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Name

Index Number

Class



WOODGROVE SECONDARY SCHOOL

MID-YEAR EXAMINATION 2016

LEVEL & STREAM : SECONDARY 4 EXPRESS

SUBJECT (CODE) : MATHEMATICS (4048)

PAPER NO : 02

DATE / DAY : 05 MAY 2016 / THURSDAY

DURATION : 2 HOURS 30 MINUTES

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate writing papers provided.

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

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

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

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.

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.

At the end of the examination, fasten all your work securely together.

DO NOT TURN OVER THE QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

*Mathematical Formulae**Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

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) Express $\frac{8}{2x-3} - \frac{11}{3x+1}$ as a single fraction in its simplest form. [2]

(b) Simplify $\frac{18m^2 - 8n^2}{3m^2 - mn - 2n^2}$. [3]

(c) Given that $(p+q)^2 = 8$ and $pq = -3$, find the value of $\left(\frac{p-q}{2}\right)^2$. [2]

(d) If $\frac{3x-2y}{2y+3x} = \frac{5}{3}$, find the value of $\frac{y}{x}$. [3]

- 2 The table shows the number of packets of rice of four brands, *A*, *B*, *C* and *D*, sold at 3 grocery shops.

	Brand <i>A</i>	Brand <i>B</i>	Brand <i>C</i>	Brand <i>D</i>
Shop 1	5	3	1	1
Shop 2	11	6	8	5
Shop 3	8	5	4	3

A packet of rice costs \$15 for Brand *A*, \$10 for Brand *B*, \$8 for Brand *C* and \$5 for Brand *D*.

(a) Given the matrix $P = \begin{pmatrix} 15 \\ 10 \\ 8 \\ 5 \end{pmatrix}$,

(i) write down a 3×4 matrix *Q* that represents the data in the table above, [1]

(ii) evaluate *QP*, [1]

(iii) explain what the elements in *QP* represent. [1]

Brand *A* comes in packets of 8 kg, Brand *B* in packets of 10 kg, Brand *C* in packets of 7 kg and Brand *D* in packets of 9 kg.

(b) (i) Write down a 4×1 matrix *S* such that matrix *QS* represents the total number of kilograms of rice sold by each shop. [1]

(ii) Evaluate *QS*. [1]

(iii) Hence deduce the average cost of rice per kilogram for Shop 2. [2]

- 3 (a) There are 30 students in a class. 14 students are in NCC and 20 students are in the Soccer team. 4 students are neither members of NCC nor the Soccer team.

Let $E = \{\text{Students in the class}\},$
 $N = \{\text{Students in NCC}\},$
 $S = \{\text{Students in the Soccer Team}\}.$

- (i) Draw a Venn Diagram to illustrate the above information. On the Venn Diagram, clearly indicate the number of elements in each distinct region. [3]

It is also given that $C = \{\text{Chinese students in the class}\},$
 $M = \{\text{Malay students in the class}\},$
 $I = \{\text{Indian students in the class}\}.$

- (ii) Describe in words the meaning of the set notation $M \cap S \neq \{ \}.$ [1]

- (iii) Describe what you can deduce from the set notation $I \subset N.$ [1]

- (iv) Express in set notation:
 $\{\text{Chinese students who are neither in NCC nor the Soccer team}\}$ [1]

- (b) A bag contains 3 blue balls and 6 yellow balls. A ball is chosen at random from the bag. If it is blue, it is replaced in the bag. If it is yellow, it is not replaced. Regardless of the colour of the ball drawn, the next ball is then drawn.

- (i) If two balls are drawn at random from the bag, draw the probability tree diagram to illustrate the possible outcomes. [2]

- (ii) Find the probability that at least one ball is blue. [2]

- (iii) If three balls were chosen at random, find the probability that all the balls would be yellow. [2]

- (iv) If the process carried on for n times, find the probability, in terms of n , that a blue ball would be drawn every time. [1]

