

From the graphs above, select one which illustrates each of the following statements.

- (a) The amount of pressure y , exerted is inversely proportional to the surface area of a cube, of sides x cm.

Answer Figure [1]

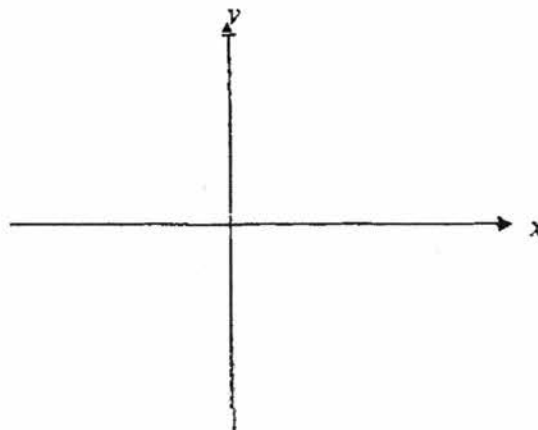
- (b) The surface area y , of a sphere is proportional to the square of the radius, x cm.

Answer Figure [1]

- (c) The total taxi fare $\$y$, of a fixed flag down fees plus x metres of distance travelled, given 1 cent is charged for every metre travelled.

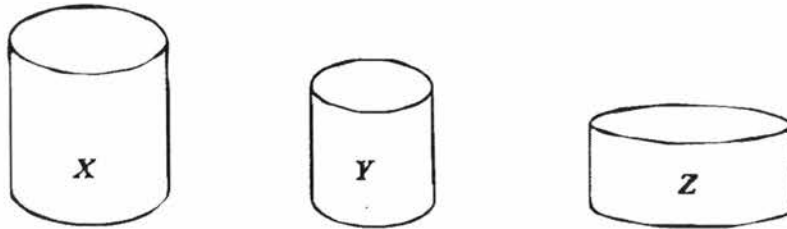
Answer Figure [1]

- 20 Sketch the graph of $y = (x + 3)(5 - x)$ on the axes below, indicating its turning point and all the intercepts on the axes clearly.



[3]

- 21 There are three mugs X , Y and Z . Mugs X and Y are geometrically similar. The volume of X and Y are 512 cm^3 and 216 cm^3 respectively.



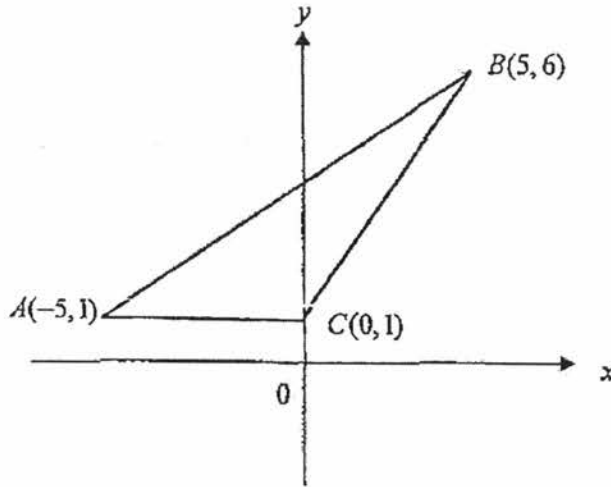
- (a) Find the ratio of the surface area of X to Y .

Answer : [2]

- (b) The volume of Y is given by the formula $V = \pi r^2 h$ where h is the height of the mug and r the radius of the circular base. Find the volume of Z which has $\frac{2}{3}$ the height of Y and twice the radius of the circular base of Y .

Answer cm^3 [2]

- 22 In the diagram, the vertices of a triangle A, B and C are $(-5, 1)$, $(5, 6)$ and $(0, 1)$ respectively.



Find

- (a) the equation of line BC ,

Answer [2]

- (b) the equation of the line which passes through A and is parallel to $3x + 6y = 5$,

Answer [2]

- (c) the area of the triangle ABC .

Answer units² [2]

- 23 A frustum and a cone were obtained by slicing a conical container, height $2h$, as shown in Diagram I at the midway of the height. These figures were then attached to a cylinder, height h , to form a new container as shown in Diagram II. Water was poured into the empty container in Diagram II at a constant rate from the top and it took 33 seconds to fill to the brim.

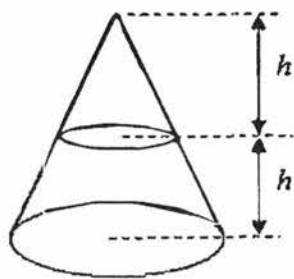


Diagram I

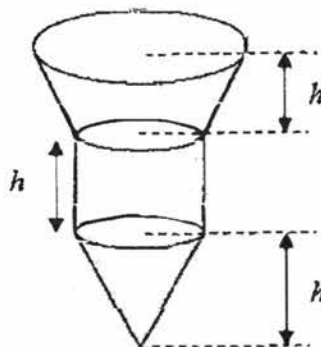


Diagram II

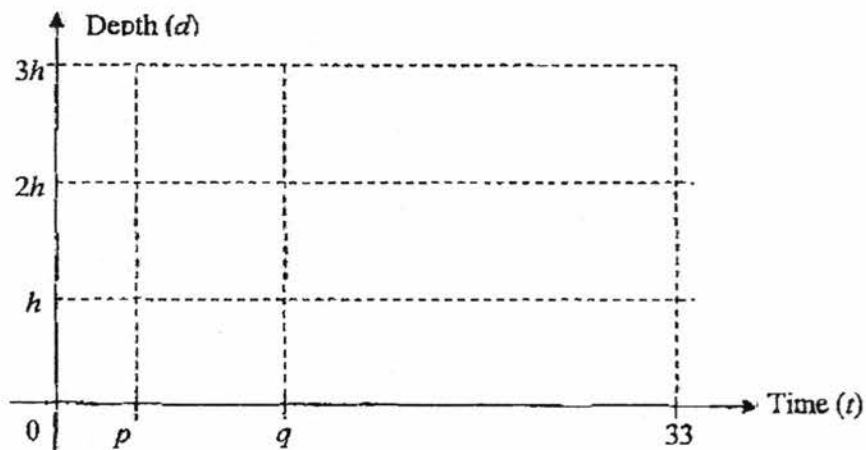
Given that it took p seconds for the water to reach the container to a height of h and q seconds to reach the height $2h$.

- (a) Find the value of p and of q .

Answer $p = \dots\dots\dots$, $q = \dots\dots\dots$ [3]

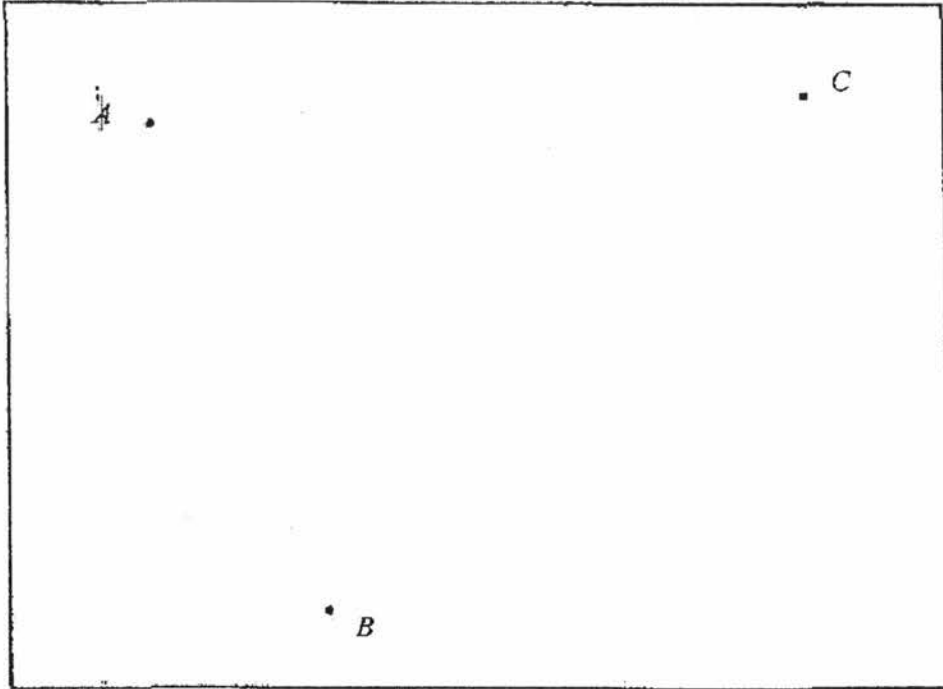
- (b) On the grid in the answer space, sketch the graph of the depth of water (d) against the time (t).

Answer



[2]

- 24 The diagram below is part of the scale drawing of a rectangular field showing the position of 3 soccer players, *A*, *B* and *C*. In the drawing, 1 cm represents 5 m.



- (a) The ball is placed in the field equidistant from *A* and *B* and 30 m from *C*. By constructing suitable lines and arcs in the answer space above, mark and label clearly the position of the ball *X*. [2]

- (b) Measure and state the distance between player *A* and the ball *X*.

Answer m [1]

- (c) Both players *A* and *C* are to run for the ball. Player *A* can run at a speed of 6 m/s while player *C*'s top speed is 7 m/s. Who will get the ball first? Show your working clearly.

Answer Player [2]

----- End of Paper -----

Answer all the questions.

- 1 (a) It is given that $H = \frac{k}{\sqrt{m-n}}$
- (i) Find H when $k = 12$, $m = 6$ and $n = -3$. [1]
- (ii) Express n in terms of H , k and m . [2]
- (b) Simplify $\frac{9a^2b}{(2a)^2} \div \frac{12ab^3}{8b^5}$, leaving your answer in positive indices. [2]
- (c) Solve the equation $\frac{5}{x+7} + \frac{4}{11-x} = 1$. [3]
- (d) Solve the following simultaneous equations:
- $$\begin{aligned} 5x - 3y &= 22 \\ y - 4x + 12 &= 0 \end{aligned}$$
- [3]

- 2 (a) Alex needs a loan of \$45 000 to buy a new car.
Bank ABC charges an interest rate of 2.45% per annum compounded monthly.
Bank XYZ charges a simple interest rate of 2.65% per annum.
- If Alex plans to take a five year loan, which bank should he loan from?
Justify your answer. [4]
- (b) Alex buys the new car on hire purchase. He uses the \$45 000 loan to pay the 30% down payment and then makes monthly payments of \$1950 for 5 years.
- (i) Calculate the cash price of the new car. [1]
- (ii) Calculate the interest Alex has to pay in this hire purchase scheme. [2]
- (iii) Calculate the rate of simple interest charged for hire purchase.
Leave your answer in 3 decimal places. [1]
- (c) Alex took his new car for a road trip from Singapore to Bangkok.
Before the trip, Alex paid S\$109 for 50 litres of petrol to fill up the tank.
In Bangkok, Alex paid a total of 9 408 Thai bahts for 320 litres of petrol he pumped into his car.
- Given S\$1 = 24.5 Thai bahts.
- Alex said that the petrol price in Bangkok is less than half the petrol price in Singapore.
Do you agree? Justify your answer. [3]

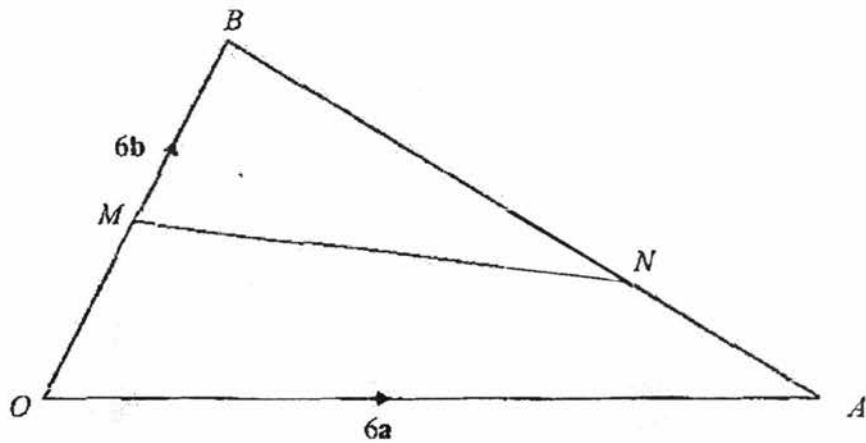
3 (a) Given $\overrightarrow{PQ} = \begin{pmatrix} -7 \\ 24 \end{pmatrix}$ and $\overrightarrow{PS} = \begin{pmatrix} k \\ 12 \end{pmatrix}$.

