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**YUSOF ISHAK SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017**

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**CANDIDATE
NAME**

CLASS

**INDEX
NUMBER**

MATHEMATICS

4048 / 01

4 Express / 5 Normal (Academic)

Paper 1

16th August 2017

Candidates answer on the Question Paper

2 hours

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a HB pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters 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.

The use of an approved scientific calculator is expected, where appropriate.

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

For π , use either your calculator value or 3.142, 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.

For Examiner's Use

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

Setter: Mr Eric Koh

[Turn over

Answer **all** the questions.

1. Evaluate the following, leaving your answer correct to four significant figures.

$$\frac{-3.3^2 \times \sqrt{2^3}}{[1 - 8(7 + 7^{-1})]^2} \times \sin \frac{\pi}{3}$$

Answer [1]

2. The value of a house decreased by 14.3% between 2000 and 2016.
In 2000 the house was valued at \$850 000.
Find its value in 2016.

Answer \$..... [2]

3. A container is unloaded by 6 men in 24 minutes.
Given that all the men work at the same rate, find how long it would take 9 men to unload the same container.

Answer minutes [2]

4. A car manufacturer states that a particular car
- Uses 5 litres of fuel in travelling 100 km
 - produces 115 grams of CO_2 for each kilometer travelled.

Use this information to calculate the mass of CO_2 produced by 1 litre of fuel.
Give your answer in kilograms.

Answer kg [2]

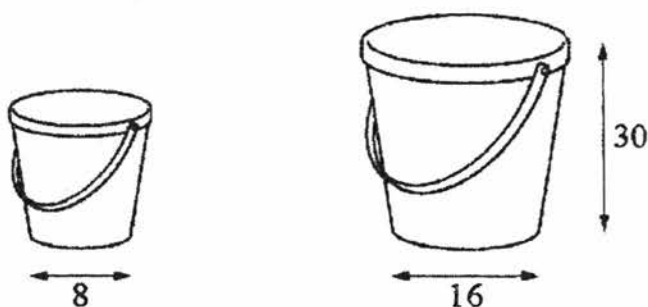
5. (a) Factorise completely $50p^2 - 72q^2$.
- (b) Solve the equation $\frac{x-2}{4} - \frac{x+1}{3} = 1$.
- (c) $T = 2\pi\sqrt{\frac{h}{g}}$. Make h the subject of the formula.

Answer (a) [2]

Answer (b) [2]

Answer (c) [2]

6. Similar buckets are available in two sizes.
The larger bucket has height 30 cm and base diameter 16 cm.
The small bucket has base diameter 8 cm.



- (a) Find the height of the small bucket.
(b) Given that the small bucket has volume 850 cm^3 , find the volume of the large bucket.

Answer (a) cm [1]

Answer (b) cm^3 [2]

7. The temperature inside a greenhouse is $p^\circ\text{C}$, and outside it is $-q^\circ\text{C}$, where p and q are positive integers.

Write down an expression for

(a) the difference between the two temperatures,

(b) the mean of the two temperatures.

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

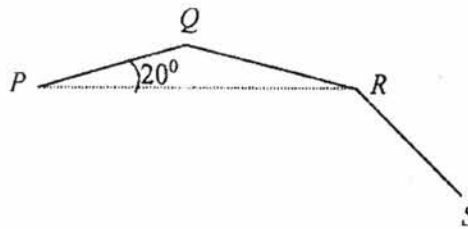
Answer (b) $^\circ\text{C}$ [1]

8. Green Line trains run every 10 minutes.
Red Line trains run every 20 minutes.
Purple Line trains run every 35 minutes.
One train from each Line leaves the city centre at 09 00.
After how many minutes will trains from all three Lines next leave the city centre in the same time?

Answer minutes [2]

9. PQ , QR and RS are adjacent sides of a regular polygon. Given that $\angle RPQ = 20^\circ$, calculate

- (a) the exterior angle of the polygon,
(b) the number of sides of the polygon,
(c) $\angle PRS$.



Answer (a) [1]

(b) [1]

(c) $\angle PRS =$ [1]

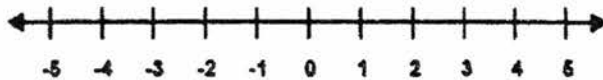
10. P is directly proportional to Q^2 .

If Q is increased by 200%, find the percentage increase of P .

Answer% [2]

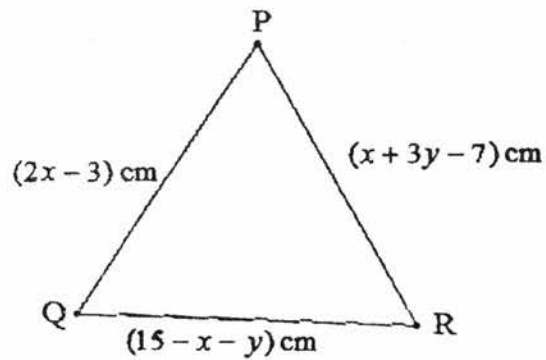
11. Solve the inequalities $\frac{10x+8}{3} + 2 < 5 + 4x < 8$.

Show your solution on the number line below.



[3]

12. The diagram shows an equilateral triangle PQR with $PQ = (2x - 3)$ cm, $QR = (15 - x - y)$ cm and $PR = (x + 3y - 7)$ cm.



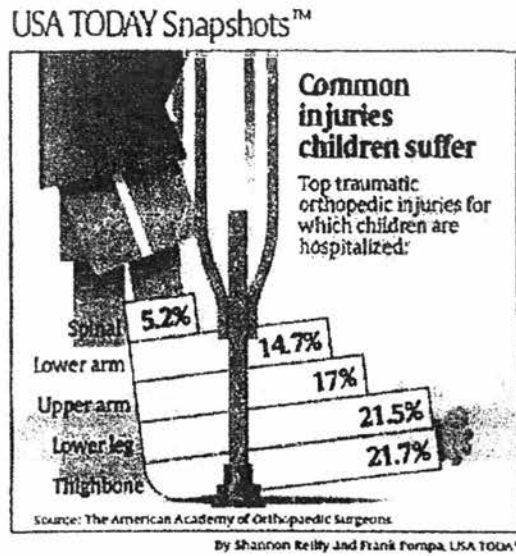
- (a) Using the information shown in the diagram, write down and simplify two simultaneous equations in x and y .
- (b) Solve these equations to find the value of x and the value of y .

Answer (a)

.....[2]

(b) $x =$ $y =$ [2]

13. The information shows the common injuries children suffer in the United States of America (USA) in 2013.



- (a) Explain **one way** in which the information is misleading.

Answer

..... [2]

- (b) Suggest **one recommendation** to overcome the misleading information provided.

Answer

..... [1]

14. A map is drawn to a scale of 1 : 50 000.

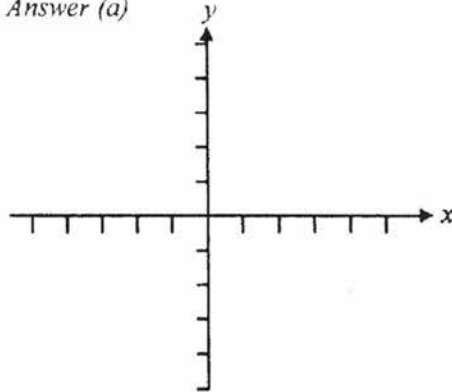
- (a) An airport runway is represented by a line of length 5.8 cm on the map. Calculate, in km, the actual length of the runway.
- (b) The actual area of the airport is 6.5 km². Calculate, in square centimetres, the area on the map which represents the airport.