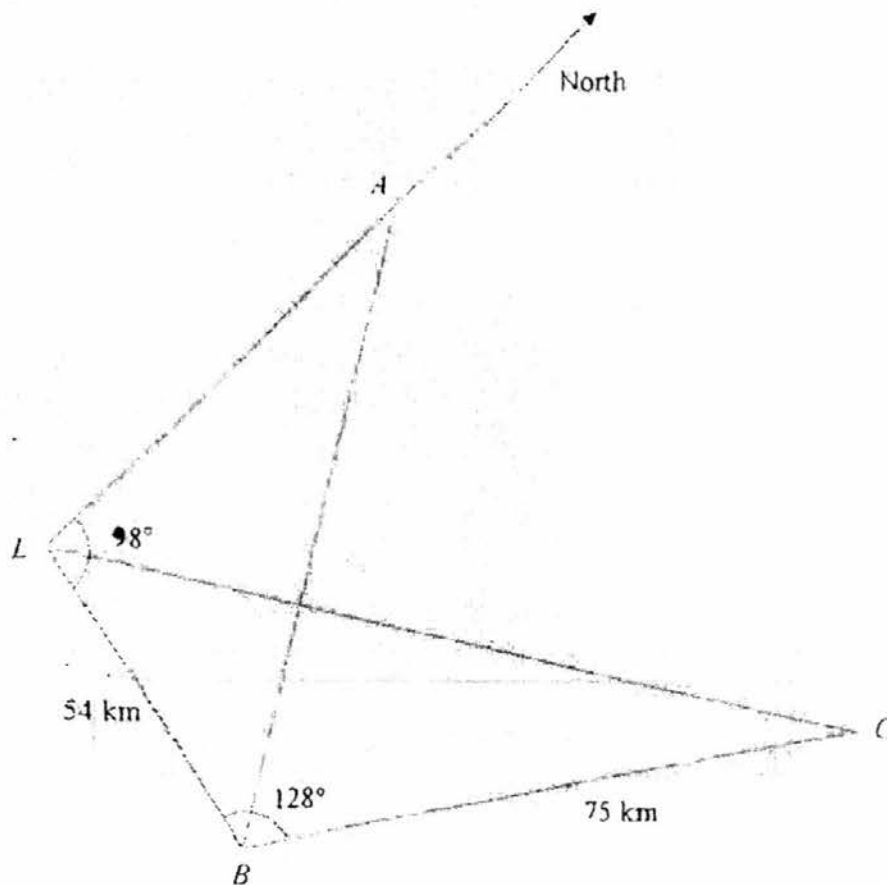
4 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation $y = \frac{18}{x^2} + 3x$. Some corresponding values of x and y , correct to 1 decimal place, are given in the following table.

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
y	21.0	12.5	10.5	10.4	11.0	12.0	13.1	14.4

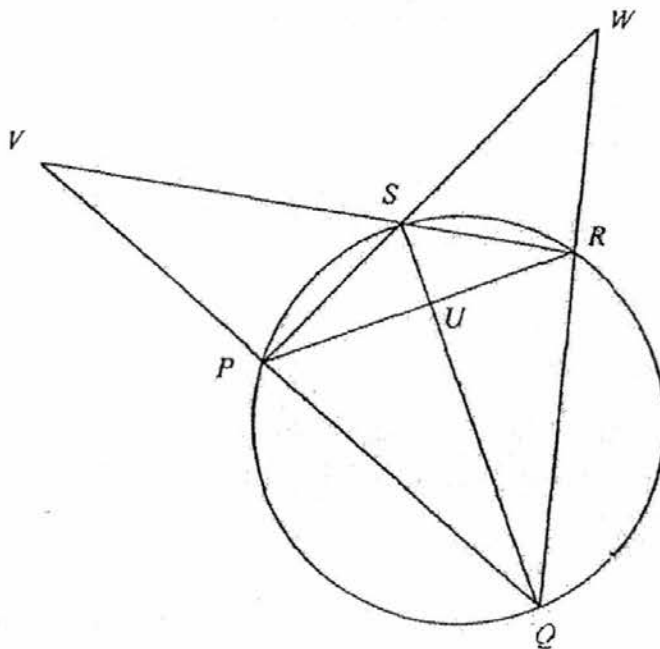
- (a) Using a scale of 4 cm to 1 unit, draw a horizontal x -axis for $0 \leq x \leq 5$.
 Using a scale of 1 cm to 1 unit, draw a vertical y -axis for $0 \leq y \leq 22$.
 On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (b) By drawing a tangent, find the gradient of the curve at $(2, 10.5)$. [2]
- (c) Use your graph to estimate, for $0 \leq x \leq 5$, the least value of $\frac{18}{x^2} + 3x$. [1]
- (d) By drawing a suitable graph, estimate, for $0 \leq x \leq 5$, the solutions of $3x^3 - 14x^2 + 18 = 0$. [3]
- (e) On the same axes, draw the graph of $y = 18 - 2x$.
 Hence estimate, for $0 \leq x \leq 5$, the range of values of x for which $5x^3 - 18x^2 + 18 \leq 0$. [3]

- 5 The diagram shows the positions of three ships A , B and C and a lighthouse, L , which is due south of A . The bearing of B from L is 098° and $\angle LBC = 128^\circ$. $LB = 54$ km and $BC = 75$ km.



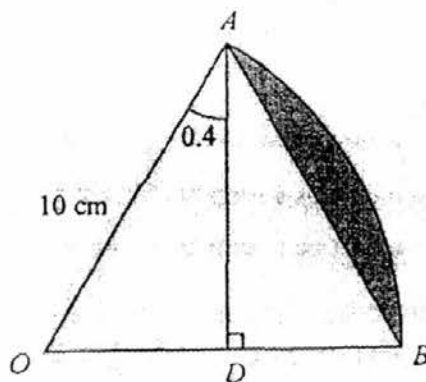
- Calculate the distance CL . [2]
- Calculate the bearing of C from B . [1]
- The bearing of B from A is 135° . Calculate the distance AB . [2]
- The ship C is moving straight towards the lighthouse L with a speed of 18 km/h. If it starts at 1300 h, at what time would it be nearest to B ? [4]

- 6 (a) The diagram shows a circle $PQRS$. QP and RS are produced to meet at V and PS and QR are produced to meet at W . The diagonals SQ and PR meet at U .



