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聖嬰中學

HOLY INNOCENTS' HIGH SCHOOL

Answer all the questions

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1. By rounding each number to 1 significant figure, estimate, to the nearest hundred, the value of $\frac{17543 \times 9.32}{714.2 + 103}$.

Answer _____ [2]

2. (a) Write down all the irrational numbers from the set given below.

$$-3, 1.2, \sqrt[3]{3}, \frac{3\pi}{2}, 4.\dot{6}\dot{2}, -\sqrt{16}, \dots$$

- (b) Consider the sequence $1, 1, \frac{3}{4}, \frac{1}{2}, \frac{5}{16}, \dots$

- (i) Write down the next term.
(ii) Express in terms of n , the n^{th} term of the sequence.

Answer (a) _____ [1]

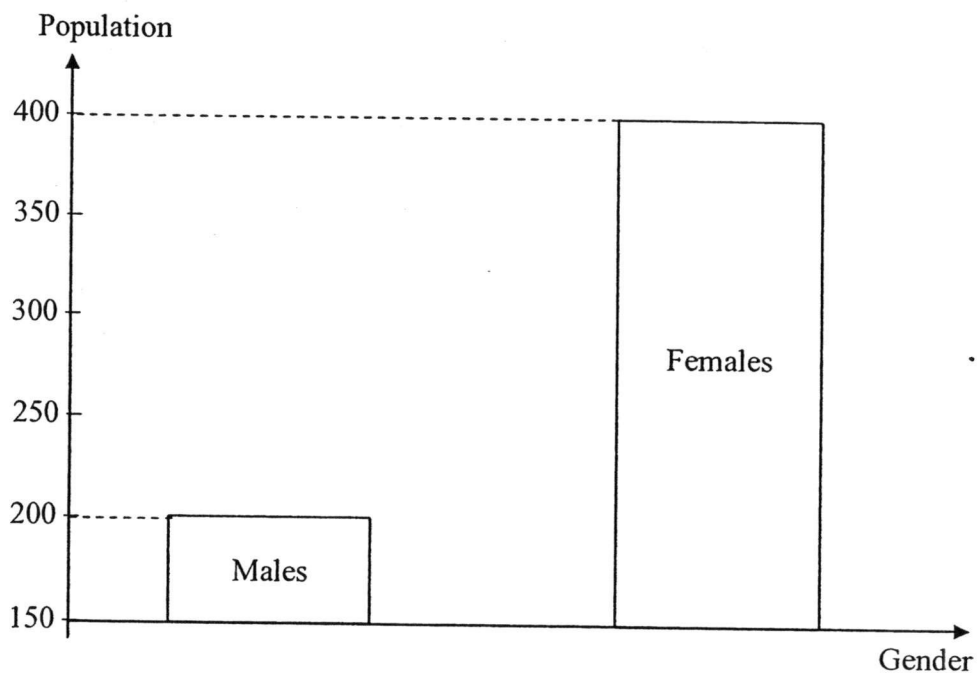
(b) (i) _____ [1]

(ii) _____ [1]

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3. The population of a small town is surveyed.
The results are shown in the bar chart below.



Explain why the bar chart is considered to be misleading.

..

Answer _____

 _____ [2]

4. The sine ratio of an angle is 0.6431.
Find the possible values of the angle.

Answer _____ [2]

5. John wrote in his Math journal that it is not possible to form a regular polygon with an interior angle of 130° .
Explain why and show all essential working clearly.

Answer _____

 _____ [2]

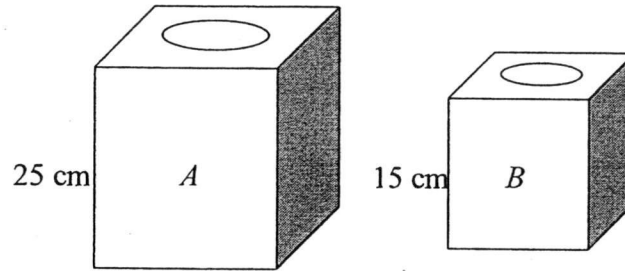
6. The cash price of a car is \$62 400.
The hire purchase price is a deposit of 20% of the cash price and equal monthly instalments for 6 years.
- (a) Agnes bought the car at the hire purchase price.
If she paid a total of \$75 840, calculate her monthly instalment.
- (b) If Agnes had bought the car at the cash price, she would have received a 5% discount.
Express the amount saved from the hired purchase price as a percentage of the hire purchase price.
Give your answer correct to the nearest percent.

Answer (a) \$ _____ [1]
 (b) _____ % [2]

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7. The heights of two geometrically similar containers are 25 cm and 15 cm respectively.



If the container *A* is filled with rice, and Benny wishes to transfer all of the rice to container *B*, how many of container *B* are required, assuming each container is filled with the rice?

Answer _____ [3]

8. Charles just returned from his trip to London.
He planned to travel to Canada in two weeks' time.
He had £2000 left and wanted to change part of it to C\$2000.
The balance was changed to Singapore dollars (S\$).
He went to a money changer and saw the following currency table.

Singapore dollar (S\$) to 1 unit of foreign currency	Currency	Buying	Selling
	Sterling Pound (£)	2.1059	2.1184
	Canadian Dollar (C\$)	1.0726	1.0875

Calculate the amount of Singapore dollars he changed.

Answer S\$ _____ [3]

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9. A grocer bought p dozens of apples at q dollars.
He found that r apples were rotten.
- (a) Express, in terms of p and r , the number of good apples he had.
- (b) If he sold the good apples at 3 for t dollars, write an algebraic expression for his profit if he sold all his apples.

Answer (a) _____ [1]

(b) \$ _____ [2]

10. Darby invested \$5 400 in a bank that pays $m\%$ interest per annum which is compounded half yearly.

If she received \$5 847.89 after $2\frac{1}{2}$ years, calculate the value of m .

Answer $m =$ _____ [3]

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11. Two variables G and H are related such that G is inversely proportional to the square of H .

If H is increased by 400%, find the percentage change in G .

Answer _____ % [3]

12. It is given that
 $\xi = \{x : x \text{ is an integer such that } 1 \leq x \leq k\}$,
 $M = \{x : x \text{ is a prime number}\}$, and
 $N = \{x : \text{the unit digit of } x \text{ is } 7\}$.

Given that $n(M \cap N) = 4$,

- (a) state the maximum value of k ,
 (b) find maximum $n(M \cup N)$,
 (c) find the element x such that $x \in N$ and $x \notin M$.

Answer (a) _____ [1]

(b) _____ [1]

(c) _____ [1]

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13. Shinkansen trains, Japan's high speed bullet trains, can reach a speed of up to 320 km/h.
- (a) Express 320 km/h in m/s.
- (b) The distance between Tokyo and Kyoto is 513.6 km.
Calculate the time taken, in hours and minutes, to travel from Tokyo to Kyoto by the Shinkansen train.

Answer (a) _____ m/s [1]

(b) _____ seconds [2]

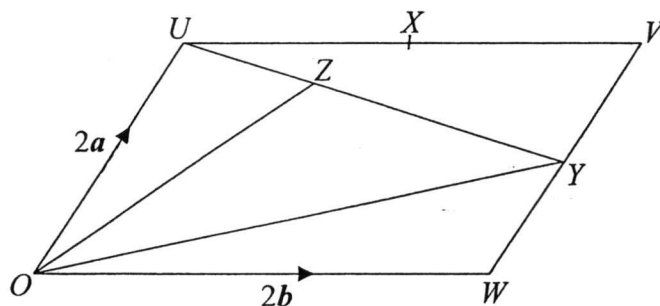
14. Express $\frac{3}{d+3e} - \frac{d-15e}{d^2-9e^2}$ as a single fraction in its simplest form.

Answer _____ [3]

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15. In the diagram, $OUVW$ is a parallelogram.
 X and Y are midpoints on UV and VW respectively.
 Z is a point on UY such that $5UZ = 2UY$.
 $\overrightarrow{OU} = 2a$ and $\overrightarrow{OW} = 2b$.



