



HOUGANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2 2020
MATHEMATICS PAPER 1 (4048/01)
SECONDARY FOUR EXPRESS / FIVE NORMAL ACADEMIC

26 August 2020, Wednesday

2 hours

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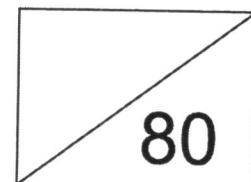
READ THESE INSTRUCTIONS FIRST

- Write your name, class register number, class and calculator model in the space provided on this page.
- Write in dark blue or black pen in the spaces provided on the question paper.
- You may use a pencil for any diagrams or graphs.
- Do not use staples, paper clips, glue or correction fluid.
- 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 the calculator value or 3.142, unless the question requires the answer in terms of π .

INFORMATION FOR PUPILS

- Answer **all** questions.
- 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.

Calculator Model : _____



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

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

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

- 1 Write the following numbers in order of size, starting with the **largest**.

$$\left(\frac{6}{7} - \frac{5}{8}\right), 0.2, 0.2\dot{3}, 0.20\dot{3}$$

Answer,,, [1]

- 2 The number of runners who participated in a charity marathon is given as 8500, correct to the nearest hundred.
Write down the maximum possible number of runners who participated.

Answer [1]

- 3 (a) Factorise $2xy + 6y^2$ completely.

Answer [1]

- (b) Simplify $5w - 3(w - 1)$.

Answer [1]

- 4 Danny drove to his office located 14 km away from home. In the first 9 km, his average speed was 70 km/h. He then took another 6 minutes to reach his office. Find the average speed for his journey in km/h.

Answer km/h [3]

- 5 It is given that

$$9 \times 10^3 + 7 \times 10^2 + 2 \times 10^m + 4 \times 10^n = 9702.04, \text{ where } m \text{ and } n \text{ are integers.}$$

- (a) Find the values of m and n .

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

- (b) Express 9702.04 in standard form.

Answer [1]

- 6 (a) Simplify $(x^2)^{-\frac{5}{2}}$ and express the answer with positive indices.

Answer [1]

- (b) Given that $10^m = 0.001^{2n}$, find an equation connecting m and n .

Answer [1]

- 7 Write as a single fraction in its simplest form $\frac{1}{4x-3} - \frac{5}{3-4x}$.

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Answer [2]

- 8 Solve the equation $3x^2 + 5 - 9x = 0$, giving both answers correct to two decimal places.

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Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- 9 $\xi = \{x : x \text{ is an integer, } 15 \leq x \leq 30\}$
 $A = \{\text{the set of even numbers}\}$
 $B = \{\text{the set of prime numbers}\}$
 $C = \{\text{the set of multiples of 4}\}$

(a) List the elements of $B \cup C$.

Answer $B \cup C = \{\dots\dots\dots\}$ [1]

(b) Is it true that $A' \cap B = \emptyset$? Explain.

Answer

..... [1]

(c) $\subset \subseteq \in \notin$

Choose a symbol from the list above to make a correct statement.

$C \square A$

Answer $C \dots\dots\dots A$ [1]

10 (a) Factorise $r^2 - 9$.

Answer

(b) Hence simplify $\frac{r^2 - 9}{2pr - 6p + 5r - 15}$.

Answer

[3]

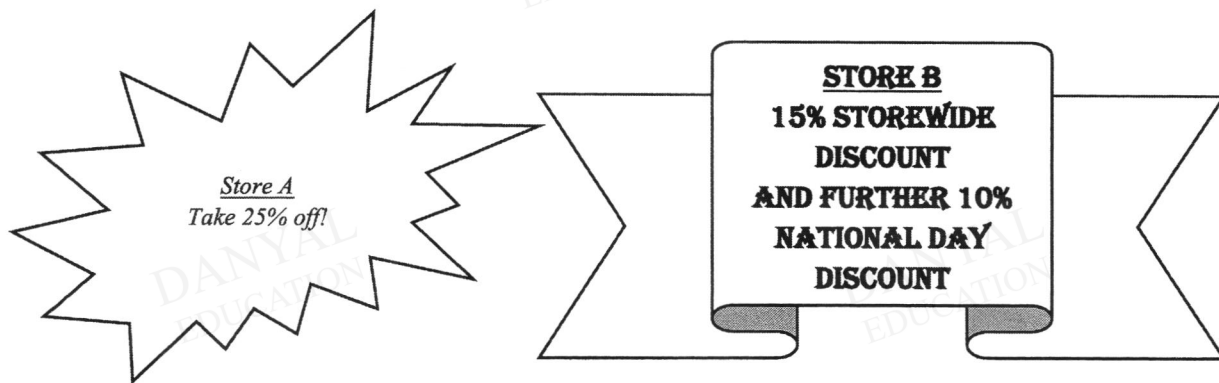
- 11 Nicky took a study loan of \$120 000 from the bank which charged an interest of 4% per annum, compounded half yearly. Calculate the total amount Nicky has to pay the bank at the end of his 4-year course, correct to 2 decimal places.

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Answer \$..... [3]

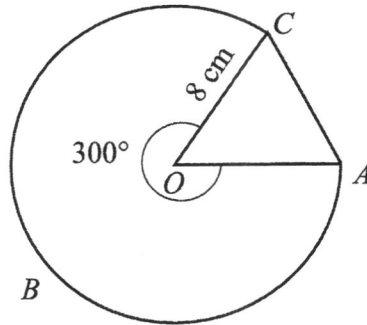
- 12 A bag with a marked price of \$120 is available at both Stores A and B. Janae thinks both stores will give her the same amount of savings. Do you agree with her? Justify your answer with calculations.



Answer I agree / do not agree with her because

..... [3]

- 13 The figure below is composed of a triangle OAC and a major sector $OABC$ of a circle with centre O and radius 8 cm. Reflex $\angle AOC = 300^\circ$.

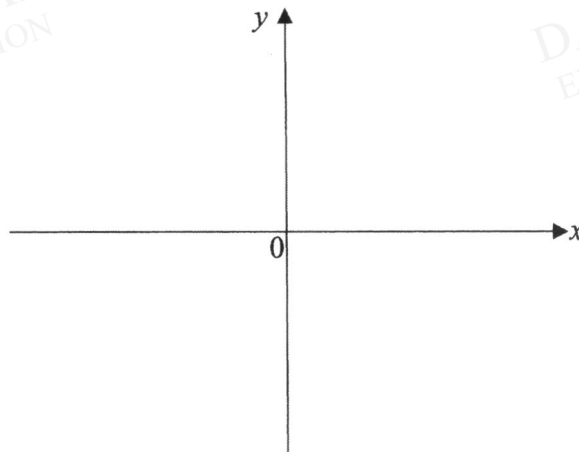


Find the area of the entire figure.

Answer cm² [3]

- 14 **Sketch** the graph of $y = -(x+3)^2 + 4$ on the axis below.

Indicate clearly the coordinates of the points where the graph crosses the axes and the maximum point on the curve. Write down the equation of the line of symmetry.



[3]

Answer [1]

- 15 (a) Express 6615 as a product of its prime factors.

Answer 6615 =[1]

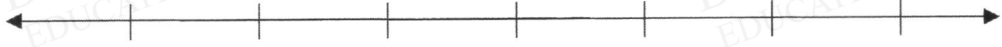
- (b) The number $\frac{6615m}{n}$ is a perfect square where m and n are prime numbers.
Find a possible value of m and of n .

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

- (c) a is a number between 150 and 200.
The highest common factor of 6615 and a is 35.
Find the smallest possible value of a .

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

- 16 (a) Solve the inequality $-11 \leq 9 - 2x < 1$ and represent your solution on the number line below.



Answer [2]

- (b) Write down all the integers which satisfy the solution in (a).

Answer [1]

- (c) State the smallest possible value of $\frac{1}{x^2}$.

Answer [1]

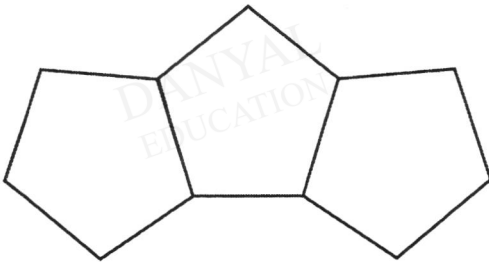
- 17 (a) Six men painted two houses in a day. Given that they need to complete painting the houses in 6 days, find the number of men needed to paint 10 houses.

Answer[2]

- (b) The value of a variable, p , is directly proportional to the cube of another variable, r . Given that r is doubled, calculate the percentage change in p .