Answer (a) km [1]

(b) cm² [2]

15. (a) Sketch the graph of $y = (1 - x)(x - 3)$.

Answer (a)

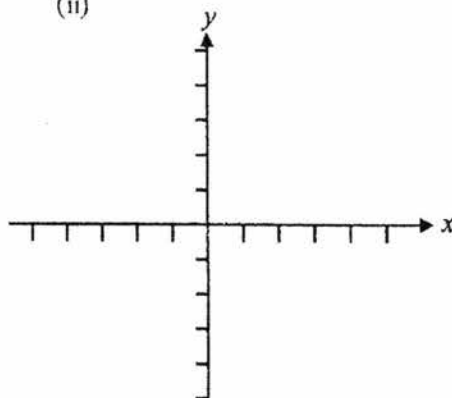


[2]

- (b) (i) Express $x^2 - 4x + 5$ in the form $(x - a)^2 + b$.
(ii) Sketch the graph of $y = x^2 - 4x + 5$.

Answer (b)(i) $x^2 - 4x + 5 = \dots\dots\dots$ [1]

(ii)



[2]

16. A company produces three types of soft drinks in 2 different sizes.

The following matrices shows the weekly production, in thousands of litres and the cost per litre in cents, for producing soft drinks of any flavour in 2 different sizes.

	Raspberry	Orange	Lemon		Regular	Large
Regular	$\begin{pmatrix} 15 & 26 & 18 \\ 14 & 24 & 16 \end{pmatrix}$			Cost	(45	60)
Large						

(a) Find $(45 \ 60) \begin{pmatrix} 15 & 26 & 18 \\ 14 & 24 & 16 \end{pmatrix}$.

Answer (a) [2]

- (b) Explain what your answer to (a) represents.

Answer (b) [1]

- 17.

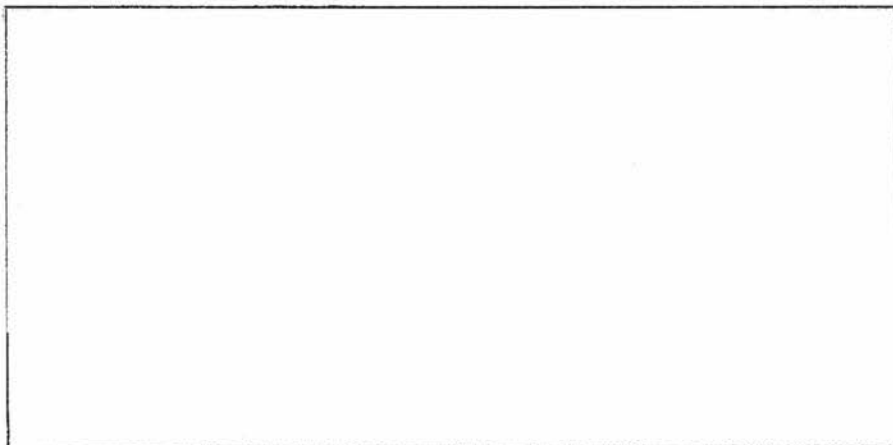
$$\varepsilon = \{x : x \text{ is an integer and } 0 < x \leq 15\}$$

$$A = \{x : x \text{ is a prime number}\}$$

$$B = \{x : x \text{ is an integer divisible by 3}\}$$

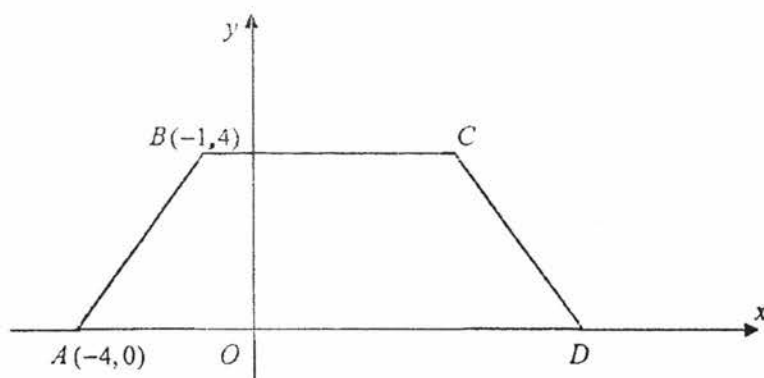
Draw a Venn diagram to illustrate this information, showing elements in each set clearly.

Answer ε



[2]

18. $ABCD$ is a trapezium in which $BC = 8$ units. A is the point $(-4, 0)$ and B is the point $(-1, 4)$. The area of the trapezium is 50 square units.



- (a) Calculate the length of AB .

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

- (b) Find the coordinates of C .

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

- (c) Find the coordinates of D .

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

- (d) Write down the value of $\cos \angle ABC$.

Answer (d) $\cos \angle ABC =$ [1]

19. A production line produces loaves of bread with a mass of 500 grams each.
Two separate production lines, P and Q , were operated and 10 loaves were taken as samples from each line which had the following masses:

Line P 502, 487, 488, 490, 507, 500, 498, 491, 505, 490

Line Q 510, 501, 482, 489, 496, 506, 478, 489, 503, 492

- (a) Find the mean mass of the products from both lines.

Answer (a) Line P [1]

Line Q [1]

- (b) Find the standard deviation of the product mass from both lines.

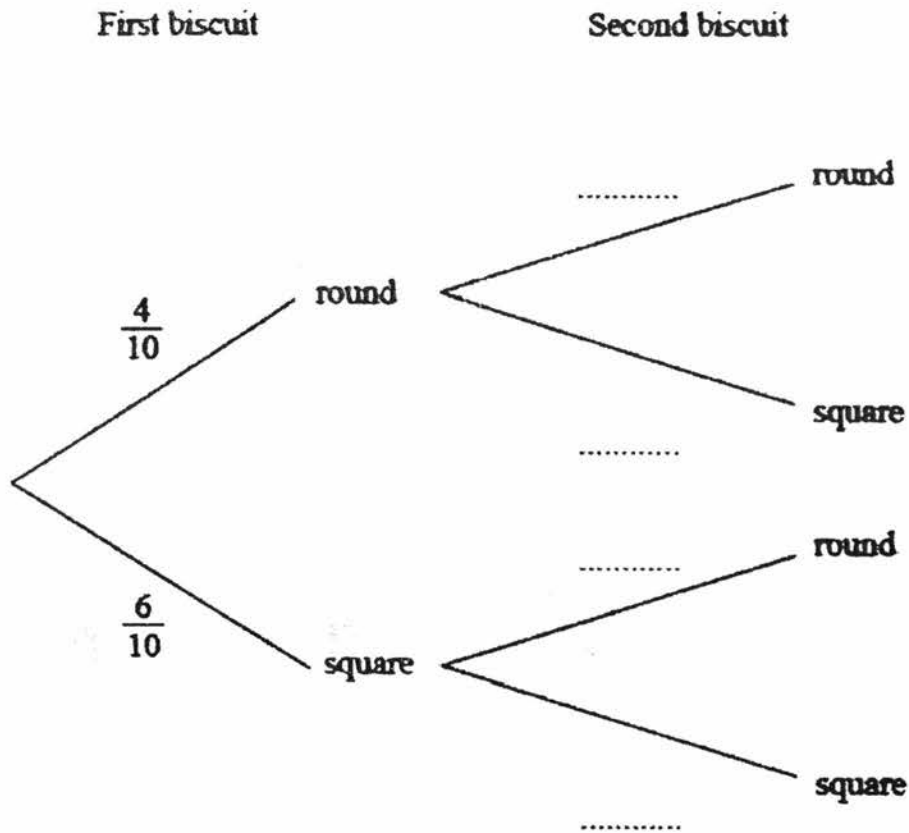
Answer (b) Line P [1]

Line Q [1]

- (c) If a loaf from each line is picked at random and each weighs 480 grams and 485 grams respectively, which line did the lighter loaf likely to come from?
Justify your decision with explanation.