- (i) Show that the sum of $\angle VPS$ and $\angle WRS$ is 180° . [2]
 It is also given that $\angle SQR = 24^\circ$ and $\angle SRQ = 98^\circ$. Find,
 (ii) $\angle RPS$, [1]
 (iii) $\angle QPR$, [1]
 (iv) $\angle VSQ$. [1]

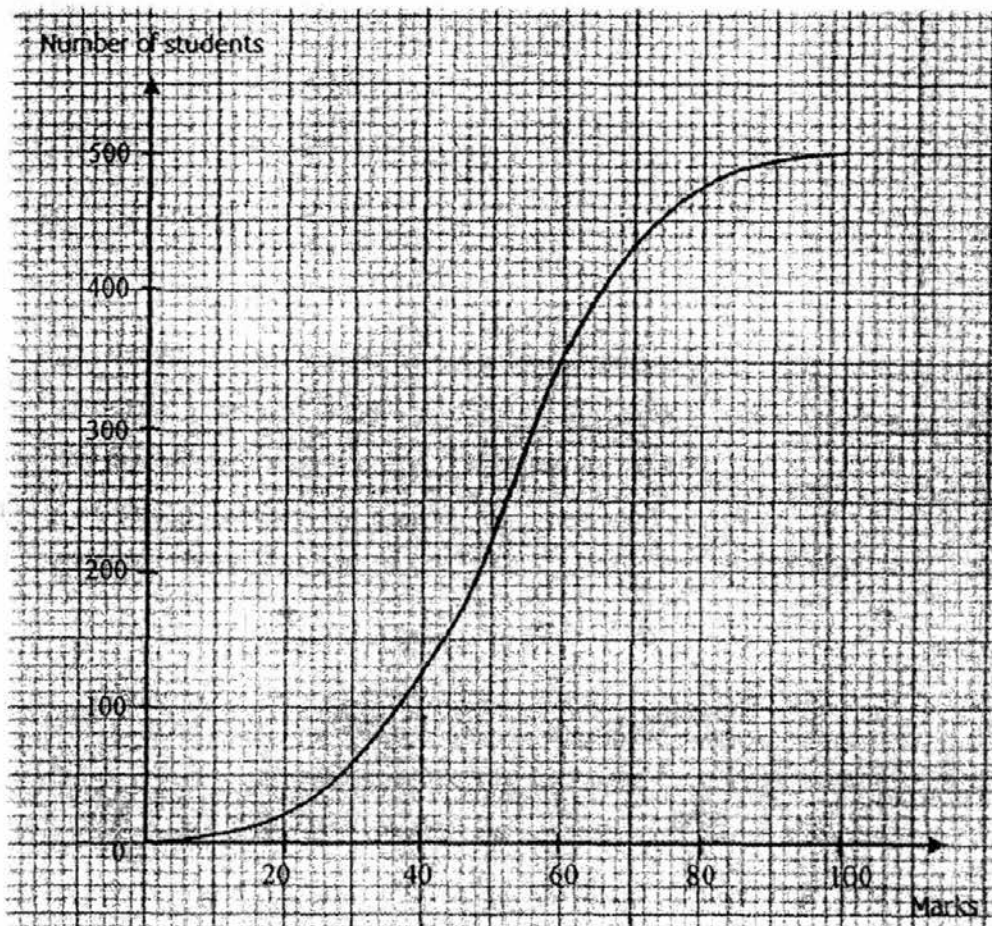
(b)



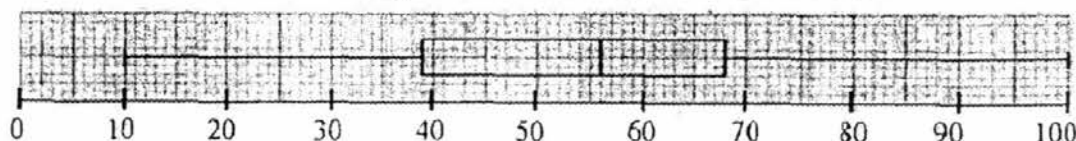
OAB is a sector of a circle, centre O and radius 10 cm, and $\angle OAD = 0.4$ radians. AD is perpendicular to OB . Calculate

- (i) the perimeter of the shaded region, [2]
 (ii) the area of the shaded region, [2]
 (iii) the length of AD . [2]

- 7 The cumulative frequency curve below illustrates the marks obtained, out of 100, by 500 students from School X in a Mathematics test.