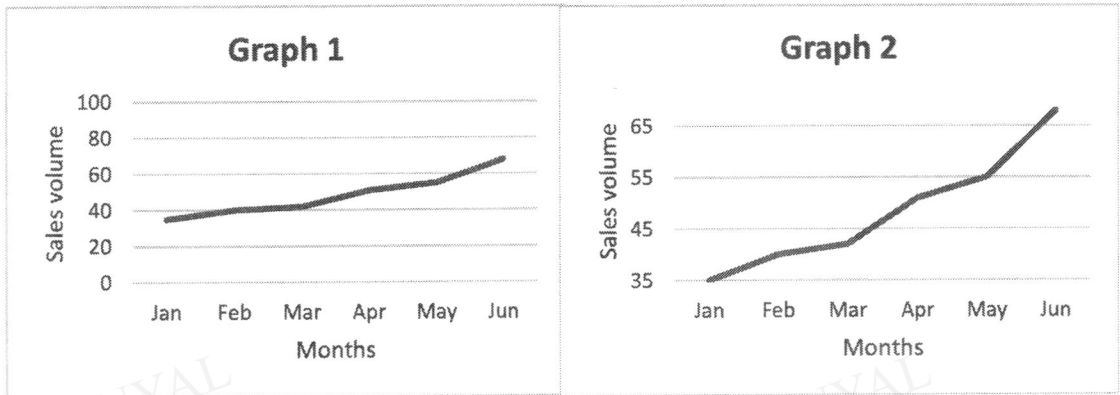
Answer % [2]

- 18 A closed ring is made using identical regular pentagons. Part of the ring is shown below with 3 pentagons. How many **more** regular pentagons are needed to form the ring?



Answer[3]

- 19 (a) Ryder wants to impress his boss by showing the increase in his sales volume over 6 months. Suggest which line graph he should present to his boss and explain why.



Answer

.....

 [2]

- (b) Jake is another sales agent and his sales volume over 6 months are recorded in the table below. The figures are either the same or increasing from month to month. His mean sales volume is 46.5, median is 42.5 and mode is 42. The smallest number is a prime number and the range of the 6 numbers is 19. The sales volume of February and May are provided. Find the rest of the figures.

Month	Jan	Feb	Mar	Apr	May	June
Sales Volume	(i)	42	(ii)	(iii)	51	(iv)

Answer (i) (ii) (iii) (iv) [2]

20 (a) Make u the subject of the formula.

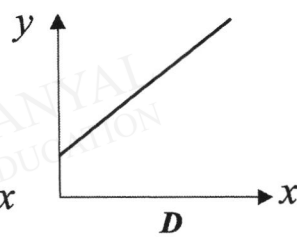
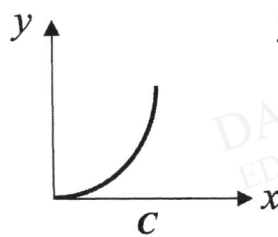
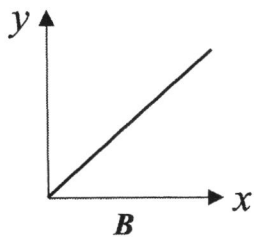
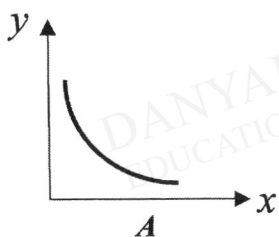
$$v = \frac{1}{u^2 - a}$$

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

(b) Match the correct graphs A to D below to represent each of the following statements.

(i) The cost, y , of renting a mobile Wi-Fi device which consists of a fixed charge plus an amount proportional to the number of days used, x .

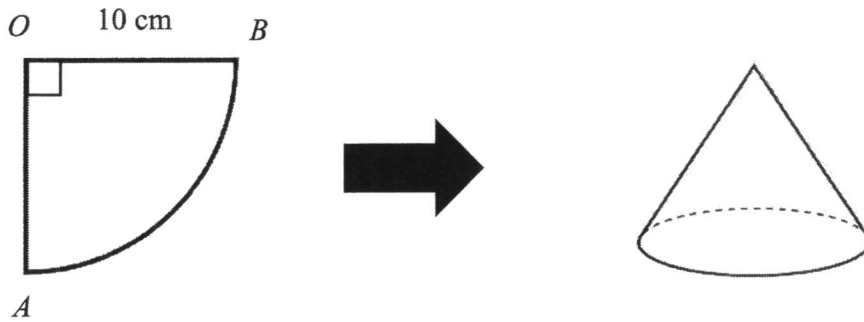
(ii) The volume, y , of a sphere is proportional to the cube of the radius x .



Answer (i) $\dots\dots\dots$ [1]

(ii) $\dots\dots\dots$ [1]

- 21 In the diagram, a quadrant of radius 10 cm is used to form a cone, where OA will meet OB .



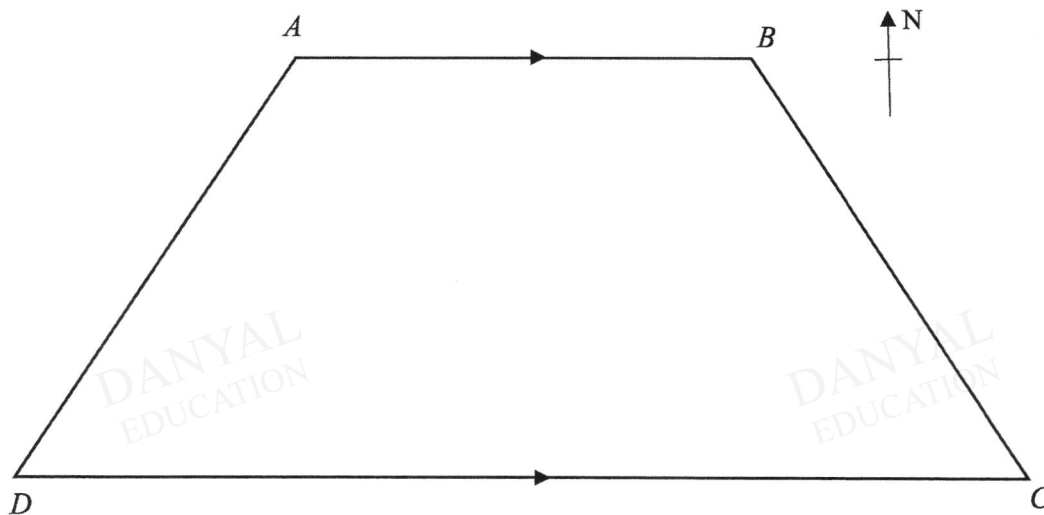
- (a) Show that the radius of the cone is 2.5 cm.

[2]

- (b) Calculate the volume of the cone.

Answer cm^3 [2]

- 22 The town of Hougangsville is represented by a trapezium $ABCD$.
The lines AB and CD are parallel.

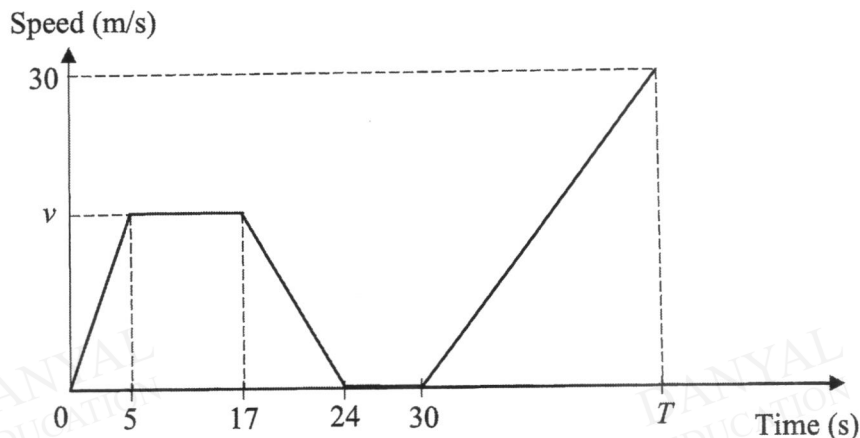


On the diagram above,

- (a) construct the perpendicular bisector of CD , [1]
- (b) construct the bisector of angle ABC , [1]
- (c) shade the region in Hougangsville that is closer to AB than BC and closer to C than to D , [1]
- (d) measure the bearing of A from E , given that E is a landmark on CD such that BE is the shortest distance from B to CD . The line BE is parallel to the true North. [2]

Answer ° [2]

- 23 The diagram below shows the speed-time graph of a car. The car starts from rest and attains a speed of v m/s in 5 seconds. It then travels at a constant speed for 12 seconds before slowing down in the next 7 seconds and stopping for 6 seconds. Thereafter, it moves off at a constant rate and reaches a speed of 30 m/s at T seconds.