Answer
.....
..... [2]

20. On a plate there are ten biscuits.
Four of the biscuits are round and six of the biscuits are square.
Joe chooses a biscuit at random from the plate and eats it.
He then chooses another biscuit at random from the plate.
The tree diagram shows the possible outcomes and some of the probabilities.



- (a) Complete the tree diagram. [2]
- (b) Calculate the probability that Joe chooses
- (i) two round biscuits,
 - (ii) one round biscuit and one square biscuit.

Answer (b)(i) [1]

(b)(ii) [2]

21. (a) Simplify the expression $(3x^2y)^3 \times (5x^{-3}y^4)^{-1}$, giving your answer in positive index notation.

Answer (a) [2]

(b) Solve $\left(\frac{1}{8}\right)^{-\frac{2}{3}} \times 32^{\frac{3}{5}} = 2^{p-2} \div 2^2$.

Answer (b) $p =$ [2]

- (c) Express the number 0.0040589 in standard form.

Answer (c) [1]

22.

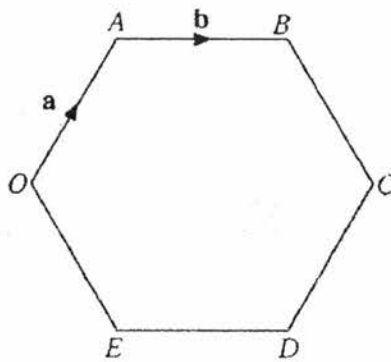
(a) Given that $p = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $q = \begin{pmatrix} m \\ 2 \end{pmatrix}$, find

- (i) $|p|$,
- (ii) the value of m such that $p + q$ is parallel to the y -axis.

Answer (a)(i)units [1]

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

(b) In the diagram, $OABCDE$ is a regular hexagon. $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{AB} = \mathbf{b}$.



(I) Express the following vectors, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$.

- (i) $\overrightarrow{OC}$,
- (ii) $\overrightarrow{BC}$,
- (iii) $\overrightarrow{AD}$.

(II) What type of quadrilateral is $ABCD$? Justify your answer using vectors.

Answer (b)(I)(i) [1]

(ii) [1]

(iii) [1]

Answer (II)..... [1]

23. All construction lines must be clearly shown.

- (a) Construct, and label clearly, the quadrilateral $ABCD$ in which $AB = BC = CD$, $\angle ABC = 70^\circ$ and $\angle BAD = 100^\circ$.
The line AB has been drawn for you. [2]
- (b) On the quadrilateral, construct
(i) the bisector of angle ABC , [1]
(ii) the perpendicular bisector of the line BC . [1]
- (c) The two bisectors in (b) intersect at the point P . Measure and write down the length of BP , in cm, correct to 1 decimal place.



Answer (c) [1]

End of Paper



YUSOF ISHAK SECONDARY SCHOOL PRELIMINARY EXAMINATION 2017

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CANDIDATE
NAME

CLASS

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INDEX
NUMBER

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Mathematics 4 Express / 5 Normal Academic

4048/02

Paper 2

18 August 2017

2 hours 30 minutes

Additional Materials: Answer paper
Graph Paper (1 sheet)

READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer all 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.
The total number of marks for this paper is 100.

This document consists of 12 printed pages.

Setter: Mr Eric Koh

[Turn over



Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

[3]

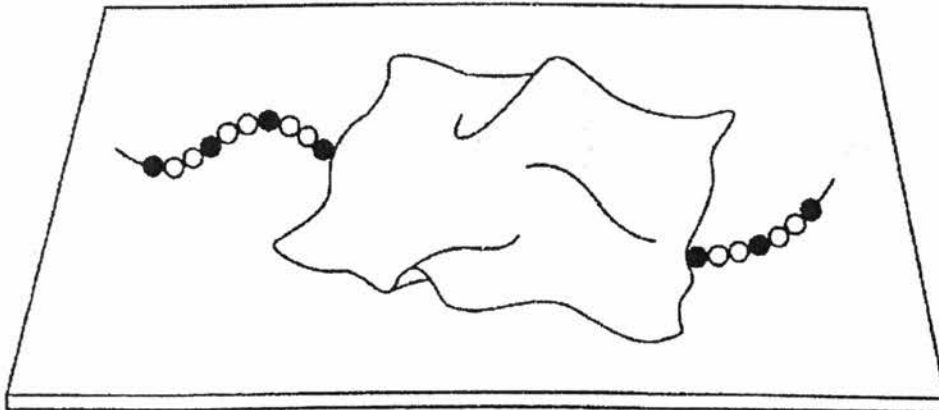
1. (a) Solve the equation $(1 + 4x)^2 = 81$. [2]

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

(c) Find the integers x such that $2x+1 < 9 < 3x+1$. [2]

(d) Factorise completely $a^2 + 9b^2 - 6ab - 2a + 6b$. [2]

2. (a) A string of beads on a table is partly covered by a piece of cloth as shown. There are 2 white beads between every 2 black beads. Altogether, there are 14 black beads. John guessed that the number of white beads was 28. Do you agree? Justify your decision with calculations. [3]



(b) It is given that $3b = 4a$ and $2c = 5a$.

(i) Find $a:b:c$. [2]

(ii) If $a + b + c = 10$, find b . [3]

[4]

3. John bought x light bulbs for \$25.

(a) Write down an expression in terms of x for the price, in dollars, he had paid for each light bulb.

(b) He wanted to sell each light bulb at a profit of 50 cents. [1]

Show that his selling price for each light bulb was $\$ \frac{50 + x}{2x}$. [1]

(c) John managed to sell 8 light bulbs at this price. Write down an expression, in terms of x , for

(i) the total amount of money, in dollars, he had received for selling the 8 light bulbs. [1]

(ii) the number of light bulbs that remained unsold. [1]

(d) John sold the remaining light bulbs at \$2 each.

Write down an expression in terms of x for the total amount of money, in dollars, he had received from selling these light bulbs. [1]

(e) John received \$46 altogether.

Form an equation in x and show that it reduces to $x^2 - 29x + 100 = 0$. [3]

(f) Hence or otherwise, find the number of light bulbs John had bought. [3]

[5]

4.

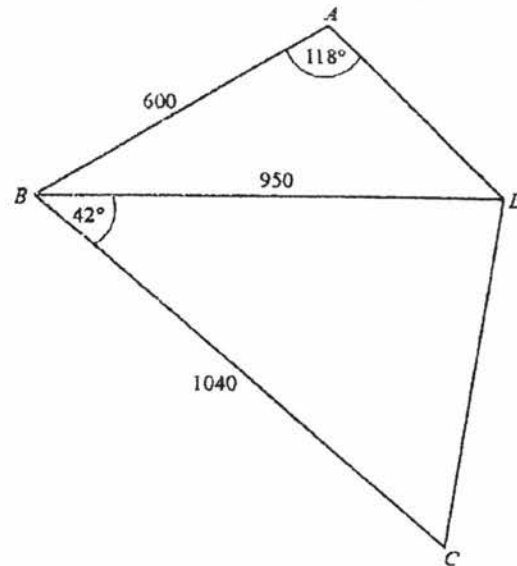


Figure 1

Figure 1 shows the quadrilateral $ABCD$. Quadrilateral $ABCD$ represent a level enclosed area for the rabbits with a path BD .

