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Class Register No.

Candidate's Name :

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TANJONG KATONG GIRLS' SCHOOL

PRELIMINARY EXAMINATION 2014 SECONDARY FOUR

4016/01

MATHEMATICS Paper 1

Tuesday

2 September 2014

2hr

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces at the top of this page and the cover page for LOT 2.

Write your working and answers 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.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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

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

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

LOT	Marks
1	
2	
Total	
Parent's Signature	

The total marks for this paper is 80.

Setters : Ms Noorhuda/Mdm Ho See Lin

Markers : Mrs Melinda Loy, Mr Ang Wee Jin, Ms Noorhuda, Ms Serena Lee

This Question Paper consists of 22 printed pages, including this 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

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

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

1. (a) Evaluate $\frac{6.44}{14.6 - 2.31^2}$, giving your answer correct to 2 significant figures.
- (b) Write, in its simplest integer form, the ratio 5.25 : 250%.

Answer: (a) _____ [1]

(b) _____ [1]

2. Simplify $\frac{x^6}{16} \div \left(\frac{y^0}{x^4}\right)^{-\frac{1}{2}}$. Leave your answer in positive index form.

Answer: _____ [2]

3. Solve the equation $9^{x-1} = 243(3^x)$.

Answer: $x =$ _____ [2]

4. The table shows the temperatures during summer at the summit and at the foot of Mount Twynam, Mount Kinabalu and Mount Elbrus.

	Mount Twynam	Mount Kinabalu	Mount Elbrus
At summit	-3.1°C	3°C	-24.7°C
At foot	17.2°C	32°C	-4.5°C

Find,

- (a) the difference between the temperatures at the summit of Mount Kinabalu and Mount Elbrus,
- (b) the mean of temperatures at the foot of the three mountains.

Answer: (a) _____ $^{\circ}\text{C}$ [1]

(b) _____ $^{\circ}\text{C}$ [1]

5. (a) The storage capacity of a thumb drive is approximately 3.85 gigabytes.
A music file is approximately 8.01 megabytes.
Find the number of music files that can be stored in the thumb drive.
- (b) Given that the size of a human cell is 12.3 nm and a plant cell is 1.37×10^{-6} m,
find the difference in size between the human cell and plant cell in metres.
Give your answer in standard form.

Answer: (a) _____ [2]

(b) _____ m [1]

6. (a) Express 1176 as a product of its prime factors.

A wholesaler sells sharpeners, erasers and wooden pencils in boxes of 84, 126 and 1176 respectively.

- (b) Mrs Carlos buys a box of each type of stationery and divides them equally into party packs. Find the largest number of party packs that can be packed.
- (c) Mrs Robinson buys sharpeners, erasers and wooden pencils in the ratio of 1 : 1 : 7. Find the least number of boxes of ~~erasers~~ ^{wooden pencils} she could have bought.

Answer: (a) _____ [1]

(b) _____ [1]

(c) _____ [2]

7. (a) A park covers an area of 1.8496 km^2 . If it is represented by 46.24 cm^2 on a map, calculate the scale of the map in the form $1 : n$.
- (b) A company owns 15 machines that produce pens. When all machines are operating, 54 000 pens are produced in 6 hours. On a particular day, 69 000 pens must be produced but 7 of the machines are out of order. Assuming the rest of the machines continue to work at the same rate, how many hours must they operate in order to meet the target?

Answer: (a) _____ [2]
(b) _____ h [2]

8. Solve the simultaneous equations,

$$3x - \frac{1}{y} = 2$$

$$\frac{4}{3}x + 10 = \frac{2}{y}$$

Answer: $x =$ _____

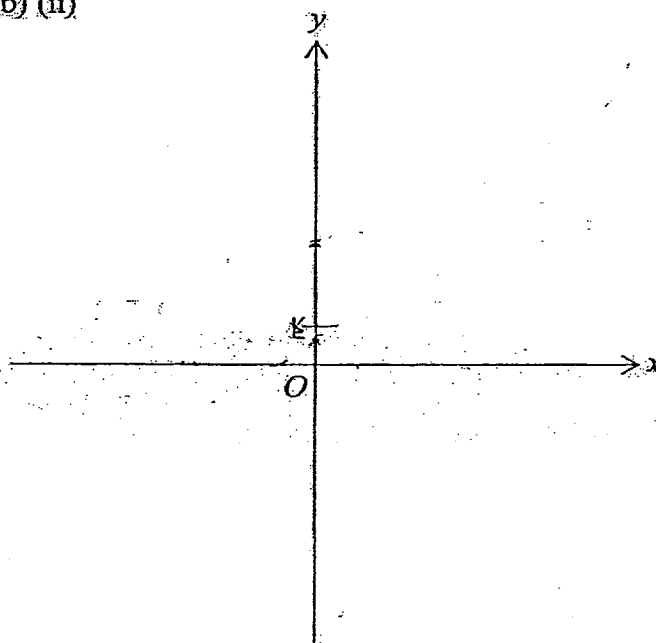
$y =$ _____ [3]

9. (a) Factorise completely $3a^2 - 12b^2 - 4ac - 8bc$.
- (b) The initial amount of bacteria is k and the amount of bacteria doubles every minute.
- (i) Find the amount of bacteria, y , in terms of k and x , after x minutes.
- (ii) Hence, sketch the graph of y for $x \geq 0$.

Answer: (a) _____ [2]

(b) (i) _____ [1]

Answer: (b) (ii)



[1]

10. The following table shows the relationship between n , P , Q and S .

n	P	Q	S
1	10	5	15
2	16	8	24
3	22	11	33
...	...	...	...

- (a) Write down a formula connecting

(i) P , Q and S .

(ii) n and Q .

- (b) Explain why S cannot be 138.

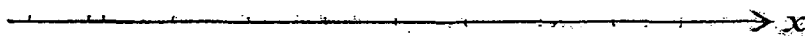
Answer: (a) (i) _____ [1]

(ii) _____ [1]

(b) _____ [2]

11. (a) Solve the linear inequalities $1\frac{1}{3}x - 14 \leq 3(x - 4) < 7.5$ and represent their solution sets on the number line provided.

- (b) Hence, write down the smallest integer which satisfies $1\frac{1}{3}x - 14 \leq 3(x - 4) < 7.5$.



Answer: (a) _____ [3]

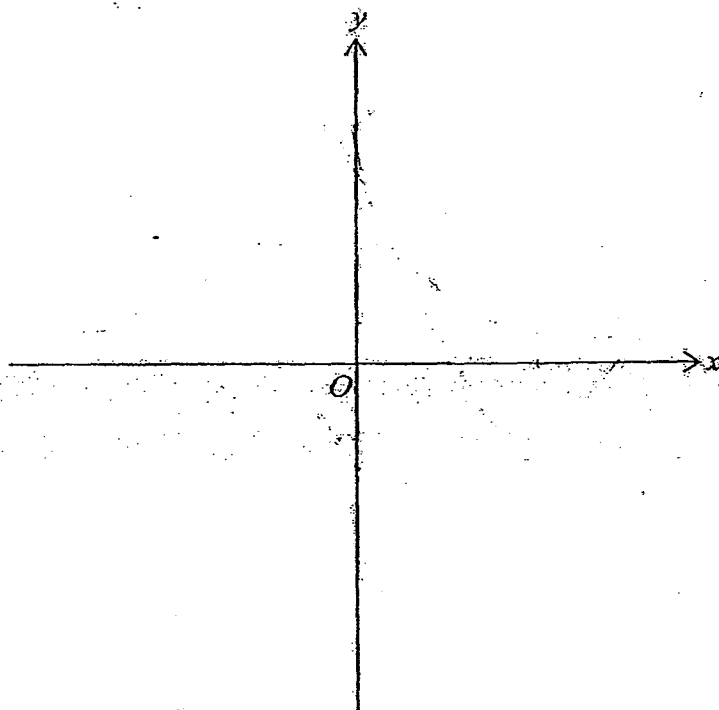
(b) _____ [1]

12. (a) Express $y = x^2 - \frac{3}{2}x + \frac{13}{16}$ in the form of $y = (x + a)^2 + b$.

(b) Sketch the graph of $y = x^2 - \frac{3}{2}x + \frac{13}{16}$.