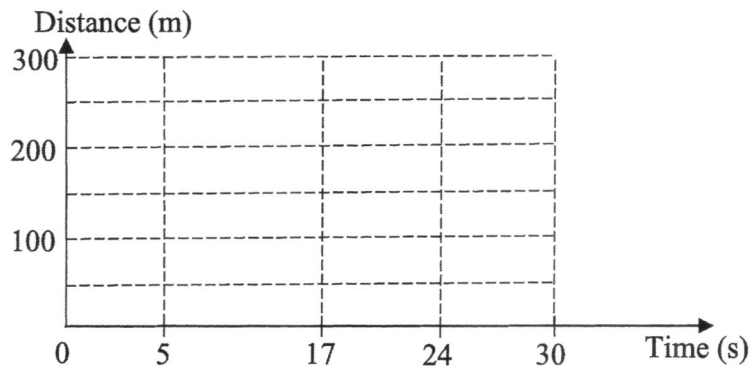
- (a) The total distance travelled by the car from 0 to 30 seconds is 288 m. Calculate the value of v .

Answer $v = \dots\dots\dots$ m/s [2]

- (b) The car reaches a speed of 20 m/s at 42 seconds. Find the value of T .

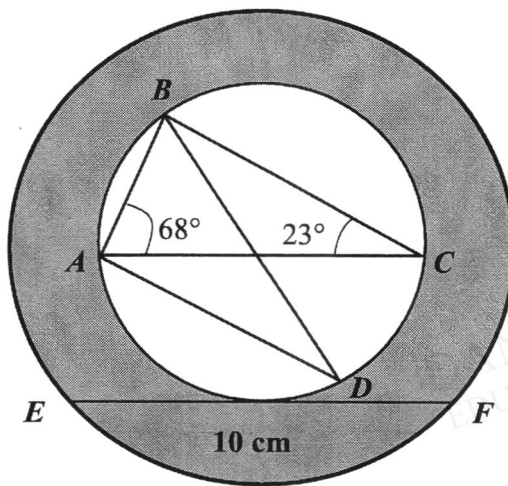
Answer $T = \dots\dots\dots$ s [2]

- (c) Use the grid below to sketch the distance-time graph for the first 30 seconds of the journey.



[2]

- 24 In the diagram, triangles ABC and ABD are designs painted onto the wheel of a toy car. The wheel is made up of two concentric circles (circles that share the same centre). $\angle BAC = 68^\circ$ and $\angle BCA = 23^\circ$. EF , which is 10 cm long, is a chord of the bigger circle and also tangent to the smaller circle.



- (a) Find $\angle BDA$, stating the reason.

Answer $\angle BDA = \dots\dots\dots^\circ$ Reason : $\dots\dots\dots$ [1]

- (b) Explain why AC is **not** a diameter of the smaller circle.

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

- (c) Find the area of the shaded region, leaving your answer in terms of π .

Answer $\dots\dots\dots\text{cm}^2$ [3]

NAME _____ () CLASS: SEC ()



HOUGANG SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2 2020

MATHEMATICS PAPER 2 4048/02

SECONDARY FOUR EXPRESS / FIVE NORMAL ACADEMIC

27 August 2020, Thursday

2 hours 30 minutes

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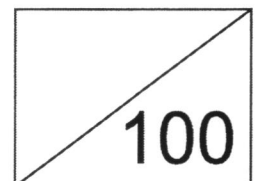
Instructions to pupils

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Information for pupils

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- The total number of marks for this paper is 100.

Calculator Model: _____



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

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

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

1 (a) (i) Simplify $\frac{9p}{4q} \div \frac{p^3}{12q^2}$

Answer..... [2]

(ii) Solve the equation

$$9^{2x-1} \times 27^{-x} = \frac{1}{81}.$$

Answer..... [3]

- (b) The table below shows the number of Secondary 3 and Secondary 4 boys and girls who are sports leaders.

	Secondary 3	Secondary 4	Total
Boys	7	6	13
Girls	9	8	17
Total	16	14	30

- (i) A sports leader is chosen at random. Find, as a fraction in its lowest terms, the probability that the sports leader is a Secondary 4 student.

Answer.....[1]

Two sports leaders are chosen at random to represent the school in an Amazing Race competition.

Find, as a fraction in simplest form, the probability that

- (ii) both sports leaders are from the same level,

Answer[2]

(iii) at least one of the two sports leaders is a girl.

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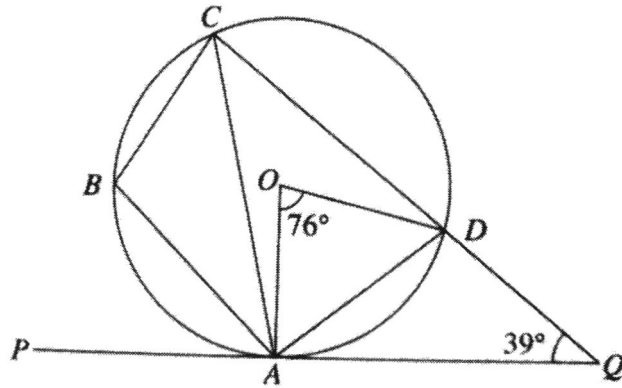
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Answer[2]

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- 2 A, B, C and D are points on the circle with centre O . PAQ is a tangent to the circle at A and meets the line CD extended at point Q .



Given that $\angle AOD = 76^\circ$ and $\angle DQA = 39^\circ$, find, giving reasons for each answer,

- (i) $\angle DAQ$,

- (ii) $\angle ABC$,

Answer [2]

Answer [2]

(iii) *LOAC*.

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Answer [3]

- 3 The local postage rates for mailing standard mail and non-standard mail are shown in the following table.

For Letters, Postcards, Printed Papers and Packets Packages		
Mass per Item up to	Standard	Non-Standard
20 g	\$0.30	\$0.60
40 g	\$0.37	
100 g	\$0.60	\$0.90
250 g	\$0.90	\$1.15
500 g	\$1.15	\$1.70
1 kg		\$2.55
2 kg		\$3.35

All rates are in Singapore Currency (inclusive of GST)

- (a) Find the total cost of mailing 5 standard mails weighing 240 g each and 4 non-standard mails weighing 350 g each locally.

Answer \$..... [2]

- (b) Aaron went to the post office to buy postage for some letters. He has x pieces of standard mails and y pieces of non-standard mails. The cost of mailing x standard mails weighing 80 g each locally is $\frac{1}{3}$ of the cost of mailing y non-standard mails weighing 95 g each locally.

- (i) Show that $x = \frac{1}{2}y$.

(ii) Aaron paid a total of \$24 for the postage of all his letters. Find the values of x and y .

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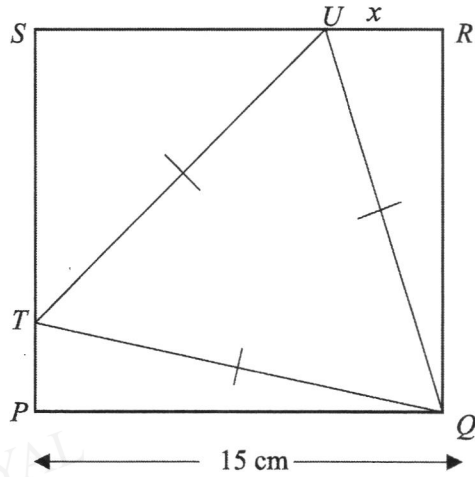
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Answer $x = \dots\dots\dots, y = \dots\dots\dots$ [3]

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- 4 In the diagram, $PQRS$ is a square of side 15 cm. QTU is an equilateral triangle and $RU = x$ cm.



- (a) Show that triangle TPQ is congruent to triangle URQ .

.....

.....

.....

.....

..... [3]

- (b) Express the length of QU in terms of x .

Answer $QU = \dots\dots\dots$ cm [1]

(c) Hence, form an equation in x and show that it reduces to $x^2 - 60x + 225 = 0$.

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[2]

(d) Solve the equation $x^2 - 60x + 225 = 0$.

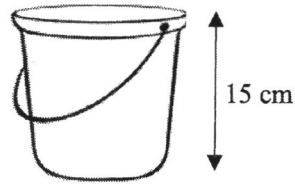
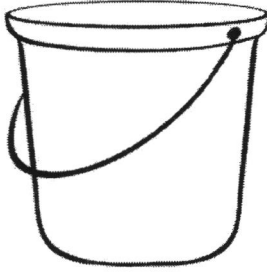
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Answer [3]

(e) A circle passes through S , T and U . Find the radius of the circle.

Answer cm [2]

- 5 (a) The diagram shows two empty metal pails that are similar. The height of the smaller pail is 15 cm. Given that both pails are filled with water at the same rate, the smaller pail can be completely filled 8 times faster than the larger pail.