$AB = 600$ m, $BC = 1040$ m, $BD = 950$ m and $\angle CBD = 42^\circ$ and $\angle BAD = 118^\circ$.

(a) Calculate

(i) $\angle ABD$, [4]

(ii) the length of CD , [4]

(iii) the shortest distance from C to BD . [2]

(b) An eagle is flying directly above the path BD at a height of 500 m.

Calculate the greatest angle of depression of the point C as seen by the eagle. [2]

[6]

5. P , Q , R , S and T are the different shaped blocks of ice stored in the refrigerated enclosed room.

(a) At 10 p.m. on Monday the cooling system failed, and the blocks started to melt.
At the end of each 24 hour period, the volume of each block was 14% less than its volume at the start of that period.

(i) Block P has a volume of 7500 cm^3 at 10 p.m. on Monday.
Calculate its volume at 10 p.m. on Wednesday. [2]

(ii) Block Q had a volume of 6490 cm^3 at 10 p.m. on Tuesday.
Calculate the volume at 10 p.m. on the previous day. [2]

(iii) **Showing your working clearly**, find on which day the volume of R was half its volume at 10 p.m. on Monday. [2]

(b) At 10 p.m. on Monday, Block S was a hemisphere with radius 18 cm.
Calculate

(i) its volume, [2]

(ii) its total surface area. [2]

(c) As block T melted, its shape was always **geometrically similar** to its original shape.
It had a volume of 5000 cm^3 when its height was 12 cm.
Calculate its height when its volume was 1080 cm^3 . [2]

6. Figure 2A shows the cross-section of an underground train tunnel.

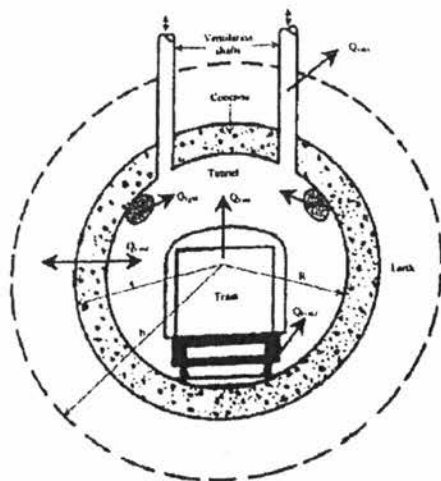


Figure 2A

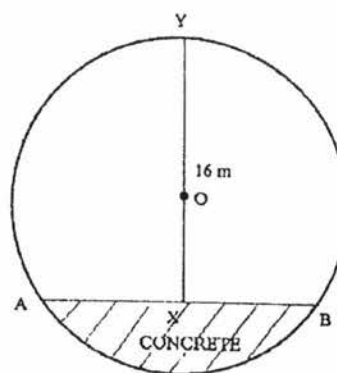


Figure 2B

With reference to Figure 2B.

AB represents the horizontal track surface, where the shaded region beneath it is covered with concrete.

Arc AYB represents the metal ceiling of the tunnel.

O is the centre of the circle with radius r metres.

X is the midpoint of AB and its vertically below Y .

Given that $AB = XY = 16\text{ m}$.

(a) Calculate

(i) the value of r . [3]

(ii) $\angle AOX$, [1]

(iii) the volume of concrete used for the tunnel, given the tunnel is 900 m long. [3]

(b) A similar model of the tunnel is made. The radius of the model's cross-section is 5 cm.

Calculate the curved surface area of the model's ceiling. [3]

(c) A 130 metre long train travelling at a speed of 50 km/h entered the tunnel.

Calculate the time, in minutes and seconds, needed for the train to completely travel out of the tunnel. [2]

7.

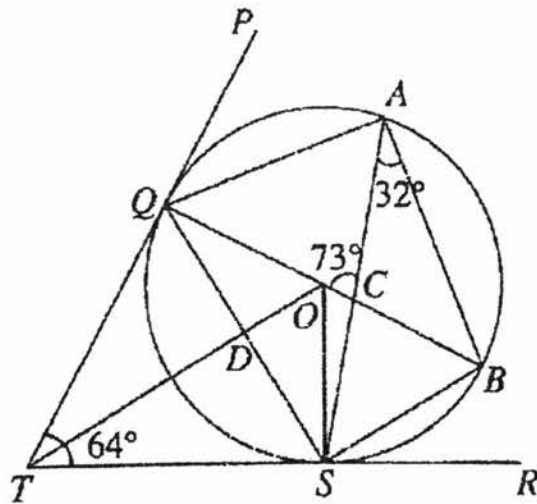


Figure 3

Figure 3 shows the circle $ABSQ$.
 $ABSQ$ has centre O . TQP and TSR are tangents to the circle.
 $\angle QTS = 64^\circ$, $\angle SAB = 32^\circ$ and $\angle ACQ = 73^\circ$.

- (a) Joseph commented that there are **at least** three right angles in Figure 3.
 Justify his comment with workings and reasons.

[3]

- (b) Calculate

(i) $\angle SQB$, [1]

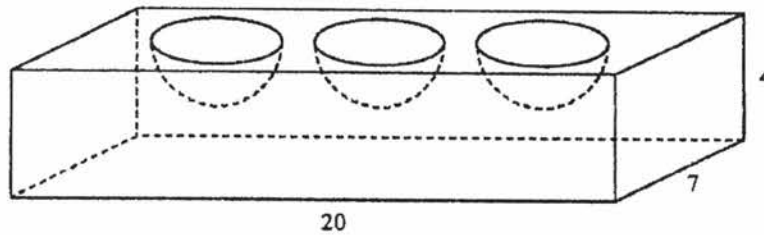
(ii) $\angle TOQ$, [2]

(iii) $\angle ABQ$, [2]

(iv) $\angle BSR$. [2]

[9]

8. A wooden cuboid has length 20 cm, width 7 cm and height 4 cm.
Three **hemisphere**, each of radius 1.5 cm, are hollowed out of the top of the cuboid, to leave the block as shown in the diagram.



- (a) Calculate the volume of wood in the block. [2]
- (b) The four vertical sides are painted pink.
Calculate the total area that is painted pink. [1]
- (c) The inside of each **hemispherical** hollow is painted white.
The flat part of the top of the block is painted green.
Calculate the total area that is painted
- (i) white, [1]
- (ii) green. [1]

[10]

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

The variables x and y are connected by the equation $y = 4x + \frac{60}{x} - 30$.

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

x	1.5	2	2.5	3	4	5	7	8
y	16	a	4	2	1	b	6.6	9.5

- (a) Calculate the values of a and b . [1]
- (b) Using the scales of 2 cm to represent 1 unit of x and 1 cm to represent 1 unit of y , draw the graph of $y = 4x + \frac{60}{x} - 30$ for the range $1.5 \leq x \leq 8$. [3]
- (c) From your graph, find
- (i) the least value of y , [1]
- (ii) the range of values of x for which $y = 4x + \frac{60}{x} - 30 < 8$. [2]
- (d) Find, by drawing a tangent, the gradient of the curve when $x = 5$. [2]
- (e) By drawing a suitable straight line on the same axes, find the solutions of the equation $3x^2 + 60 - 30x = 0$. [3]

10. All employees in Singapore have a compulsory savings known as the Central Provident Fund (CPF).

Each worker is required to save a certain percentage of what he earns each month with the CPF and the employer contributes another percentage of his salary to his CPF account.