- (a) Express, in terms of a and/or b ,
- $\overrightarrow{OX}$,
 - $\overrightarrow{OZ}$.
- (b) Prove that OZ , when produced, will pass through X .

Answer (a) (i) _____ [1]

(ii) _____ [2]

(b) _____

_____ [1]

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16. (a) Simplify $\left(\frac{z^8}{196}\right)^{-\frac{1}{2}}$, leaving your answer in positive index.

(b) If $2^x 3^y = 3^9 + 3^8$, find the value of x and of y .

Answer (a) _____ [1]

(b) $x =$ _____, $y =$ _____ [3]

17. The available balance, $\$Y$, of a pre-paid mobile card changes with the duration of local calls made in t minutes.

The initial value of the card was $\$38$.

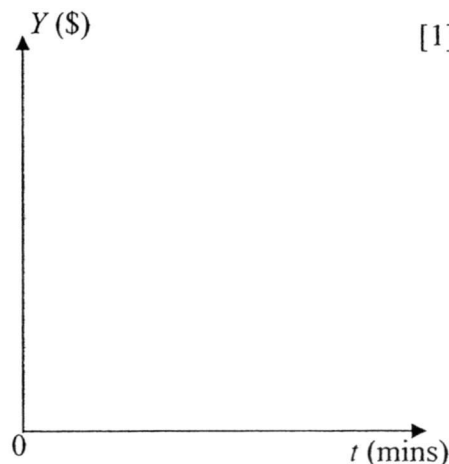
After a total of 1.25 hours of local calls, the balance in the card is $\$25.25$.

(a) Sketch the graph of Y against t .

(b) Calculate the gradient of the graph and explain its significance.

(c) Determine the available balance if local calls of another 100 minutes are made.

Answer (a) $Y (\$)$ [1]



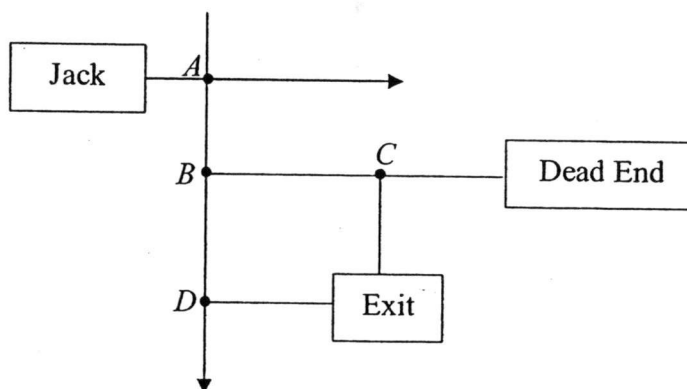
(b) The gradient is _____ and it represents _____ [2]

(c) $\$$ _____ [1]

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18. The diagram shows four junctions A , B , C and D in the game 'Maze Runner' played at a carnival.



Jack decided to participate in the game.
He had to find the exit in the shortest time to win a laptop.
Once Jack runs pass a junction, he is not able to make a turnaround.

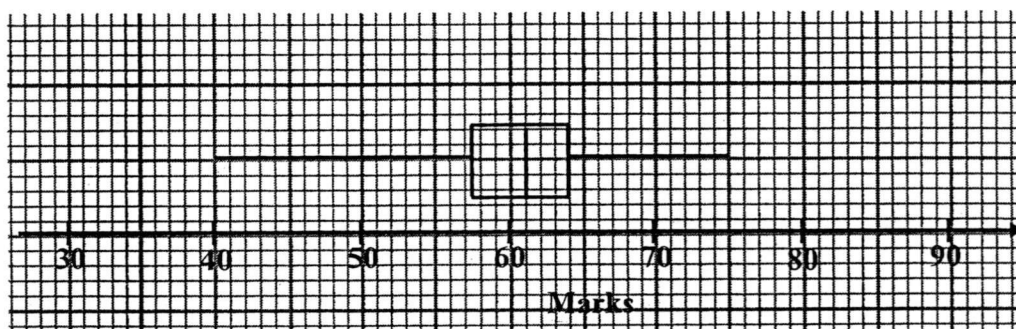
The probability that Jack goes straight at every junction is $\frac{2}{5}$.

Calculate the probability that Jack

- (a) hits the dead end,
- (b) wins the laptop.

Answer (a) _____ [1]
(b) _____ [3]

19. A group of students from Class A took a Mathematics test and their results are shown in the box-and-whisker plot.



- (a) Find the
- median score,
 - inter-quartile range of Class A.
- (b) Another group of students from Class B took the same test and their results are summarised in the table below.

Median	65 marks
Minimum score	55 marks
Maximum score	85 marks
Lower quartile	60 marks
Upper quartile	75 marks

State two differences in the box-and-whisker plot for Class B, as compared to that of Class A.

Answer (a) (i) _____ [1]

(ii) _____ [1]

(b) 1st difference : _____

2nd difference : _____

_____ [2]

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20. When a group of children shared a box of 200 beads equally, there were 4 beads left.
When the remaining beads were added to another box of 80 beads and shared equally, there was no remainder.
Calculate the number of beads left if 250 beads are shared equally among the children.

Answer _____ [5]

21. A cylindrical tank is filled with water to three-quarter of its height.
Water is then pumped into the tank at a rate of 20 millimetres per second.
However, there is water leaking through a hole at the base at a rate of 10 millilitres per second.
After 1.5 minutes, there are 5.7 litres of water in the tank.
Calculate how much more time needed to fill the tank completely.

Answer _____ seconds [5]

22. Lisa and Nancy wanted to surprise their parents by buying them a present for their 15th wedding anniversary. Every day, they saved the balance of their pocket money in their piggy banks. After 3 months, they opened their piggy banks to count how much they have saved. The number of coins they have saved is given in the table below.

	50 cents	20 cents	10 cents
Lisa	30	35	40
Nancy	24	40	50

- (a) Write a matrix S of order 2×3 to represent the above data.
- (b) (i) Write a matrix T to represent the denomination of the coins such that ST exists.
Hence evaluate ST .
- (ii) Explain the significance of ST .
- (c) If the girls have planned a budget of \$50 for the gift, using matrix multiplication, determine if they can achieve this target.
Explain your reasons.

Answer (a) $S =$ _____ [1]

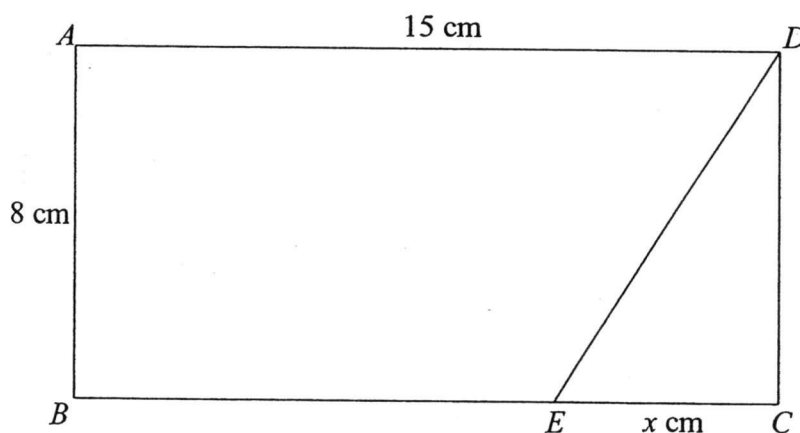
(b) (i) $T =$ _____ [1]

$ST =$ _____ [1]

(b) (ii) _____ [1]

(c) _____ [2]

23. The diagram below shows $ABCD$ as the cross section of a solid cuboid.
 $AB = 8 \text{ cm}$, $AD = 15 \text{ cm}$ and $EC = x \text{ cm}$.



- Explain why $\angle ADE = \angle CED$.
- Write down an expression, in terms of x , for the area of quadrilateral $ABED$.
- Given that the area of triangle DEC is $\frac{1}{6}$ of the area of quadrilateral $ABED$, express EC as a percentage of BC .