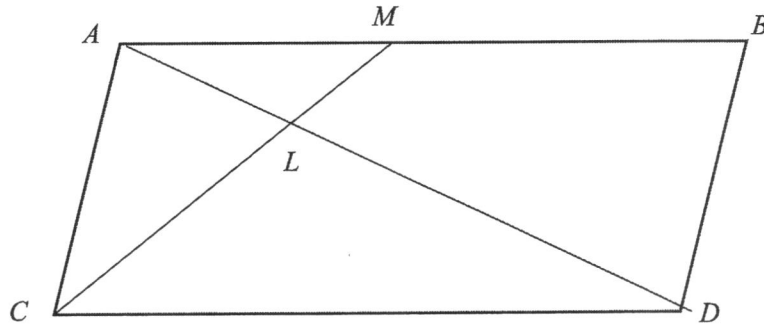
Find

- (i) the height of the larger pail.

Answer [2]

- (ii) Mary wants to paint the exterior surface area of the two pails in (i). She bought a can of paint which can cover a total area of 3 m^2 . She found out that the total exterior surface area of the smaller pail is 0.25 m^2 . She wants to give both pails two coats of paint. Will the tin of paint Mary bought be sufficient? Justify with calculations.

(b) $ABCD$ is a parallelogram and L is a point on AD . The line CL produced meets AB at M .



Given that $CL = 3LM$, find

(i) $\frac{\text{Area of } \triangle ALM}{\text{Area of } \triangle DLC}$,

(ii) $\frac{\text{Area of } \triangle AML}{\text{Area of } \triangle ACL}$

Answer [1]

Answer [1]

- 6 A square of 4 numbers is selected from an array of 25 consecutive odd numbers shown below. The diagram outlines one such square.

1	3	5	7	9
11	13	15	17	19
21	23	25	27	29
31	33	35	37	39
41	43	45	47	49

- (a) A selected square is moved one column to the right and one row downwards. By how much is the sum of the 4 numbers in the square decreased or increased ?

Answer [2]

- (b) Given that a number at the top right-hand corner of a selected square is $2x + 1$, find the expression of the sum of the 4 numbers in terms of x .

Answer..... [2]

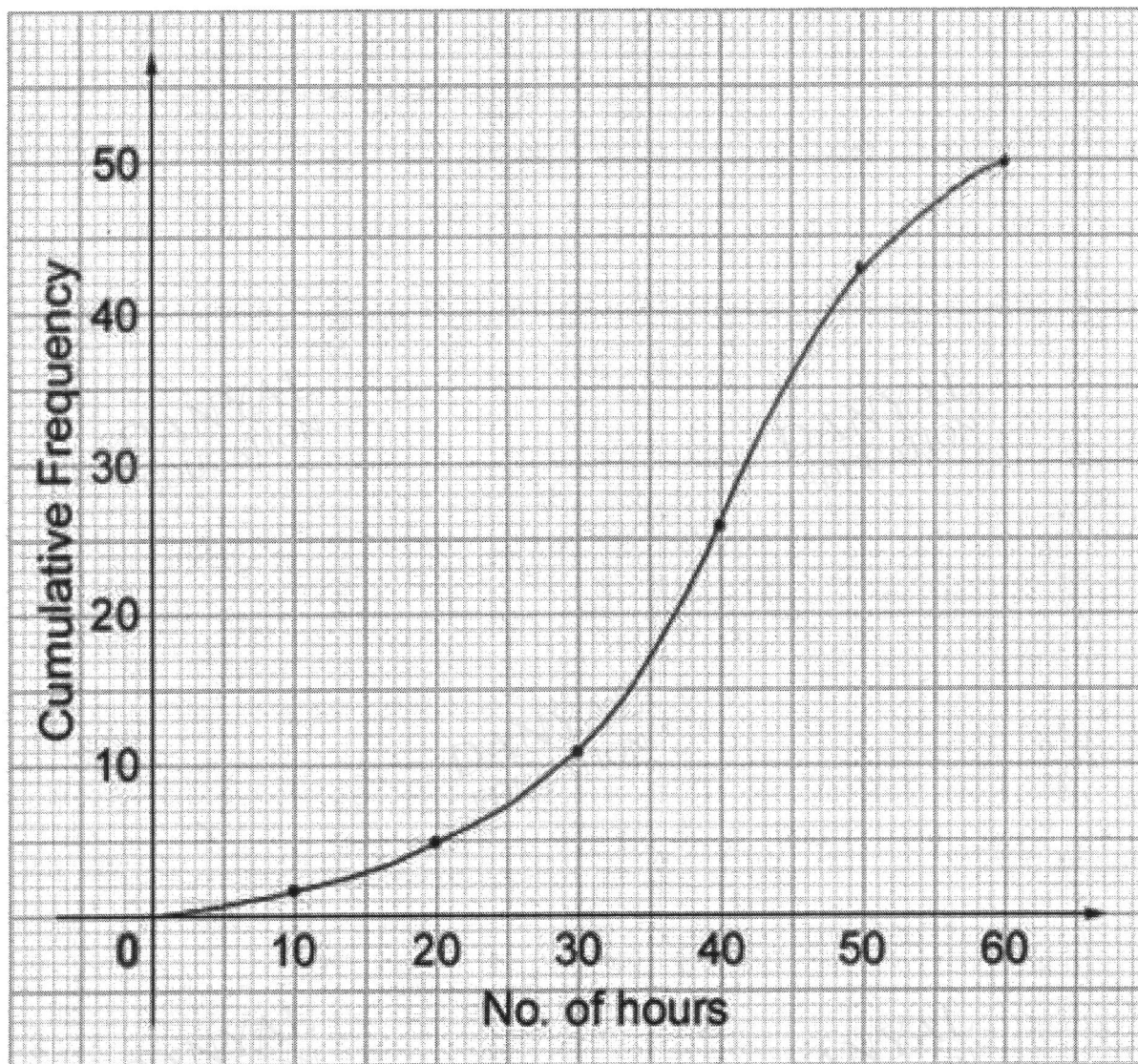
- (c) The mean of the 4 numbers in a particular selected square is 41. Find the value of the smallest number in the square.

Answer [3]

- (d) Explain why the sum of the 4 numbers in a selected square can never be an odd number.

.....
 [1]

- 7 The following cumulative frequency curve shows the number of hours spent by a group of students in Class A on their smart phones in the last 10 days.



- (a) From the graph, find
 (i) the interquartile range of the number of hours spent on their smart phones,

Answer..... h [1]

- (ii) the 80th percentile of the distribution,

Answer h [1]

(iii) the value of x given that 30% of the students spend x to 40 hours on their smart phones.

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

(iv) In another class, Class B, the median and inter-quartile range of hours is found to be 30 hours and 10 hours respectively.
Make two comparisons of the times spent on smartphones between the Class A and Class B.

.....
.....
.....
.....
.....
.....
.....

[2]

- (b) The frequency table below shows the time spent by another group of 50 students in Class C on their smart phones in the last 10 days.

Time x (hours)	Frequency
$0 \leq x < 10$	2
$10 \leq x < 20$	5
$20 \leq x < 30$	10
$30 \leq x < 40$	12
$40 \leq x < 50$	16
$50 \leq x < 60$	5

- (i) Calculate an estimate for the mean number of hours spent on their smart phones for Class C, and

Answer h [1]

- (ii) calculate the standard deviation of the number of hours spent on their smart phones for Class C.

Answer h [2]

8 The number of copies of Chinese and English copies of a title were sold in two outlets of a bookstore in a particular month as shown in the following table.

	Chinese	English
Hougang outlet	35	46
Bishan outlet	43	70

The average production costs of a Chinese copy and an English copy of the title are \$15 and \$10 respectively.

(a) The information above can be represented by the matrices $N = \begin{pmatrix} 35 & 46 \\ 43 & 70 \end{pmatrix}$ and $C = \begin{pmatrix} 15 \\ 10 \end{pmatrix}$.

(i) Find the matrix NC .

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

(ii) State what the elements of NC represent.

.....

 [1]

(b) Given that the selling prices Chinese and English copies are \$ p and \$ q respectively at the two outlets, write down a 2×1 matrix, S to represent this information. Hence find the matrix NS in terms of p and q .

Answer $S = \dots\dots\dots NS = \dots\dots\dots$ [2]

- (c) The total earnings in the Hougang and Bishan outlets from selling all copies of the title are \$1905 and \$2745 respectively. Using the answers from (a)(i) and (b), solve for the values of p and q .

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Answer $p = \dots\dots\dots, q = \dots\dots\dots$ [4]

- 9 The variables x and y are connected by the equation $y = x^2 + \frac{2}{x} - 1$.

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

x	0.5	1	2	3	4	5
y	3.3	2	4	8.7	p	24.4

- (a) Calculate the value of p .

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

- (b) Using a scale of 2 cm to 1 unit on the x -axis and 2 cm to 5 units on the y -axis, draw the graph of $y = x^2 + \frac{2}{x} - 1$ for $0.5 \leq x \leq 5$. [3]

- (c) By drawing a tangent, find the gradient of the curve at $x = 2$.