The total CPF contribution is then kept into 3 accounts in the proportion as shown in the table below.

Contribution rates from 1 January 2016 for private sector and public sector non-pensionable employees being:

- Singapore Citizen
- SPR* from the third year of obtaining SPR status
- SPR during the first two years of obtaining SPR status but who has jointly applied with employer to contribute at full employer-full employee rates

*SPR (Permanent Resident)

Employee's age (years)	Contribution Rates from 1 Jan 2016 (for monthly wages $\geq$ \$750)		
	By Employer (% of wage)	By Employee (% of wage)	Total (% of wage)
55 and below	17	20	37
Above 55 to 60	13	13	26
Above 60 to 65	9	7.5	16.5
Above 65	7.5	5	12.5

Figure 4A

Allocation rates from 1 January 2016 for private sector and public sector non-pensionable employees

Employee's age (years)	Allocation Rates from 1 Jan 2016 (for monthly wages $\geq$ \$750)		
	Ordinary Account (% of wage)	Special Account (% of wage)	Medisave Account (% of wage)
35 and below	23	6	8
Above 35 to 45	21	7	9
Above 45 to 50	19	8	10
Above 50 to 55	15	11.5	10.5
Above 55 to 60	12	3.5	10.5
Above 60 to 65	3.5	2.5	10.5
Above 65	1	1	10.5

Figure 4B

[12]

In October 2016, Mr Ong who is 38 years old, earns \$3000 a month, while his wife, who is 34 years old, earns \$2000 a month.

- (a) Calculate Mr Ong's contribution and his employer's contribution to his CPF account monthly. [2]

Both Mr Ong and his wife have just paid the 10% downpayment for their HDB flat which costs \$400 000. They intend to pay the rest over a period of 20 years.

- (b) Calculate how much they will have to pay per month for the 20 years. [2]

For a part of the amount they have to pay, the Ongs will use the money from both their Ordinary Accounts, and they will borrow the balance from a bank.

- (c) Show that the amount from both their Ordinary Accounts to be used for the monthly payment of the flat is \$1090. [2]

- (d) Calculate the amount of money they have to borrow from the bank over the period of 20 years. [1]

The Ongs have to pay a simple interest rate of 1.48% for Year 1 and 1.58% thereafter.

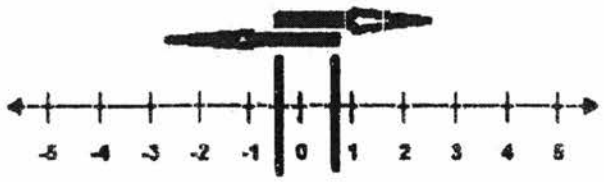
- (e) Calculate the total amount they have to pay the bank after 20 years. [3]

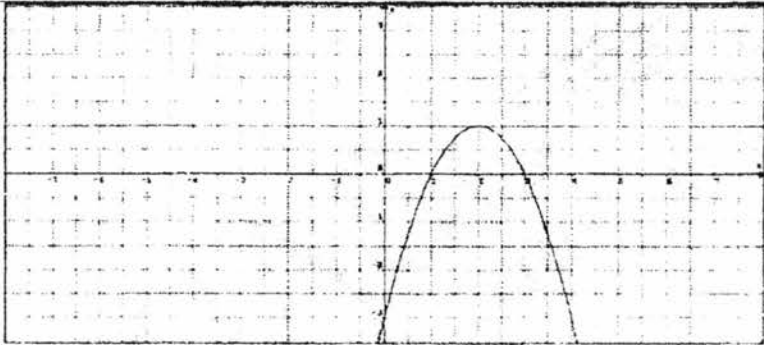
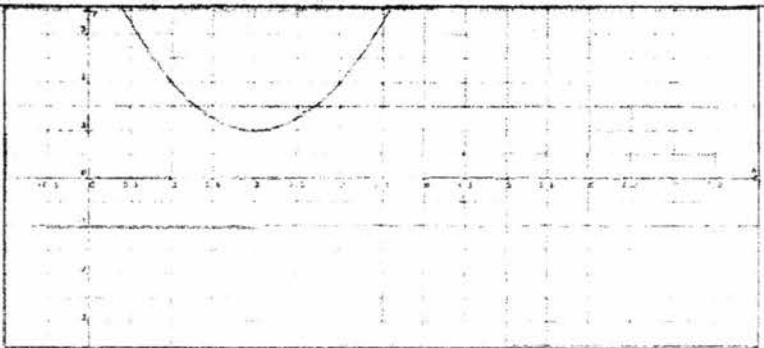
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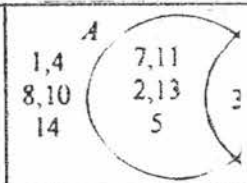
**YUSOF ISHAK SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
MATHEMATICS PAPER 1
SEC 4E/5N**

MARKING SCHEME

1	$\frac{-3.3^2 \times \sqrt{2^3}}{[1 - 8(7 + 7^{-1})]^2} \times \sin \frac{\pi}{3} = -0.0084628 \quad \left[\sin \frac{\pi}{3}, \text{radian mode} \right]$ $= -0.008463 \text{ (4 sig. figures)}$	Do not accept -0.0001785935 (Degree mode) B1 [1]
2	$\$850000 \times (100 - 14.3)\%$ $= \$728450$	M1 A1 [2]
3	24×6 16 minutes	M1 A1 [2]
4	$1 \text{ litre} = 20 \text{ km}$ $20 \text{ km will emit } 115 \times 20 = 2300 \text{ grams of CO}_2$ 2.3 kg	M1 A1 [2]
5(a)	$50p^2 - 72q^2$ $2(25p^2 - 36q^2)$ $2(5p - 6q)(5p + 6q)$	M1 A1 [2]
5(b)	$\frac{x-2}{4} - \frac{x+1}{3}$ $\frac{3(x-2) - 4(x+1)}{12}$ $\frac{3x-6-4x-4}{12} = 1$ $-x-10=12$ $x=-22$	M1 A1 [2]
5(c)	$T = 2\pi \sqrt{\frac{h}{g}}$ $\left(\frac{T}{2\pi}\right)^2 = \frac{h}{g}$ $h = g\left(\frac{T}{2\pi}\right)^2 \text{ or } h = \frac{gT^2}{4\pi^2}$	M1 A1 [2]
6(a)	As the two buckets are similar $\frac{\text{Height of small bucket}}{\text{Height of large bucket}} = \frac{8}{16}$ $\frac{\text{Height of small bucket}}{30} = \frac{8}{16}$ $\text{Height of small bucket} = \frac{8}{16} \times 30 = 15 \text{ cm}$	B1 [1]
6(b)	$\frac{\text{Volume of large bucket}}{\text{Volume of small bucket}} = \left(\frac{16}{8}\right)^3$ $\frac{\text{Volume of large bucket}}{850} = (2)^3$ $\text{Volume of large bucket} = 8 \times 850 = 6800 \text{ cm}^3$	M1 A1 [2]