Answer: (a) _____ [2]

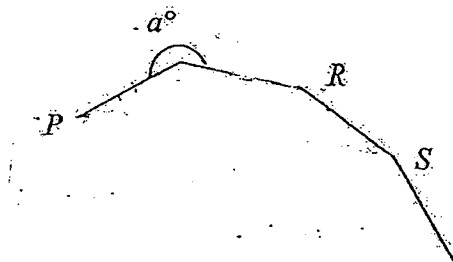
Answer: (b)



[2]

13. PQ , QR and RS are adjacent sides of an n -sided regular polygon.

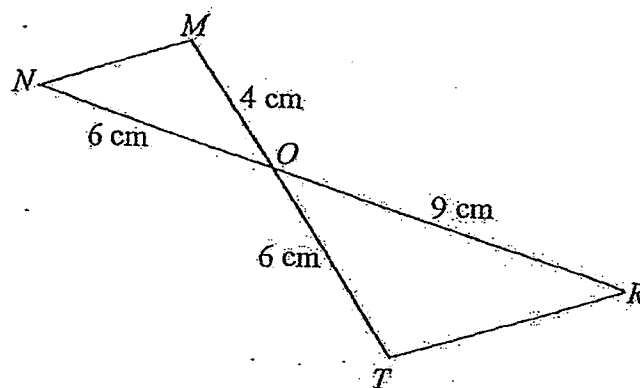
- (a) If the reflex angle PQR is a° , find n in terms of a .
(b) If angle PRS is 150° , find the value of a .



Answer: (a) _____ [2]

(b) $a =$ _____ [2]

14. In the diagram, MOT and NOR are straight lines.
 $MO = 4$ cm, $NO = TO = 6$ cm and $RO = 9$ cm.



- (a) Prove that triangles MON and TOR are similar.

Answer:

(a) _____

_____ [2]

- (b) Given also that $TR = 5.4$ cm, calculate MN .

Answer: (b) _____ cm [2]

Class / Register No.

Candidate's Name :

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TANJONG KATONG GIRLS' SCHOOL

PRELIMINARY EXAMINATION 2014 SECONDARY FOUR

4016/1

MATHEMATICS
Paper 1

Tuesday

2 September 2014

2hr

LOT 2

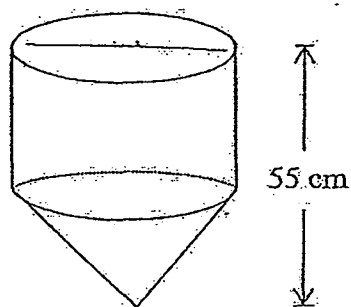
For Examiner's Use	
Marks	

The total marks for this paper is 80.

Setters : Ms Noorhuda/Mdm Ho See Lin

Markers : Mrs Melinda Loy, Mr Ang Wee Jin, Ms Noorhuda, Ms Serena Lee

15. The figure below shows an open container formed by a cone and a cylinder of diameter 14 cm. The height of the container is 55 cm and the total volume of the container is 5.390 cm^3 .



- (a) Taking $\pi = \frac{22}{7}$, calculate the height of the cone.
- (b) Water is poured into the container. If it takes 10 minutes to fill up the cone, calculate the time taken to fill up the container to the height of 15 cm.

Answer: (a) _____ cm [2]

(b) _____ min [1]

16. (a) $\overrightarrow{OP} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$, $\overrightarrow{OQ} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$, $\overrightarrow{OR} = \begin{pmatrix} -2 \\ -4 \end{pmatrix}$ and $\overrightarrow{OS} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

The translation of the point S to the point R is represented by a column vector $\begin{pmatrix} a \\ b \end{pmatrix}$.

Find this column vector.

(b) A point $T(2, c)$ is such that $2|\overrightarrow{QT}| = |\overrightarrow{PS}|$. Find the possible values of c .

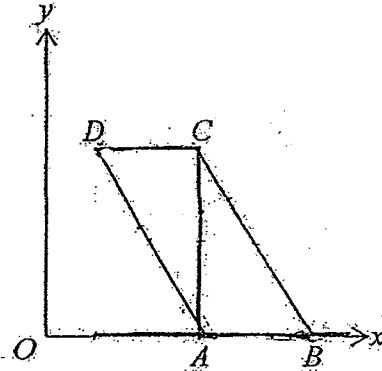
Answer: (a) _____ [1]

(b) $c =$ _____ or _____ [3]

17. $ABCD$ is a parallelogram. A and C are points $(5, 0)$ and $(5, 4)$ respectively. The equation of BC is $4x + 3y = 32$. B is on the x -axis.

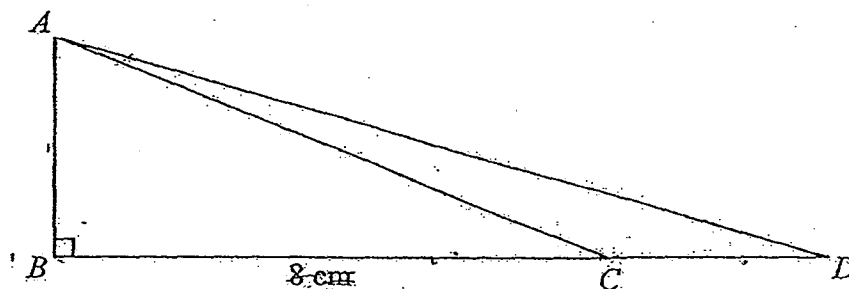
Find

- (a) the equation of AD ,
- (b) the coordinates of B , and
- (c) the shortest distance between AD and BC .



- Answer: (a) _____ [2]
(b) _____ [1]
(c) _____ units [2]

18. The diagram shows a triangle ABC , where $\angle ABC = 90^\circ$ and BC is produced to D . It is given that $BC = 8$ cm, $CD : AB = 2 : 3$ and the area of $\triangle ACD$ is 12 cm^2 .



- (a) Show that the length of AB is 6 cm.

Answer:

(a) _____

 _____ [2]

Without the use of a calculator, write down the exact value of

- (b) $\tan \angle BAD$, and

- (c) $\cos \angle ACD$.

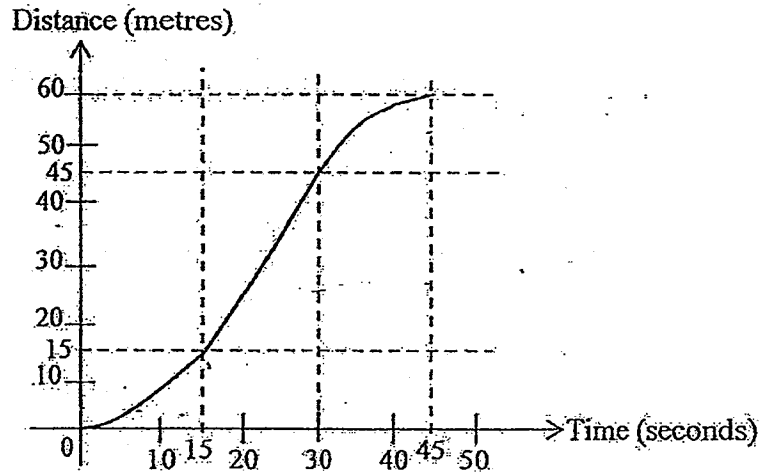
Answer: (b) _____ [1]

(c) _____ [2]

19. A field is in the form of a quadrilateral $ABCD$. C is 135 m due East of A .
The bearing of B from A is 120° and from C is 200° .
 D is equidistant from A and B and $\angle ACD = \angle ACB$.

- (a) Using a scale of 1 cm to represent 15 m, construct an accurate scale drawing of the field. [4]
- (b) In a Treasure Hunt, a prize is hidden at a point in the field equidistant from A and B and nearer to BC than AB . Label, with the letter P , a possible position where the prize is hidden. [2]

20. The diagram shows the distance-time graph of a particle for the first 45 seconds. The particle started from rest.



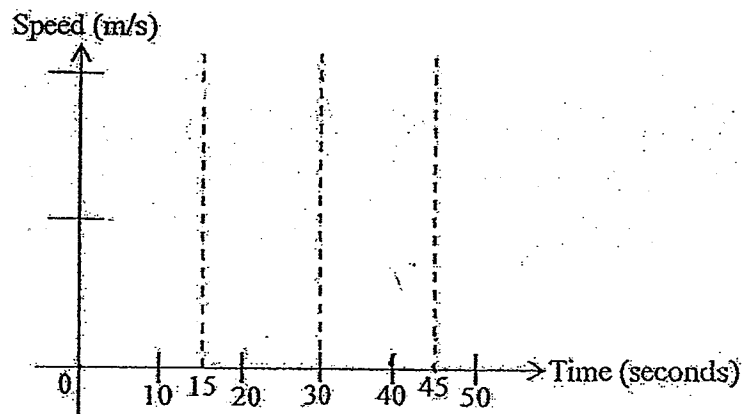
- (a) Find the average speed of the particle for the first 15 seconds in km/h.
- (b) The particle moved with a constant acceleration for the first 15 seconds. Find this acceleration in m/s^2 .