Answer (a) _____ [1]

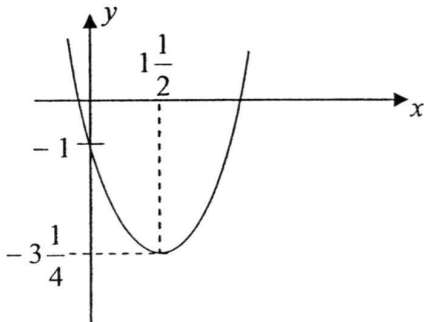
(b) _____ cm^2 [2]

(c) _____ % [3]

~ End of Paper 1 ~

Answer

Qn	Answer
1	-0.010
2	$= (2a + 5b + 2c)(2a + 5b - 2c)$
3a	$2.63 \times 10^8 \text{ m}$
3b	1 hr 10 min 8 sec
4	$-1\frac{3}{4}$
5ai	3
5aii	2
5b	$H \subset I$
6a	$\therefore 3\frac{1}{4} \leq k < 22$
6b	16
7ai	4, 10, 20, 34
7aii	$2n^2 + 2 = 2(n^2 + 1)$, which contains a factor of 2. Or $2n^2$ is an even number and when added to 2 (an even number), $2n^2 + 2$ is even.
7b	$2n^2 - n - 2$
8	$\frac{-5}{x-2}$ or $\frac{5}{2-x}$
9a	$\frac{8}{17}$
9b	$-\frac{8}{17}$
10a	18
10b	$\frac{1}{2}$
11a	$180 = 2^2 \times 3^2 \times 5$
11b	20 cm
11c	45
12a	$0 \leq x \leq 8$ or $0 \leq x < 9$
12b	11
12c	16

Qn	Answer
13a	15 km
13b	10 cm^2
13c	1 : 25 000
14	See attached
14cii	$11.4 \text{ m} \leq y < 14.6 \text{ m}$
15ai	e.g. $y = -\frac{1}{2}x - 1$ negative gradient with numerical value less than 1, y-intercept of -1
15aii	$y = a^{-x} + 2$
15bi	$\left(x - 1\frac{1}{2}\right)^2 - 3\frac{1}{4}$
15bii	
16ai	210°
16aii	30°
16b	$\angle BAR = (180^\circ - 150^\circ) \div 2 = 15^\circ$ (base $\angle$ of isos. Δ) $\angle PAR = 45^\circ + 120^\circ + 15^\circ = 180^\circ$ $\therefore PAR$ is a straight line <u>Alternatively</u> $\angle BAR = (180^\circ - 150^\circ) \div 2 = 15^\circ$ (base $\angle$ of isos. Δ) $\angle QAR = 150^\circ - 15^\circ = 135^\circ$ $\angle PAQ + \angle QAR = 45^\circ + 135^\circ = 180^\circ$
16c	4

PRELIMINARY EXAM 2015
SECONDARY 4 EXPRESS 5 NORMAL (ACADEMIC)

Mathematics Paper 1

Qn	Solution and Answer	Marks allocation
1	$\approx \frac{20000 \times 9}{700 + 100} = \dots$ $\approx 200 \text{ (to nearest hundred)}$	M1: rounding off each number to 1 s.f. A1
2(a)	$\sqrt[3]{3}, \frac{3\pi}{2}$	B1: c.a.o
2(bi)	$\frac{6}{2^5} = \frac{3}{16}$	B1
(ii)	$\frac{n}{2^{n-1}}$	B1
3	From the bar chart, <u>the number of females in the small town seems to be 5 times that of the male</u> , when it is <u>actually just twice</u> instead.	B1 B1
4	Let the angle be θ $\sin \theta = 0.6431 \Rightarrow \theta = \sin^{-1} 0.6431$ $\therefore \theta = 40.0^\circ \text{ or } 140.0^\circ$	M1 A1: both answers
5	If each interior angle = 130° , each exterior angle = 50° $\Rightarrow$ number of sides = $\frac{360^\circ}{50^\circ} = 7.2$, which is not possible. Hence it is not possible to have a regular polygon with an interior angle of 130° .	B1: each exterior angle B1: number of sides not integer value
6(a)	$\frac{75840 - 0.2 \times 62400}{6 \times 12} = \frac{63360}{72} = \880	B1
6(b)	Amount saved = $\$75840 - 0.95 \times 62400 = \16560 $\therefore \% \text{ saved} = \frac{16560}{75840} \times 100\% = 21.83\% \approx 22\%$	M1 A1: final answer
7	$\frac{V_A}{V_B} = \left(\frac{25}{15}\right)^3 = \frac{125}{27}$ $\therefore \text{No. of filled smaller containers} = \frac{125}{27} = 4.629\% \approx 5$	M1: ratio of the 2 volumes M1, A1
8	$\text{£}2000 = 2000 \times 2.1059 = \text{S\$}4211.80$ $\text{C\$}2000 = 2000 \times 1.0875 = \text{S\$}2175$ $\therefore \text{Amount of S\$ kept} = 4211.80 - 2175 = \text{S\$}2036.80$	M1 M1 A1
9(a)	$12p - r$	B1
9(b)	$\text{Total selling price} = \frac{12p - r}{3} \times \$t = \$\left(\frac{12pt - rt}{3}\right)$ $\therefore \text{Profit} = \$\left(\frac{12pt - rt}{3} - q\right)$	M1 B1

Qn	Solution and Answer	Marks allocation
10	$5847.89 = 5400 \left(1 + \frac{m/2}{100} \right)^5$ $1 + \frac{m}{200} = \sqrt[5]{\frac{5847.89}{5400}}$ $\therefore m = 3.21$	M1: using compound interest formula M1: simplification A1
11	$G = \frac{k}{H^2}$ When H is increased by 400%, $H_{\text{new}} = 5H_{\text{original}}$ $\Rightarrow G_{\text{new}} = \frac{k}{(5H_{\text{original}})^2} = \frac{k}{25H_{\text{original}}^2}$ $G_{\text{new}} = \frac{1}{25} G_{\text{original}} \quad \Rightarrow \quad \frac{G_{\text{new}}}{G_{\text{original}}} = \frac{1}{25} = \frac{4}{100}$ $\% \text{ change in } G = \frac{4-100}{100} \times 100\% = -96\%$	M1: finding new G M1: ratio of the 2 G values A1
12(a)	$M = \{x : x \text{ is a prime number}\}$ and $N = \{x : \text{the unit digit is } 7\}$ Since $n(M \cap N) = 4 \Rightarrow M \cap N = \{7, 17, 37, 47\}$ $\Rightarrow M = \{2, 3, 5, 7, 11, \dots, 47, 53\}$ and $N = \{7, 17, 27, 37, 47\}$ $\therefore$ maximum of $k = 56$	B1
12(b)	Maximum $n(M \cup N) = 17 \quad \dots$	B1
12(c)	$x = 27$	B1
13(a)	$320 \text{ km/h} = \frac{320000 \text{ m}}{3600 \text{ s}} = 88 \frac{8}{9} \text{ m/s}$	B1
13(b)	$\frac{513.6}{320} = 1.605 \text{ h} = 1 \text{ h } 36.3 \text{ mins}$	M1, A1
14	$\frac{3}{d+3e} - \frac{d-15e}{d^2-9e^2} = \frac{3(d-3e)-d+15e}{(d+3e)(d-3e)}$ $= \frac{2d+6e}{(d+3e)(d-3e)}$ $= \frac{2}{d-3e}$	M1: LCM as common denominator M1: as 1 fraction A1: simplest form
15(ai)	$\overrightarrow{OX} = \overrightarrow{OU} + \overrightarrow{UX} = \overrightarrow{OU} + \frac{1}{2} \overrightarrow{UV} = 2a + b$	B1
15(aii)	$\overrightarrow{UY} = \overrightarrow{UV} + \overrightarrow{VY} = \overrightarrow{OU} + \frac{1}{2} \overrightarrow{VW} = 2b - a$ $\overrightarrow{UZ} = \frac{2}{5} \overrightarrow{UY} = \frac{2}{5} (2b - a)$ $\overrightarrow{OZ} = \overrightarrow{OU} + \overrightarrow{UZ} = 2a + \frac{2}{5} (2b - a) = \dots = \frac{8}{5} a + \frac{4}{5} b$	M1: $\overrightarrow{UZ}$ A1