7(a)	$p + q$	B1 [1]
7(b)	$\frac{1}{2}(p - q)$	B1 [1]
8	LCM of 10, 20, 35 = $5 \times 2 \times 2 \times 7$ = 140 After 140 minutes	M1 A1 [2]
9(a)	40°	B1 [1]
9(b)	9	B1 [1]
9(c)	120°	B1 [1]
10	$P \propto Q^2$ $P = kQ^2$ where k is a constant New $P_{\text{NEW}} = k(3Q)^2$ Percentage increase = $\frac{k(9Q^2 - Q^2)}{kQ^2} \times 100\% = 800\%$	M1 A1 [2]
11	$\frac{10x+8}{3} + 2 < 5 + 4x < 8$ $\frac{10x+8}{3} + 2 < 5 + 4x$ and $5 + 4x < 8$ $10x + 8 + 6 < 15 + 12x$ and $4x < 3$ $2x > -1$ and $x < \frac{3}{4}$ $x > -\frac{1}{2}$ $\therefore -\frac{1}{2} < x < \frac{3}{4}$ 	M1 A1 A1 [3]
12(a)	$2x - 3 = x + 3y - 7$ or $2x - 3 = 15 - x - y$ or $x - 3y = -4$ $3x + y = 18$ $x + 3y - 7 = 15 - x - y$ $2x + 4y = 22$ (Any two of the equations) $x + 2y = 11$	M1 A1 [2]
12(b)	$x = 5$ $y = 3$	M1 A1 [2]

13(a)	The information did not specify the total of number of children surveyed/population. OR The information did not specify the information was obtained in one hospital/all hospitals in the USA. OR BIG HEADLINE makes you think that 5.3% of children get spinal cord injuries... a pretty scary statistic for parents.	Any 1 with explanation B2 [2] To explain why is this important to mention the population of the children surveyed.
13(b)	For the record, the real figure should be based on the number of injuries per year out of a population of certain number in that country	B1 [1]
14(a)	1 : 50 000 1 cm represent 0.5 km 5.8 cm represent $0.5 \times 5.8 = 2.9$ km	B1 [1]
14(b)	1 cm² represent 0.5×0.5 km² $\frac{6.5}{0.25} = 26$ cm²	M1 A1 [2]
15(a)		
15(b)(i)	$x^2 - 4x + 5 = (x - 2)^2 + 1$	B1 [1]
15(b)(ii)		B1 – turning point B1 – y intercept [2]
16(a)	(1515 2610 1770)	M1 A1 [2]
16(b)	The total weekly costs for Raspberry, Orange and Lemon drinks are \$15.15, \$26.10 and \$17.70 respectively	B1 [1]

17		B2 B1 (one number wrong)
18(a)	Length of $AB = \sqrt{4^2 + 3^2} = 5 \text{ units}$	B1 [1]
18(b)	$C(7, 4)$	B1 [1]
18(c)	$50 = \frac{1}{2}(8 + x) \times 4 \Rightarrow x = 17$ $D(13, 0)$	M1 A1 [2]
18(d)	$\cos \angle ABC = -\frac{3}{5}$	B1 [1]
19(a)	Mean mass of Line $P = 495.8 \text{ g}$ Mean mass of Line $Q = 494.6 \text{ g}$	B1 B1 [2]
19(b)	Standard deviation of Line $P = 7.07 \text{ g}$ Standard deviation of Line $Q = 9.92 \text{ g}$	B1 B1 [2]
19(c)	The lighter loaf is likely to come from Q where the mean is lower The mass of line Q's products are also more varied from their mean value and hence, a higher chance of being lighter.	B1 B1 [2]
20(a)	$\frac{3}{9}, \frac{6}{9}, \frac{4}{9}, \frac{5}{9}$ oe	B1 for all three correct [1]
20(b)(i)	$\frac{12}{90}$	FT from their tree diagram 1FT [1]
20(b)(ii)	$\frac{48}{90}$	FT from their tree diagram. B1 for $\frac{24}{90}$ oe FT seen Or M1 for $\left(\frac{4}{10} \times \frac{6}{9}\right) + \left(\frac{6}{10} \times \frac{4}{9}\right)$ oe FT 2FT [2]

21(a)	$(3x^2y)^{-1} \times (5x^{-3}y^4)^{-1}$ $= 27x^6y^3 \times \frac{1}{5}x^3y^{-4}$ $= \frac{27x^9}{5y}$	M1 A1 [2]
21(b)	$\left(\frac{1}{8}\right)^{-\frac{2}{3}} \times 32^{\frac{3}{5}} = 2^{p-2} \div 2^2$ $4 \times 8 = 2^{p-4}$ $2^3 = 2^{p-4}$ $p = 9$	M1 A1 [2]
21(c)	$0.0040589 = 4.0589 \times 10^{-3}$	B1 [1]
22(a)(i)	$ p = \sqrt{(3)^2 + (4)^2}$ $ p = 5 \text{ units}$	B1 [1]
22(a)(ii)	$m = -3$	B1 [1]
22(l)(b)(i)	$\overline{OC} = 2\overline{AB} = 2b$	B1 [1]
22(b)(ii)	$\overline{BC} = \overline{BA} + \overline{AO} + \overline{OC}$ $= -b - a + 2b$ $= b - a$	B1 [1]
22(b)(iii)	$\overline{AD} = \overline{AB} + \overline{BC} + \overline{CD}$ $= b + b - a - a$ $= 2b - 2a$	B1 [1]
22(b)(II)	Since $\overline{AD} = 2\overline{BC}$ $AD \parallel BC$ $ABCD$ is a trapezium	B1 [1]
23(a) (b)(i) (b)(ii)		(a) [2] (b)(i) [1] (b)(ii) [1] 2 possible location of point D. But no effect on the answer.
23(c)	$BP = 3.9 \text{ cm} \pm 0.1 \text{ cm}$	B1 [1]

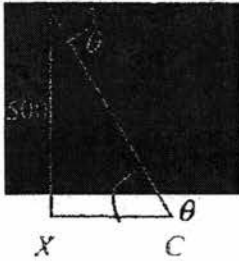
Yusof Ishak Secondary School
Preliminary Examination 2017
Mathematics Paper 2

Marking Scheme

1 (a)	$(1+4x)^2 = 81$ $1+4x = \pm\sqrt{81}$ $1+4x = 9$ or $1+4x = -9$ $4x = 8$ or $4x = -10$ $x = 2$ or $x = -2.5$	M1 A1 [2]
1 (b)	$\frac{1}{2x+3} + \frac{3}{2x-1}$ $= \frac{1(2x-1) + 3(2x+3)}{(2x+3)(2x-1)}$ $= \frac{2x-1+6x+9}{(2x+3)(2x-1)}$ $= \frac{8x+8}{(2x+3)(2x-1)}$	M1 A1 [2]
1 (c)	$2x+1 < 9 < 3x+1$ $2x+1 < 9$ and $9 < 3x+1$ $\Rightarrow 2x < 8$ and $3x > 8$ $\Rightarrow x < 4$ and $x > \frac{8}{3}$ $x=3$	M1 A1 [2]
1 (d)	$a^2 + 9b^2 - 6ab - 2a + 6b$ $= (a^2 + 9b^2 - 6ab) - 2a + 6b$ $= (a-3b)^2 - 2(a-3b)$ $= (a-3b)(a-3b-2)$	M1 A1 [2]