Answer: (a) _____ km/h [1]

(b) _____ m/s^2 [2]

The particle decelerates uniformly for a further distance of 15 m in the last 15 seconds.

- (c) Complete the corresponding speed-time graph for the first 45 seconds.



[2]

21. (a) A survey was conducted to find the number of children in each family surveyed.

Number of children per family	0	1	2	3	4
Number of families	1	x	$2(x+2)$	19	11

- (i) Given that the modal number of children in each family is 3, find the largest possible value of x .
- (ii) Given that the median number of children per family is 3, find the largest possible value of x .

Answer: (a) (i) $x =$ _____ [1]

(ii) $x =$ _____ [1]

21. (b). Three boxes, P , Q and R , contain the following balls.

Box P : 2 black balls and 1 white ball.

Box Q : 1 black ball and 5 white balls.

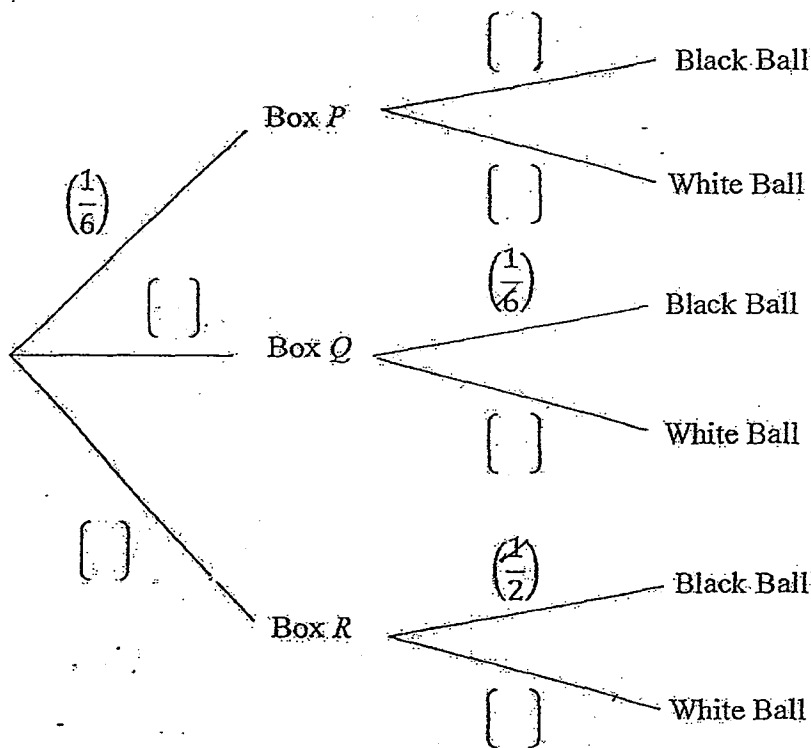
Box R : 2 black balls and 2 white balls.

One ball is drawn from a box at random, the box being chosen by throwing a die and applying the following rules:

1. If the outcome on the die is 6, choose Box P .
2. If the outcome on the die is a 4 or a 5, choose Box Q .
3. If the outcome on the die is a 1, a 2 or a 3, choose Box R .

(i) Complete the tree diagram.

[2]



(ii) A prize is awarded only if a black ball is chosen. Calculate the probability of winning a prize.

Answer: (b) (ii) _____ [2]

END OF PAPER

1a. 0.70

1b. 21:10

2. $\left(\frac{x}{2}\right)^4$

3.7

4a. 27.7

4b. 14.9

5a. 480 music files

5b. 1.3577×10^{-6}

6a. $1176 = 2^3 \times 3 \times 7^2$

6b. 42 party pack

6c. 3 boxes

7a. 1:20000

7b. $14\frac{3}{8}$

8. $x=3$

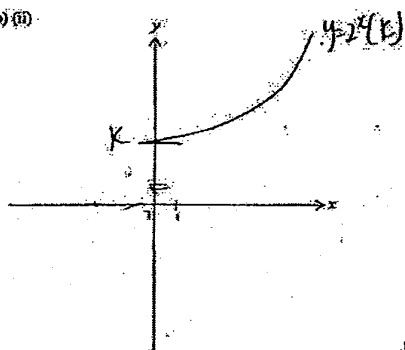
$y=\frac{1}{7}$

9a. $a+2b$

9b. $y=2^x(K)$

9bii

Answer: (b) (ii)



(ii)

10a i. $P+Q=S$

10a ii. $Q=3n+2$

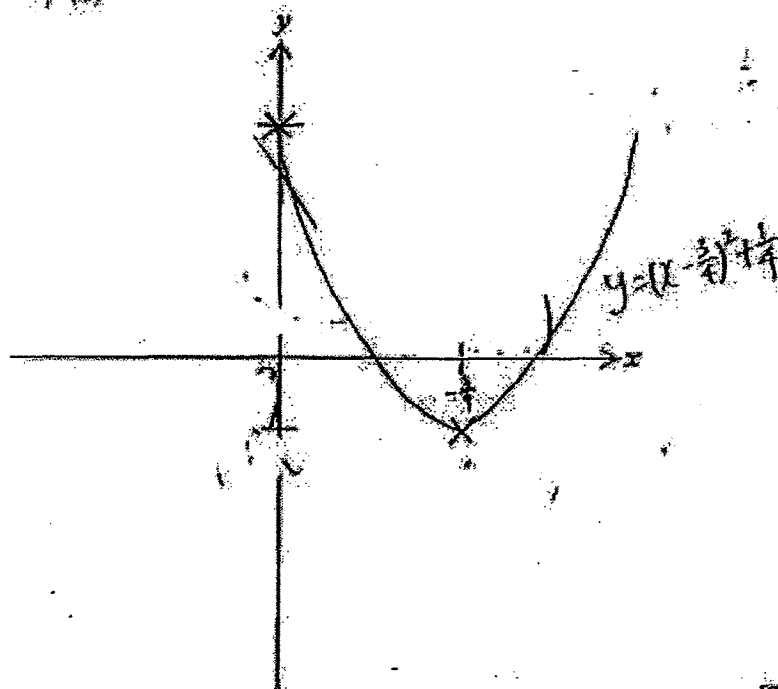
10b. S cannot be 138, as through calculations, its n is not a whole number.

11a. $-1\frac{1}{5} \leq x < 6\frac{1}{2}$

11b. -1

12a. $y = (x - \frac{3}{4})^2 + \frac{1}{4}$

12a.b.



$$13a. n = \frac{360}{a-180}$$

$$13b. a = 200^\circ$$

14a. MON=ROT (vert opp angles)

$$\frac{MO}{TO} = \frac{4}{6} = \frac{2}{3}$$

$$\frac{NO}{RO} = \frac{6}{9} = \frac{2}{3}$$

$$\frac{MO}{TO} = \frac{NO}{RO} = \frac{2}{3}$$

MON and TOR are similar by sas test (proven)

$$14b. 3.6\text{cm}$$

$$15a. 30\text{cm}$$

$$15b. 1.25\text{min}$$

$$16a. \left(\frac{2}{-5} \right)$$

$$16b. c = -1 \text{ or } -3$$

$$17a. 3y + 4x = 20$$

$$17b. B(8,0)$$

$$17c. 2.4 \text{ unit}$$

$$18a.$$

$$\text{Area of } \triangle ACD = \frac{1}{2} \times \frac{2}{3} \times AB \times AB$$

$$\frac{1}{3} AB^2$$

$$12 =$$

$$\frac{1}{3} AB^2$$

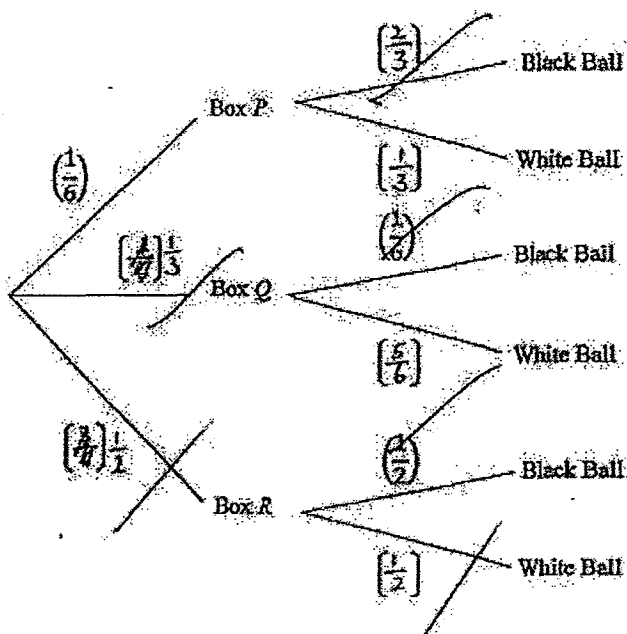
$$AB = 6 \text{ cm}$$

$$18b. 2$$

21a.i.x=7

21a ii.x=8

21b i



21bii $\frac{5}{12}$



TANJONG KATONG GIRLS' SCHOOL

PRELIMINARY EXAMINATION 2014

SECONDARY FOUR

4016/2

MATHEMATICS PAPER 2

Wednesday

17 SEPTEMBER 2014

2 h 30 min

Additional Materials : Writing Paper
 Graph Paper (1 Sheet)

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, and 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. Give answers in degrees to one decimal place.