Qn	Solution and Answer	Marks allocation
15(aiii)	$\overrightarrow{OZ} = \frac{8}{5}\mathbf{a} + \frac{4}{5}\mathbf{b} = \frac{4}{5}(2\mathbf{a} + \mathbf{b}) = \frac{4}{5}\overrightarrow{OX}$ Since $\overrightarrow{OZ}$ and $\overrightarrow{OX}$ are in the same direction, O, Z and X are collinear points. $\therefore OZ$ when produced will pass through X. Alternative approach: Find $\overrightarrow{ZX} = \frac{2}{5}\mathbf{a} + \frac{1}{5}\mathbf{b} = \frac{1}{5}(2\mathbf{a} + \mathbf{b})$	B1
16(a)	$\left(\frac{z^8}{196}\right)^{-\frac{1}{2}} = \left(\frac{196}{z^8}\right)^{\frac{1}{2}} = \frac{14}{z^4}$	B1
16(b)	$2^x 3^y = 3^9 + 3^8 = 3^8(3+1) = 3^8 \times 2^2$ $\therefore x = 2, y = 8$	M1 A1 each
17(a)		B1: linear graph with given information shown clearly
17(b)	Gradient = $-\frac{12.75}{75} = -\frac{17}{100}$ It represents the cost deducted per minute for local calls.	B1 B1
17(c)	Available balance in card $= 38 - \frac{17}{100} \times (175) = \8.25	B1
18(a)	P (hits the dead end) = P (turns at A, turn at B, straight at C) $= \frac{3}{5} \times \frac{3}{5} \times \frac{2}{5} = \frac{18}{125}$	M1, B1
18(b)	P (wins the laptop) = P (hits exit) = P (turns at A, straight at B and turns at D, or turns at A, B and C) $= \frac{3}{5} \times \frac{2}{5} \times \frac{3}{5} + \left(\frac{3}{5}\right)^3 = \frac{9}{25}$	M2, A1
19(ai)	Median = 61 marks	B1
19(aii)	IQR = $64 - 57.5 = 6.5$ marks	B1
19(b)	For Class B: IQR = $75 - 60 = 15$ marks 1st difference: the length of the <u>box</u> is <u>longer</u> as the IQR is wider. 2nd difference: the <u>left whisker</u> is <u>shorter</u> as the difference between the lower quartile and minimum value is smaller.	B1 B1

Qn	Solution and Answer	Marks allocation
20	$196 = 2^2 \times 7^2$ and $84 = 2^2 \times 3 \times 7$ No. of children in the group $= \text{HCF of } 196 \text{ and } 84 = 2^2 \times 7 = 28$ No. of beads each child has if 250 beads are shared equally $= \frac{250}{28} = 8.92... \approx 8$ $\therefore \text{No. of beads left} = 250 - 28 \times 8 = 26$	M2: prime factorisation M1: no. of children M1: no. of beads each child has A1
21	Pumped in 20 ml/sec and leaked 10 ml/sec $\Rightarrow 10\text{ml of water added in 1 sec}$ $\Rightarrow \text{Amount of water added in 1.5 mins} = 1.5 \times 60 \times 10 = 900\text{ ml}$ Initial volume of water in tank $= 5700 - 900 = 4800\text{ ml}$ $\Rightarrow \text{Capacity of tank} = \frac{4}{3} \times 4800 = 6400\text{ ml}$ $\therefore \text{Time needed to fill tank} = \frac{6400 - 5700}{10} = 70\text{ sec}$	M1 M1 M1 M1 A1
22(a)	$S = \begin{pmatrix} 30 & 35 & 40 \\ 24 & 40 & 50 \end{pmatrix}$	B1
22(bi)	$T = \begin{pmatrix} 50 \\ 20 \\ 10 \end{pmatrix}$ $ST = \begin{pmatrix} 30 & 35 & 40 \\ 24 & 40 & 50 \end{pmatrix} \begin{pmatrix} 50 \\ 20 \\ 10 \end{pmatrix} = \dots = \begin{pmatrix} 2600 \\ 2500 \end{pmatrix}$	B1: matrix T B1: ST
22(bii)	The total amount of money, in cents, saved by each girl in 3 months	B1
22(c)	Let $M = \begin{pmatrix} 1 & 1 \end{pmatrix}$ Total amount saved by both girls $= MST = \begin{pmatrix} 1 & 1 \end{pmatrix} \begin{pmatrix} 2600 \\ 2500 \end{pmatrix}$ $= \begin{pmatrix} 5100 \end{pmatrix}$ The girls can achieve this target as they saved a total of \$51.	M1 B1
23(a)	$\angle ADE = \angle CED$ as they are alternate angles since AD and EC are parallel to each other.	B1
23(b)	Area of quadrilateral $ABED = \frac{1}{2} \times [15 + (15 - x)] \times 8$ $= 4(30 - x) = 120 - 4x$	M1 A1
23(c)	Since area of triangle DEC is $\frac{1}{6}$ the area of $ABED$, $\Rightarrow \frac{1}{2} \times 8 \times x = \frac{1}{6} (120 - 4x) \Rightarrow 24x = 120 - 4x$ $\Rightarrow 28x = 120 \Rightarrow x = 4\frac{2}{7}$ $\therefore EC$ as a percentage of $BC = \frac{4\frac{2}{7}}{15} \times 100\% = 28\frac{4}{7}\%$	M1: form eqn in x M1: value of x A1



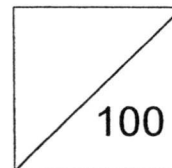
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HOLY INNOCENTS' HIGH SCHOOL

Name of Student

Class

Index Number



PRELIMINARY EXAMINATION 2015
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
MATHEMATICS PAPER 2

4016 / 02

Date: 31 July 2015

Duration: 2 h 30 min

Additional Materials: 1 string
1 sheet of graph paper
6 sheets of writing paper

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 an HB pencil for any diagrams or graphs.
Do not use paper clips, glue or correction tape/fluid.

Answer **ALL** questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is **100**.

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.

Set by: Ms Lua Bee Hian

Vetted by: Mdm Hayati & Ms Goh Lay Ching

This document consists of 10 printed pages (including cover page).

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Mathematical Formulae

Compound interest

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

Geometry and Measurement

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1. (a) Solve the inequality $1 > \frac{7x+2}{3}$. [2]
- (b) (i) Factorise completely $x^2 + 4xy + 4y^2 - 9$. [2]
- (ii) Simplify $\frac{2x^2 + 2x - 4}{x+2}$. [2]
- (c) It is given that $v^2 = u^2 + 2as$.
- (i) Find v^2 when $u = 0$, $a = 9.8$ and $s = 3$. [1]
- (ii) Express u in terms of a , s and v . [2]

2. Food waste is one of the top waste types in Singapore.

The table shows an overview of the waste figures for food waste in megatonnes in 2014.

Waste Type	Waste Disposed	Waste Recycled	Waste Generated
Food waste	0.6872	0.1014	0.7886

- (a) Convert the total amount of food waste generated into tonnes.
Give your answer in standard form. [2]
- (b) Calculate the percentage of the food waste that was recycled. [2]
- (c) The population of Singapore in 2014 was 5.47 million.
Calculate the average amount of food waste generated by per person, in tonnes.
Give your answer correct to 3 significant figures. [2]
- (d) The amount of food waste generated in Singapore has increased by about 48 per cent over the past 10 years.
Calculate the amount of food waste generated, in tonnes, in 2005.
Give your answer correct to the nearest kilotonnes. [2]
- (e) Food waste accounts for about 10.5 per cent of the total waste generated in Singapore. In 2014, 2.7 per cent of the total waste generated was used as fuel in biomass plants.
Calculate the amount of waste, in tonnes, that was used as fuel in biomass plants.
Give your answer correct to 3 significant figures. [2]

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

A pebble was thrown from the top of a vertical building.