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

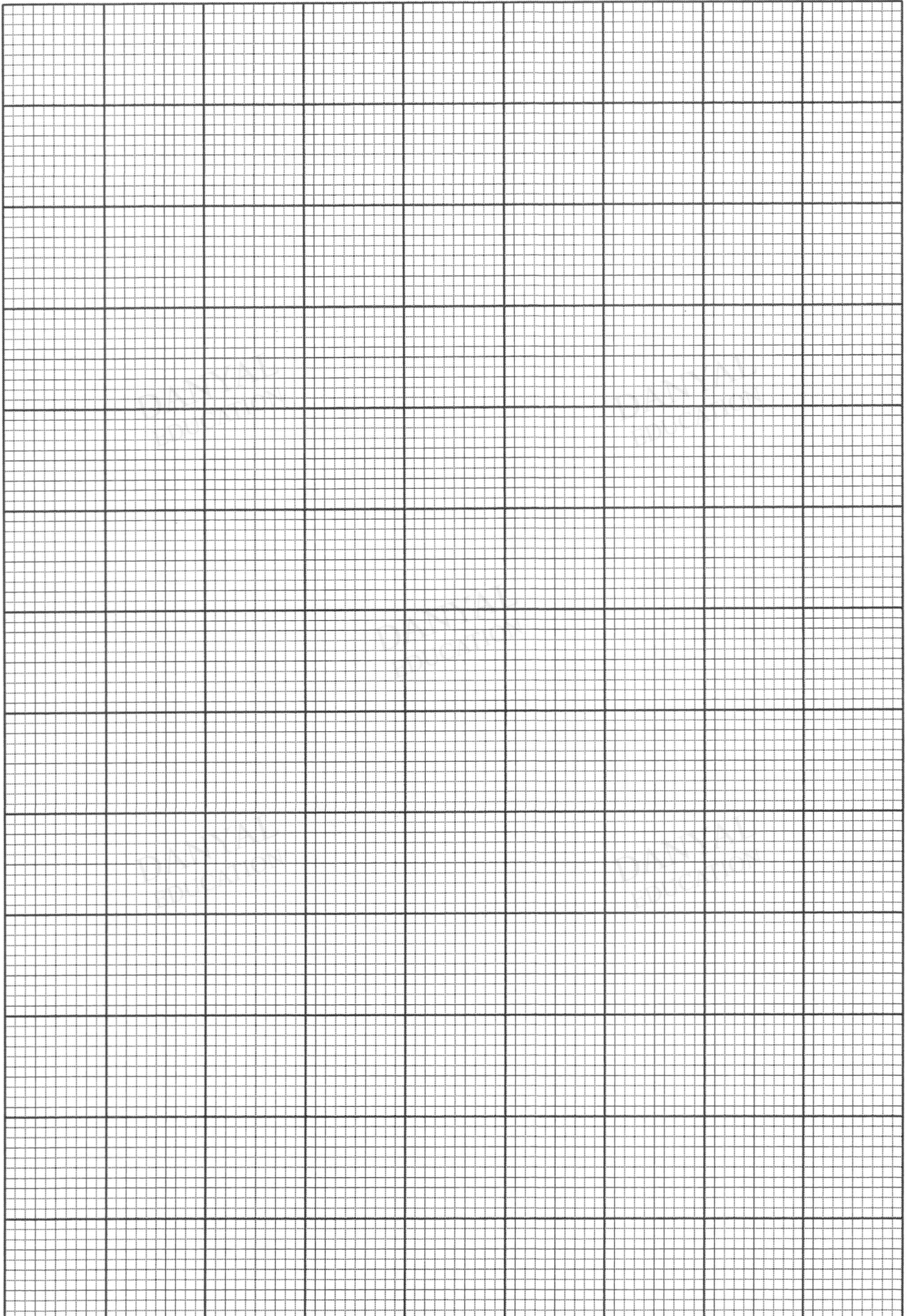
- (d) (i) On the same grid, draw the graph of $y = 3x$ for $0.5 \leq x \leq 5$. [1]

- (ii) Show that the points of intersection of the line and the curve give the solutions of the equation $x^3 - 3x^2 - x + 2 = 0$.

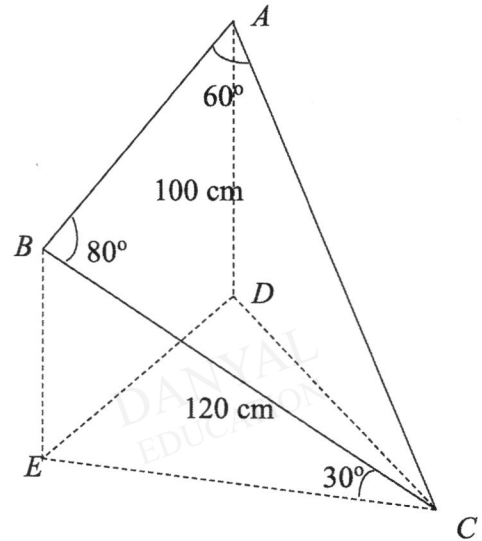
[2]

- (iii) Use your graphs to solve the equation $x^3 - 3x^2 - x + 2 = 0$.

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



10 (a) In the diagram, a thin triangular board ABC is held to the horizontal ground at the vertex C . D and E are points on the ground vertically below A and B respectively. BC is inclined at an angle of 30° with the horizontal. It is given that $AD = 100$ cm, $BC = 120$ cm, $\angle CAB = 60^\circ$ and $\angle ABC = 80^\circ$.



(i) Calculate the length of AB .

Answercm [2]

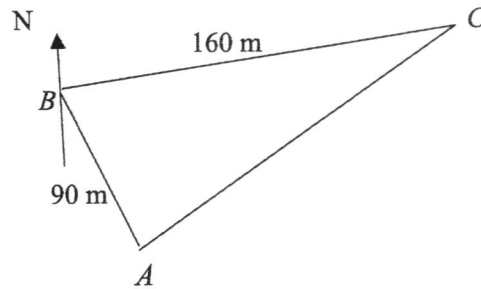
(ii) Find the area of $\triangle ABC$.

Answercm² [2]

(iii) Find the angle of depression of B from A .

Answer^o [3]

- (b) In the diagram, A , B and C are three points on level ground. The bearing of A from B is 150° and the bearing of B from C is 245° . The distance of A from B is 90 m and C from B is 160 m.



- (i) Calculate the distance AC .

Answer m [3]

- (ii) A coconut tree of height 28 m is located at C . Ahmad walks along AC and stops at X where he spotted a monkey $\frac{1}{3}$ up the tree. Given his angle of elevation of the monkey is 15° , find the distance he walked.

Answerm [3]

11 Here is some information about a front load washing machine.

In this question, the washing drum can be modelled as a cylindrical container.

The average amount of water used in a typical washing cycle is shown.

Front Load Washing Machine

Height (h): 850 mm

Diameter (d) of washing drum: 400 mm

Length of washing drum: 550 mm

Mass of washing machine (m): 50 kg

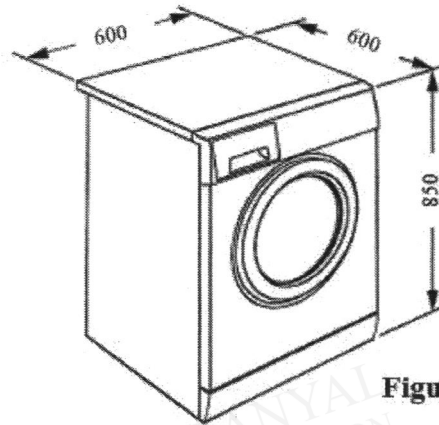
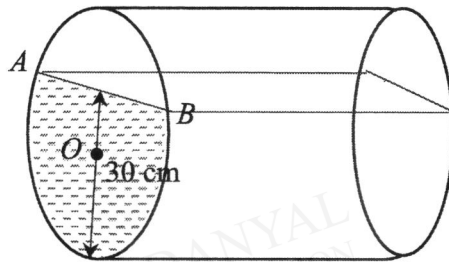


Figure 1



- (a) Given that O is the centre of the cross-sectional area of the washing drum, show that the area of the shaded segment of the washing drum is approximately 1010 cm^2 .

(b) Calculate the volume of water, in m^3 , in the washing drum.

Answer m^3 [2]

(c) Calculate the cost of water used for 4 washing cycles given that 1 m^3 of water cost \$1.17.

Answer \$..... [2]

In another washing machine shown in **Figure 2**, the dimensions of the drum is the same as the washing machine in **Figure 1** except that the laundry is loaded from the top. The amount of water used is 90% of the capacity of the drum.