- (a) Use the graph to find
- (i) the median mark, [1]
 - (ii) the interquartile range, [2]
 - (iii) the 94th percentile mark, [1]
 - (iv) the pass mark, if 65% of the students passed the test, [1]
 - (v) the probability of a student scoring a distinction, if the student had to score above 82 marks to obtain a distinction. [1]
- (b) Another group of 500 students from School Y took the same Mathematics test. The box and whisker diagram below illustrates the marks obtained.

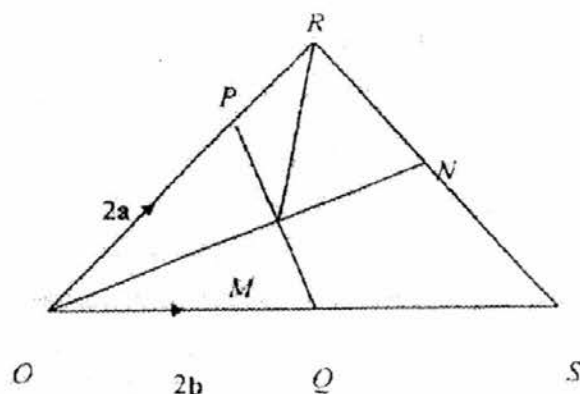


Compare the results of the two groups of students from School X and School Y in two different ways.

[2]

- 8 In $\triangle ORS$, the point P on OR is such that $OP = \frac{2}{3}OR$. M is the midpoint of PQ .

Q is the midpoint of OS and $RN : NS = 3 : 4$. $\overrightarrow{OP} = 2\mathbf{a}$ and $\overrightarrow{OQ} = 2\mathbf{b}$.



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

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

(ii) $\overrightarrow{OM}$, [1]

(iii) $\overrightarrow{RS}$, [1]

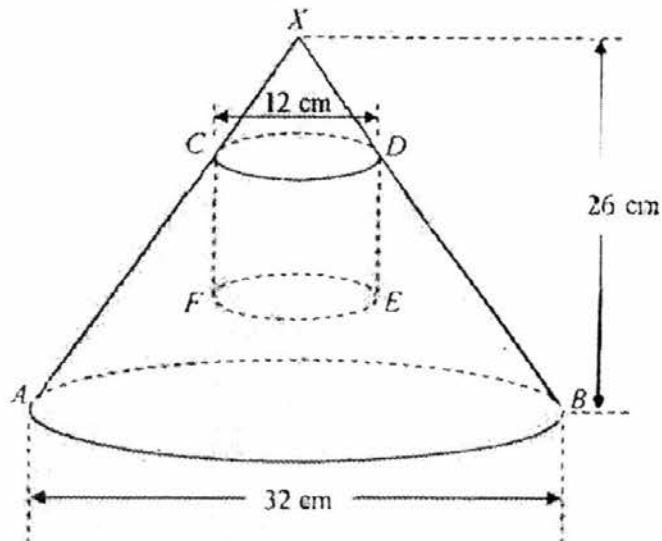
(iv) $\overrightarrow{MR}$, [1]

- (b) (i) Express $\overrightarrow{MN}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [2]

- (ii) State two relationships between O , M and N . [2]

- (c) Find $\frac{\text{area of } \triangle PRM}{\text{area of } \triangle ORN}$. [2]

- 9 In the diagram, the base diameter and the height of the solid cone AXB are 32 cm and 26 cm respectively. The base diameter of the solid cone CXD is 12 cm. The cone CXD is cut off from the cone AXB . A cylindrical hole $CDEF$ is then drilled on the frustum. The curved surface area of the cylindrical hole is $120\pi \text{ cm}^2$.



- (a) Find
- the height of the cone CXD , [1]
 - the length of CF , [2]
 - the length of AC . [2]
- (b) The cost of paint needed to paint the cone AXB is \$32. Calculate the cost of paint needed to paint the cone CXD . [2]
- (c) Calculate the volume of the remaining solid in terms of π . [3]

Average Monthly Household Expenditure¹ by Household Size,

2002/03 - 2012/13



Per Household Member

2012/13	\$1.961	\$1.513	\$1.388	\$1.355	\$1.326	\$1.231
2007/08	\$1.617	\$1.285	\$1.107	\$1.068	\$1.042	\$946
2002/03	\$1.283	\$1.137	\$978	\$922	\$884	\$864

¹Expenditure data exclude imputed rental of owner-occupied accommodation.*[The above data was extracted from www.singstat.gov.sg]*

- Which household size has the highest average monthly expenditure? [1]
- Find the percentage increase of the average monthly household expenditure for household size 4 from 2002/03 to 2012/13. [2]
- Calculate the mean of the average monthly household expenditure per household member in 2012/13. [2]
- Calculate the standard deviation of the average monthly household expenditure per household member in 2012/13. [2]
- Compare the consistency of the average monthly household expenditure per household member for 2012/13 and 2007/08. Justify your answer. [2]
- Regardless of the household size, give a possible reason for the average monthly household expenditure increase across the years. [1]

END OF PAPER 2

Calculator Model:

Name

Index Number

Class



WOODGROVE SECONDARY SCHOOL MID-YEAR EXAMINATION 2016

LEVEL & STREAM : SECONDARY 5 NORMAL (ACADEMIC)
SUBJECT (CODE) : ELEMENTARY MATHEMATICS (4016)
PAPER NO : 01
DATE / DAY : 10 MAY 2016 / TUESDAY
DURATION : 2 HOURS

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

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 in the space below that question.