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

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 of the marks for this paper is 100.

This Question Paper consists of 11 printed pages, including this 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

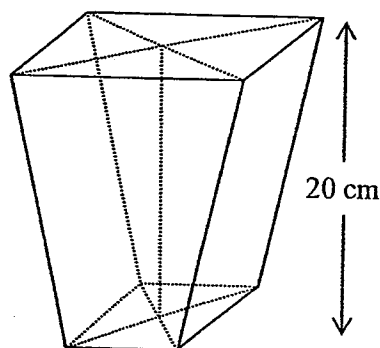
$$\text{Mean} = \frac{\sum fx}{\sum f}$$

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

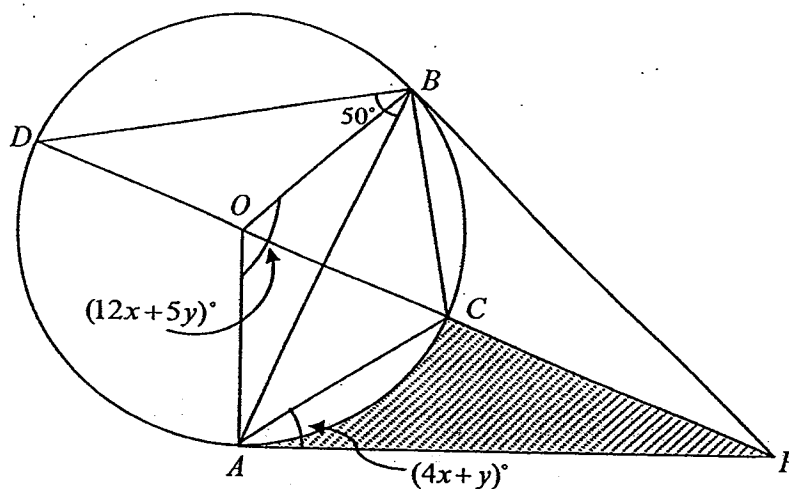
Answer all questions on the writing paper provided.

1. (a) Given that $(x + y)^2 = 25$ and $xy = 5$, find the numerical value of $\frac{x}{y} + \frac{y}{x} + 2$. [2]
 - (b) (i) Express as a single fraction in its simplest form $\frac{2}{x+1} + \frac{1}{x^2-1}$. [2]
 - (ii) Hence solve $1 - \frac{2}{x+1} = \frac{1}{x^2-1}$. [2]
 - (c) It is given that $P = \left(\frac{3f}{t+2}\right)^{\frac{1}{3}}$.
 - (i) Evaluate P when $t = 2.5$ and $f = 12$. [1]
 - (ii) Express t in terms of f and P . [2]
2. Azizah, Belle and Chitra each decided to buy a new Italian sofa set which was priced in the showroom at \$3500.
 - (a) Azizah paid for the new sofa set in cash and was given a discount. Given that she paid \$3255 for it, calculate the percentage discount she received. [1]
 - (b) Belle paid \$200 as down payment and the balance amount in instalment for a period of 2 years using credit card. If the credit card company charges simple interest at a rate of 2.5% per annum, calculate
 - (i) the balance amount Belle had to pay, [1]
 - (ii) the total interest paid by Belle, [1]
 - (iii) the monthly instalment, giving your answer to the nearest dollar. [2]
 - (c) Chitra took a loan for 3 years from a bank to pay for the sofa set. The bank charges a compound interest of 2% per annum compounded half yearly. Calculate the total amount she had to pay for the sofa set. [2]
 - (d) The store had initially hoped to sell each new sofa set for \$4000, so that it would make a profit of 25% on the cost price. Calculate the cost price of the sofa set. [1]

3. Popcorns are sold in containers at a cineplex as shown in the diagram below. Each container has a height of 20 cm. The square cover at the top has an area of 169 cm^2 and the square base has an area of 64 cm^2 . It is given that the container is cut from a right pyramid with height h .



- Find the height of the original pyramid. [2]
 - Calculate the volume of the container. [2]
 - Find the total surface area of the container. [3]
4. In the diagram, O is the centre of the circle, $DOCP$ is a straight line, and AP and BP are tangents to the circle at A and B respectively. [Take $\pi = \frac{22}{7}$]



- Given that $\angle PAC = (4x + y)^\circ$, $\angle AOB = (12x + 5y)^\circ$ and $\angle ABD = 50^\circ$,
 - find the values of x and y , [4]
 - hence, find the value of $\angle ACB$, stating all reasons clearly. [2]
- Given that the radius of the circle is 3.5 cm, find the area of the shaded region ACP . [4]
- Given that the length of minor arc $DA = 6.11 \text{ cm}$, find $\angle DOA$ in radian. [2]

5. (a) $\xi = \{\text{integers } x: 2 \leq x \leq 12\}$
 $A = \{\text{prime numbers}\}$
 $B = \{\text{odd integers } x: 2 \leq 2x < 19\}$

- (i) Draw a Venn diagram to illustrate this information. [2]
(ii) Write down $n(B)$. [1]
(iii) List the elements contained in the set $(A \cup B)'$. [1]

- (b) The Mathematics and Science departments sold donuts and popsicles to raise fund for charity during Open House. The details of their sales on that day are given below.

Department	Donuts	Popsicles
Mathematics	22	33
Science	18	45

- (i) Represent this information by a matrix D . [1]

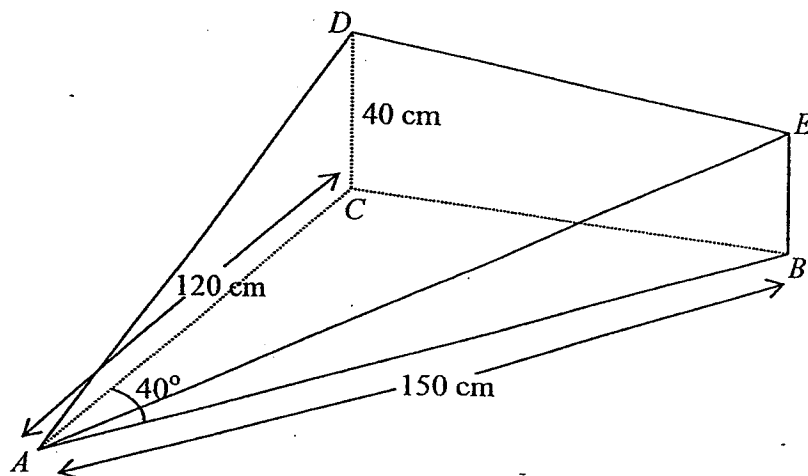
They sold the donuts at 80 cents each and popsicles at 50 cents each. They purchased the donuts and popsicles from a wholesaler at 40 cents and 30 cents each respectively. The selling price of the donuts and popsicles can

be represented by the matrix $S = \begin{pmatrix} 0.80 \\ 0.50 \end{pmatrix}$ and the cost price of the 2 items

can be represented by the matrix $C = \begin{pmatrix} 0.40 \\ 0.30 \end{pmatrix}$.