(i) Find $|\overrightarrow{PQ}|$. [1]

(ii) Find the value of k such that P , Q and S are collinear. [2]

(iii) Find the coordinates of Q if P is the point $(10, -15)$. [1]

(b) In the diagram, $\overrightarrow{OA} = 6\mathbf{a}$, $\overrightarrow{OB} = 6\mathbf{b}$ and $3\overrightarrow{AN} = \overrightarrow{AB}$. M is the mid-point of OB .



Express, as simply as possible, in terms of \mathbf{a} and/or \mathbf{b} ,

(i) \overrightarrow{AN} , [1]

(ii) \overrightarrow{ON} , [1]

(iii) \overrightarrow{NM} . [1]

P is a point not shown in the diagram such that $\overrightarrow{MP} = 3\overrightarrow{MN}$.

(iv) Find the position vector of P . [1]

(v) Make two statements about the points O , A and P . [2]

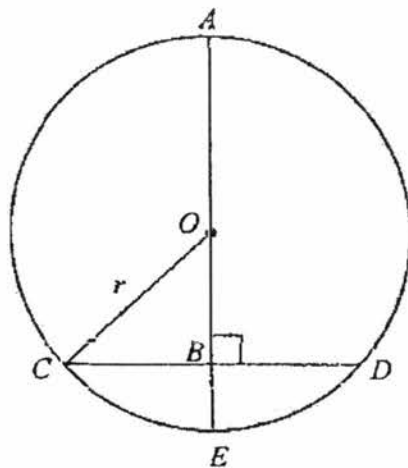
Calculate the value of

(vi) $\frac{\text{area of } \triangle AMN}{\text{area of } \triangle BMN}$, [1]

(vii) $\frac{\text{area of } \triangle BMN}{\text{area of } \triangle BOA}$. [1]

- 4 A photocopier prints pages in either 'black and white' or in 'colour'.
- (a) In one minute, this photocopier prints x pages in black and white. Write down an expression in terms of x , for the number of seconds it takes to print one page in black and white. [1]
- (b) In one minute, this photocopier prints 2 more copies in black and white than it does in colour. Write down an expression, in terms of x , for the number of seconds it takes to print one page in colour. [1]
- (c) It takes 1.2 seconds longer to print one page in colour than it takes to print one page in black and white. Form an equation in terms of x and show that it reduces to $x^2 - 2x - 100 = 0$. [3]
- (d) Solve the equation $x^2 - 2x - 100 = 0$, leaving your answers in 2 decimal places. [2]
- (e) Hence, find the time taken in minutes and seconds to print 85 pages in colour. Give your answer corrected to the nearest second. [2]

- 5 The diagram shows a circle, centre O and radius r cm. AB is perpendicular to the CD . Given that $AB = 9$ cm and $CD = 6$ cm.



- (a) Express OB in terms of r . [1]
- (b) Show that the radius of the circle = 5 cm. [3]
- (c) Calculate the area of the minor segment CDE . [4]

- 6 (a) The first four terms in a sequence of numbers, $u_1, u_2, u_3, u_4, \dots$, are given below

$$u_1 = 1^2 + 1 = 2$$

$$u_2 = 2^2 + 3 = 7$$

$$u_3 = 3^2 + 5 = 14$$

$$u_4 = 4^2 + 7 = 23$$

- (i) Write down an expression for u_5 and show that $u_5 = 34$. [1]
- (ii) Find an expression, in terms of n , for u_n . [2]
- (iii) Evaluate u_{30} . [1]
- (b) A toy manufacturing company makes toy boats and toy cars.
The following table is used in calculating the cost of manufacturing each toy boat and toy car.

	Labour (hours)	Wood (blocks)	Paint (tins)
Boat	6	4	5
Car	4	2	3

This information can be represented by the matrix $T = \begin{pmatrix} 6 & 4 & 5 \\ 4 & 2 & 3 \end{pmatrix}$.

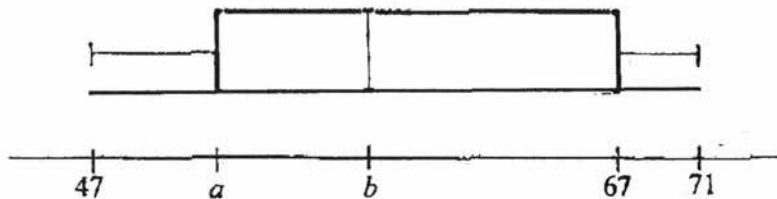
- (i) Labour cost \$8 per hour, wood cost \$5 per block and paint costs \$3 per tin.
Represent the cost by a 3×1 column matrix C . [1]
- (ii) Evaluate the matrix $V = TC$. [2]
- (iii) State what the elements of V represent. [1]
- (iv) Given that $W = (80 \ 50)$,
evaluate WV and explain what the answer represents. [2]
-

- 7 The stem and leaf diagram below shows the mass of 21 students.

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

Key : 5|2 means 52 kg

- (a) Find
- the modal mass, [1]
 - the percentage of students more than 62 kg. [1]
- (b) The box-and-whisker plot for the above distribution is shown below.



- Write down the value of a and of b . [2]
 - Find the interquartile range. [1]
- (c) Two students are selected from the group.
Calculate the probability that only one student is at least 50 kg. [2]

- 8 The diagram shows three markers A , B and C placed on a horizontal ground. The marker A is 250 m from C and the marker B is 400 m due West from A . Angle $BAC = 65^\circ$

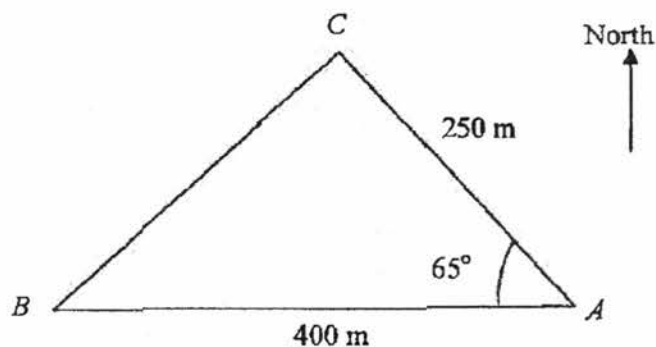
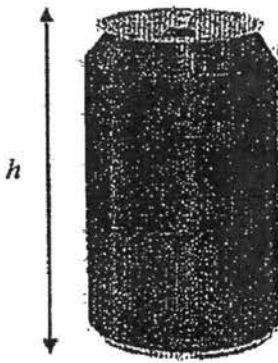
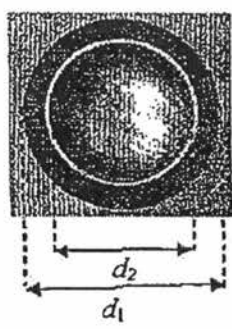


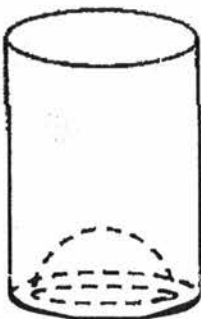
Diagram is not drawn to scale

- (a) Calculate
- (i) the length BC , [3]
 - (ii) the area of the triangle ABC , [2]
 - (iii) the angle ABC and [2]
 - (iv) the bearing of C from B . [1]
- (b) An eagle is hovering vertically above A .
The angle of elevation of the eagle from B is 18° .
Find the angle of depression of C from the eagle. [3]

- 9 Some information about a soda can is shown below.

<p>Soda Can</p> <p>Height (h): 11.4 cm</p> <p>Outer Diameter (d_1): 6.4 cm</p> <p>Inner Diameter (d_2): 5.0 cm</p>	 <p>Side view</p>	 <p>Bottom view</p>
<p>Density of soda: 1.2 g/cm³</p> <p>Safety Information: the soda can is to be filled to a maximum of 95% of its total volume.</p>		

In this question, the soda can (above) can be modelled as a cylinder with an inner hemisphere that is hollowed inwards (concave) at the base of the can.



- (a) Calculate
- the base area, in square centimetres, of the soda can and [2]
 - the total volume, in cubic centimetres, of the soda can. [2]
- (b) The material used to make the wall of the soda can must be carefully chosen such that the total mass of each filled soda can is below 620 g.
- The manager of the soda manager proposed to use an alloy which has a mass of 0.8 g for every 1 cm² to make the can.
- If the thickness of the soda can is negligible, will you accept his proposal?
- Justify your answer with suitable calculation.

[6]

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

The table below gives the values of x and y connected by the equation $y = \frac{x^2}{6} + \frac{12}{x} - 6$.

The table below shows some corresponding values of x and y .

x	1	1.5	2	3	4	5	6	7
y	6.2	2.4	0.7	-0.5	-0.3	0.6	k	3.9

- (a) Calculate the value of k . [1]
- (b) Using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $0 \leq x \leq 8$.
Using a scale of 2 cm to 1 unit, draw a vertical y -axis for $-1 \leq y \leq 7$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) By drawing a tangent, find the gradient of the curve at $x = 1.5$. [2]
- (d) (i) On the same axes, draw the line $y = \frac{x}{6}$. [1]
(ii) Write down the x -coordinate of the points where the line intersects the curve. [2]
(iii) These values of x is a solution of the equation $x^3 - x^2 + Ax + B = 0$.
Find the value of A and value of B . [2]

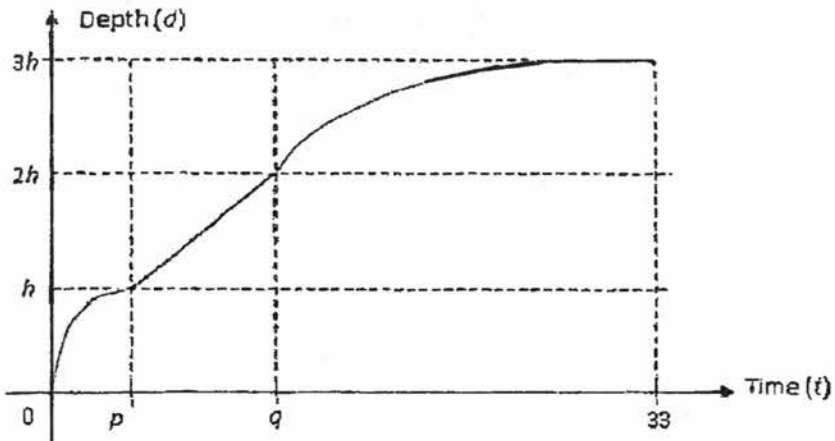
... End of Paper 2 ...

