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Name:	Class:	Index Number:
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MID-YEAR EXAMINATION 2017

Mathematics

4048

Level: Secondary 2 Express

Duration: 2 hours 15 minutes

Additional Materials: Writing Paper
Graph Paper

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen on both sides of the paper.

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

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

Answer all the questions.

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

Section A

Write all your answers on the Question Paper.

Section B

Write all your answers on the separate answer paper provided. Leave two lines after each part question. Start every question on a fresh page.

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 total number of marks for this paper is 90.

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.

For Examiner's Use	
Section A	
Section B	
Total	

This question paper consists of **14** printed pages including the cover page.

[Turn Over

*Mathematical Formulae**Mensuration*

Curved surface area of a cone = πrl

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

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

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

Section A
Answer **all** the questions.

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

$$30\% \quad 0.35 \quad \frac{1}{3} \quad 0.\dot{3}0$$

Answer [1]

- 2 (a) Calculate $\frac{33.17 + 55.2^2}{0.31413 + \sqrt[3]{647.9}}$.

Write down the first five digits on your calculator display.

Answer [1]

- (b) Write your answer to part (a) correct to 2 significant figures.

Answer [1]

- 3 The chairs in Auditorium A are arranged in 108 equal rows.

The chairs in Auditorium B are arranged in 150 equal rows.

Each auditorium has the same number of chairs.

- (a) Given that $108 = 2^2 \times 3^3$, express 150 as a product of its prime factors.

Answer $150 = \dots\dots\dots$ [1]

- (b) Hence, find the least number of chairs in each auditorium.

Answer [1]

4

- 4 In triangle ABC , $AB = 7.5$ cm, $BC = 7.1$ cm and $AC = 2.4$ cm.
Determine if triangle ABC is a right-angled triangle.

Answer
..... [2]

- 5 (a) Simplify $x^2 - (x - a)(x + a)$.

Answer [1]

- (b) Hence, evaluate $18750^2 - 18747 \times 18753$ without the use of a calculator.

Answer [1]

5

6

Height of plants (cm)	2	3	4	5
Number of plants	4	7	y	8

The table above shows the height of plants in the school's garden.

- (a) State the largest value of y such that the median is 3.

Answer [1]

- (b) If $y = 5$, find the mean height of the plants.

Answer cm [2]

- 7 It is given that $p = \frac{2q+1}{3q-1}$.

- (a) Find the value of p when $q = \frac{2}{3}$.

Answer [1]

- (b) Express q in terms of p .

Answer [2]

- 8 The actual area of Sungei Buloh Wetland Reserve is 2.02 km^2 .
A scale of 1 cm represents 500m on the map.
(a) Express the scale in the form 1 : n .

Answer [1]

- (b) Calculate the area of Sungei Buloh Wetland Reserve on the map in square centimetres.

Answer cm^2 [2]

-
- 9 Factorise completely

(a) $8 - 4y^2 - 14y$,

Answer [2]

(b) $8px - 15ay - 6py + 20ax$.

Answer [2]

- 10 A class of 15 boys and 15 girls took an English test. The marks are shown in the stem-and-leaf diagram.

Boys					Girls				
			5	4	4	5	6		
		6	3	5					
	5	5	2	6	2	3			
6	5	4	3	7					
	8	6	5	8	3	5	6	6	7
		1	1	9	2	2	8	8	8

Key (Boys)
9 | 3 means 39

Key (Girls)
3 | 8 means 38

- (a) Write down the median of the boys' marks.

Answer [1]

- (b) With reference to (a), explain briefly whether the boys or the girls performed better in the test.

Answer

.....

.....

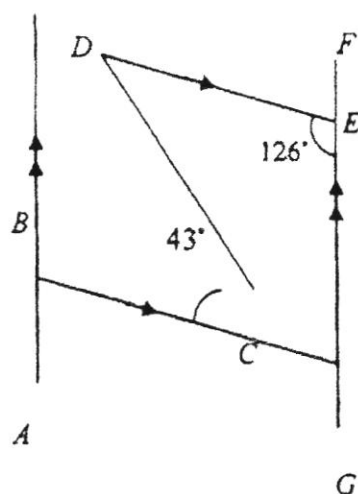
..... [1]

- (c) The mean score of this test for the whole class was 75. A new student joined the class and sat for the same test. The mean score became 74.5.

Find the score of the new student.

Answer [2]

- 11 In the diagram below, AB is parallel to GF and BC is parallel to DE .
 $\angle BCD = 43^\circ$ and $\angle DEG = 126^\circ$.