Its position during the flight is represented by the equation $y = 30 + 4x - x^2$, where y metres is the height of the pebble above the ground and x metres is its horizontal distance from the foot of the building.

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

x	0	1	2	3	4	5	6	7
y	30	33	34	33	30	25	k	9

(a) Find the value of k . [1]

(b) Using a scale of 2 cm to represent 1 metres, draw a horizontal x -axis for $0 \leq x \leq 7$.

Using a scale of 2 cm to represent 5 metres, draw a vertical y -axis for $0 \leq y \leq 40$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

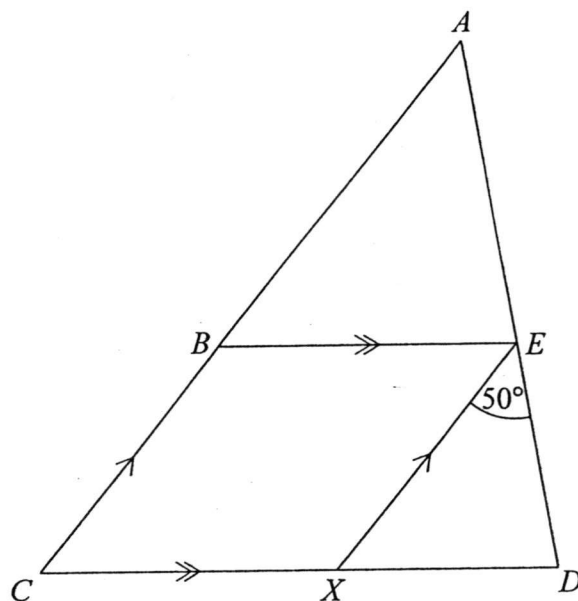
(c) Use your graph to find the greatest height reached by the pebble. [1]

(d) Find the horizontal distances of the pebble when $y = 33.5$ m. [2]

(e) (i) By drawing a tangent, find the gradient of the graph at the point (5, 25). [2]

(ii) Use your answer to (e)(i) to explain what was happening to the stone at $x = 5$. [1]

4.

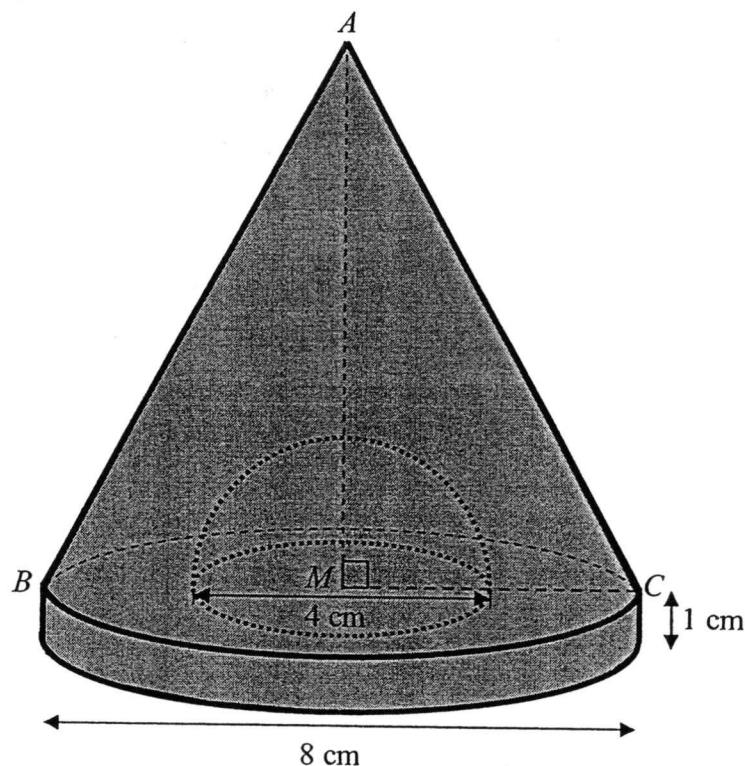


The diagram shows triangle ACD .

$BCXE$ is a parallelogram such that XE bisects angle BED and $\angle XED = 50^\circ$.

- (a) Find angle EDX . [1]
- (b) Show that triangle ABE is similar to triangle EXD . [2]
- (c) State another triangle that is similar to ABE and EXD . [1]
- (d) The ratio $AE : ED = 4 : 3$.
 - (i) Find the ratio $CD : XD$. [1]
 - (ii) Given that the area of triangle $ABE = 36 \text{ cm}^2$, find the area of triangle BXE . [3]

5.



The figure shows a trophy that is made up of a circular base and conical top. The circular base of the trophy has a diameter of 8 cm and thickness of 1 cm. A hemisphere of diameter 4 cm is removed from the centre of the trophy as shown in the diagram.

The ratio $AM : MC = 3 : 2$.

[Take $\pi = 3.142$]

- (a) Show that the angle $ACM = 56.3^\circ$, correct to 3 significant figures. [2]
- (b) Find the height of the trophy. [2]
- (c) The exterior surface area of the trophy is coated with rose gold. Find the total surface area that is coated with rose gold. [4]
- (d) Find the volume of the trophy. [3]

6. (a) C is the point $(-3, 5)$ and D is the point $(4, 3)$.

(i) Write down the column vector $\overrightarrow{CD}$. [1]

(ii) Find $\left| \overrightarrow{CD} \right|$. [2]

(iii) Given that $4\overrightarrow{DE} = 3\overrightarrow{DC}$, find the coordinates of point E . [2]

- (b) The position vector of a point Q is $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$.

(i) Find the equation of the line QR . [2]

(ii) The equation of the line ST is $4y - 3x = 18$.

Find the coordinates of the point of intersection of QR and ST . [3]

7. A printer prints pages on either single or double sides.

- (a) In one minute, it prints x pages on single side.

Write down an expression, in terms of x , for the number of seconds it takes to print one page on single side. [1]

- (b) In one minute, it prints 3 more copies on single side than it does on double sides. Write down an expression, in terms of x , for the number of seconds it takes to print one page on double sides. [1]

- (c) It takes 4 seconds shorter to print single side than it takes to print double sides.

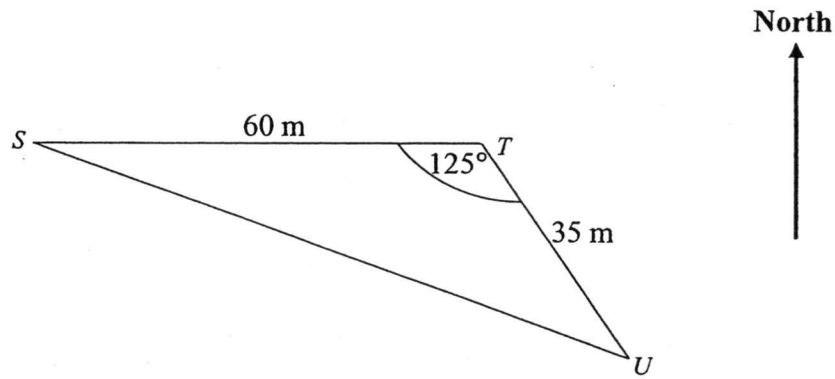
(i) Write down an equation in x to represent this information, and show that it reduces to $x^2 - 3x - 45 = 0$. [3]

(ii) Solve the equation $x^2 - 3x - 45 = 0$, giving your solutions correct to 1 decimal places. [3]

(iii) Find the time taken to print 20 pages on double sides. [2]

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8.



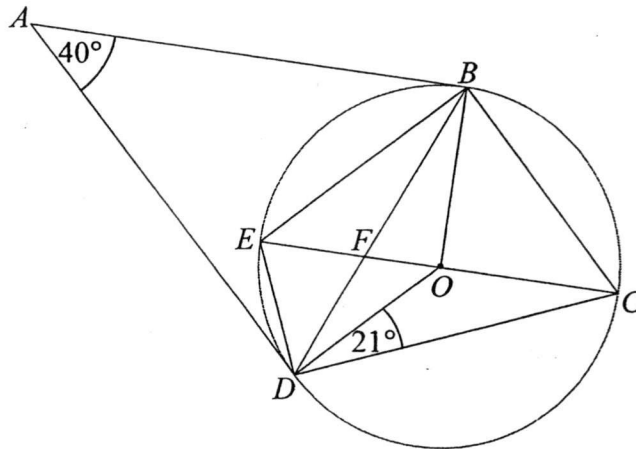
The positions of 3 islands on a map are represented by S , T and U as shown in the diagram.