**Manjusri Secondary School
Preliminary Examination 2017
Elementary Mathematics 4048 Paper 1
Answer key**

1(a)	7
1(b)	35%, $\sqrt{0.35}$, $\frac{35}{53}$, 3.5
2(a)	-18
2(b)	$x - 13$
3	\$215
4(a)	$3a^2b^4$
4(b)	$\frac{1}{4}$
5(a)	11, 13, 14, 16, 17
5(b)	11, 13, 17
5(c)	14, 16
6	$(3a - 2b)(p - 4q)$
7(a)	52.5 cm
7(b)	3.6cm
	20 cm^2
8	5.75×10^3
9(a)	$x > 5$
9(b)	28 cm
10	$\frac{3x+4}{(x+2)(x-2)}$ or $\frac{3x+4}{x^2-4}$
11	27
12	Data from Year 2007, 2009, 2011 to 2015 are missing. The scale in horizontal axis is not consistent. The line graph may not be sloping upward as it seem to be.
13	4 : 10 : 15
14	660°

15	8 hours 40 minutes
16(a)	$\frac{1}{2}(360^\circ - x)$ or $180^\circ - \frac{1}{2}x$
16(b)	$x - 180^\circ$
17	$BC = EC = 7 \text{ cm}$ $CD = CA = 10 \text{ cm}$ $\angle ACB = \angle DCE = 90^\circ$ $\therefore \triangle ABC \cong \triangle DEC \text{ (SAS)}$
18(a)	$2^3 \times 3 \times 7$
18(b)	441
18(c)	$4 \times 6 \times 7$
19(a)	Figure 3
19(b)	Figure 5
19(c)	Figure 2
20	
21(a)	16 : 9
21(b)	576 cm^2
22(a)	$y = x + 1$
22(b)	$y = -\frac{1}{2}x - \frac{3}{2}$ or $2y = -x - 3$
22(c)	12.5 units^2
23(a)	$p = 3, q = 12$

23(b)

24(b) 25 ± 0.5 m

24(c) Player A

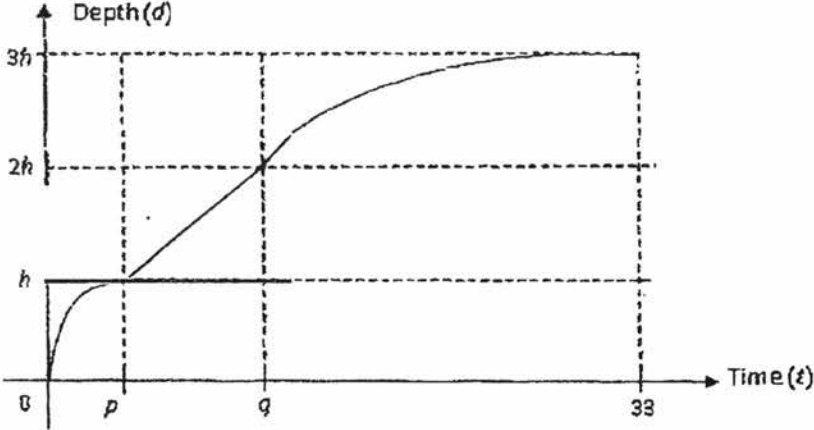
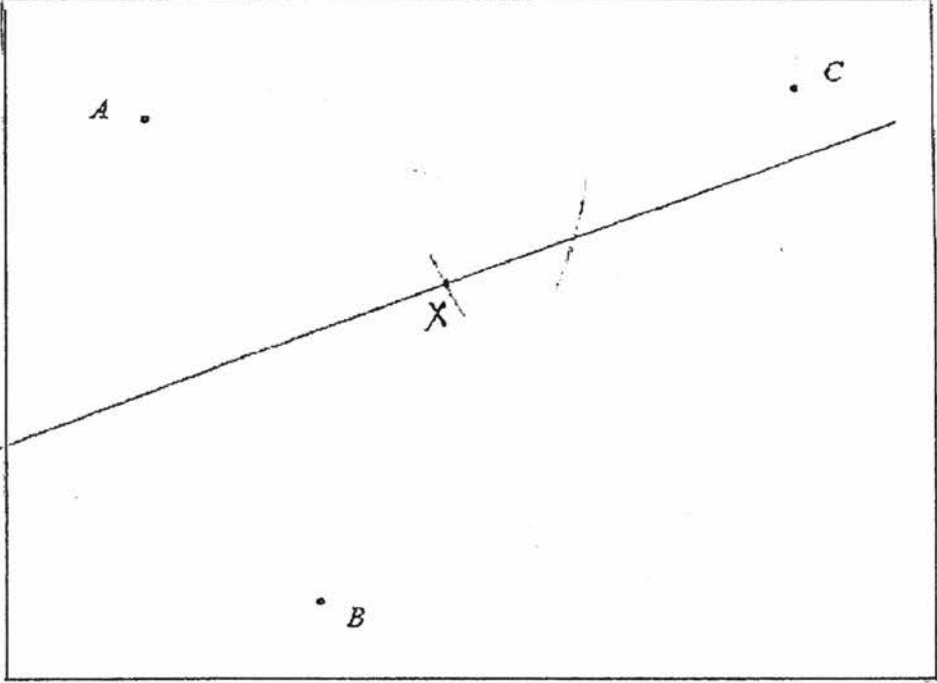
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Preliminary Examination 2017
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Elementary Mathematics 4048 Paper 1
Marking Scheme

1 (a)	$\frac{5^2 - \sqrt{16}}{\sqrt[3]{27}} = 7$	B1
1 (b)	$\sqrt{0.35} \approx 0.59$ $35\% = 0.35$ $\frac{35}{53} \approx 0.66$ $35\%, \sqrt{0.35}, \frac{35}{53}, 3.5$	M1 A1
2 (a)	$x + 45 = 27$ $x = -18$	B1
2 (b)	$15(x - 13) - 14(x - 13)$ $= x - 13$	M1 A1
3	$\frac{100}{85} \times 182.75$ $= \$215$	M1 A1
4 (a)	$3a^2b^4$	B1
4 (b)	$2^{\frac{1}{2}} \times 2^{2n} = 2^0$ $\frac{1}{2} + 2n = 0$ $n = -\frac{1}{4}$	M1 A1
5 (a)	11, 13, 14, 16, 17	B1
5 (b)	11, 13, 17	B1
5 (c)	14, 16	B1
6	$3ap - 12aq + 8bq - 2bp$ $= 3a(p - 4q) + 2b(4q - p)$ $= (3a - 2b)(p - 4q)$	M1 A1

7 (a)	$1 \text{ cm} : 500 \text{ cm}$ $1 \text{ cm} : 5 \text{ m}$ $10.5 \text{ cm} : 10.5 \times 5 = 52.5 \text{ m}$	B1
7 (b)	$1 \text{ cm}^2 : 25 \text{ m}^2$ $500 \text{ m}^2 : \frac{500}{25} = 20 \text{ cm}^2$	M1 A1
8	$\frac{1.898 \times 10^{27}}{3.3 \times 10^{23}} \approx 5751$ $= 5.75 \times 10^3$	M1 A1
9 (a)	$3x - 8 + 2x + 5 > 3x + 7$ $x > 5$	M1 A1
9 (b)	$(3x - 8) + (2x + 5) + (3x + 7) \leq 85$ $x \leq 10\frac{1}{8}$ Largest possible length = $3 \times 7 + 7 = 28 \text{ cm}$	M1 B1 A1
10	$\frac{x}{x^2 - 4} + \frac{2}{x - 2}$ $= \frac{x + 2(x + 2)}{(x + 2)(x - 2)}$ $= \frac{3x + 4}{(x + 2)(x - 2)}$ or $\frac{3x + 4}{x^2 - 4}$	M1 A1
11	$(n - \frac{1}{n})^2 = n^2 - 2 + \frac{1}{n^2}$ $n^2 + \frac{1}{n^2} = 5^2 + 2$ $= 27$	M1 A1
12	Data from Year 2007, 2009, 2011 to 2015 are missing. The scale in horizontal axis is not consistent. The line graph may not be sloping upward as it seem to be. (Do not accept: the vertical axis does not start from 0)	B1 B1
13	$x : y = 2 : 5$ $y : z = 2 : 3$ $x : y : z = 4 : 10 : 15$	B1 B1 B1

14	<p>Sum of interior angles in pentagon = $(5 - 2) \times 180^\circ$ = 540°</p> <p>Sum of angles a, b, c, d and $e = 5(360^\circ) - 540^\circ - 10(60^\circ)$ = 660°</p> <p>(deduct one mark if student assumed regular pentagon)</p>	M1 M1 A1
15	<p>In 1 hour, Jane made $\frac{8}{7}$ dresses. Judy made $\frac{7}{6}$ dresses.</p> <p>Both made $(\frac{8}{7} + \frac{7}{6}) = \frac{97}{42}$ dresses.</p> <p>Time to make 20 dresses = $20 \div \frac{97}{42}$ = 8.659 hour = 8 hours 40 minutes</p>	M1 M1 A1
16 (a)	<p>$\angle AOB = 360^\circ - x$</p> <p>$\angle ACB = \frac{1}{2}(360^\circ - x)$ or $180^\circ - \frac{1}{2}x$</p>	M1 A1
16(b)	<p>$\angle OAP = \angle OBP = 90^\circ$</p> <p>$\angle APB = 180^\circ - (360^\circ - x) = x - 180^\circ$</p>	M1, A1
17	<p>$BC = EC = 7$ cm $CD = CA = 10$ cm $\angle ACB = \angle DCE = 90^\circ$ $\therefore \triangle ABC \cong \triangle DEC$ (SAS)</p>	M1 M1 A1
18 (a)	$\begin{array}{r} 2 \overline{) 168} \\ \underline{4} \\ 2 \overline{) 84} \\ \underline{14} \\ 7 \overline{) 42} \\ \underline{21} \\ 7 \overline{) 21} \\ \underline{21} \\ 0 \end{array}$ <p>$168 = 2^3 \times 3 \times 7$</p>	M1 A1
18 (b)	<p>$\frac{168}{3 \times 7} = 2^3$</p> <p>$\sqrt{m} = 21$</p> <p>$m = 441$</p>	M1 A1
18 (c)	<p>$168 = 2^2 \times (2 \times 3) \times 7$</p> <p>$= 4 \times 6 \times 7$</p>	M1 A1