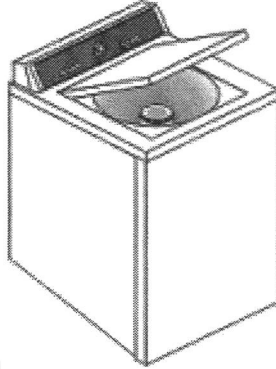


Figure 2

- (d) Which washing machine, **Figure 1** or **Figure 2**, is more water efficient?
Justify your answer with calculations.

[3]

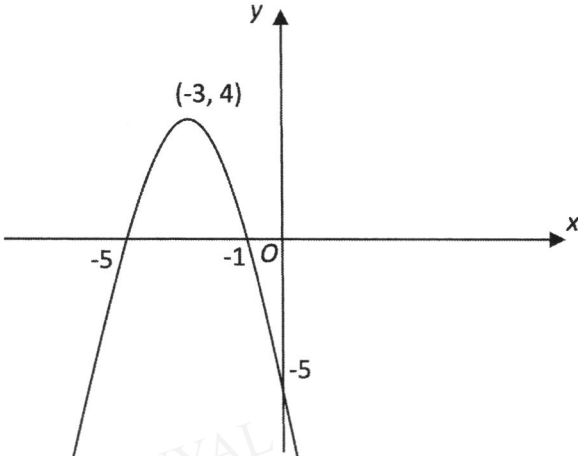
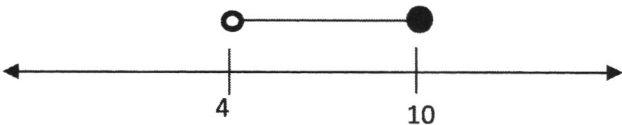
End of Paper

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Mathematics Department
Markscheme
Mathematics Syllabus Express

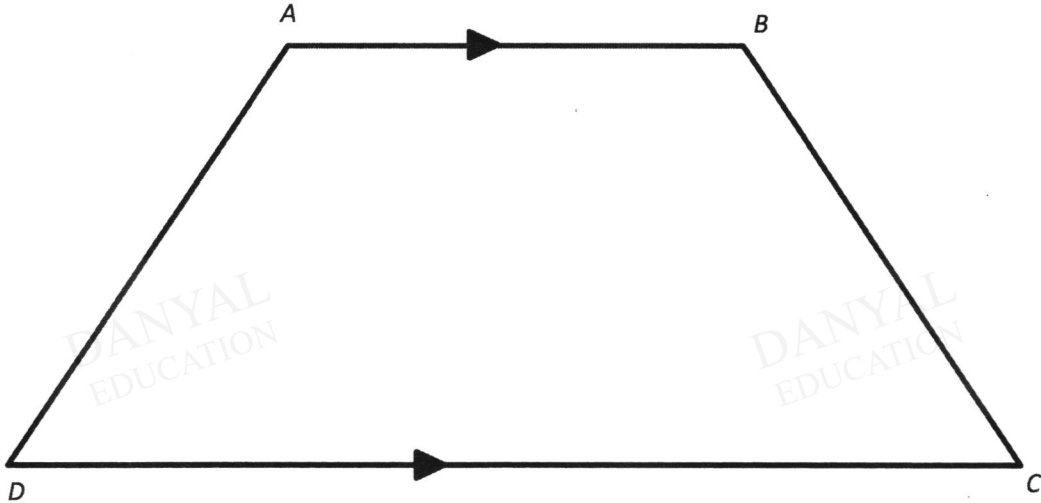
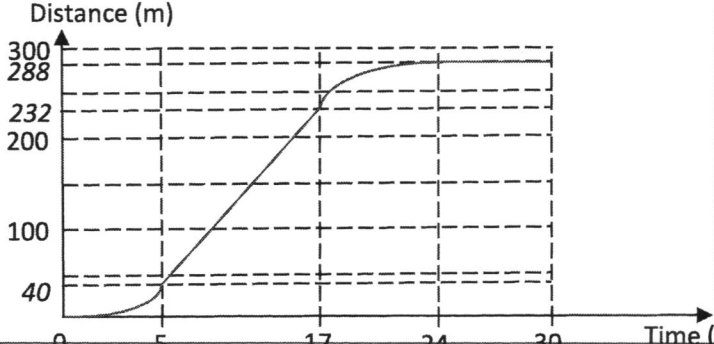
Subject : Mathematics
Examination : Prelim 2 2020
Level : Secondary 4E/5N
Paper : 1

Qn	Working	Marks	Remarks
1	$0.2\dot{3}, \left(\frac{6}{7} - \frac{5}{8}\right), 0.\dot{2}0\dot{3}, 0.2$	B1	
2	8549	B1	
3(a)	$2xy + 6y^2 = 2y(x + 3y)$	B1	
3(b)	$5w - 3(w - 1) = 5w - 3w + 3$ $= 2w + 3$	B1	
4	Time taken for first 9 km = $\frac{9}{70}$ h Total time taken = $\frac{9}{70} + \frac{6}{60} = \frac{8}{35}$ h Average speed = $14 \div \frac{8}{35} = 61.25$ km/h	M1 M1 A1	
5(a)	$m = 0, n = -2$	B1	For both correct
(b)	9.70204×10^3	B1	
6(a)	$(x^2)^{-\frac{5}{2}} = x^{-5} = \frac{1}{x^5}$	B1	Must be positive indices
(b)	$10^m = 0.001^{2n}$ $10^m = 10^{-3(2n)}$ $m = -6n$	B1	
7	$\frac{1}{4x-3} - \frac{5}{3-4x} = \frac{1}{4x-3} + \frac{5}{4x-3}$ $= \frac{6}{4x-3}$	M1 A1	
8	$3x^2 + 5 - 9x = 0$ $x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(3)(5)}}{2(3)}$ $x = 2.26$ or $x = 0.74$ (2d.p.)	M1 A1	Zero for whole question if quadratic formula not shown For both ans correct

		A1	2 d.p.
9(a)	$B \cup C = \{16,17,19,20,23,24,28,29\}$	B1	
(b)	No, $17 \in A' \cap B$ Or 17 is not an even number and is also a prime number	B1	For any example to show that $A' \cap B$ is not empty
(c)	\subset	B1	
10(a)	$r^2 - 9 = (r+3)(r-3)$	B1	
(b)	$\frac{r^2 - 9}{2pr - 6p + 5r - 15} = \frac{(r+3)(r-3)}{2p(r-3) + 5(r-3)}$ $= \frac{(r+3)(r-3)}{(r-3)(2p+5)}$ $= \frac{r+3}{2p+5}$	M1 M1 A1	
11	Final amount = $120000(1 + \frac{2}{100})^8$ = \$140599.13 (2 d.p.)	M2 A1	M1 - Cpd Int Form M1 - correct r or n 2d.p. ans
12	Store A: Savings = $\frac{25}{100} \times 120 = \30 Store B: $\frac{15}{100} \times 120 = \18 $\frac{10}{100} \times (120 - 18) = \10.20 Total savings = \$28.20 I do not agree with her because Store A will give her more savings than Store B.	M1 M1 A1	Either savings or selling price at each store Stand and comparison between stores
13	Area of sector OABC = $\frac{300}{360} \times \pi(8)^2$ = 167.5516 Area of triangle OAC = $\frac{1}{2} \times 8 \times 8 \times \sin 60^\circ$ = 27.71281 Total area of figure = 167.5516 + 27.71281 = 195 cm ² (3 s.f.)	M1 M1 A1	

14	 <p style="text-align: center;">Line of symmetry : $x = -3$</p>	<p>B2</p> <p>B1</p> <p>B1</p>	<p>Correct y-intercept and x-intercepts</p> <p>Correct Max pt</p> <p>Penalise one mark if curve is not smooth or not symmetrical</p> <p>B0 if no x</p>
15(a)	$6615 = 3^3 \times 5 \times 7^2$	B1	
(b)	$m = 5, n = 3$ or $m = 3, n = 5$	B2	B1 for each
(c)	$6615 = 3^3 \times 5 \times 7^2$ $a = 5^2 \times 7 = 175$ $HCF = 35 = 5 \times 7$	B1	For 175
16(a)	$-11 \leq 9 - 2x$ and $9 - 2x < 1$ $2x \leq 20$ $-2x < -8$ $x \leq 10$ $x > 4$  <p style="text-align: center;">$\therefore 4 < x \leq 10$</p>	<p>M1</p> <p>A1</p>	<p>Either correct inequality solution</p> <p>Both number line and final combined solution correct</p>
(b)	5, 6, 7, 8, 9, 10	B1	
(c)	smallest possible value of $\frac{1}{10^2} = \frac{1}{100}$ or 0.01	B1	ECF if (a) wrong
17 (a)	6 men 1 day 2 houses 1 man 6 days 2 houses <u>5 men</u> 6 days 10 houses	<p>M1</p> <p>A1</p>	M1 for 30 men 10 houses 1 day / 3 men 1 house 1 day
(b)	Original $p = kr^3$ New $p = k(2r)^3$ $= 8(kr^3) = 8p$ % change in $p = \frac{8p - p}{p} \times 100\%$ $= 700\%$	<p>M1</p> <p>A1</p>	Sub double value of r