Angle $STU = 125^\circ$ and island T is due east of island S .

$ST = 60$ m and $TU = 35$ m.

- (a) Show that $SU = 85.1$ m. [3]
- (b) Calculate the bearing of T from U . [2]
- (c) The area of the triangle STU is 860.11 m^2 .
Find the shortest distance to sail from island T to SU . [2]
- (d) An eagle is hovering directly above T .
The angle of depression of point U viewed from the eagle is 65° .
 - (i) Find the distance between the eagle and point T . [2]
 - (ii) Calculate the greatest possible angle of elevation of the eagle when viewed from a ship that sails along SU . [2]

9.

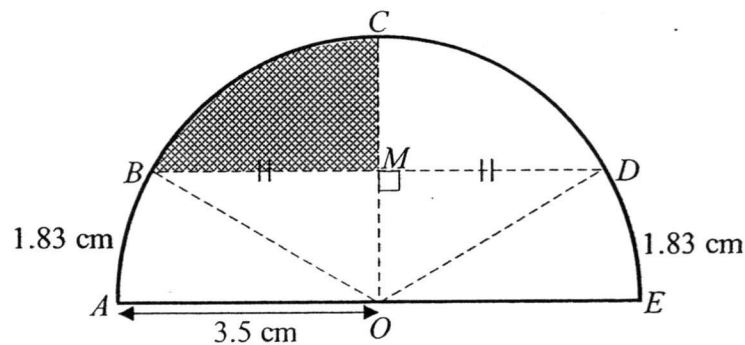


- (a) The diagram shows a circle $BCDE$, centre O .
 F is a point of intersection of BD and diameter EC .
 AB and AD are tangents to the circle such that angle $BAD = 40^\circ$.
Angle $ODC = 21^\circ$.

Find, giving reasons for each answer,

- (i) obtuse angle BOD , [1]
- (ii) angle BED , [2]
- (iii) angle ODF , [1]
- (iv) angle ABE . [1]

(b)



$OABCDE$ is a semi circle, centre O , of radius 3.5 cm.
 M is the midpoint of BD .
Length of arc AB = Length of arc DE = 1.83 cm.

- (i) Show that angle $BOD = 2.096$ radians. [2]
- (ii) Find the area of the shaded region. [3]

2.7

10. (a) 40 students from Class 4 Excel were surveyed on the number of hours they spent on revision the previous week.
The results of this survey are summarised in the table below.

No. of hours spent on revision (x)	Number of people (f)	fx
0	1	0
1	3	3
2	2	4
3	a	18
4	2	8
5	b	c
6	10	60
7	9	63
8	3	24
Total	40	d

- (i) Find
- (a) the values of a , b , c and d , [2]
 - (b) the mean, [1]
 - (c) the standard deviation. [2]
- (b) In a group, there are 15 students with dimples and 9 students without dimples. Two students are selected at random.
- (i) Draw a tree diagram to show the probabilities of the possible outcomes. [2]
 - (ii) Find the probability that
 - (a) both students selected are with dimples, [1]
 - (b) one student with dimples and the other without dimples are selected. [1]
 - (iii) A third student is selected.
Find the probability that at least one of the students selected is with dimples. [2]

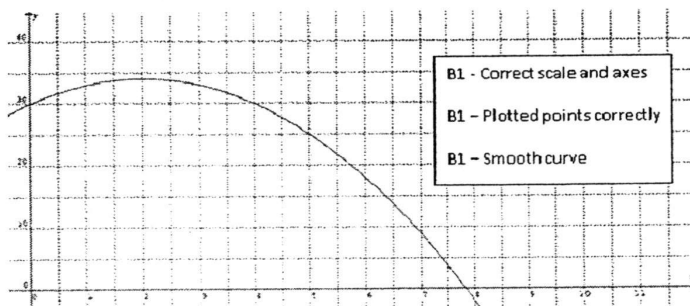
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Answers:

- Q1.** (a) $x < \frac{1}{7}$
 (b) (i) $(x+2y+3)(x+2y-3)$
 (ii) $2x-2$
 (c) (i) $v^2 = 58.8$
 (ii) $u = \pm\sqrt{v^2 - 2as}$

- Q2.** (a) 7.886×10^5 tonnes
 (b) 12.9%
 (c) 0.144 tonnes
 (d) 533 kilotonnes
 (e) 203000 tonnes

- Q3.** (a) $k = 18$
 (b)



- (c) 34 m
 (d) 1.3 m and 2.7 m
 (e) (i) gradient = -6 ± 0.5
 (ii) The height of the pebble above the ground decreases at a rate of 6 m for every 1 m it travels horizontally / falls.

- Q4.** (a) $\angle EDX = 80^\circ$
 (b) $\angle AEB = \angle EDX = 80^\circ$
 (corresponding angles)
 $\angle ABE = \angle EXD = 50^\circ$
 (alternate angles)
 $\angle BAE = \angle XED = 50^\circ$
 (sum of angles in triangle). $\therefore \triangle ABE$ is similar to $\triangle EXD$.
 (c) $\triangle ACD$
 (d) (i) 7 : 3

(ii) Area of $\triangle BXE = 27 \text{ cm}^2$

Q5. (a) $\tan \angle ACM = \frac{3}{2}$

$$\angle ACM = \tan^{-1}\left(\frac{3}{2}\right)$$

$$= 56.309932$$

$$\approx 56.3^\circ \text{ (shown)}$$

(b) Height of trophy = 7 cm

(c) 166 cm^2
 (d) 134 cm^3

Q6. (a) (i) $\overrightarrow{CD} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$

(ii) 7.28
 (iii) $(-1.25, 4.5)$

(b) (i) $3y = 5 - 2x$
 (ii) $(-2, 3)$

Q7. (a) $\frac{60}{x}$

(b) $\frac{60}{x-3}$

(c) (i) $\frac{60}{x-3} - \frac{60}{x} = 4$

$$60x - 60(x-3) = 4x(x-3)$$

$$60x - 60x + 180 = 4x^2 - 12x$$

$$4x^2 - 12x - 180 = 0$$

$$x^2 - 3x - 45 = 0 \text{ (shown)}$$

(ii) $x \approx 8.4$ or $x \approx -5.4$
 (iii) 223 seconds

Q8. (a) $SU^2 = 60^2 + 35^2 - 2(60)(35)\cos 125^\circ$

$$SU^2 = 6^2 + 3.5^2 - 2(6)(3.5)\cos 125^\circ$$

$$SU^2 = 7234.0210$$

$$SU = \sqrt{7234.0210}$$

$$\approx 85.1 \text{ km}$$

(b) Bearing of T from U = 325°

(c) 20.2 m 218

(d) (i) 75.1 m

(ii) 74.9°

- Q9.** (a) (i) 140°
 (ii) angle $BED = 110^\circ$
 (iii) angle $ODF = 20^\circ$
 (iv) angle $ABE = 49^\circ$

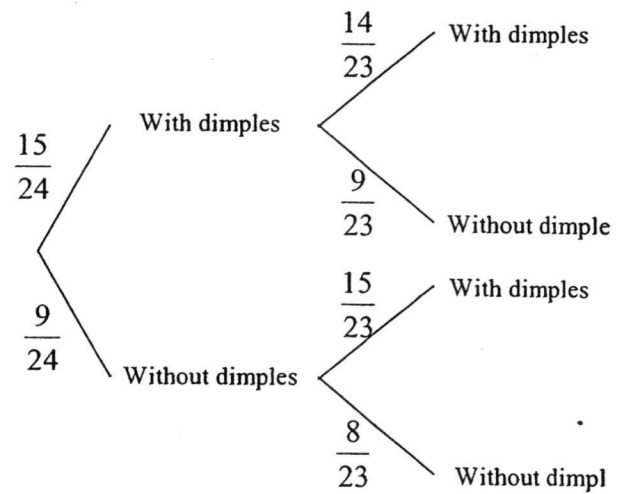
(b) (i) $\theta = \frac{s}{r}$
 $= 1.83 \div 3.5$
 $= \frac{183}{350}$