2(a)	Number of sets of 2 white beads and 1 black bead $14 - 1 = 13$ Total number of white beads $13 \times 2 = 26$  Disagree Students must be able to explain and show how they obtained the answer	B3 [3]
2(b)(i)	$3b = 4a \Rightarrow \frac{a}{b} = \frac{3}{4} \Rightarrow a : b = 3 : 4$ $2c = 5a \Rightarrow \frac{a}{c} = \frac{2}{5} \Rightarrow a : c = 2 : 5$ $\therefore a : b : c = 6 : 8 : 15$	B1 B1 [2]
2(b)(ii)	Let $a = 6k, b = 8k, c = 15k$ $6k + 8k + 15k = 10$ $k = \frac{10}{29}$ $\therefore b = \frac{80}{29}$	M1 A1 A1 [3]

3 (a)	x bulbs cost \$25 1 bulb cost $\$ \frac{25}{x}$	B1 [1]
3 (b)	Selling price for each light bulb = $\$ \frac{25}{x} + \0.50 $= \$ \frac{25 + \$0.50x}{x}$ $= \$ \frac{2(25 + 0.5x)}{2x}$ $= \$ \frac{50 + x}{2x}$	B1 [1]
3 (c)(i)	Total amount = $\$ \frac{50 + x}{2x} \times 8$ $= \$ \frac{4(50 + x)}{x}$	B1 [1]
3(c)(ii)	Number of unsold light bulbs = $x - 8$	B1 [1]
3(d)	Total amount = $\$2 \times (x - 8)$ $= \$2(x - 8)$	B1 [1]
3(e)	$\frac{4(50 + x)}{x} + 2(x - 8) = 46$ $\frac{200 + 4x}{x} + 2x - 16 = 46$ $\frac{200 + 4x + 2x^2 - 16x}{x} = 46$ $2x^2 - 12x + 200 = 46x$ $2x^2 - 58x + 200 = 0$ $x^2 - 29x + 100 = 0$ (Shown)	M1 A1 A1 [3]
3(f)	$x = \frac{-(-29) \pm \sqrt{(-29)^2 - 4(1)(100)}}{2(1)}$ $x = \frac{29 \pm \sqrt{441}}{2}$ $x = \frac{29 \pm 21}{2}$ $x = 25$ or $x = 4$ The number of light bulbs cannot be less than 8. $\therefore x = 4$ is not applicable The number of light bulbs, $x = 25$.	M1 A1 A1 [3]

4(a)(i)	In $\triangle ABD$, Using Sine Rule, $\frac{\sin 18^\circ}{950} = \frac{\sin \angle ADB}{600}$ $\Rightarrow \sin \angle ADB = \frac{600 \times \sin 18^\circ}{950}$ $\angle ADB = 33.89^\circ$ $\angle ADB = 33.9^\circ \text{ (1 decimal place)}$ $\angle ABD = 180^\circ - 118^\circ - 33.9^\circ$ $= 28.1^\circ$	M1 A1 A1 A1 [4]
4(a)(ii)	In $\triangle BCD$, Using Cosine Rule, $CD = \sqrt{950^2 + 1040^2 - 2(950)(1040)\cos 42^\circ}$ $CD = 718.1$ $CD = 718 \text{ m (3 sig. figures)}$	M2 A1 A1 [4]
4(a)(iii)	Let the required distance be h. $\text{Area of } \triangle BCD = \frac{1}{2} \times 950 \times 1040 \times \sin 42^\circ$ $\frac{1}{2} \times 950 \times 1040 \times \sin 42^\circ = \frac{1}{2} \times 950 \times h$ $h = 1040 \times \sin 42^\circ$ $h = 695.9$ $h = 696 \text{ m (3 sig. figures)}$	M1 A1 [2]
4(b)	The greatest angle of depression occurs when the eagle is directly above the point on BD such that it is nearest to C.  $\tan \theta = \frac{500}{695.9}$ $\theta = 35.7^\circ$ Greatest angle of depression is 35.7° (1 decimal place)	M1 A1 [2]

5(a)(i)	On Monday, volume = 7500 cm^3. On Tuesday, volume = 86% of 7500 $= \frac{86}{100} \times 7500 = 6450$ On Wednesday, volume = 86% of 6450 $= \frac{86}{100} \times 6450 = 5547$ $= 5547 \text{ cm}^3 \text{ (3 sig. figures)}$	M1 A1 [2]
5(a)(ii)	Let x be the actual volume of Block Q. the volume of Block Q has been reduced as 86% of its actual volume on Tuesday. $\Rightarrow 86\% \text{ of } x = 6450$ $x = 6450 \times \frac{100}{86} = 7500$ Actual volume of Block Q on Monday = 7500 cm^3 (3 sig. figures)	M1 A1 [2]
5(a)(iii)	Let v be the volume of Block R on Monday On Tuesday, volume = $\frac{86}{100}v = 0.86v$ On Wednesday, volume = $\frac{86}{100}(0.86v) = 0.7396v$ On Thursday, volume = $\frac{86}{100}(0.7396v) = 0.6361v$ On Friday, volume = $\frac{86}{100}(0.6361v) = 0.547v$ On Saturday, volume = $\frac{86}{100}(0.547v) = 0.470v$ Volume reduces to half on Saturday.	M1 A1 [2]
5(b)(i)	Volume of hemisphere = $\frac{1}{2} \left(\frac{4}{3} \pi r^3 \right)$ Volume of S = $\frac{1}{2} \left(\frac{4}{3} \pi (18)^3 \right)$ $= \frac{2}{3} \times 3.142 \times 5832$ $= 12216.1$ $= 12200 \text{ cm}^3 \text{ (3 sig. figures)}$	M1 A1 [2]
5(b)(ii)	Total surface area of solid hemisphere S $= \frac{1}{2} (4\pi r^2) + \pi r^2$ $= \frac{1}{2} (4\pi (18)^2) + \pi (18)^2$ $= 2036016 + 1018008$ $= 3054024$ $= 3050 \text{ cm}^2 \text{ (3 sig. figures)}$	M1 A1 [2]
5(c)	Volume before = $\left(\frac{\text{height before}}{\text{height after}} \right)^3$ $\left(\frac{5000}{1080} \right) = \left(\frac{12}{h} \right)^3$	

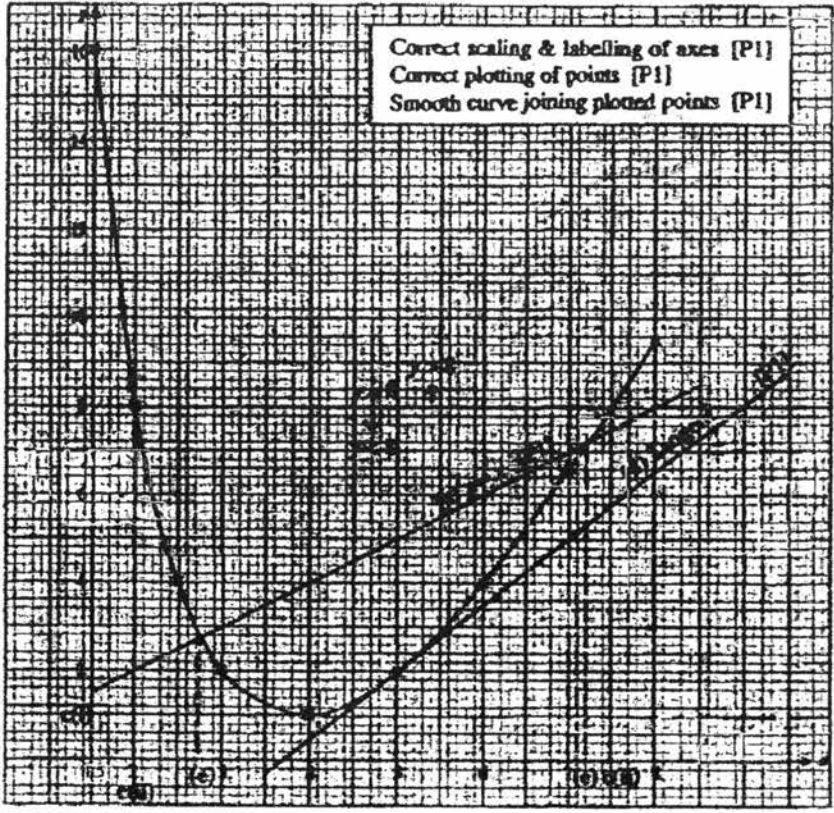
[18]