19 (a)	Figure 3	B1
19 (b)	Figure 5	B1
19 (c)	Figure 2	B1
20		<p>B1 – correct shape</p> <p>B1 – indicating turning point</p> <p>B1 – x and y-intercepts</p>
21(a)	$\sqrt[3]{\frac{512}{216}} = \frac{4}{3}$ $\frac{\text{Surface area of } x}{\text{Surface area of } y} = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$ <p>Ratio = 16 : 9</p>	<p>M1</p> <p>A1</p>
21(b)	<p>Volume of Z</p> $= \pi(2r)^2 \frac{2}{3}h$ $= \frac{8}{3} \times \pi r^2 h$ $= \frac{8}{3} \times 216$ $= 576 \text{ cm}^3$	<p>M1</p> <p>A1</p>
22(a)	<p>Gradient $BC = \frac{6-1}{5-0} = 1$</p> <p>Equation: $y = x + 1$</p>	<p>B1</p> <p>B1</p>
22(b)	$m = -\frac{1}{2}$ $y = mx + c$ $1 = -\frac{1}{2}(-5) + c \quad \Rightarrow \quad c = -\frac{3}{2}$ $y = -\frac{1}{2}x - \frac{3}{2} \text{ or } 2y = -x - 3$	<p>M1</p> <p>A1</p>
22(c)	<p>Area = $\frac{1}{2}(6-1)(0+5)$</p> <p>= 12.5 units²</p>	<p>M1</p> <p>A1</p>

23(a)	$\frac{\text{Vol of small cone}}{\text{Vol of big cone}} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$ $\frac{\text{Vol of small cone}}{\text{Vol of frustum}} = \frac{1}{7}$ $\frac{\text{Vol of small cone}}{\text{Vol of cylinder}} = \frac{1}{3}$ $p = 33 \div 11 = 3$ $q = 3 \times 4 = 12$	M1 A1 A1
23(b)		B1 - correct shape for 0 - p or q - 33s B1 - correct shapes for p - q s
		

24(a)	Construct the perpendicular bisector of AB Mark the point X 6 cm from C .	B1 B1
24(b)	$5 \times 5 = 25 \pm 0.5$ m	B1
24(c)	Time taken to reach the ball A: $\frac{25}{6} = 4.17$ sec C: $\frac{30}{7} = 4.28$ Player A will get the ball first.	M1 A1

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Answer key

1	(a)(i)	4		
	(a)(ii)	$n = m - \left(\frac{k}{H}\right)^2$		
1	(b)	$\frac{3b^3}{2a}$		
1	(c)	2 or 3		
1	(d)	$x = 2$ and $y = -4$		
2	(a)	Bank ABC.		
2	(b)(i)	\$150 000		
2	(b)(ii)	\$12 000		
2	(b)(iii)	2.286%		
2	(c)	No		
3	(a)(i)	25 units		
3	(a)(ii)	-3.5		
3	(a)(iii)	(3, 9)		
3	(b)(i)	$2b - 2a$		
3	(b)(ii)	$4a + 2b$		
3	(b)(iii)	$b - 4a$		
3	(b)(iv)	$12a$		
3	(b)(v)	Points O, A and P are collinear points/ form a straight line . A is a mid-point of OP / $OA = \frac{1}{2}OP$.		
3	(b)(vi)	$\frac{1}{2}$		

3	(b)(vii)	$\frac{1}{3}$		
4	(a)	$\frac{60}{x}$		
4	(b)	$\frac{60}{x-2}$		
4	(c)	$\frac{60}{x-2} - \frac{60}{x} = 1.2$		
4	(d)	$x = -9.05$ or 11.05		
4	(e)	9 min 24 sec		
5	(a)	$9 - r$		
	(b)	$(9 - r)^2 + 3^2 = r^2$		
	(c)	4.09 cm^2		
6	(a)(i)	$u_5 = 5^2 + 9 = 34$		
6	(a)(ii)	$u_n = n^2 + 2n - 1$		
6	(a)(iii)	959		
6	(b)(i)	$\begin{pmatrix} 8 \\ 5 \\ 3 \end{pmatrix}$		
6	(b)(ii)	$\begin{pmatrix} 83 \\ 51 \end{pmatrix}$		
6	(b)(iii)	Elements of V represent the cost of manufacturing each toy boat and toy car respectively.		
6	(b)(iv)	(9190) The answer represents the total cost of manufacturing 80 toy boats and 50 toy cars.		
7	(a)(i)	56 kg		
7	(a)(ii)	$33\frac{1}{3}\%$ or 33.3%		
7	(b)(i)	$a = 53, b = 58$		
7	(b)(ii)	14 kg		

7	(c)	$\frac{9}{35}$		
8	(a)(i)	371 m		
8	(a)(ii)	45 300 m ²		
8	(a)(iii)	37.6°		
8	(a)(iv)	052.4°		
8	(b)	27.5°		
9	(a)(i)	51.8 cm ²		
9	(a)(ii)	334 cm ³		
9	(b)	Total mass of each filled soda can = 631.308 g Will NOT accept the proposal,		
10	(a)	$k = 2$		
10	(c)	Gradient = -4.8 ± 0.5 (Range accepted from -5.1 to -4.3)		
10	(d)(i)	Draw the line $y = \frac{x}{6}$		
10	(d)(ii)	$x = 2.1 \pm 0.1$ or $x = 5.2 \pm 0.1$		
10	(d)(iii)	$A = -36$, $B = 72$		

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Marking Scheme

1	(a)(i)	$H = \frac{12}{\sqrt{6 - (-3)}}$ $= 4$	BI	
	(a)(ii)	$H\sqrt{m-n} = k$ $m-n = \left(\frac{k}{H}\right)^2$ $n = m - \left(\frac{k}{H}\right)^2$	M1 A1	
	(b)	$\frac{9a^2b}{4a^2} \times \frac{8b^5}{12ab^3} = \frac{9 \times 8}{4 \times 12} a^{2-3} b^{1+5-3}$ $= \frac{3b^3}{2a}$	M1 A1	
	(c)	$5(11-x) + 4(x+7) = (x+7)(11-x)$ $x^2 - 5x + 6 = 0$ $(x-2)(x-3) = 0$ $x = 2 \text{ or } x = 3$	M1 M1 A1	Factorise
	(d)	Substitute $y = 4x - 12$ into $5x - 3y = 22$ $5x - 3(4x - 12) = 22$ $x = 2$ and $y = -4$	M1 A1 A1	Elimination method can be used
				11 Marks
2	(a)	Bank ABC: Amount = $45\,000 \left[1 + \frac{2.45}{12(100)}\right]^{5 \times 12}$ $= \$50\,858$ Bank XYZ: Interest = $45\,000 \times \frac{2.65}{100} \times 5 = \$5\,962.50$ Amount = $\$50\,962$ Alex should loan from Bank ABC.	M1 M1 M1 A1	

	(b)(i)	Cash Price: $\frac{100}{30} \times 450\,000$ $= \$150\,000$	B1	
	(b)(ii)	Hire Purchase Price $45\,000 + (1950 \times 5 \times 12) = \$162\,000$ Interest = \$12 000	M1 A1	
	(b)(iii)	Rate = $\frac{12\,000 \times 100}{105\,000 \times 5}$ $= 2.286\% (3 \text{ d.p.})$	B1	
	(c)	Price of 1 litre of petrol in Singapore: $\frac{109}{50} = \$2.18$ Bangkok: $\frac{9408}{320} = 29.4 \text{ Thai bahts}$ $= \frac{29.4}{24.5} = \$1.20$ Half of Singapore price = $\frac{1}{2} \times 2.18 = \1.09 Since $1.20 > 1.09$, I do not agree.	M1 M1 A1	
				11 Marks
3	(a)(i)	$\sqrt{(-7)^2 + 24^2} = 25 \text{ units}$	B1	
	(a)(ii)	$\overline{PQ} = n \overline{PS}$ $\begin{pmatrix} -7 \\ 24 \end{pmatrix} = n \begin{pmatrix} k \\ 12 \end{pmatrix}$ $n = 2$ $k = -3.5$	M1 A1	Accept $\frac{12}{k} = \frac{24}{-7}$ but not $\frac{k}{12} = \frac{-7}{24}$
	(a)(iii)	$\overline{OQ} = \overline{OP} + \overline{PQ}$ $= \begin{pmatrix} 10 \\ -15 \end{pmatrix} + \begin{pmatrix} -7 \\ 24 \end{pmatrix} = \begin{pmatrix} 3 \\ 9 \end{pmatrix}$ Coordinates of $Q = (3, 9)$	B1	
	(b)(i)	$\overrightarrow{AN} = \frac{1}{3} \overrightarrow{AB}$ $= 2\mathbf{b} - 2\mathbf{a}$	B1	

	(b)(ii)	$\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$ $= 4a + 2b$	B1	
	(b)(iii)	$\overrightarrow{NM} = \overrightarrow{OM} - \overrightarrow{ON}$ $= b - 4a$	B1	
	(b)(iv)	$\overrightarrow{MP} = 3\overrightarrow{MN}$ $\overrightarrow{OP} = \overrightarrow{OM} - 3\overrightarrow{NM}$ $= 3b - 3(b - 4a)$ $= 12a$	B1	
	(b)(v)	Points O, A and P are collinear points/ form a straight line. A is a mid-point of OP / $OA = \frac{1}{2}OP$.	B1 B1	
	(b)(vi)	$\frac{\text{Area of } \triangle AMN}{\text{Area of } \triangle BMN} = \frac{1}{2}$	B1	
	(b)(vii)	$\frac{\text{Area of } \triangle BMN}{\text{Area of } \triangle BOA} = \frac{1}{3}$	B1	
				12 Marks
4	(a)	$\frac{60}{x}$	B1	
	(b)	$\frac{60}{x-2}$	B1	
	(c)	$\frac{60}{x-2} - \frac{60}{x} = 1.2$ $60x - 60(x-2) = 1.2x(x-2)$ $x^2 - 2x - 100 = 0$ (shown)	M1 M1 A1	Form equation Attempt to simplify
	(d)	$x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-100)}}{2(1)}$ $x = -9.05$ or 11.05 (2 d.p)	M1 A1	
	(e)	Time taken = $85 \left(\frac{60}{11.05 - 2} \right)$ $= 564$ seconds $= 9$ min 24 sec	M1 B1	
				9 Marks

5	(a)	$OB = 9 - r$	B1	
	(b)	$(9 - r)^2 + 3^2 = r^2$ $81 - 18r + r^2 + 9 = r^2$ $r = 5 \text{ cm (Shown)}$	B1 M1 A1	
	(c)	$\sin \angle BOC = \frac{3}{5}$ $\angle BOC = 36.869^\circ \text{ or } 0.6435 \text{ rad}$ $\angle COD = 73.739^\circ \text{ or } 1.287 \text{ rad}$ Area of sector = $\frac{73.739}{360} \times \pi \times 5^2$ or $\frac{1}{2} \times 5^2 \times 1.287$ $= 16.0875 \text{ cm}^2$ Area of $\triangle OCD = \frac{1}{2} \times 4 \times 6 = 12 \text{ cm}^2$ Area of req. segment = 4.09 cm^2 . (3 s.f.)	B1 M1 M1 A1	
				8 Marks
6	(a)(i)	$u_5 = 5^2 + 9 = 34$	B1	
	(a)(ii)	$u_n = n^2 + 2n - 1$	B1 B1	B1 for n^2 B1 for $2n - 1$
	(a)(iii)	$U_{30} = 30^2 + 2(30) - 1$ $= 959$	B1	
6	(b)(i)	$\begin{pmatrix} 8 \\ 5 \\ 3 \end{pmatrix}$	B1	
	(b)(ii)	$V = \begin{pmatrix} 6 & 4 & 5 \\ 4 & 2 & 3 \end{pmatrix} \begin{pmatrix} 8 \\ 5 \\ 3 \end{pmatrix}$ $= \begin{pmatrix} 83 \\ 51 \end{pmatrix}$	B1 B1	
	(b)(iii)	Elements of V represent the cost of manufacturing each toy boat and toy car respectively.	B1	
	(b)(iv)	$WV = \begin{pmatrix} 80 & 50 \end{pmatrix} \begin{pmatrix} 83 \\ 51 \end{pmatrix} = (9190)$ The answer represents the total cost of manufacturing 80 toy boats and 50 toy cars.	B1 B1	