<p>18</p>	$1 \text{ Int } \angle \text{ of pentagon} = \frac{(5-2) \times 180}{5}$ $= 108^\circ$ <p>1 Int \angle of unknown inner polygon = $360 - 2(108)$ $= 144^\circ$ (\angles at a pt)</p> <p>1 ext \angle of unknown inner polygon = $180 - 144$ $= 36^\circ$</p> $n = \frac{360}{36}$ $= 10$ <p>need $10 - 3 = 7$ more pentagons</p>	<p>M1</p> <p>M1</p> <p>A1</p>	<p>Either 144° or 36°</p>
<p>19 (a)</p>	<p>Ryder should present Graph 2 as the <u>scale/range for the vertical axis is smaller</u> and <u>does not start from zero</u>, making the <u>increase in sales volume between each month appear larger</u>.</p>	<p>B1</p> <p>B1</p>	<p>Stand</p> <p>Any underlined reason</p> <p>Don't accept 'can see more clearly / obviously / easily'</p>
<p>(b)</p>	<p>(i) 41 (ii) 42 (iii) 43 (iv) 60</p>	<p>B2</p>	<p>B1 for at least 2 values correct</p>
<p>20(a)</p>	$v = \frac{1}{u^2 - a}$ $u^2 - a = \frac{1}{v}$ $u^2 = \frac{1}{v} + a$ $u = \pm \sqrt{\frac{1}{v} + a}$	<p>M1</p> <p>A1</p>	<p>Accept</p> $vu^2 - va = 1$ $vu^2 = 1 + va$ $u = \pm \sqrt{\frac{1 + va}{v}}$
<p>(b)</p>	<p>(i) D (ii) C</p>	<p>B1</p> <p>B1</p>	
<p>21(a)</p>	<p>Arc length of quadrant = $\frac{2\pi(10)}{4}$</p> <p>Let r be radius of cone.</p> <p>Circumference of base of cone = $\frac{2\pi(10)}{4} = 2\pi r$</p> <p>$r = 2.5$ cm (shown)</p>	<p>M1</p> <p>A1 Last 2 steps</p> <p>Must be exactly 2.5</p> <p>A0 if rounded off</p>	<p>Accept area method</p> $\frac{\pi(10)^2}{4} = \pi r(10)$ <p>Accept arc length / area method in radian too</p>

(b)	<p>Let h be perpendicular height of cone.</p> $h = \sqrt{10^2 - 2.5^2} = 9.682458366 \text{ cm}$ <p>Volume of cone = $\frac{1}{3} \pi (2.5)^2 (9.682458366) = 63.4 \text{ cm}^3$ (3 s.f.)</p>	M1 A1	
22(a)- (c)	 <p style="text-align: center;"> B1 – perpendicular bisector of CD B1 – angle bisector of angle ABC B1 – correct shaded region (ECF even if bisectors not right) </p>		
(d)	<p>BE must be perpendicular to CD and marked on diagram. Bearing of A from $E = 313^\circ$</p>	M1 A1	Accept range of 312° to 314°
23(a)	$\text{Distance} = \frac{1}{2} \times v \times (12 + 24) = 288$ $v = 16$	M1 A1	Area under graph
(b)	$\text{Acceleration} = \frac{20 - 0}{42 - 30} = \frac{20}{12} = \frac{5}{3} \text{ m/s}^2$ $\frac{30 - 0}{T - 30} = \frac{5}{3}$ $5T - 150 = 90$ $5T = 240$ $T = 48$	M1 A1	Gradient of line
(c)		B1 B2	<p>For at least 2 intervals drawn correctly (points and gradient must be correct)</p> <p>For all intervals drawn correctly</p>

24(a)	$\angle BDA = 23^\circ$ Reason : \angle s in same segment	B1	B0 if wrong reason
(b)	$\angle ABC = 180 - 68 - 23 = 89^\circ$ (\angle sum of triangle) Since <u>$\angle ABC$ is not 90°</u> , then <u>$\angle ABC$ is not angle in semicircle</u> , therefore AC is not a diameter of the smaller circle.	M1 A1	Either underlined key phrase must be present
(c)	Let R be radius of larger circle and r be radius of smaller circle. Area of shaded region = $\pi R^2 - \pi r^2 = \pi(R^2 - r^2)$ $r^2 + 5^2 = R^2$ By Pythagoras' Theorem, $\therefore R^2 - r^2 = 25$ Area of shaded region = $25\pi \text{ cm}^2$	M1 M1 A1	M1 - Attempt to find difference in Areas of 2 circles M1 - Pyth Thm

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Hougang Secondary School
Mathematics Department
MARKSCHEME

Mathematics Syllabus Express/Normal Academic/Normal Technical

Subject : Mathematics
Examination : Prelim 2
Level : 4E/5N/4AO
Paper : 2

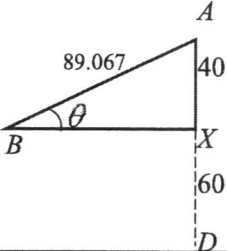
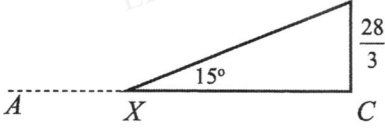
Qn	Working	Marks	Remarks
Q1(a) (i)	$\frac{9p}{4q} \div \frac{p^3}{12q^2}$ $= \frac{9p}{4q} \times \frac{12q^2}{p^3}$ $= \frac{27q}{p^2}$	M1 A1	
(a)(ii)	$9^{2x-1} \times 27^{-x} = \frac{1}{81}$ $(3^2)^{2x-1} \times (3^3)^{-x} = 3^{-4}$ $3^{4x-2-3x} = 3^{-4}$ $3^{x-2} = 3^{-4}$ $x-2 = -4$ $x = -2$	M1 M1 A1	Apply laws of indices Simplifying the powers
Q1(b) (i)	$P(\sec 4) = \frac{14}{30}$ $= \frac{7}{15}$	B1	
b(ii)	$P(\text{both sec 3}) + P(\text{both sec 4})$ $= \frac{16}{20} \times \frac{15}{29} + \frac{14}{20} \times \frac{13}{29}$ $= \frac{211}{435}$	M1 A1	

b(iii)	<p>Required prob $= 1 - P(\text{both boys})$ $= 1 - \frac{13}{30} \times \frac{12}{29}$</p> $= \frac{119}{145}$ <p><u>Alternative Mtd:</u> $P(\text{boy, girl}) + P(\text{girl, boy}) + P(\text{both girls})$</p> $= \frac{13}{30} \times \frac{17}{29} + \frac{17}{30} \times \frac{13}{29} + \frac{17}{30} \times \frac{16}{29}$ $= \frac{119}{145}$	<p>M1</p> <p>A1</p>	
Q2(a)	$\sphericalangle OAD = \frac{180^\circ - 76^\circ}{2} \text{ (base } \sphericalangle \text{ of isos } \sphericalangle)$ $= 52^\circ$ $\sphericalangle DAQ = 90^\circ - 52^\circ \text{ (rad } \perp \text{ tangent)}$ $= 38^\circ$	<p>M1</p> <p>A1</p>	
Q2(b)	$\sphericalangle CDA = 38^\circ + 39^\circ \text{ (ext } \sphericalangle = \text{ sum of 2 int opp } \sphericalangle s)$ $= 77^\circ$ $\sphericalangle ABC = 180^\circ - 77^\circ \text{ (} \sphericalangle \text{ in opp seg are supp)}$ $= 103^\circ$	<p>M1</p> <p>A1</p>	
Q2(c)	$\sphericalangle ACD = \frac{76^\circ}{2} \text{ (} \sphericalangle \text{ at centre} = 2 \text{ at circumference)}$ <p>In $\triangle ACD$,</p> $\sphericalangle CAD = 180^\circ - 38^\circ - 39^\circ \text{ (sum of } \sphericalangle s \text{ in a } \triangle)$ $= 103^\circ$ $\sphericalangle CAD = \sphericalangle OAC + \sphericalangle OAD$ $103^\circ = \sphericalangle OAC + 90^\circ$ $\sphericalangle OAC = 103^\circ - 90^\circ$ $= 13^\circ$	<p>M1</p> <p>M1</p> <p>A1</p>	
Q3(a)	$5 \times \$0.90 + 4 \times \1.70 $= \$11.30$	<p>M1</p> <p>A1</p>	