$\frac{125}{27} = \left(\frac{12}{h}\right)^3$ $\left(\frac{5}{3}\right)^3 = \left(\frac{12}{h}\right)^3$ $\frac{5}{3} = \frac{12}{h}$ $5h = 36$ $h = 7.2 \text{ cm}$	M1 A1 [2]
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6(a)(i)	$OA^2 = OX^2 + AX^2$ $r^2 = (16-r)^2 + 8^2$ $r^2 = 256 - 32r + r^2 + 8^2$ $32r = 320$ $r = 10$	M1 A1 A1 [3]
6(a)(ii)	$\sin \angle AOX = \frac{AX}{OA}$ $= \frac{8}{10}$ $\angle AOX = \sin^{-1}\left(\frac{8}{10}\right)$ $\angle AOX = 53.1^\circ$ (1 decimal place)	B1 [1]
6(a)(iii)	$\angle AOB = 2(53.1^\circ)$ Shaded region = $\frac{2(53.1^\circ)}{360} \times \pi \times 10^2 - \frac{1}{2} \times 10 \times 10 \sin 2(53.1^\circ)$ $= 44.74 \text{ m}^2$ Volume of concrete used $= 4474 \times 900$ $= 40\,266 \text{ m}^3$ $= 40\,300 \text{ m}^3$ (correct to 3 sig. figures)	M1 A1 A1 [3]
6 (b)	Length of the model tunnel = $\frac{900}{10} \times 5$ $= 450 \text{ m}$ Reflex $\angle AOB = 360^\circ - 2(53.1^\circ) = 253.74^\circ$ Curved surface area = $\frac{253.74^\circ}{360} \times 2\pi \times 5 \times 450$ $= 9965.6 \text{ cm}^2$ $= 9970 \text{ cm}^2$ (3 sig. figures)	B1 M1 A1 [3]
6 (c)	Total distance the train has to travel = $900 + 130 = 1030 \text{ m}$ Time taken = $\frac{1030}{50000} \times 60 = 1.236 \text{ minutes}$ 1 minute 14 seconds	M1 A1 [2]

7(a)	$\angle BSQ = 90^\circ$ (rt. $\angle$ in a semicircle) $\angle BAQ = 90^\circ$ (rt. $\angle$ in a semicircle) $\angle OST$ or $\angle OQT = 90^\circ$ (tangent perp. radius at point of contact)	B1 B1 B1 [3]
7(b)(i)	$\angle SQB = 32^\circ$ ($\angle$ s in the same segment)	B1 [1]
7(b)(ii)	$\angle OTQ = \frac{64^\circ}{2} = 32^\circ$ (OT bisects $\angle QTS$) $\angle TOQ = 180^\circ - 32^\circ - 90^\circ = 58^\circ$ ($\angle$ sum of Δ)	M1 A1 [2]
7(b)(iii)	$\angle ACB = 180^\circ - 73^\circ = 107^\circ$ (adj. $\angle$ s on a str. line) $\angle ABQ = 180^\circ - 32^\circ - 107^\circ = 41^\circ$ ($\angle$ sum of Δ)	M1 A1 [2]
7(b)(iv)	$QT = ST$ (tangents drawn to circle from ext. point are equal) $\angle DST = \frac{180^\circ - 64^\circ}{2}$ (base $\angle$ s of isosceles Δ) $= 58^\circ$ $\angle BSR = 180^\circ - 90^\circ - 58^\circ$ (adj. $\angle$ s on a str. line) $= 32^\circ$ OR $\angle BSR = 32^\circ$ (alternate segment theorem)	M1 A1 [2] B1, B1 [2]

8(a)	Volume of wood in the block = $(20 \times 7 \times 4) - 3 \left(\frac{1}{2} \times \frac{4}{3} \times \pi \times 1.5^3 \right)$ $= 560 - 21.2085$ $= 538.7915$ $= 539 \text{ cm}^3$ (3 significant figures)	M1 A1 [2]
8(b)	Total area that is painted pink = $2(7 \times 4) + 2(20 \times 4) = 56 + 160$ $= 216 \text{ cm}^2$	B1 [1]
8(c)(i)	Total area that is painted white = $2 \times \pi \times (1.5)^2 \times 3$ $= 42.417$ $= 42.4 \text{ cm}^2$ (3 significant figures)	B1 [1]
8(c)(ii)	Total area that is painted green = $(20 \times 7) - 3(\pi \times 1.5^2)$ $= 118.7915$ $= 119 \text{ cm}^2$	B1 [1]

9(a)	$a = y = 4(2) + \frac{60}{2} - 30$ $= 8 + 30 - 30$ $= 8$ $b = y = 4(5) + \frac{60}{5} - 30$ $= 20 + 12 - 30$ $= 2$	1 wrong B0 B1 [1]
8(b)	 Correct scaling & labelling of axes [P1] Correct plotting of points [P1] Smooth curve joining plotted points [P1]	P1 P1 P1 [3]
8(c)(i)	Least value of $y = 1$	[B1]
8(c)(ii)	For $4x + \frac{60}{x} - 30 < 8$ $2 < x < 7.5$	M1 A1 [2]
8(d)	At $x = 5$, using 2 points on the tangent, (7, 5) and (5, 2) Gradient of tangent = $\frac{5-2}{7-5} = \frac{3}{2}$ or 1.5	M1 A1 [2]
8(e)	$3x^2 + 60 - 30x = 0$ $3x + \frac{60}{x} - 30 = 0$ $4x + \frac{60}{x} - 30 = x$ The solution is the intersection of the graphs	M1

[22]

$y = 4x + \frac{60}{x} - 30$ and $y = x$ <i>i.e.</i> when $x = 2.75$ or $x = 7.2$	P1 A1 [3]
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10(a)	Mr Ong's monthly contribution = $\frac{20}{100} \times \$3000 = \600 His employer's monthly contribution = $\frac{17}{100} \times \$3000 = \510	B1 B1 [2]
10(b)	They have to pay $\frac{90}{100} \times \$400000 = \360000 over 20 years Each month, they have to pay $\frac{\$360000}{20 \times 12} = \1500	M1 A1 [2]
10(c)	Amount to be used for monthly payment $= \left(\frac{21}{100} \times \$3000 \right) + \left(\frac{23}{100} \times \$2000 \right) = \$1090$ (Shown)	M1 A1 [2]
10(d)	They have to borrow $(\$1500 - \$1090) \times 20 \times 12 = \98400	B1 [1]
10(e)	They have to pay $\left(\frac{1.48}{100} \times 98400 \times 1 \right) = \1456.32 Year 1 Interest $\left(\frac{1.58}{100} \times 98400 \times 19 \right)$ Year 2 onwards \$29539.68 $\$98400 + \$14563.2 + \$29539.68$ $= \$129396$	M1 M1 [A1]