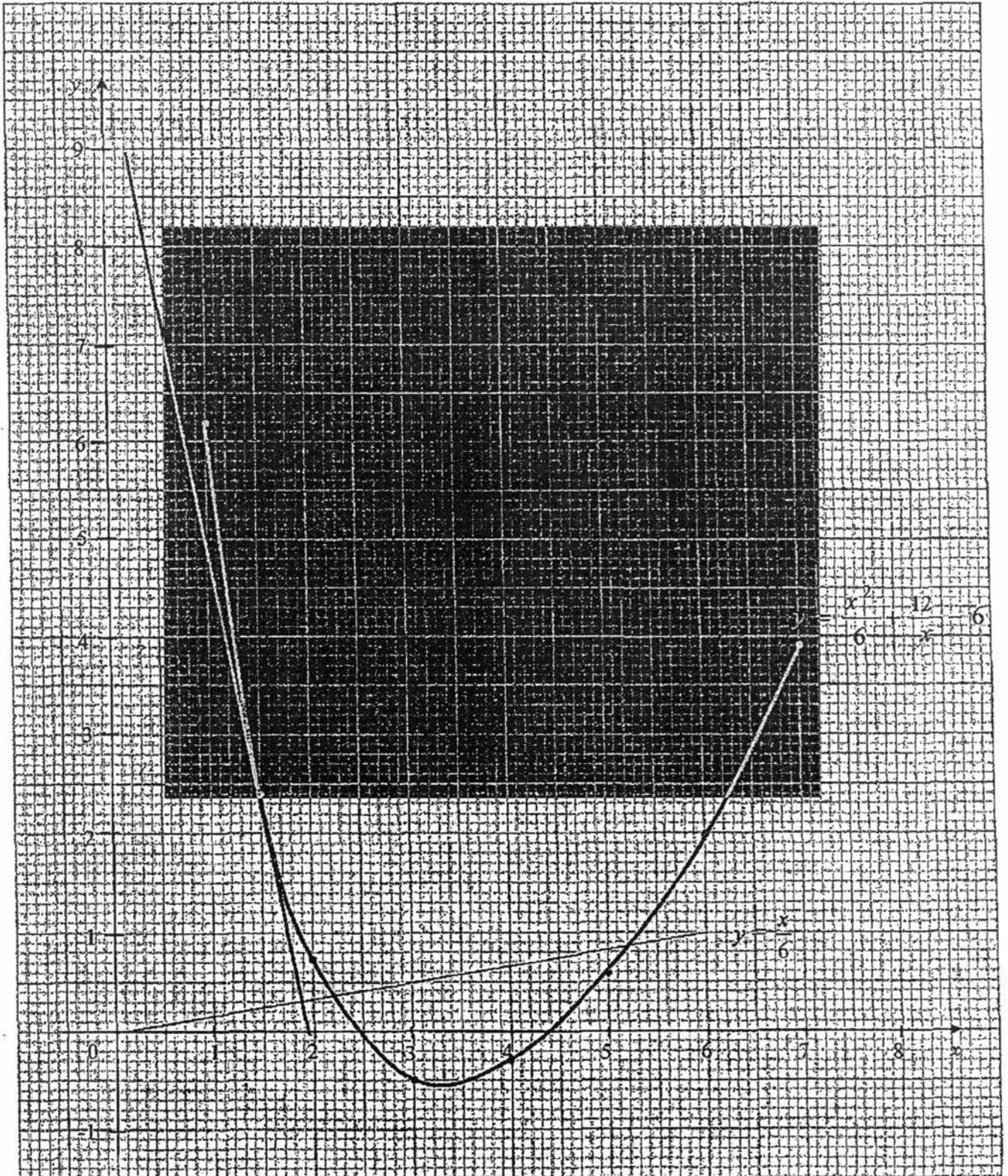
				10 Marks
7	(a)(i)	Modal mass = 56 kg	B1	
	(a)(ii)	$\frac{7}{21} \times 100\% = 33\frac{1}{3}\%$ or 33.3%	B1	
	(b)(i)	$a = 53$ $b = 58$	B1 B1	
	(b)(ii)	Interquartile range = $67 - 53$ = 14 kg	B1	
	(c)	$\left(\frac{18}{21} \times \frac{3}{20}\right) + \left(\frac{3}{21} \times \frac{18}{20}\right)$ $= \frac{9}{35}$	M1 A1	
				7 Marks
8	(a)(i)	$BC^2 = 250^2 + 400^2 - 2(250)(400)\cos 65^\circ$ $BC = 371.45$ = 371 m (3 s.f.)	B1 B1 A1	
	(a)(ii)	Area = $\frac{1}{2}(250)(400)\sin 65^\circ$ = 45 315.38 = 45 300 m ² (3 s.f.)	M1 A1	
	(a)(iii)	$\frac{\sin \angle ABC}{250} = \frac{\sin 65^\circ}{371.45}$ $\angle ABC = 37.588$ $\approx 37.6^\circ$ (1 d.p.)	M1 A1	
	(a)(iv)	Bearing = $90^\circ - 37.6^\circ$ = 052.4°	B1	
	(b)	Let h be the height of eagle above the ground $\frac{h}{400} = \tan 18^\circ$ $h = 129.967$ m $\tan \angle ACE = \frac{129.967}{250}$ $\angle ACE = 27.46^\circ$ Angle of depression = 27.5° (to 1 d.p.)	B1 M1 A1	
				11 Marks

10	(c)	Tangent is drawn at the point $x = 1.5$ Refer to attached graph Gradient = -4.8 ± 0.5 (Range accepted from -5.3 to -4.3)	B1	
			B1	
	(d)(i)	Draw the line $y = \frac{x}{6}$ Refer to attached graph.	B1	
	(d)(ii)	$x = 2.2 \pm 0.1$ or $x = 5.2 \pm 0.1$	B1 B1	
	(d)(iii)	$\frac{x^2}{6} + \frac{12}{x} - 6 = \frac{x}{6}$ $x^3 - x^2 - 36x + 72 = 0$ $A = -36, B = 72$	M1	
			A1	Both correct
				11 Marks

Name: _____ ()

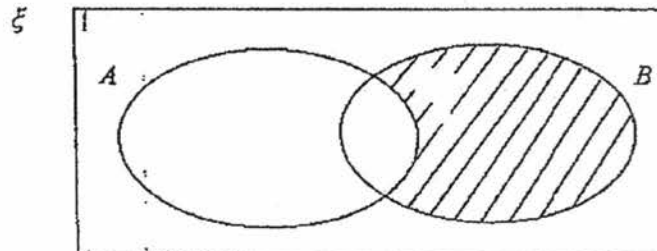
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Answer all the questions.

- 1 Express in set notation, the set shaded in the following Venn diagram.



Answer [1]

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

Answer [1]

- (b) Factorise completely $32a^2 - 18b^2$.

Answer [2]

- 3 Factorise completely $12bx - 6ay + 8by - 9ax$.

Answer [2]

- 4 Write as a single fraction in its simplest form $\frac{5}{2+x} + \frac{6x}{x^2-4}$.

Answer [2]

- 5 Show that for all p , where p is a positive integer
 $(7p-3)^2 - 4p(p-3) + 6$ is divisible by 15.

Answer

[2]

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

Answer [2]

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

Answer

[2]



7 A bicycle rental shop uses the formula $C = 5.5 + 3.5h$ to calculate charges for rental of bicycles, where C is the cost of rental and h is the number of hours of rental.

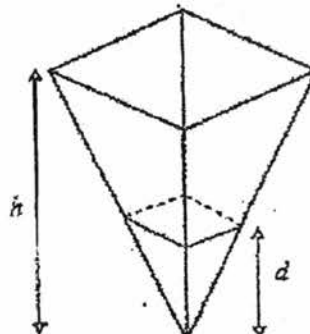
(a) State the basic charge to be paid regardless of the number of hours of rental.

Answer \$ [1]

(b) Mathew and Ethan both rented a bicycle each for different number of hours. The difference in the cost of rental between the two of them is \$14. Find the difference in the number of hours of rental between the two boys.

Answer: hours [2]

8 The diagram shows an inverted pyramid with a capacity of 800 cm^3 .



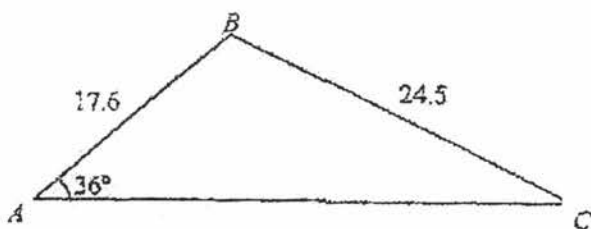
The depth of the liquid in the inverted pyramid, d , is one-third the height, h , of the pyramid. Calculate the volume of the liquid.

Answer cm^3 [2]



9

6



ABC is a triangle, where $AB = 17.6$ cm, $BC = 24.5$ cm and angle $BAC = 36^\circ$
Find angle ABC .

Answer angle $ABC = \dots\dots\dots$ [3]

- 10 Jane plans to travel back to Singapore from the United States
In Singapore, the exchange rate is SGD \$1 = USD \$0.71
In the United States, the exchange rate is USD \$100 = SGD \$153.
Jane wants to change USD \$1426 into Singapore dollars.
Which country should Jane change her money in order to get a better deal?
You must show your calculations.

Answer $\dots\dots\dots$ [3]



- 11 Hector was arranging 315 one-centimetre cubes into a cuboid.
The perimeter of the base of the cuboid is 28 cm.
Each side of the cuboid has a length greater than 3 cm.
Find the height of the cuboid.

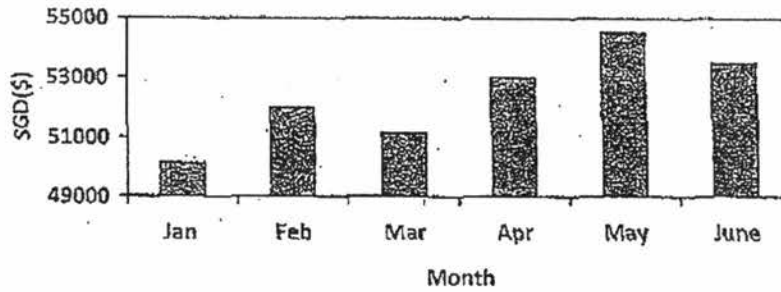
Answer

.. cm [2]



- 12 The bar graph shows the COE price of small cars in Singapore over a period of 6 months.