Angle $BOD = \pi - 2\left(\frac{183}{350}\right)$
 ≈ 2.096
 (shown)

(ii) 3.77 cm^2

- 10.** (a) (i) (a) $a = 6, b = 4, c = 20$
 and $d = 200$
 (b) 5
 (c) 2.18

- (b) (i)



(b) (ii) (a) $\frac{35}{92}$

(b) $\frac{45}{92}$

(iii) $\frac{485}{506}$

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Q1. (a) $1 > \frac{7x+2}{3}$

$3 > 7x+2$

$1 > 7x$ [M1]

$7x < 1$

$x < \frac{1}{7}$ [A1]

(b) (i) $x^2 + 4xy + 4y^2 - 9$

$= (x+2y)^2 - 9$ [M1]

$= (x+2y+3)(x+2y-3)$ [A1]

(ii) $\frac{2x^2 + 2x - 4}{x+2}$

$= \frac{2(x^2 + x - 2)}{x+2}$

[M1, factorising numerator correctly]

$= \frac{2(x+2)(x-1)}{x+2}$

$= 2x - 2$

[A1, accept $2(x-1)$]

(c) (i) $v^2 = 0^2 + 2(9.8)(3)$

$v^2 = 58.8$ [B1]

(ii) $v^2 = u^2 + 2as$

$u^2 = v^2 - 2as$ [M1]

$u = \pm \sqrt{v^2 - 2as}$ [A1]

Q2. (a) 788600 [M1, convert to tonnes]

$= 7.886 \times 10^5$ tonnes [A1 or s.o.i. B2]

(b) Percentage of food waste that was recycled

$= 0.1014 \div 0.7886 \times 100$ [M1 o.e.]

$= 12.85822$

$\approx 12.9\%$ [A1]

(c) Average amount of food waste generated by per person

$= 0.7886 \div 5.47$ [M1 o.e.]

≈ 0.144 tonnes [A1]

(d) Amount of food waste generated in 2005

$= 0.7886 \div 1.48 \times 10^6$ [M1 o.e.]

≈ 532838

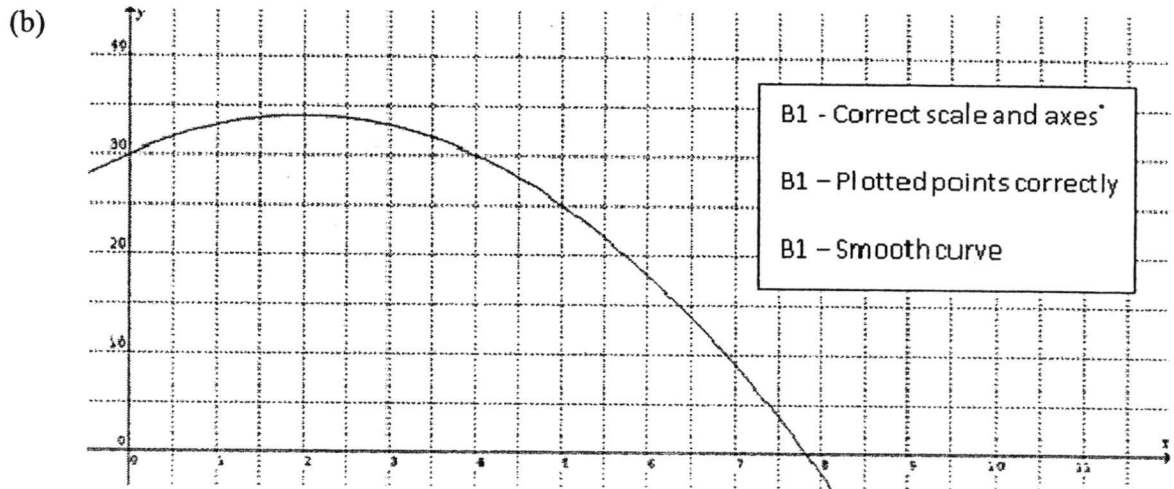
≈ 533 kilotonnes [A1]

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- Q2. (e) Amount of waste used as fuel in biomass plants
 $= 0.7886 \div 10.5 \times 2.7 \times 10^6$ [M1]
 ≈ 202782
 ≈ 203000 tonnes [A1]

- Q3. (a) $k = 18$ [B1]



- (c) 34 m [B1]
- (d) 1.3 m and 2.7 m [B1 each]
- (e) (i) B1 - Draw tangent
 B1 - gradient = -6 ± 0.5
- (ii) The height of the pebble above the ground decreases at a rate of 6 m for every 1 m it travels horizontally / falls. [B1]

- Q4. (a) $\angle EDX = 180^\circ - 50^\circ - 50^\circ$
 $= 80^\circ$ [B1]
- (b) $\angle AEB = \angle EDX = 80^\circ$ (corresponding angles)
 $\angle ABE = \angle EXD = 50^\circ$ (alternate angles)
 $\angle BAE = \angle XED = 50^\circ$ (sum of angles in triangle) [M1]

$\therefore \triangle ABE$ is similar to $\triangle EXD$. [A1]

- (c) $\triangle ACD$ [B1]

- (d) (i) 7 : 3 [B1]

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Q4. (d) (ii) Area of $\triangle EXD = \frac{36 \times 3^2}{4^2}$ [M1]
 $= 20.25 \text{ cm}^2$

Area of $\triangle ACD = \frac{36 \times 7^2}{4^2}$ [M1]
 $= 110.25 \text{ cm}^2$

Area of $\triangle BXE = \frac{110.25 - 36 - 20.25}{2}$ [A1]
 $= 27 \text{ cm}^2$

Q5. (a) $\tan \angle ACM = \frac{3}{2}$ [M1]

$\angle ACM = \tan^{-1}\left(\frac{3}{2}\right)$
 $= 56.309932$
 $\approx 56.3^\circ$ (shown) [A1]

(b) $\frac{3}{2} = \frac{AM}{4}$
 $AM = \frac{3}{2} \times 4$
 $= 6 \text{ cm}$ [M1]

Height of trophy $= 6 + 1$
 $= 7 \text{ cm}$; [A1]

(c) $\cos 56.3^\circ = \frac{4}{AC}$
 $AC = \frac{4}{\cos 56.3^\circ}$ [M1]
 $= 7.209228$

total surface area coated with rose gold

$= 3.142 \times 4 \times \frac{4}{\cos 56.3^\circ} + 2 \times 3.142 \times 4 \times 1 + 3.142 \times 4^2$ [M2, correct substitution]
 $= 166.013$
 $\approx 166 \text{ cm}^2$ [A1]

(d) Volume of trophy
 $= \text{Vol. of cone} + \text{Vol. of cylindrical base} - \text{Vol. of hemisphere}$
 $= \frac{1}{3} \times 3.142 \times 4^2 \times 6 + 3.142 \times 4^2 \times 1 - \frac{2}{3} \times 3.142 \times 2^3$ [M2, minus 1m for one error]
 $= 134.05866$
 $\approx 134 \text{ cm}^3$ [A1]

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Q6. (a) (i) $\overrightarrow{CD} = \begin{pmatrix} 4+3 \\ 3-5 \end{pmatrix}$
 $= \begin{pmatrix} 7 \\ -2 \end{pmatrix}$ [B1]

(ii) $|\overrightarrow{CD}| = \sqrt{7^2 + (-2)^2}$ [M1, allow e.c.f.]
 $= \sqrt{53}$
 ≈ 7.28 [A1]

(iii) $4\overrightarrow{DE} = 3\overrightarrow{DC}$
 $\overrightarrow{DE} = \frac{3}{4} \begin{pmatrix} -7 \\ 2 \end{pmatrix}$ [M1, recognised $\overrightarrow{DC} = -\overrightarrow{CD}$]

$$\overrightarrow{OE} = \frac{3}{4} \begin{pmatrix} -7 \\ 2 \end{pmatrix} + \begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

$$= \begin{pmatrix} -1.25 \\ 4.5 \end{pmatrix}$$

Coordinates of point E is $(-1.25, 4.5)$ [A1]

(b) (i) $\frac{-4}{6} = \frac{y-3}{x+2}$ [M1]

$$-4x - 8 = 6y - 18$$

$$6y = 10 - 4x$$

$$3y = 5 - 2x$$
 [A1 o.e.]