- (ii) Find DC and interpret the results. [2]
(iii) Find $S - C$ and interpret the results. [2]
(iv) Using matrix multiplication of 2 matrices, which department raised more fund during the Open House? [2]

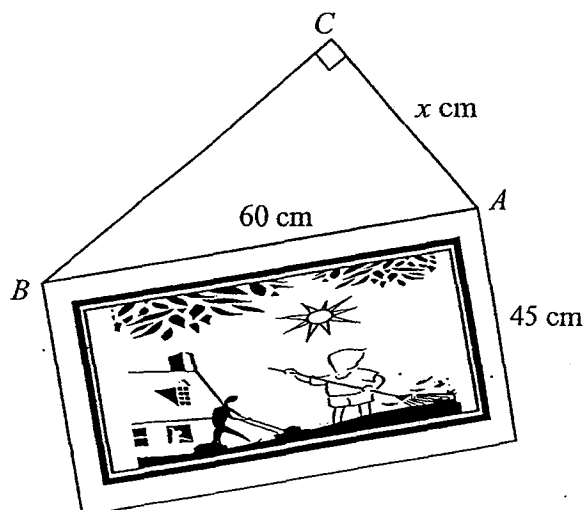
6. A triangular art installation with base ABC is placed in a museum for display. It is given that $AB = 150$ cm, $AC = 120$ cm and $\angle CAB = 40^\circ$. The points E and D are vertically above B and C respectively, $CD = 40$ cm and $4BE = 3CD$.



Calculate

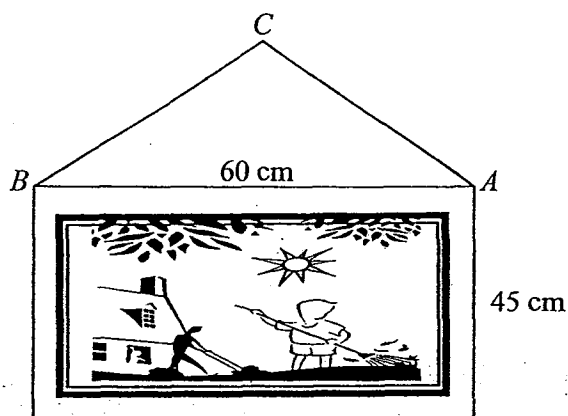
- | | |
|-----------------------|-----|
| (a) the length BC , | [2] |
| (b) $\angle ACB$, | [2] |
| (c) $\angle DAC$, | [2] |
| (d) $\angle BED$. | [3] |

7. (a) A piece of 80 cm long string is used to hold up a 60 cm by 45 cm photo frame. When mounted with a nail at C , the two parts of the string, AC and BC where $BC > AC$, are both straight and $\angle ACB = 90^\circ$. The length of AC is x cm.



- (i) Write down, in terms of x , the length of BC . [1]
- (ii) Write down an equation in x and show that it reduces to $x^2 - 80x + 1400 = 0$. [3]
- (iii) Solve the equation $x^2 - 80x + 1400 = 0$. [3]
- (iv) Hence, find the length of AC , giving your answer correct to two decimal places. [2]

(b)



The photo frame is adjusted such that it is no longer slanted. Explain clearly why $\angle ACB \neq 90^\circ$. [2]

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

In a Design & Technology class, the students are taught to construct a rectangular tray. Four equal squares with length of 2 cm are cut at the corners of a rectangular metal sheet of area 100 cm^2 (Diagram I). The sides of the remaining metal sheet are then folded up to make the rectangular tray (Diagram II).

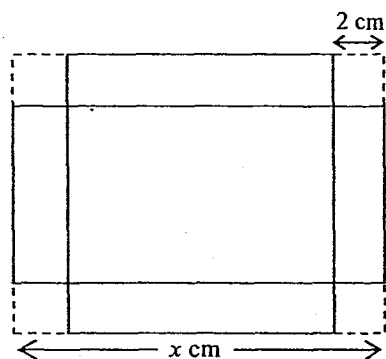


Diagram I

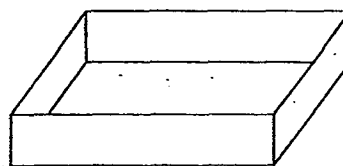


Diagram II

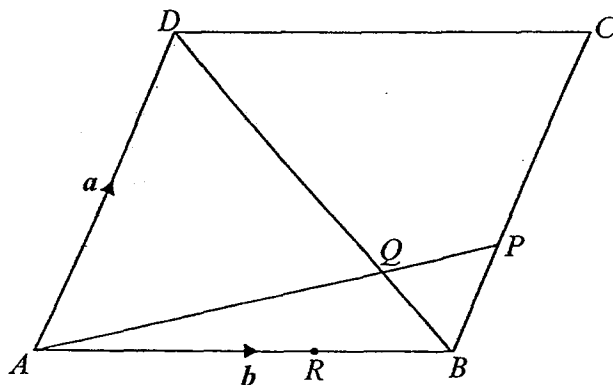
- (a) Given that the length of the metal sheet is $x \text{ cm}$, show that the volume of the tray, $V \text{ cm}^3$, is $V = (8x - 32) \left(\frac{25 - x}{x} \right)$. [3]

The corresponding values of x and V are shown in the table below.

x	4	6	8	10	12	14	16
V	0	50.7	68.0	72.0	69.3	62.9	p

- (b) Calculate the value of p . [1]
- (c) Explain briefly why when $x = 4$, the volume is 0 cm^3 . [1]
- (d) Using a scale of 2 cm to represent 2 cm, draw a horizontal x -axis for $4 \leq x \leq 16$. Using a scale of 2 cm to represent 10 cm^3 , draw a vertical V -axis for $0 \leq V \leq 80$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (e) Use your graph to estimate
- the volume of the tray when $x = 15 \text{ cm}$, [1]
 - the value of x for which the volume of the tray is maximum. [1]
- (f) Use your graph to find the coordinates of a point on the curve at which the gradient of the tangent is equal to 4. [2]

9. $ABCD$ is a parallelogram. AP intersects BD at Q . It is given that $\overrightarrow{AD} = \mathbf{a}$, $\overrightarrow{AB} = \mathbf{b}$ and $3\overrightarrow{BP} = \overrightarrow{BC}$.



- (a) Express, in terms of $\mathbf{a}$ and $\mathbf{b}$,

(i) $\overrightarrow{AP}$, [1]

(ii) $\overrightarrow{QC}$. [2]

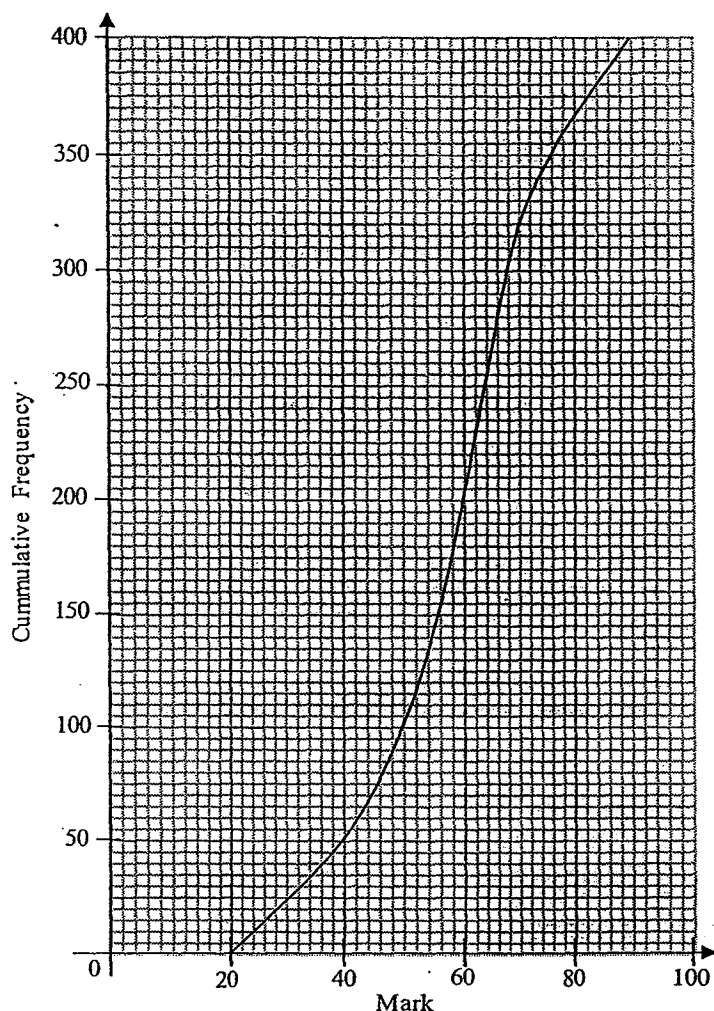
- (b) Given that R is a point on AB such that $AR = 2RB$. Show that C , Q and R are collinear. [3]

- (c) Find the numerical value of

(i) $\frac{\text{area of } \triangle BPQ}{\text{area of } \triangle ADQ}$, [1]

(ii) $\frac{\text{area of } \triangle ADQ}{\text{area of } \triangle PCDQ}$. [2]

10. The results of a Mathematics test taken by 400 Sec 4 pupils are distributed as shown in the cumulative frequency curve below.