COE PRICE OF SMALL CARS IN SINGAPORE



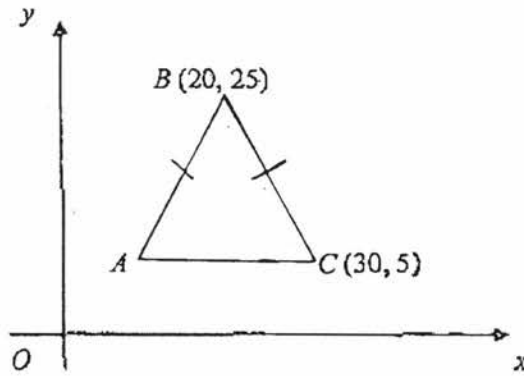
State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

Answer

.....

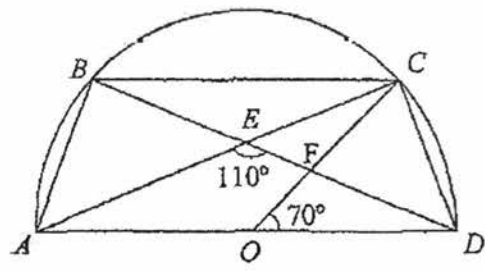
..... [2]

- 13 The diagram shows an isosceles triangle.
 AC is parallel to the x -axis.
 Point B has coordinates $(20, 25)$ and C has coordinates $(30, 5)$



Find the coordinates of A .

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



$ABCD$ is a semicircle with centre O .
 BED and AEC are straight lines.
 Angle $COD = 70^\circ$ and angle $AED = 110^\circ$.

(a) Stating your reasons clearly, calculate
 (i) angle ACD ,

Answer angle $ACD = \dots\dots\dots[1]$

(ii) angle ADC ,

Answer angle $ADC = \dots\dots\dots[1]$

(iii) angle ABC ,

Answer angle $ABC = \dots\dots\dots[1]$

(iv) angle BFC .

Answer angle $BFC = \dots\dots\dots[3]$

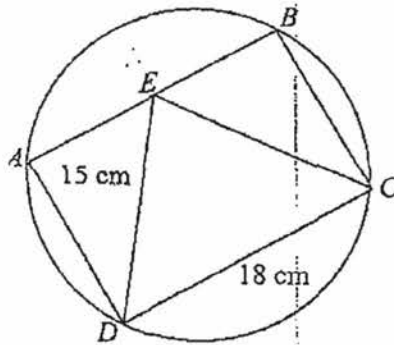
(b) Explain why BC is parallel to AD .

Answer

..... [1]



- 15 The diagram shows a circle $ABCD$.
 E is the midpoint of the chord AB .
 $ABCD$ is a rectangle.
 $DE = 15$ cm and $DC = 18$ cm.



- (a) Calculate the area of triangle ADE .

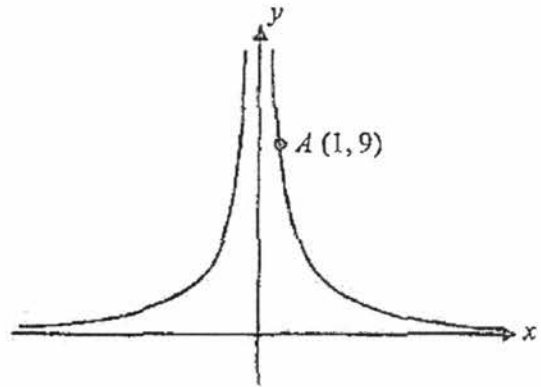
Answer cm² [2]

- (b) Calculate the circumference of the circle.

Answer cm [2]



- 16 The sketch shows the graph of $y = 3^k \times x^{-n}$.
The graph passes through the point $A(1, 9)$.



- (a) (i) State a possible value of n .

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

- (ii) Find the value of k .

$k = \dots\dots\dots$ [1]

- (b) Given that the coordinates of B is $(-2, 2.25)$, find the length of the line segment AB .

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

- 17 (a) Express 3780 as the product of its prime factors.

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

- (b) Using your answer to part (a), explain why 3780 is not multiple of 49.

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

- (c) c is a composite number and p is a prime number.

Find the values of p and c such that $3780 \times \frac{c}{p}$ is a perfect square and c has the least value.

Answer $p = \dots\dots\dots$

$c = \dots\dots\dots$ [2]

- 18 A map of Singapore is such that 9 cm^2 on the map represents the actual area of 36 km^2 on the land.

(a) Express the scale of the map in the form $1 : n$.

Answer 1 : [2]

- (b) The length of Bukit Timah Expressway on the map is 5 cm.
Calculate the actual distance, in kilometres, of the Bukit Timah Expressway.

Answer km [1]

- 19 The table shows the prices of one litre of petrol and the discounts offered by leading petrol companies

Company	Petrol price per litre	Discount
A	\$1.723	18%
B	\$1.689	15%
C	\$1.702	12% discount plus \$3 off for every \$30 sale after discount

- (a) Ronn wants to fill up his car with 55 litres of petrol at Company C.
Calculate the total amount Ronn paid for the petrol.

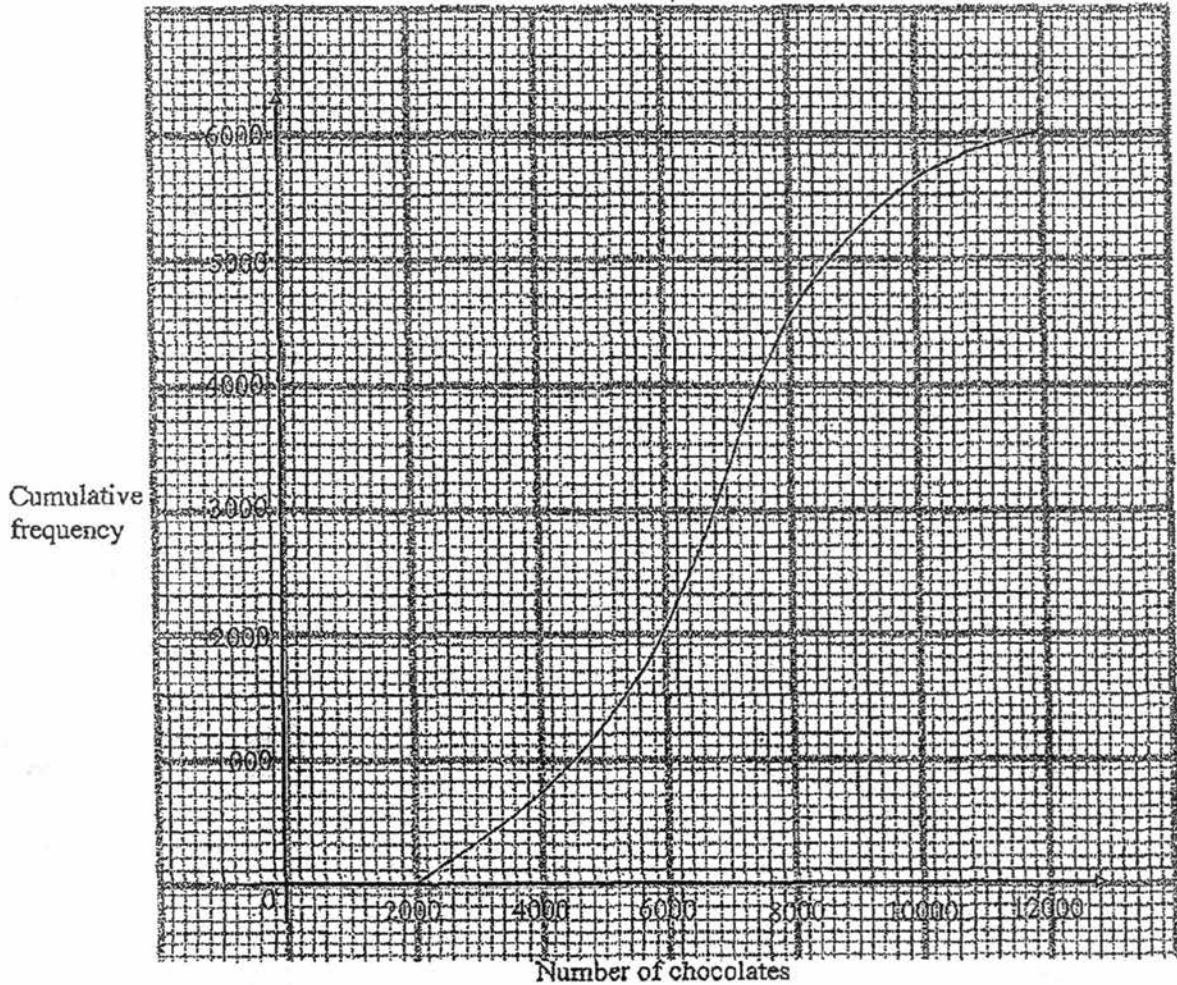
Answer \$ [2]

- (b) Comparing Company A and B, show clearly which company offers a better deal.

Answer [2]

20 6000 customers participated in a contest where they have to guess the number of chocolates in a big glass container.

The cumulative frequency curve below shows the distribution of their guesses.



The actual number of chocolates is 6000.

(a) Find the median.

Answer chocolates [1]

(b) Find the interquartile range.

Answer chocolates [1]

(c) Find the probability that a customer, chosen at random, gave an estimate within 10% of the actual number of chocolates.

Answer [3]

21 Gate *B* and Gate *C* are 400 m apart in a park. Gate *A* is such that angle $ACB = 105^\circ$ and $AB = 550$ m.

- (a) Using a scale of 1 cm to 50 m and the line *BC* is drawn for you, complete the scale drawing of triangle *ABC*. [1]



- (b) A pavilion, inside the park, is located equidistant from the three gates. By construction, find and label the position of the pavilion *P*. [2]
- (c) Measure and calculate the actual distance between Gate *A* and the pavilion *P*.

Answer m [1]



22 The position vectors of A and B are $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$ respectively.

(a) Find the length of \overrightarrow{OB} .

Answer [1]

(b) C is the point $(0, p)$ where $p > 0$.

$$\overrightarrow{OC} = 4 \overrightarrow{OA} + 4 \overrightarrow{OB}.$$

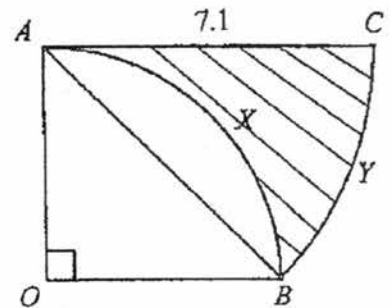
Find the value of p .

Answer $p =$ [2]

(c) What type of quadrilateral is $OACB$?

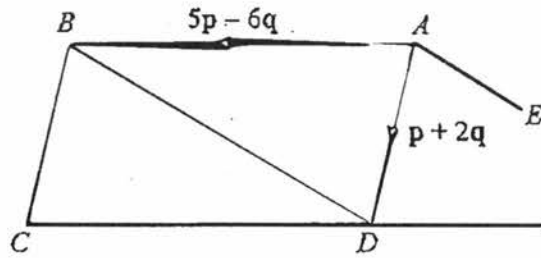
Answer [1]

23 In the diagram, angle $AOB = 90^\circ$; AC is parallel to OB and $AC = 7.1$ cm.
 AXB is an arc of a circle with centre O and CYB is an arc of a circle with centre A .
 Find the area of the shaded region.