Omission of essential working will result in a loss of marks.

The use of a scientific calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

For π , use 3.142, unless the question requires the answer in terms of π .

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

The total number of marks for this paper is 80.

DO NOT TURN OVER THE QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

This document consists of **17** printed pages including this cover page

Setter : Mrs Shirley Choo

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

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.

- 1 (a) Calculate $\sqrt{1\frac{1}{7} \div \frac{16}{17}} \times (0.23 - 4.678)$.

Write down the first six digits on your calculator display.

Answer [1]

- (b) Write your answer to part (a) correct to 4 decimal places.

Answer [1]

- 2 These are the first four terms in a sequence.

27 33 39 45

- (a) Write down the tenth term in the sequence.

Answer [1]

- (b) Write down an expression, in terms of n , for the n th term in the sequence.

Answer [1]

- 3 (a) Evaluate $\sqrt{10^5 \div 10^9}$ without the use of a calculator.

Answer [2]

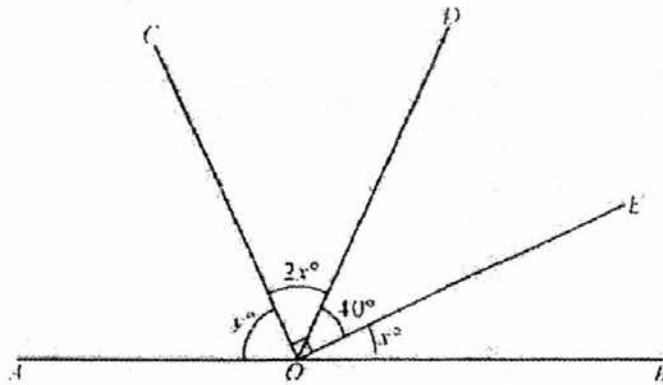
- (b) Joel practises Mathematics for exactly 2 hours everyday. Find the number of seconds he spent practising Mathematics in the year 2016, expressing your answer in standard form. (The year 2016 is a leap year.)

Answer seconds [2]

- 4 $\triangle ABC$ has sides $AB = 28$ cm, $AC = 96$ cm and $BC = 100$ cm. Stating your reasons clearly, determine whether $\triangle ABC$ is a right-angled triangle.

Answer

- 5 In the diagram below, AOB is a straight line.



- (a) Find x .

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

- (b) Find y .

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

- 6 The advertisement below shows the promotion happening over three days.

LAST 3 DAYS

TO

GO BIG ON SHOPPING

— 18 - 20 MARCH —

70% OFF + 20% OFF
(ADDITIONAL)

UP TO **30% OFF**

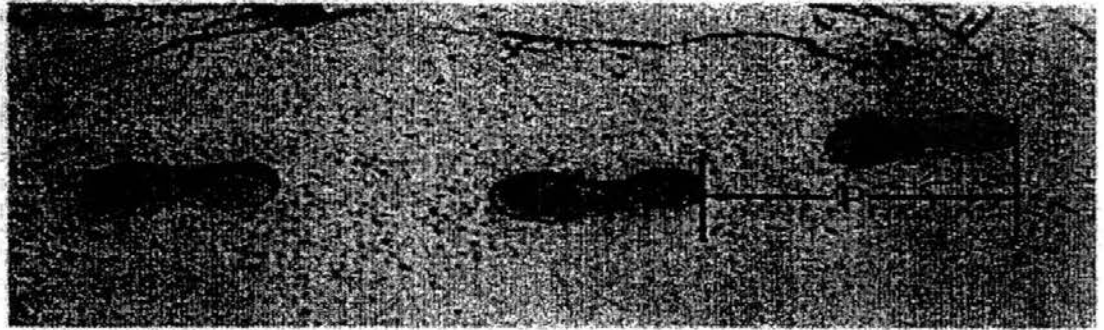
Explain one way in which the advertisement is misleading.

Answer

.....

..... [2]

- 7 The picture below shows the footprints of a man walking. The pacelength P is the distance between the rear of two consecutive footprints. For men, the formula, $\frac{n}{P} \approx 140$, gives an approximate relationship between n and P where n is the number of steps per minute



This formula applies to Bert's walking. Bert knows his pacelength is 0.8 metres. Calculate Bert's speed of walking in metres per minute.

Answer

m/min [3]

- 8 It is given that $\varepsilon = \{x : x \text{ is an integer, } 11 - x \leq 5x - 12 < 25\}$, $R = \{x : x \text{ is a prime number}\}$ and $S = \{x : x \text{ is an integer, } 0 < x \leq 6\}$.