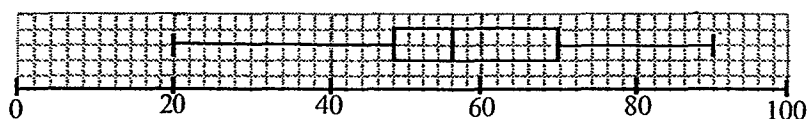


- (a) Use your curve to estimate
- (i) the median mark, [1]
 - (ii) the interquartile range. [2]
- (b) Several days later, it was discovered that every pupil should be awarded 4 marks more for the test. Find the adjusted value of
- (i) the median mark, [1]
 - (ii) the interquartile range. [1]

The above cumulative curve for the unadjusted marks can be represented by the following frequency table.

Mark (x)	Frequency (f)
$0 < x \leq 20$	0
$20 < x \leq 40$	50
$40 < x \leq 60$	p
$60 < x \leq 80$	165
$80 < x \leq 100$	q

- (c) (i) Find the values of p and q . [2]
- (ii) Estimate the mean mark. [1]
- (iii) Estimate the standard deviation of the marks. [2]
- (d) The same group of pupils took an English test. The box and whiskers plot shows the distribution of their marks.



Make two comparisons between the performances of the pupils in the two tests. [2]

—End of Paper —

P2 Answer Key

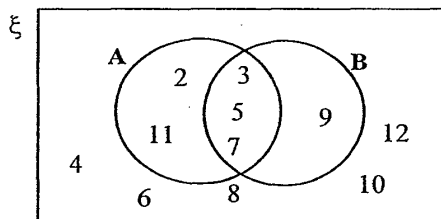
1. (a) 5
 (b) (i) $\frac{2x-1}{x^2-1}$
 (ii) $x=0$ or $x=2$
 (c) (i) $P=2$
 (ii) $t = \frac{3f}{p^3} - 2$

2. (a) 7%
 (b) (i) \$3300
 (ii) \$165
 (iii) \$144
 (c) \$3715.32
 (d) \$3200

3. (a) 52 cm
 (b) $2246\frac{2}{3}\text{ cm}^3$
 (c) 1073 cm^3

4. (a) (i) $x=5, y=20$
 (ii) 100°
 (b) 26.2 cm^2
 (c) 1.75 rad.

5. (a) (i)



- (ii) $n(B) = 4$
 (iii) $\{4, 6, 8, 10, 12\}$
 (b) (i) $D = \begin{pmatrix} 22 & 33 \\ 18 & 45 \end{pmatrix}$
 (ii) $\begin{pmatrix} 18.70 \\ 20.70 \end{pmatrix}$

The elements represent the total amount paid for the 2 items by Mathematics and Science departments respectively.

- (iii) $\begin{pmatrix} 0.40 \\ 0.20 \end{pmatrix}$

The elements represent the profit made from selling 1 donut and 1 popsicles respectively.

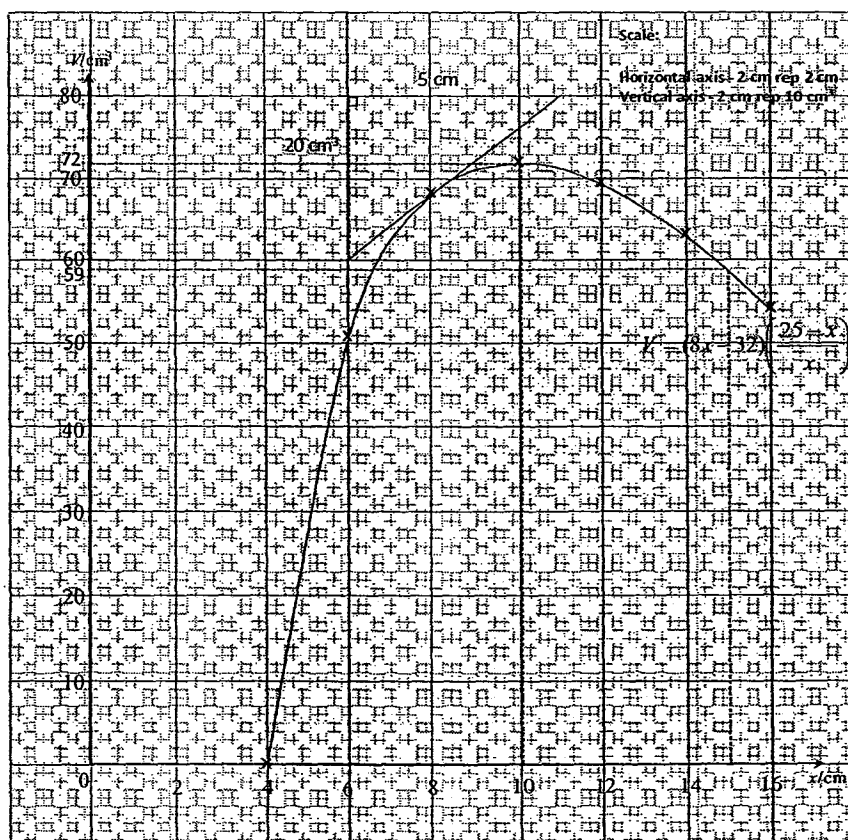
(iv) $\begin{pmatrix} 15.40 \\ 16.20 \end{pmatrix}$

The Science department raised more fund as their profit of \$16.20 is higher than the Mathematics department's \$15.40 by \$0.80.

6. (a) 96.6 cm
(b) 87.0°
(c) 18.4°
(d) 95.9°

7. (a) (i) $BC = 80 - x$
(ii) $60^2 - x^2 = (80 - x)^2$
(iii) 54.1 cm or 25.9 cm
(iv) $\therefore AC = 25.86$ cm
 $x = 54.14$ cm is rejected because $BC > AC$.
(b) Converse of Pythagoras' Thm

8. (a) $2(x-4)\left(\frac{100}{x} - 4\right)$
(b) 54
(c) Since the square corners to be cut off are equal to 2 cm in length each, if $x = 4$ cm, the height/length of the tray will be 0 cm. $\therefore$ volume is also 0 cm^3 .
(d)

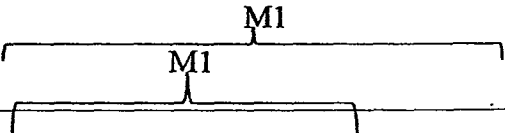


- (e) (i) When $x = 15$ cm, $V = 59 \text{ cm}^3$.
(ii) When V is maximum, $x = 10$ cm
(f) From the graph, the values of the coordinates are (8, 59).

9. (a) (i) $\frac{1}{3}a + b$
 (ii) $\frac{1}{4}(3a + b)$
 (b) Since $\overline{RC} = \frac{4}{3}\overline{QC}$ and C is a common point, $\therefore C, Q$ and R are collinear.
 (c) (i) $\frac{1}{9}$
 (ii) $\frac{9}{11}$
10. (a) (i) 60 marks
 (ii) 18 marks
 (b) (i) 64 marks
 (ii) 18 marks
 (c) (i) $p = 150$
 $q = 35$
 (ii) 59.25 marks
 (iii) 16.4 marks
 (d) On average, the pupils performed better for the Maths test as their median marks of 60 is higher than the EL test of 56 marks.
 They are also more consistent in their Maths test as the Interquartile range of 18 marks is lower than the EL test of 22 marks.