Q3(b) (i)	$0.60x = \frac{1}{3}(0.90y)$ $x = \frac{0.30y}{0.60} = \frac{1}{2}y \quad (\text{shown})$	B1	
(b)(ii)	$x = \frac{1}{2}y \quad \text{-----(1)}$ <p>Also, total cost $24 = 0.60x + 0.90y \quad \text{-----(2)}$ Sub (1) into (2) $0.60\left(\frac{1}{2}y\right) + 0.90y = 24$ $1.2y = 24$ $y = 20$ $x = \frac{1}{2}(20) = 10$</p>	M1 M1 A1	A1 for both x and y
Q4(a)	$\left. \begin{array}{l} \square TPQ = \square URQ = 90^\circ \text{ (property of a square)} \\ TQ = UQ \text{ (given, } \square UTQ \text{ equilateral)} \\ PQ = RQ \text{ (side of a square)} \end{array} \right\}$ $\Delta TPQ \equiv \Delta URQ \quad (\text{RHS})$	M2 A1	Any 2 correct State correct test
Q4(b)	$UQ = \sqrt{x^2 + 15^2} = \sqrt{x^2 + 225}$	B1	Accept $\sqrt{x^2 + 15^2}$
Q4(c)	$ST = SU = 15 - x$ $UT = \sqrt{(15-x)^2 + (15-x)^2} = \sqrt{2(15-x)^2}$ $UT = UQ$ $\sqrt{2(15-x)^2} = \sqrt{x^2 + 225}$ $2(225 - 30x + x^2) = x^2 + 225$ $x^2 - 60x + 225 = 0 \quad (\text{shown})$	M1 M1	For UT For expanding
Q4(d)	$x = \frac{60 \pm \sqrt{(-60)^2 - 4(1)(225)}}{2(1)}$ $= 55.98 \quad \text{or} \quad 4.0192$ Since $x < 15$, $x = 4.02$	M1 M1 A1	Using formula
Q4(e)	$TU = \text{diameter of circle}$ $= \sqrt{225 + (4.0192)^2} = 15.529$ Radius $= \frac{15.529}{2} = 7.76$	M1 A1	

Q7(a) (i)	$Q_3 = 46, Q_1 = 31.5, IQR = 14.5$	B1	Allowance ± 0.5
(ii)	the 80 th percentile of the distribution, $0.8N = 40$, no. of hrs = 48	B1	Accept 47.5
(iii)	30% of 50 students = 15 students No of students who spend ≤ 40 hrs = 26 No of students who spend $\leq x$ hrs = $26 - 15 = 11$ From graph $x = 30$	M1 M1 A1	
(iv)	From graph, median of class A is $39 >$ median of class B On average, Class A spent more time on their smartphones than Class B. IQR of Class B $<$ IQR of Class A indicates less variation (or smaller spread) in hours spent by Class B (or no of hours spent on smartphones by Class B is more consistent/ homogenous.	B1 B1	Accept median = 39 ± 0.5
Q7(b) (i)	Mean = $\frac{5 \times 2 + 15 \times 5 + 25 \times 10 + 35 \times 12 + 45 \times 16 + 55 \times 5}{50}$ = 35	B1	
(b)(ii)	$\sum fx^2 = 69650$ S.D. = $\sqrt{\frac{69650}{50} - 35^2}$ = 12.961 = 13.0	M1 A1	Accept 12.96
Q8(a) (i)	$NC = \begin{pmatrix} 35 & 46 \\ 43 & 70 \end{pmatrix} \begin{pmatrix} 15 \\ 10 \end{pmatrix}$ = $\begin{pmatrix} 985 \\ 1345 \end{pmatrix}$	B1	
(a)(ii)	The elements represent the total costs of producing both titles at Hougang and Bishan outlets. Or The cost of producing both titles at Hougang and Bishan outlets are \$985 and \$1345 respectively.	B1	

Q8(b) (i)	$S = \begin{pmatrix} p \\ q \end{pmatrix}, NS = \begin{pmatrix} 35 & 46 \\ 43 & 70 \end{pmatrix} \begin{pmatrix} p \\ q \end{pmatrix} = \begin{pmatrix} 35p + 46q \\ 43p + 70q \end{pmatrix}$	B1 B1	
(b) (ii)	$NS - NC = \begin{pmatrix} 1905 \\ 2745 \end{pmatrix}$ $\begin{pmatrix} 35p + 46q \\ 43p + 70q \end{pmatrix} - \begin{pmatrix} 985 \\ 1345 \end{pmatrix} = \begin{pmatrix} 1905 \\ 2745 \end{pmatrix}$ $35p + 46q - 985 = 1905$ $43p + 70q - 1345 = 2745$ $35p + 46q = 2890 \text{ -----(1)}$ $43p + 70q = 4090 \text{ -----(2)}$ <p>(1) x 43 - (2) x 35 :</p> $(1505p + 1978q) - (1505p + 2450q) = -18880$ $-472q = -18880$ $q = 40,$ $p = \frac{2890 - 46(40)}{35} = 30$	M1 M1 M1 A1	Accept solving by substitution
Q9(a)	$p = 4^2 + \frac{2}{4} - 1 = 15.5$	B1	
Q9(b)	Graph sketching	B3	B1- correct scale B1- correct points plotted B1- shape
Q9(c)	Sketch of tangent line to curve at $x = 2$ Gradient of tangent at $x = 2$ is $\frac{11-4}{4-2} = 3.5$	M1 A1	Accept 2.73 - 4.44
Q9(d) (i)	Sketch of $y = 3x$	B1	Accept if line does not start from $x = 0.5$
Q9(d) (ii)	$y = 3x \text{ -----(1)}$ $y = x^2 + \frac{2}{x} - 1 \text{ -----(2)}$ <p>At points of intersection, (1) = (2)</p> $x^2 + \frac{2}{x} - 1 = 3x$ $x^3 + 2 - x = 3x^2$ $x^3 - 3x^2 - x + 2 = 0 \text{ (shown)}$	M1 M1	
(iii)	From graphs, $x = 0.75 (\pm 0.1)$ or $x = 3.05 (\pm 0.1)$	B2	

Q10(a) (i)	$\frac{AB}{\sin 40^\circ} = \frac{120}{\sin 60^\circ}$ $AB = 89.067 = 89.1$	M1 A1	
(a)(ii)	$\text{Area} = \frac{1}{2}(89.067)(120)\sin 80^\circ$ $= 5263.83$ $= 5260 \quad (3\text{sf})$	M1 A1	
(a)(iii)	<p>In $\triangle BEC$, $BE = 120\sin 30^\circ = 60 = XD$ Angle of depression = Angle of elevation of A from B $= \theta$</p> <p>$AX = 100 - 60 = 40$ m</p> $\sin \theta = \frac{40}{89.067}$ $\theta = 26.7^\circ$	 M1 M1 A1	
Q10(b) (i)	$\sphericalangle ABC = 150^\circ - (245^\circ - 180^\circ) = 85^\circ$ <p>By cosine rule,</p> $AC^2 = 90^2 + 160^2 - 2(90)(160)\cos 85^\circ$ $AC = 176.61 = 177 \text{ m}$	M1 M1 A1	
(b)(ii)	$h = \frac{1}{3}(28) = \frac{28}{3} \text{ m}$ $\tan 15^\circ = \frac{\frac{28}{3}}{XC}$ $XC = \frac{\frac{28}{3}}{\tan 15^\circ} = 34.832$ <p>Distance walked = $176.61 - 34.832$ $= 141.78 = 142 \text{ m}$</p>	 M1 M1 A1	

Q11(a)	$\cos \angle COB = \frac{10}{20}$ $\angle COB = \cos^{-1}\left(\frac{1}{2}\right) = 60^\circ$ <p>Reflex $\angle AOB = 240^\circ$</p> <p>Area of shaded segment</p> $= \frac{240^\circ}{360^\circ} \times \pi \times (20)^2 + \frac{1}{2}(20)(20)\sin 120^\circ$ $= 837.758 + 173.205$ $= 1010.96 \text{ cm}^2$ $\approx 1010 \text{ cm}^2$	<p>M1</p> <p>M1,M1</p> <p>A1</p>	<p>M1- Area of triangle, M1 – Area of sector</p>
Q11(b)	<p>Volume of water used in Fig 1 = 1010.96×55</p> $= 55602.8 \text{ cm}^3$ $\approx 0.0556 \text{ m}^3$	<p>M1</p> <p>A1</p>	
Q11(c)	<p>Cost of water used = $0.05560885 \times 4 \times \\1.17</p> $= \$0.26$	<p>M1</p> <p>A1</p>	
Q11(d)	<p>Volume of water used in Fig 2 = $\frac{90}{100} \times \pi \times (20)^2 \times (55)$</p> $= 62203.53 \text{ cm}^3$ <p>Since $55608.85 < 62211.6$, the washing machine in Fig 1 is more water efficient.</p>	<p>M1</p> <p>M1</p> <p>A1</p>	