(a) List all the elements in the universal set ε .

Answer [3]

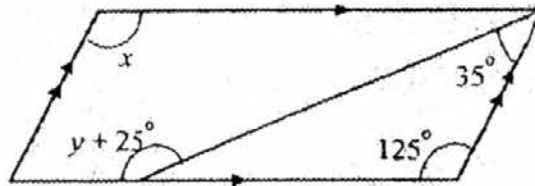
(b) List all the elements in the set $(R \cap S)$.

Answer [1]

(c) Find $n(R \cup S)$.

Answer [1]

- 9 The following diagram shows a parallelogram.



(a) Find x .

Answer ° [1]

(b) Find y .

Answer ° [2]

Question No.	Marking Point	Marks Awarded	Remarks
1	(a) $\frac{8}{2x-3} - \frac{11}{3x+1}$ $= \frac{8(3x+1) - 11(2x-3)}{(2x-3)(3x+1)}$ $= \frac{2x+41}{(2x-3)(3x+1)}$	M1 A1	
	(b) $\frac{18m^2 - 8n^2}{3m^2 - mn - 2n^2}$ $= \frac{2(9m^2 - 4n^2)}{(3m+2n)(m-n)}$ $= \frac{2(3m-2n)(3m+2n)}{(3m+2n)(m-n)}$ $= \frac{2(3m-2n)}{m-n}$	M1 M1 A1	Accept $\frac{6m-4n}{m-n}$
	(c) $\left(\frac{p-q}{2}\right)^2$ $= \frac{p^2 + q^2 - 2pq}{4}$ $= \frac{(p+q)^2 - 2pq - 2pq}{4}$ $= \frac{8 - 4(-3)}{4}$ $= 5$	M1 A1	
	(d) $\frac{3x-2y}{2y+3x} = \frac{5}{3}$ $10y+15x = 9x-6y$ $6x = -16y$ $\frac{y}{x} = -\frac{3}{8}$	M1 M1 A1	

2	(a)(i)	$Q = \begin{pmatrix} 5 & 3 & 1 & 1 \\ 11 & 6 & 8 & 5 \\ 8 & 5 & 4 & 3 \end{pmatrix}$	B1	
	(a)(ii)	$QP = \begin{pmatrix} 5 & 3 & 1 & 1 \\ 11 & 6 & 8 & 5 \\ 8 & 5 & 4 & 3 \end{pmatrix} \begin{pmatrix} 15 \\ 10 \\ 8 \\ 5 \end{pmatrix}$ $= \begin{pmatrix} 118 \\ 314 \\ 217 \end{pmatrix}$	B1	
	(a)(iii)	The elements represent the total amount of money (in dollars) each shop received from selling the rice packets respectively.	B1	
	(b)(i)	$S = \begin{pmatrix} 8 \\ 10 \\ 7 \\ 9 \end{pmatrix}$	B1	
	(b)(ii)	$QS = \begin{pmatrix} 5 & 3 & 1 & 1 \\ 11 & 6 & 8 & 5 \\ 8 & 5 & 4 & 3 \end{pmatrix} \begin{pmatrix} 8 \\ 10 \\ 7 \\ 9 \end{pmatrix}$ $= \begin{pmatrix} 86 \\ 249 \\ 169 \end{pmatrix}$	B1	
	(b)(iii)	Av. cost of rice/kg for Shop 2 = $\$ \frac{314}{249}$ = \$1.26	M1 A1	
3	(a)(i)	Deduct 1m each for two overlapping circles <i>N</i> & <i>S</i> missing/wrong. Deduct 1m for missing/wrong label of <i>E</i> , <i>N</i> & <i>S</i> . Deduct 1m for any numbers (6, 8, 12, 4) missing/	B3	

	wrong.		
(a)(ii)	There are Malay students in the soccer team.	BI	
(a)(iii)	All Indian students are members of the NCC	BI	
(a)(iv)	$C \cap (N \cup S)'$ OR $C \cap (N' \cap S')$	BI	
(b)(i)			
	Correct probabilities for first branch	BI	
	Correct probabilities for second branch	BI	
(b)(ii)	$P(\text{at least one blue}) = 1 - \left(\frac{2}{3} \times \frac{5}{8}\right)$ $= \frac{7}{12}$	MI AI	Accept $\left(\frac{1}{3} \times \frac{1}{3}\right) + \left(\frac{1}{3} \times \frac{2}{3}\right) + \left(\frac{2}{3} \times \frac{3}{8}\right)$ $= \frac{7}{12}$
(b)(iii)	$P(YYY) = \frac{6}{9} \times \frac{5}{8} \times \frac{4}{7}$	MI AI	