Answer cm² [5]

24 In the diagram, $ABCD$ is a parallelogram, $\vec{AD} = p + 2q$ and $\vec{AB} = 5p - 6q$.



(a) Express, as simply as possible, in terms of p and q ,

(i) \vec{CB} ,

Answer [1]

(ii) \vec{DB} .

Answer [2]

(b) E is a point such that $\vec{EA} = p - 2q$.

(i) Explain why \vec{DB} is parallel to \vec{EA} .

Answer

..... [1]

(ii) Find the ratio of the area of triangle ADE to the area of triangle DBA .

Answer [2]

End of Paper



MATHEMATICAL FORMULAE

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

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 (a) (i) Factorise $-3x^2 - 2x + 5$. [1]

(ii) Simplify $\frac{6x+12}{3x^2-15x-42}$. [2]

(b) It is given that $d = \sqrt{\frac{5e-f}{ef}}$.

(i) Find d when $e = 4$ and $f = 2$. [1]

(ii) Express e in terms of d and f . [2]

(c) Solve the equation $\frac{3x+2}{5} - \frac{1}{2} = \frac{x}{2}$. [2]

(d) Solve these simultaneous equations.

$$7x + 4y = -37$$

$$x - 5y = 17$$

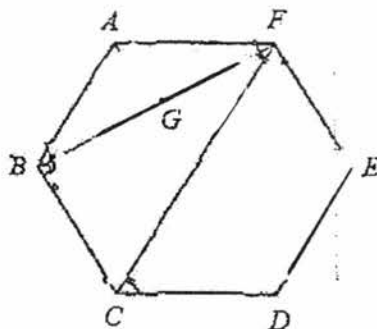
[3]

- 2 In one small packet of gummies, there are both gummy bears and gummy snakes in two colours; red and green. In a large packet, there are 10 small packets.

The information can be represented by the matrix $A = \begin{matrix} & \begin{matrix} \text{Green} & \text{Red} \end{matrix} \\ \begin{pmatrix} 5 & 5 \\ 4 & 6 \end{pmatrix} & \begin{matrix} \text{Bear} \\ \text{Snake} \end{matrix} \end{matrix}$

- (a) Evaluate the matrix $B = 10A$. [1]
- (b) It costs \$0.10 and \$0.12 to produce 1 green and red gummy respectively.
Represent the cost of each colour of gummy in a 2×1 column matrix C in dollars. [1]
- (c) Evaluate the matrix $D = BC$. [1]
- (d) State what the elements of D represent. [1]
- (e) Another gummy-making company, Company Y , packs 6 green gummy bears, 4 red gummy bears, 7 green gummy snakes and 3 red gummy snakes in one small packet. The costs to produce one green gummy and one red gummy remain the same. One large packet is also made up of 10 small packets.
Calculate the total cost for Company Y to produce one large packet. [3]
-

- 3 (a) The diagram shows a regular hexagon.



- (i) Calculate the interior angle of a regular hexagon. [2]
- (ii) It is given that $2AG = BC$. Find $\frac{\text{area of triangle } ABF}{\text{area of triangle } BFC}$. [2]
- (b) (i) Simplify $\frac{(mn^2)^3}{p^5} \div \frac{n^5}{p^4}$. [2]
- (ii) Given that $\frac{2^{q+5}}{4^{2q}} = \frac{1}{16}$, find the value of q . [3]
-

4 The first five terms in a sequence of numbers are given below.

0, 3, 8, 15, 24...

- (a) Find the next two terms. [2]
- (b) Find an expression, in terms of n , for the n th term, T_n , of the above sequence. [1]
- (c) T_n and T_{n+1} are consecutive terms in the sequence.
Find and simplify an expression, in terms of n , for $T_{n+1} - T_n$. [3]
- (d) Explain why two consecutive terms of the sequence cannot have a difference of 8. [2]

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

The variables x and y are connected by the equation

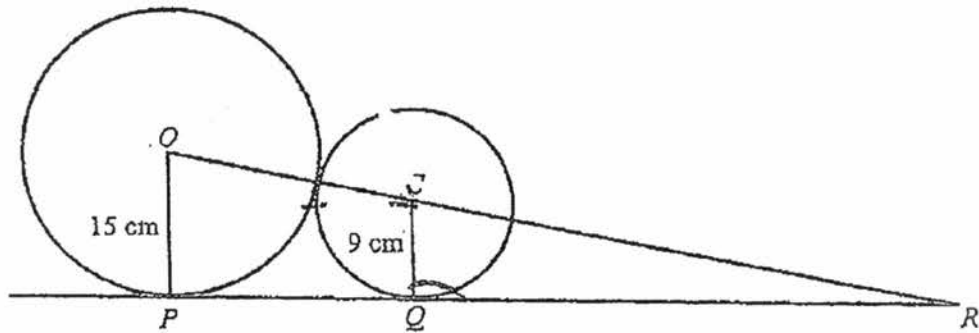
$$y = x^3 - 4x^2 + \frac{5}{2}$$

Some corresponding values of x and y are given in the table below.

x	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	-9.875	-2.5	1.375	2.5	p	-0.5	-3.125	-5.5

- (a) Find the value of p . [1]
- (b) Using a scale of 4 cm to represent 1 unit, draw a horizontal x -axis for $-1.5 \leq x \leq 2$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $-12 \leq y \leq 4$.
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 coordinates of the maximum point of $y = x^3 - 4x^2 + \frac{5}{2}$, in the range of $-1.5 \leq x \leq 2$. [1]
- (d) Use your graph to find the solutions to the equation $x^3 - 4x^2 + 6 = 0$, in the range $-1.5 \leq x \leq 2$. [3]
- (e) By drawing a tangent, find the gradient of the curve at $(-1, -2.5)$. [2]
- (f) (i) On the same axes, draw the line $y = -3x - 4$ for $-1.5 \leq x \leq 2$. [1]
(ii) Write down the coordinates of the point where this line intersects the curve. [1]
-

- 6 The diagram shows a circle, centre O , with radius 15 cm touching another circle, centre C , with radius 9 cm.
 OCR and PQR are straight lines and PQR is a tangent to both the circles at points P and Q .



- (a) State the value of angle CQR and explain your answer. [2]
- (b) Show that triangles OPR and CQR are similar.
 Give a reason for each statement you make. [2]
- (c) Find the value of $\frac{\text{area of triangle } CQR}{\text{area of trapezium } OCQP}$ [2]
- (d) Find the difference in the areas of the two circles.
 Leave your answer in terms of π . [2]
-

7 A company manufactures and sells posters for decoration and display.

- (a) The posters manufactured by the company are sold in local shops and department stores. In a particular week, the number of posters available for sale in local shops and department stores are in the ratio 3 : 7.
Given that 160 more posters are available for sale in department stores, find the total number of posters available for sale in that week. [2]

- (b) A shop owner bought x posters for \$60 from the company.
(i) Write down an expression, in terms of x , for the cost of each poster in dollars. [1]

The shop owner decides to sell the posters at a profit of \$1 each. ∞

- (ii) Write down an expression, in terms of x , for the selling price of each poster in dollars. [1]

The shop owner managed to sell 10 posters at the selling price in (ii).

He decided to sell the rest of the posters at \$5 each.

- (iii) Write down an expression, in terms of x , for the total amount of money in dollars, that he collected from the sale of all posters. [1]

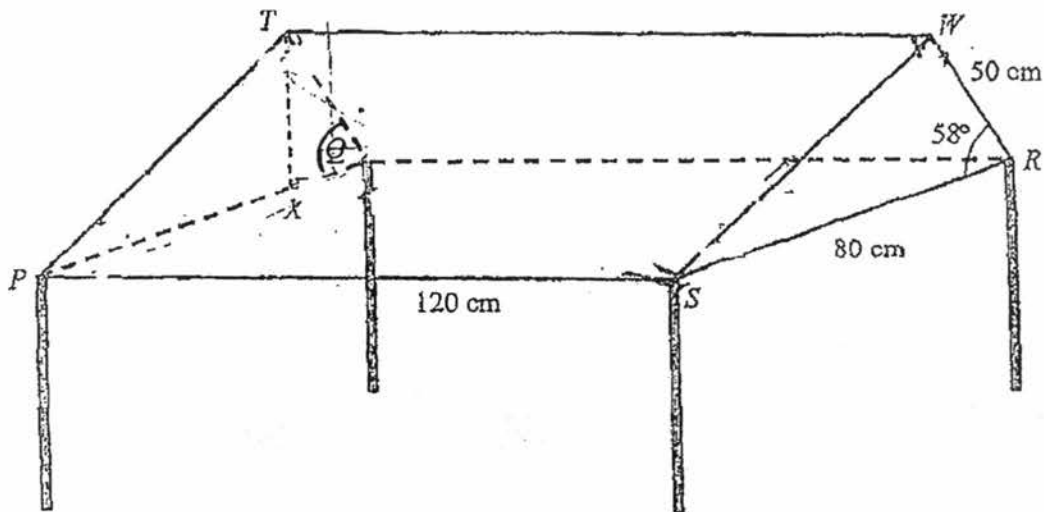
- (iv) Given that the shop owner collected a total of \$130 from the sale of all posters, write down an equation in x to represent this information and show that it reduces to

$$x^2 - 34x + 120 = 0 \quad [3]$$

- (v) Solve the equation $x^2 - 34x + 120 = 0$. [3]

- (vi) Find the cost price of each poster. [1]
-

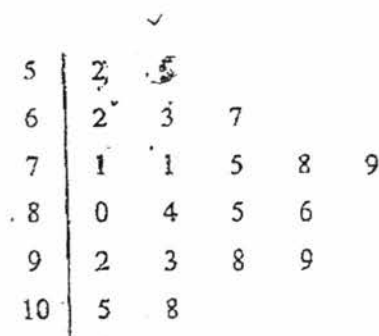
- 8 The diagram shows a table used by an interior designer.
 It is made up of a prism and 4 table legs for support.
 The rectangle $PQRS$ lies on a horizontal plane.
 T is vertically above X .
 $PS = 120$ cm, $RS = 80$ cm and $WR = 50$ cm.
 Angle $WRS = 58^\circ$.



Calculate

- (a) WS , [3]
 (b) the volume of the prism, [3]
 (c) TX , [2]
 (d) XS , [4]
 (e) the angle of elevation of T from S . [2]

- 9 (a) The amount of money, in dollars, spent by a group of 20 students (Group *A*) in the month of May is shown in the stem-and-leaf diagram below.



Key $5|6$ means \$56

- (i) Find the mean amount of money spent by the 20 students. [1]
 (ii) Find the standard deviation of the amount of money spent by the 20 students. [1]
 (iii) The mean and standard deviation of the amount of money spent by another group of 20 students (Group *B*) in May were \$70 and \$12 respectively.

Use the information to comment on two differences between the two distributions.

[2]

- (b) John plays a game at a carnival. In this game, he has to pick 2 coloured balls from two bags, *A* and *B*. He is only allowed to pick one ball from each bag. He has to pick one ball from Bag *A*, followed by another ball from Bag *B*.

Bag *A* contains 2 red balls, 3 blue balls and 6 yellow balls.

Bag *B* contains 4 red balls, 1 blue ball and 4 yellow balls.