(ii) $4y - 3x = 18$ ----- (1)
 $3y = 5 - 2x$ ----- (2)

From (2), $y = \frac{5-2x}{3}$ ----- (3)

Subst. (3) into (1),

$$4\left(\frac{5-2x}{3}\right) - 3x = 18$$
 [M1]

$$20 - 8x - 9x = 54$$

$$17x = -34$$

$$x = -2$$
 [A1]

$$y = \frac{5+4}{3} = 3$$
 [A1]

Coordinates of point of intersection is $(-2, 3)$.

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Q7. (a) $\frac{60}{x}$ [B1]

(b) $\frac{60}{x-3}$ [B1]

(c) (i) $\frac{60}{x-3} - \frac{60}{x} = 4$ [M1, formulate equation]

$60x - 60(x-3) = 4x(x-3)$ [M1, remove denominator]

$60x - 60x + 180 = 4x^2 - 12x$

$4x^2 - 12x - 180 = 0$

$x^2 - 3x - 45 = 0$ (shown) [A1]

(ii) $x = \frac{3 \pm \sqrt{(-3)^2 - 4(1)(-45)}}{2(1)}$

$x = \frac{3 \pm \sqrt{189}}{2}$ [M1, for $\sqrt{189}$]

$x = 8.37386$ or $x = -5.37386$

$x \approx 8.4$ $x \approx -5.4$ [A2, 1m each]

(iii) time taken to print 20 pages in double side

$= \frac{60}{8.37386 - 3} \times 20$ [M1]

≈ 223 seconds [A1]

Q8. (a) $SU^2 = 60^2 + 35^2 - 2(60)(35)\cos 125^\circ$ [M1, subst. in correctly]

$SU^2 = 6^2 + 3.5^2 - 2(6)(3.5)\cos 125^\circ$

$SU^2 = 7234.0210$

$SU = \sqrt{7234.0210}$ [M1]

≈ 85.1 km [A1]

(b) $\alpha = 35^\circ$ [M1]

Bearing of T from $U = 325^\circ$ [A1]

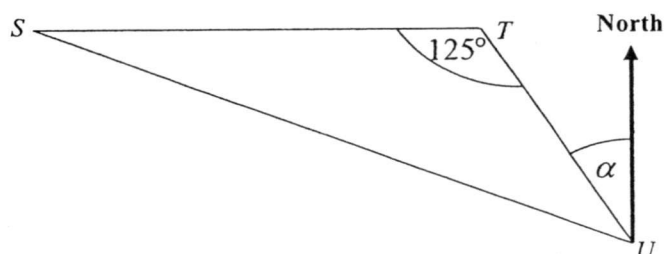
Q8. (c) Shortest distance

$= \frac{860.11}{0.5 \times \sqrt{7234.0210}}$ [M1]

$\approx \frac{860.11}{0.5 \times \sqrt{7234.0210}}$

$= 20.2249$

≈ 20.2 m [A1]



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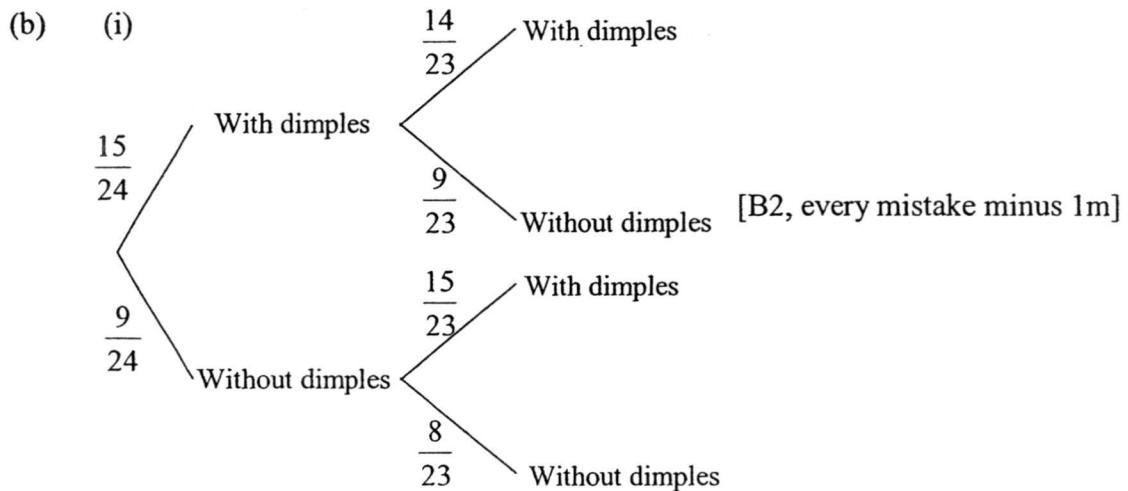
- Q8. (d) (i) $\tan 65^\circ = \frac{\text{Dis tan ce}}{35}$
 $\text{Dis tan ce} = 35 \tan 65^\circ$ [M1]
 $\approx 75.1 \text{ m}$ [A1]
- (ii) greatest possible angle of elevation
 $= \tan^{-1}\left(\frac{35 \tan 65^\circ}{20.2249}\right)$ [M1]
 $\approx 74.9^\circ$ [A1]
- Q9. (a) (i) obtuse angle BOD = $180^\circ - 40^\circ$ (tangent to ext. pt.)
 $= 140^\circ$ [B1]
- (ii) reflex angle BOD = $360^\circ - 140^\circ$
 $\text{angle } BED = \frac{360^\circ - 140^\circ}{2}$ (angle at centre = two angles at circumference) [M1]
 $= 110^\circ$ [A1]
- (iii) $\text{angle } ODF = \frac{180^\circ - 220^\circ}{2}$
 $= 20^\circ$ [B1]
- (iv) $\text{angle } ABE = 90^\circ - 20^\circ - 21^\circ$
 $= 49^\circ$ [B1]
- (b) (i) $\theta = \frac{s}{r}$
 $= 1.83 \div 3.5$
 $= \frac{183}{350}$ [M1]
 $\text{Angle } BOD = \pi - 2\left(\frac{183}{350}\right)$
 ≈ 2.096 [A1]
- (ii) $\text{area of triangle } OMB = \frac{1}{2} \times 3.5 \times 3.5 \times \sin 2.096 \times \frac{1}{2}$
 $= 2.6497 \text{ cm}^2$ [M1, use any method to find the area]
- Area of shaded region = Area of sector OBC – area of triangle OMB
 $= \frac{1}{2} \times 3.5^2 \times 2.096 \times \frac{1}{2} - 2.6497$ [M1, correct subst.]
 $= 3.7693$
 $\approx 3.77 \text{ cm}^2$ [A1]

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Q10. (a) (i) (a) $a = 6, b = 4, c = 20$ and $d = 200$ [B1 for every two correct]

(b) Mean = 5 [B1]

(c) Standard deviation = 2.17944
 $= \approx 2.18$ [B2]



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(b) (ii) (a) P(both students with dimples)
 $= \frac{15}{24} \times \frac{14}{23}$
 $= \frac{35}{92}$ [B1]

(b) P(one student with dimples and the other without dimples)
 $= \frac{15}{24} \times \frac{9}{23} + \frac{9}{24} \times \frac{15}{23}$
 $= \frac{45}{92}$ [B1]

(iii) P(at least one student with dimples)
 $= 1 - P(\text{all three students without dimples})$
 $= 1 - \frac{9}{24} \times \frac{8}{23} \times \frac{7}{22}$ [M1 o.e.]
 $= \frac{485}{506}$ [A1]

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