		$= \frac{5}{21}$		
	(b)(iv)	$\left(\frac{1}{3}\right)^n$	B1	
4	(a)	Correct labelled scale used for x-axis and y-axis Points plotted correctly Graph drawn smoothly	G1 G1 G1	
	(b)	The tangent of the curve at (2, 10.5) cuts the points (0, 13.5) and (3, 9). $\Rightarrow \text{gradient} = \frac{9-13.5}{3-0} = -1.5$ Acceptable answer: -1.5 ± 0.2 (i.e. between -1.7 and -1.3)	M1 A1	
	(c)	least value of $y = 10.3 \pm 0.2$ (i.e. between 10.1 & 10.5)	B1	
	(d)	$3x^3 - 14x^2 + 18 = 0$ $3x - 14 + \frac{18}{x^2} = 0$ $\frac{18}{x^2} + 3x = 14$ Correct graph of $y = 14$ drawn. $x = 1.35 \pm 0.05, x = 4.35 \pm 0.05$	M1 M1 A1	
	(e)	Correct graph of $y = 18 - 2x$ drawn. intersection of the 2 graphs, $\frac{18}{x^2} + 3x = 18 - 2x$	P1	

		$\frac{18}{x^2} + 5x - 18 = 0$ $18 + 5x^3 - 18x^2 = 0$ $5x^3 - 18x^2 + 18 = 0$ $x = 1.25 \pm 0.05 \quad \text{or } x = 3.25 \pm 0.05$ For $5x^3 - 18x^2 + 18 \leq 0$, $\frac{18}{x^2} + 3x \leq 18 - 2x$ $\Rightarrow 1.2 \sim 1.3 \leq x \leq 3.2 \sim 3.3$	M1 A1	
5	(a)	$CL^2 = 75^2 + 54^2 - 2(75)(54)\cos 128^\circ$ $CL = 116.3093$ $CL \approx 116 \text{ km}$	M1 A1	
	(b)	$128^\circ - (180^\circ - 98^\circ)$ $= 046^\circ$	B1	
	(c)	$\frac{AB}{\sin 98^\circ} = \frac{54}{\sin 45^\circ}$ $AB = 75.6243$ $AB \approx 75.6 \text{ km}$	M1 A1	
	(d)	$\frac{\sin \angle BCL}{54} = \frac{\sin 128^\circ}{116.3093}$ $\angle BCL = 21.4603^\circ$ If P is nearest to B along CL , then BP is perpendicular to CL . $\cos 21.4603^\circ = \frac{CP}{75}$ $CP = 69.8003 \text{ km}$	M1 M1	

		time taken to reach P = $\frac{69.8003}{18}$ ≈ 3.8778 h ≈ 3 h 53 min	M1	
		Ship C would reach P at 16 53 h	A1	
6	(a)(i)	$\angle VPS + \angle WRS$ $= (180^\circ - \angle SPQ) + (180^\circ - \angle SRQ)$ $= 360^\circ - (\angle SPQ + \angle SRQ)$ $= 360^\circ - 180^\circ$ ($\angle$ s in opp. segment) $= 180^\circ$ (shown)	M1 A1	
	(a)(ii)	$\angle RPS = 24^\circ$ ($\angle$ s in the same segment)	B1	
	(a)(iii)	$\angle QPR = 180^\circ - 98^\circ - 24^\circ$ $= 58^\circ$ ($\angle$ s in the same segment)	B1	
	(a)(iv)	$\angle VSQ = 98^\circ + 24^\circ$ $= 122^\circ$ (ext $\angle$ of triangle)	B1	
	(b)(i)	$\angle AOB = \frac{\pi}{2} - 0.4 = 1.1708$ Perimeter of shaded region $= AB + \text{arc length } AB$ $= \sqrt{10^2 + 10^2} - 2 \times 10 \times 10 \times \cos 1.1708 + 10 \times 1.1708$ $= 11.0506 + 11.7079$ ≈ 22.8 cm	M1 A1	
	(b)(ii)	Area of shaded region $= \frac{1}{2} \times 10^2 \times 1.1708 - \frac{1}{2} \times 10^2 \times \sin 1.1708$ $= 58.539 - 46.053$ ≈ 12.5 cm ²	M1 A1	
	(b)(iii)	$\cos 0.4 = \frac{AD}{10}$ or $\sin 1.1708 = \frac{AD}{10}$ $AD = 10 \cos 0.4$ $AD = 10 \sin 1.1708$	M1	