- (i) Draw a tree diagram to show the probabilities of the possible outcomes. [2]
 (ii) John will win a large prize if he picks 2 balls that are blue, a small prize if he picks only one ball that is blue and goes home empty-handed otherwise.
 Find, as a fraction in the simplest form, the probability that

- (a) John will win a large prize, [1]
 (b) John will win a small prize, [1]
 (c) John will not win anything. [1]

- 10 A group of students are tasked to design, print and distribute brochures containing tips to save water to students in school, as part of the school's effort to raise awareness of the importance of saving water in school.

The students have been allocated a budget of \$1200 to complete this task.

The students are required to print and distribute a copy of the brochure to each student and teacher in the school.

Each brochure is printed on both sides of 2 sheets of A4 size paper.

Students will be given brochures printed in black and white and teachers will be given brochures printed in colour. They will have to purchase the sheets of A4 size paper and toner cartridges from *ABC* bookstore, which will be delivered to school.

In addition, the students are also tasked to design and print 50 copies of A3 size coloured posters containing tips to save water, to be put up in all classrooms and various areas in the school. They have sourced for an external supplier, *XYZ* supplier, to print the posters. The posters will be delivered to school as well.

The information that the students require is found in Annex A, on the opposite page.

The students estimates that they have to distribute the brochures to 1360 students and 90 teachers.

- (a) How many sheets of A4 size paper will the students require to purchase to print the brochures for all students and teachers? [1]
- (b) How many toner cartridges will the students require to purchase to print the brochures for all students and teachers? [3]
- (c) Given that one of the students in the group is a member of *ABC* bookstore and that the students aim to reduce the cost as far as possible, determine if the amount of budget allocated is sufficient to cover all costs.
Justify your answer with relevant mathematical working. [6]

1) Cost of purchasing stationaries from ABC Bookshop:

Item	Description	Unit Cost (excluding GST)
A4 Paper	White paper	
	1 pack of 100 sheets	\$2.00
	1 pack of 500 sheets	\$5.00
	5 packs of 500 sheets each	\$22.50
	10 packs of 500 sheets each	\$42.00
Toner Cartridges	Black printing (each cartridge is able to print 1200 pages)	\$136.00
	Colour printing (each cartridge is able to print 900 pages)	\$140.00
The above prices are subjected to 7% Goods and Services Tax (GST).		
Member discount: 10% off total bill, after 7% GST		
Delivery cost: \$30 per trip (not subjected to 7% GST) (Free delivery for minimum purchase of \$200 in total bill, inclusive of 7% GST and after member discount.)		

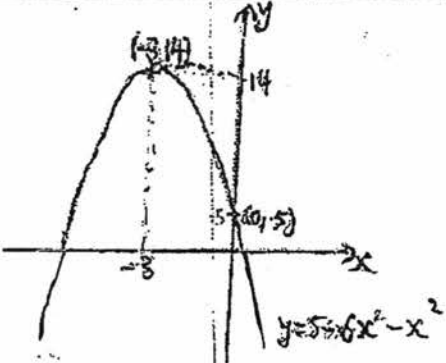
2) Cost of printing A3 size coloured posters

Supplier: XYZ Printing

Item	Description	Unit Cost (excluding GST)
Black and White Posters	10 sheets	\$25.00
	50 sheets	\$120.00
Coloured Posters	10 sheets	\$35.00
	50 sheets	\$170.00
The above prices are subjected to 7% Goods and Services Tax (GST).		
Delivery cost: \$20 per trip (not subjected to 7% GST) (Free delivery for minimum purchase of \$200 in total bill, inclusive of 7% GST.)		

End of Paper

Pei Hwa Secondary School
Mid Year Examination 2017
Sec 4E & 5N Mathematics Paper 1
Answer Key

1(a)	$A \cap B$
2(a)	$-2x^2 + x + 3$
2(b)	$2(4a + 3b)(4a - 3b)$
3	$(4b - 3a)(3x + 2y)$
4	$\frac{11x - 10}{(x + 2)(x - 2)}$
5	$(7p - 3)^2 - 4p(p - 3) + 6$ $= 49p^2 - 42p + 9 + 4p^2 + 12p + 6$ $= 45p^2 - 30p + 15$ $= 15(3p^2 - 2p + 1)$ <p>\therefore for all p, $(7p - 3)^2 - 4p(p - 3) + 6$ is divisible by 15. (Shown)</p>
6(a)	$14 - (x + 3)^2$
6(b)	 <p style="text-align: center;">$y = 5 - 6x^2 - x^2$</p>
7(a)	\$5.50
7(b)	4 hours
8	29.6 cm^3 (3 s.f.)
9	119.0° (1 d.p.)
10	<p>Amount of money Jane will get in Singapore</p> $= \frac{1426}{0.71}$ $= \text{SGD}\$2008.45$ <p>Amount of money Jane will get in the United States</p> $= \frac{153}{100} \times 1426$ $= \text{SGD}\$2181.78$

	Jane will change her money in the <u>United States</u> as she will get back more Singapore dollars.
11	7 cm
12	In the graph, the data doesn't start at \$0, but somewhere around \$49000. This makes the differences appear much larger proportionally.
13	(10, 5)
14(a)(i)	90°
14(a)(ii)	55°
14(a)(iii)	125°
14(a)(iv)	75°
14(b)	Angle $BCE = 35^\circ$ (Angles in the same segment) Since angle $BCE =$ angle CAO (by property of alternate angles), BC is parallel to AD
15(a)	54cm^2
15(b)	68.0cm
16(a)(i)	$n = -2$
16(a)(ii)	$9 = 3^k \times (1)^{-2}$ $k = 2$
16(b)	7.39 units
17(a)	$2^2 \times 3^3 \times 5 \times 7$
17(b)	Index of 7 is not at least 2
17(c)	$c = 15$ $p = 7$
18(a)	1 : 200000
18(b)	10 km
19(a)	\$76.38
19(b)	Company B offers a better deal.
20(a)	6800
20(b)	2600
20(c)	$\frac{1}{5}$

<p>21a,b</p>	
<p>21(c)</p>	<p>Distance $= 5.7 (\pm 0.1) \times 50$ $= 285 (\pm 5) \text{ m}$</p>
<p>22(a)</p>	<p>5 units</p>
<p>22(b)</p>	<p>$p = 32$</p>

22(c)	Kite
23	12.6 cm^2
24(a)(i)	$-p - 2q$
24(a)(ii)	$4p - 8q$
24(b)(i)	$\begin{aligned} & \overrightarrow{DB} \\ &= 4(p - 2q) \\ &= 4 \overrightarrow{EA} \end{aligned}$
24(b)(ii)	$\frac{1}{4}$

PHSS 4E EM MYE Paper 2 2017 Answer Key

No.	Answer
1(a)(i)	$-3x^2 - 2x + 5 = (3x + 5)(1 - x)$
1(a)(ii)	$\frac{2}{x - 7}$
1(b)(i)	$d = 1.5$ or $d = 1\frac{1}{2}$
1(b)(ii)	$e = \frac{f}{5 - d^2 f}$
1(c)	$x = 1$
1(d)	$x = -3, y = -4$
2(a)	$B = \begin{pmatrix} 50 & 50 \\ 40 & 60 \end{pmatrix}$
2(b)	$C = \begin{pmatrix} 0.10 \\ 0.12 \end{pmatrix}$
2(c)	$D = \begin{pmatrix} 11 \\ 11.2 \end{pmatrix}$
2(d)	The elements of D represent the cost to produce all the gummy bears and gummy snakes in a large packet respectively.
2(e)	Total cost = \$10.80 + \$10.60 = \$21.40
3(a)(i)	120°
3(a)(ii)	$\frac{1}{2}$
3(b)(i)	$\frac{m^3 n}{p}$
3(b)(ii)	$q = 3$
4(a)	$T_6 = 35$ $T_7 = 48$
4(b)	$T_n = n^2 - 1$ or $(n + 1)(n - 1)$
4(c)	$T_{n+1} - T_n = n^2 + 2n - (n^2 - 1)$ = $2n + 1$

No.	Answer
4(d)	$2n + 1 = 8$ $n = 3.5$ Assuming that the difference between two terms is 8, the first consecutive term is 3.5, which does not exist. Therefore, two consecutive terms cannot have a difference of 8. OR The difference $(2n + 1)$ is an odd number. Therefore, two consecutive terms cannot have a difference of 8, which is an even number.
5(a)	$p = 1.625$
5(b)	If all 8 points plotted correctly, otherwise, at least 6 points plotted correctly. Smooth curve
5(c)	Maximum point = (0, 2.5)
5(d)	From the graph, $x = -1.10 \pm 0.10$ and $x = 1.55 \pm 0.10$
5(e)	Gradient = 8.67 ± 3
5(f)(i)	Correctly drawn line
5(f)(ii)	$(-0.85, -1.4)$
6(a)	$\angle CQR = 90^\circ$ tangent perpendicular to radius
6(b)	$\angle OPR = 90^\circ$ (tangent perpendicular to radius) $\angle OPR = \angle CQR$ $\angle PRO = \angle QRC$ (common angle) $\angle POR = \angle QCR$ (corresponding angles, $OP \parallel CQ$) Hence, triangle OPR is similar to triangle CQR . (AA Similarity)
6(c)	$\frac{9}{16}$
6(d)	$144\pi \text{ cm}^2$
7(a)	400
7(b)(i)	$\$ \left(\frac{60}{x} \right)$
7(b)(ii)	$\$ \left(\frac{60}{x} + 1 \right)$
7(b)(iii)	$\frac{600}{x} + 5x - 40$

7(b)(iv)	$\frac{600}{x} + 10 + 5x - 50 = 130$ $\frac{600}{x} + 5x - 170 = 0$ $600 + 5x^2 - 170x = 0$ $5x^2 - 170x + 600 = 0$ $x^2 - 34x + 120 = 0 \text{ (shown)}$
7(b)(v)	$x = 30$ or $x = 4$
7(b)(vi)	\$2
8(a)	68.3 cm
8(b)	204000 cm ³
8(c)	$TX = 42.4$ cm
8(d)	$XS = 131$ cm
8(e)	$\theta = 17.9^\circ$
9(a)(i)	\$80.15
9(a)(ii)	\$15.60
9(a)(iii)	<ol style="list-style-type: none"> 1. The mean amount of money spent by students in Group A is higher than that of Group B. On average, students in Group A spent more money than students in Group B. 2. The standard deviation of the amount of money spent by students in Group B is lower than that of Group A. There is a smaller spread in the amount of money spent by students in Group B. The amount of money spent by students in Group B is more consistent.

9(b)(i)	<div style="text-align: center;"> <p>Bag A Bag B</p> </div>
9(b)(ii)(a)	$\frac{1}{33}$
9(b)(ii)(b)	$\frac{32}{99}$
9(b)(ii)(c)	$\frac{64}{99}$
10(a)	2900
10(b)	6
10(c)	<p><u>Cost of purchase from ABC Bookstore</u> Total cost with delivery cost, after member discount = \$816.1425</p> <p><u>Cost of purchase from XYZ Printing</u> Total cost with delivery = \$20 + \$181.90 = \$201.90</p> <p>Grand total cost = \$816.1425 + \$201.90 = \$1018.04</p> <p>The amount of budget of \$1200 is <u>sufficient</u> to cover all costs.</p>