1.	(a)	$\frac{x}{y} + \frac{y}{x} + 2 = \frac{x^2 + y^2 + 2xy}{xy}$ $= \frac{(x+y)^2}{xy}$ $= \frac{25}{5}$ $= 5$	
	(b)	(i) $\frac{2}{x+1} + \frac{1}{x^2-1} = \frac{2}{x+1} + \frac{1}{(x-1)(x+1)}$ $= \frac{2(x-1)+1}{x^2-1}$ $= \frac{2x-2+1}{x^2-1}$ $= \frac{2x-1}{x^2-1}$	
		(ii) $1 - \frac{2}{x+1} = \frac{1}{x^2-1}$ $\frac{1}{x^2-1} + \frac{2}{x+1} = 1$ $\frac{2x-1}{x^2-1} = 1$ $2x-1 = x^2-1$ $x^2-1+1-2x=0$ $x^2-2x=0$ $x(x-2)=0$ $x=0 \text{ or } x=2$	
	(c)	(i) $P = \sqrt[3]{\frac{3(12)}{2.5+2}}$ $P = \sqrt[3]{8}$ $P = 2$	
		(ii) $P = \left(\frac{3f}{t+2} \right)^{\frac{1}{3}}$ $P^3 = \frac{3f}{t+2}$ $P^3(t+2) = 3f$ $tP^3 + 2P^3 = 3f \quad \text{or} \quad (t+2) = \frac{3f}{P^3}$ $tP^3 = 3f - 2P^3$	

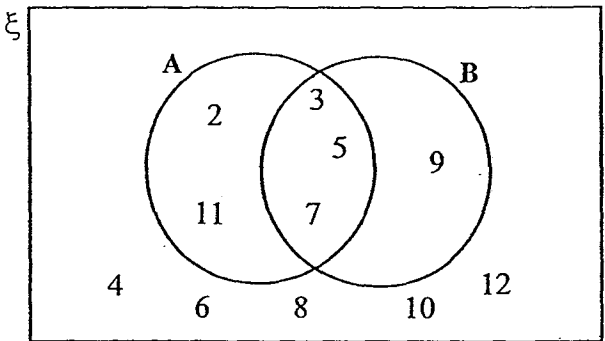
614			$t = \frac{3f - 2P^3}{P^3}$ or $t = \frac{3f}{P^3} - 2$	
2.	(a)	Percentage discount = $\frac{3500 - 3255}{3500} \times 100\%$ = 7%		
	(b)	(i)	Balance amount = $3500 - 200$ = \$3300	
		(ii)	Total interest paid = $\frac{3300 \times 2.5 \times 2}{100}$ = \$165	
		(iii)	Monthly instalment = $\frac{3300 + 165}{24}$ = \$144.38 $\approx$ \$144 (nearest dollar)	
	(c)	Amount paid by Chitra = $3500 \left(1 + \frac{\frac{2}{100}}{1} \right)^6$ = \$3715.321 = \$3715.32 (nearest cent)		
	(d)	Cost price of sofa set = $\frac{4000}{1.25}$ = \$3200		

3.	(a)	$\left. \begin{aligned} \frac{h}{h-20} &= \sqrt{\frac{169}{64}} \\ \frac{h}{h-20} &= \frac{13}{8} \end{aligned} \right\}$ $8h = 13h - 260$ $5h = 260$ $h = 52$ The height of the original pyramid = 52 cm		
	(b)	Volume of box = $\left(\frac{1}{3} \times 169 \times 52 \right) - \left(\frac{1}{3} \times 64 \times 32 \right)$ = $2246\frac{2}{3} \text{ cm}^3$		
	(c)			

		$\text{Total surface area} = 4 \times \left[\frac{1}{2} \times (\sqrt{169} + \sqrt{64}) \times 20 \right] + 169 + 64$ $= 1073 \text{ cm}^3$	
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4.	(a)	(i)	$\angle DCA = \angle DBA$ ($\angle$ s in same segment) $= 50^\circ$ $\angle AOC = 180^\circ - (2 \times 50^\circ)$ (base $\angle$ s of isos Δ) $= 80^\circ$ $\angle AOB = 80^\circ \times 2$ (tangents from ext. point) $= 160^\circ$ $\therefore 12x + 5y = 160$ -----(1) $\angle OAC = \angle OCA$ (base $\angle$ s of isos Δ) $= 50^\circ$ $\angle CAP = 90^\circ - 50^\circ$ (tangent $\perp$ radius) $= 40^\circ$ $\therefore 4x + y = 40$ -----(2) $(2) \times 5$ $20x + 5y = 200$ -----(3) $(3) - (1)$ $8x = 40$ $x = 5$ Subst $x = 5$ into eqn (2) $4(5) + y = 40$ $y = 20$	
		(ii)	$\text{Reflex } \angle AOB = 360^\circ - 160^\circ$ ($\angle$ at a point) $= 200^\circ$ $\angle ACB = \frac{200^\circ}{2}$ ($\angle$ at centre = 2 $\angle$ at circumference) $= 100^\circ$	
	(b)		$AP = 3.5 \times \tan 80^\circ$ $= 19.8495 \text{ cm}$ $\text{Area of } \Delta OAP = \frac{1}{2} \times 19.8495 \times 3.5$ $= 34.7366 \text{ cm}^2$ $\text{Area of minor sector } OAC = \frac{80^\circ}{360^\circ} \times \frac{22}{7} \times (3.5)^2$ $= 8.5556 \text{ cm}^2$ $\text{Area of shaded region} = 34.7366 - 8.5556$ $= 26.181$ $= 26.2 \text{ cm}^2$ (3s.f.)	
	(c)		$3.5 \times \angle DOA = 6.11$ $\angle DOA = \frac{6.11}{3.5}$	

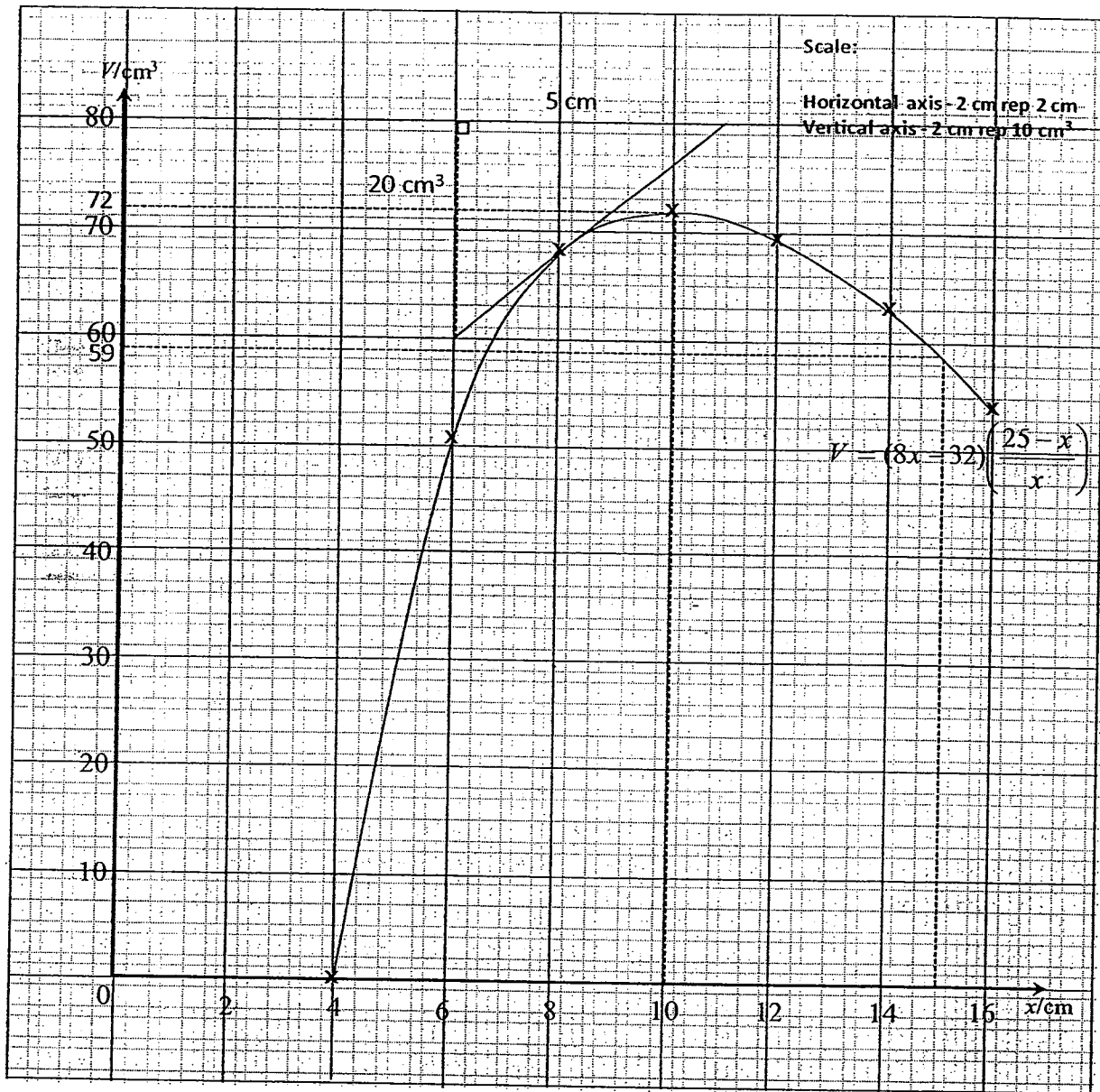
616		$= 1.7457$ $= 1.75 \text{ rad.}$	
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5.	(a)	(i)		
		(ii)	$n(B) = 4$	
		(ii)	$(A \cup B)' = \{4, 6, 8, 10, 12\}$	
	(b)	(i)	$D = \begin{pmatrix} 22 & 33 \\ 18 & 45 \end{pmatrix}$	
		(ii)	$DC = \begin{pmatrix} 22 & 33 \\ 18 & 45 \end{pmatrix} \begin{pmatrix} 0.40 \\ 0.30 \end{pmatrix}$ $= \begin{pmatrix} 18.70 \\ 20.70 \end{pmatrix}$ The elements represent the total amount paid for the 2 items by Mathematics and Science departments respectively.	
		(iii)	$S - C = \begin{pmatrix} 0.80 \\ 0.50 \end{pmatrix} - \begin{pmatrix} 0.40 \\ 0.30 \end{pmatrix}$ $= \begin{pmatrix} 0.40 \\ 0.20 \end{pmatrix}$ The elements represent the profit made from selling 1 donut and 1 popsicles respectively.	
		(iv)	$D(S - C) = \begin{pmatrix} 22 & 33 \\ 18 & 45 \end{pmatrix} \begin{pmatrix} 0.40 \\ 0.20 \end{pmatrix}$ $= \begin{pmatrix} 15.40 \\ 16.20 \end{pmatrix}$ The Science department raised more fund as their profit of \$16.20 is higher than the Mathematics department's \$15.40 by \$0.80.	