		$\approx 9.21 \text{ cm}$ $\approx 9.21 \text{ cm}$ Alternatively, $\frac{1}{2} \times AD \times 10 = \frac{1}{2} \times 10 \times 10 \times \sin\left(\frac{\pi}{2} - 0.4\right)$ $AD \approx 9.21 \text{ cm}$	A1	
7	(a)(i)	Median mark = 52	B1	
	(a)(ii)	Interquartile range = 62 - 40 = 22	M1 A1	
	(a)(iii)	94 th percentile = 78	B1	
	(a)(iv)	Pass mark = 46	B1	
	(a)(v)	$P(\text{student scoring distinction}) = \frac{20}{500} = \frac{1}{25}$	B1	
	(b)	School Y: Median mark = 56 IQR = 68 - 39 = 29 Range = 90 In general, students from School Y performed better for the Mathematics test than students from School X as its median is higher. The results from School Y is more widespread than School X as its IQR is greater.	B1 B1	Or, the results of school X is more consistent than school Y as its IQR is smaller.
8	(a)(i)	$\overline{PM} = \frac{1}{2} \overline{PQ} = b - a$	B1	
	(a)(ii)	$\overline{OM} = 2a + b - a$ = $a + b$	B1	
	(a)(iii)	$\overline{RS} = -3a + 4b$	B1	
	(a)(iv)	$\overline{MR} = 3a - (a + b) = 2a - b$	B1	

	$\text{Or, } \overrightarrow{MR} = \overrightarrow{MO} + \overrightarrow{OR}$ $= -(a + b) + 3a = 2a - b$			
(b)(i)	$\overrightarrow{RN} = \frac{3}{7} \overrightarrow{RS} = \frac{3}{7}(-3a + 4b)$ $\overrightarrow{MN} = \overrightarrow{MR} + \overrightarrow{RN}$ $= 2a - b + \frac{3}{7}(-3a + 4b)$ $= \frac{5}{7}(a + b)$	M1 A1		
(b)(ii)	$O, M \text{ and } N \text{ are collinear.}$ $\overrightarrow{MN} = \frac{5}{7} \overrightarrow{OM} \quad \text{or} \quad 7 \overrightarrow{MN} = 5 \overrightarrow{OM}$	B1 B1		
(c)	$\frac{\text{area of } \triangle PRM}{\text{area of } \triangle ORM} = \frac{1}{3} \quad (1)$ $\frac{\text{area of } \triangle ORM}{\text{area of } \triangle ORN} = \frac{7}{12} \quad (2)$ $\text{From (1) and (2), } \frac{3 \times \text{area of } \triangle PRM}{\text{area of } \triangle ORN} = \frac{7}{12}$ $\frac{\text{area of } \triangle PRM}{\text{area of } \triangle ORN} = \frac{7}{36}$	M1 A1		
9	(a)(i)	$\frac{h}{26} = \frac{12}{32} = \frac{3}{8}$ $h = 9.75 \text{ cm}$	B1	
	(a)(ii)	$\text{Curved surface area} = 120\pi$ $2 \times \pi \times 6 \times CF = 120\pi$ $\therefore CF = 10 \text{ cm}$	M1 A1	
	(a)(iii)	$AX = \sqrt{26^2 + 16^2} = \sqrt{932}$ $\frac{CX}{\sqrt{932}} = \frac{12}{32}$ $CX = 11.44825 \dots$ $\therefore AC = \sqrt{932} - 11.44825$	M1	

	$= 19.080$ $\approx 19.1 \text{ cm}$	A1	
(b)	$\frac{A_1}{A_2} = \left(\frac{3}{8}\right)^2 = \frac{9}{64}$ $\text{Cost} = \frac{9}{64} \times \$32 = \$4.50$	M1 A1	
(c)	$\frac{\text{vol. of cone } CXD}{\text{vol. of cone } AXB} = \left(\frac{3}{8}\right)^3 = \frac{27}{512}$ $\therefore \frac{\text{vol. of frustum}}{\text{vol. of cone } AXB} = \frac{485}{512}$ $\text{Vol. of frustum} = \frac{485}{512} \times \left(\frac{1}{3} \times \pi \times 16^2 \times 26\right)$ $= 2101\frac{2}{3} \pi \text{ cm}^3$ $\text{Vol. of remaining solid} = 2101\frac{2}{3} \pi - \pi \times 6^2 \times 10$ $= 1741\frac{2}{3} \pi \text{ cm}^3$	M1 M1 A1	
10	(a) 6 or more	B1	
(b)	$\frac{5421 - 3688}{3688} \times 100\%$ $= 46.990\%$ $\approx 47.0\%$	M1 A1	Accept $46\frac{913}{922}\%$
(c)	$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{8774}{6}$ $\approx \$1462.33$	M1 A1	or B2
(d)	$s = \sqrt{\frac{\sum x^2}{N} - \left(\frac{\sum x}{N}\right)^2}$ $= \sqrt{\frac{13170896}{6} - \left(\frac{8774}{6}\right)^2}$ $\approx \$238.18$	M1 A1	or B2

(e)	$s = \sqrt{\frac{\sum x^2}{N} - \left(\frac{\sum x}{N}\right)^2}$ $= \sqrt{\frac{8612667}{6} - \left(\frac{7065}{6}\right)^2}$ $\approx \$221.22$ The average monthly household expenditure per member for 2007/08 is more consistent than that for 2012/13 as it has lower standard deviation.	M1 A1	
(f)	- Inflation - Greater material needs now than in the past	B1	Accept any similar logical reasoning

Question 4(a)