618 ⁶ .	(a)	$\text{the length } BC = \sqrt{150^2 + 120^2 - 2(150)(120)\cos 40^\circ}$ $= 96.5526$ $= 96.6 \text{ cm (3s.f.)}$	
	(b)	$\angle ACB = \sin^{-1}\left(\frac{\sin 40^\circ}{96.5526} \times 150\right) \text{ or } \sin \angle ACB = \frac{\sin 40^\circ}{96.5526} \times 150$ $= 86.9758$ $= 87.0^\circ (1 \text{ d.p.})$	
	(c)	$\angle DAC = \tan^{-1}\left(\frac{40}{120}\right) \text{ or } \tan \angle DAC = \frac{40}{120}$ $= 18.4349$ $= 18.4^\circ (1 \text{ d.p.})$	
	(d)	Draw a line from E to CD such that it is $\parallel$ to BC, let X be the foot of the perpendicular line from E to CD. $XD = 40 - 30$ $= 10 \text{ cm}$ $EX = BC = 96.5526 \text{ cm}$ $\angle XED = \tan^{-1}\left(\frac{10}{96.5526}\right)$ $= 5.9131^\circ$ $\angle BED = 90^\circ + 5.9131^\circ$ $= 95.913^\circ$ $= 95.9^\circ (1 \text{ d.p.})$	

7.	(a)	(i)	$BC = 80 - x$ or $BC = \sqrt{60^2 - x^2}$	
		(ii)	$60^2 - x^2 = (80 - x)^2$ or $\sqrt{60^2 - x^2} + x = 80$ $60^2 - x^2 = 6400 - 160x + x^2$ $2x^2 - 160x + 2800 = 0$ $x^2 - 80x + 1400 = 0$ (shown)	
		(iii)	$x = \frac{-(-80) \pm \sqrt{(-80)^2 - 4(1)(1400)}}{2(1)}$ $= \frac{80 \pm \sqrt{800}}{2}$ $= 54.142 \quad \text{or} \quad 25.858$ $= 54.1 \text{ cm} \quad \text{or} \quad 25.9 \text{ cm (3s.f.)}$	
		(iv)	$\therefore AC = 25.86 \text{ cm (2 d.p.)}$ $x = 54.14 \text{ cm}$ is rejected because $BC > AC$.	
	(b)		If $\angle ACB = 90^\circ$, then $AC^2 + BC^2 = 60^2$ (Pythagoras Theorem) Since AC and BC are equal, $AC = BC = 40 \text{ cm}$ But $40^2 + 40^2 \neq 60^2$ By converse of Pythagoras' Theorem, $\angle ACB \neq 90^\circ$.	

8. 620	(a)	$\text{Volume of tray, } V = 2(x-4)\left(\frac{100}{x} - 4\right)$ $= (2x-8)\left(\frac{100-4x}{x}\right)$ $= 4(2x-8)\left(\frac{25-x}{x}\right)$ $= (8x-32)\left(\frac{25-x}{x}\right) \text{ (shown)}$	
	(b)	$p = (8 \times 16 - 32)\left(\frac{25-16}{16}\right)$ $= 54$	
	(c)	Since the square corners to be cut off are equal to 2 cm in length each, if $x = 4$ cm, the height of the tray will be 0 cm. $\therefore$ volume is also 0 cm^3 .	
	(d)	See graph below.	
	(e)	(i) When $x = 15$ cm, $V = 59 \text{ cm}^3$.	
		(ii) When V is maximum, $x = 10$ cm	
	(f)	From the graph, the values of the coordinates are (8, 68).	



9.	(a)	(i)	$\overrightarrow{BP} = \frac{1}{3} \overrightarrow{BC}$ $= \frac{1}{3} \mathbf{a}$ $\overrightarrow{AP} = \overrightarrow{AB} + \overrightarrow{BP}$ $= \mathbf{b} + \frac{1}{3} \mathbf{a}$ $= \frac{1}{3} \mathbf{a} + \mathbf{b}$	
		(ii)	$\overrightarrow{QP} = \frac{1}{4} \overrightarrow{AP} \text{ (corr. sides of similar triangles)}$ $= \frac{1}{4} \left(\frac{1}{3} \mathbf{a} + \mathbf{b} \right)$ $= \frac{1}{12} \mathbf{a} + \frac{1}{4} \mathbf{b}$ $\overrightarrow{QC} = \overrightarrow{QP} + \overrightarrow{PC}$ $= \frac{1}{12} \mathbf{a} + \frac{1}{4} \mathbf{b} + \frac{2}{3} \mathbf{a}$ $= \frac{3}{4} \mathbf{a} + \frac{1}{4} \mathbf{b}$ $= \frac{1}{4} (3\mathbf{a} + \mathbf{b})$	
	(b)		$\overrightarrow{RC} = \overrightarrow{RB} + \overrightarrow{BC}$ $= \frac{1}{3} \mathbf{b} + \mathbf{a}$ $= \mathbf{a} + \frac{1}{3} \mathbf{b}$ $= \frac{1}{3} (3\mathbf{a} + \mathbf{b})$ Since $\overrightarrow{RC} = \frac{4}{3} \overrightarrow{QC}$ and C is a common point, $\therefore C, Q$ and R are collinear.	
	(c)	(i)	$\frac{\text{area of } \triangle BPQ}{\text{area of } \triangle ADQ} = \left(\frac{1}{3} \right)^2$ $= \frac{1}{9}$	
		(ii)	$\frac{\text{area of } \triangle ADQ}{\text{area of } \triangle AQB} = \frac{3}{1}$ $= \frac{3 \times 3}{1 \times 3}$	

$$\begin{aligned} &= \frac{9}{11} \\ &\frac{\text{area of } \triangle ADQ}{\text{area of } \triangle BPQ} = \frac{9}{1} \\ &\frac{\text{area of } \triangle ADQ}{\text{area of } PCDQ} = \frac{9}{9+3-1} \\ &= \frac{9}{11} \end{aligned}$$

10.	(a)	(i)	Median mark = 60 marks	
		(ii)	Interquartile range = $68 - 50$ = 18 marks	
	(b)	(i)	Median mark = $60 + 4$ = 64 marks	
		(ii)	Interquartile range = 18 marks	
	(c)	(i)	$p = 150$ $q = 35$	
		(ii)	Mean = $\frac{(10 \times 0) + (30 \times 50) + (50 \times 150) + (70 \times 165) + (90 \times 35)}{400}$ $= \frac{23700}{400}$ = 59.25	
		(iii)	Standard deviation = $\sqrt{\frac{(10^2 \times 0) + (30^2 \times 50) + (50^2 \times 150) + (70^2 \times 165) + (90^2 \times 35)}{400} - \left(\frac{23700}{400}\right)^2}$ $= \sqrt{\frac{1512000}{400} - 3510 \frac{9}{16}}$ = 16.415 = 16.4	
	(d)	On average, the pupils performed better for the Maths test as their median marks of 60 is higher than the EL test of 56 marks. They are also more consistent in their Maths test as the Interquartile range of 18 marks is lower than the EL test of 22 marks.		