Find, stating your reasons clearly,

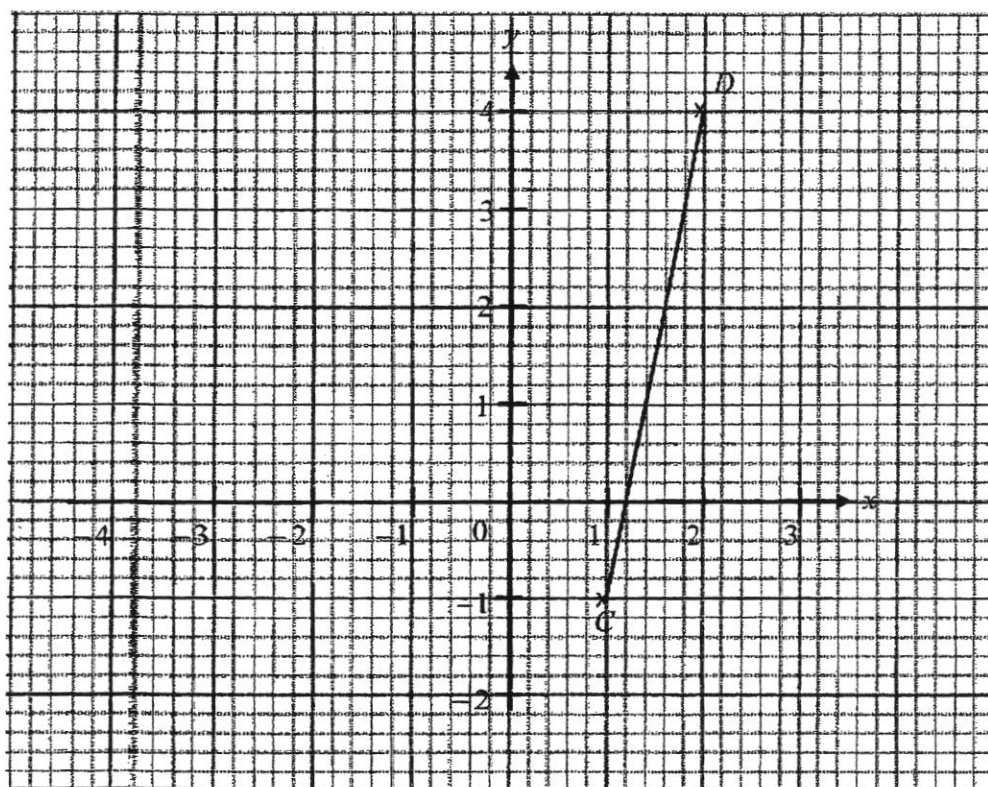
- (a) acute $\angle ABC$,

Answer [2]

- (b) reflex $\angle CDE$.

Answer [2]

- 12 The vertices of a quadrilateral are given as $A(-2, 4)$, $B(-3, -1)$, $C(1, -1)$ and $D(2, 4)$.



- (a) Mark and label the points A and B on the axes above. [1]
- (b) Calculate the area of quadrilateral $ABCD$.

Answer units² [1]

- (c) Write down the gradient of AD .

Answer [1]

- (d) Write down the equation of the line BC .

Answer [1]

- 13 The employees in an electrical firm are offered a monthly wage increase according to one of the two schemes below:

Scheme A	7% increase of their present salaries
Scheme B	5% increase of their present salaries + \$100

- (a) Andy earns \$2300 per month now. Which scheme should he choose?
Justify your choice with relevant working.

Answer

..... [3]

- (b) Either of the schemes will give Sarah the same wage increase.
Calculate Sarah's present monthly salary.

Answer S..... [3]

Section BAnswer **all** the questions.

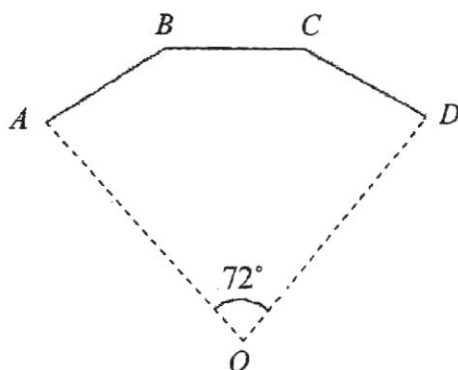
- 14 Solve the simultaneous equations.

$$2x - 3y = 15$$

$$3x = 7y + 27.5$$

[3]

- 15 The diagram shows part of a regular
- n
- sided polygon with centre
- O
- .

 AB , BC and CD are three equal sides of the polygon and $\angle AOD$ is 72° .

Find

- (a)
- n
- , [2]

- (b) the size of
- $\angle ABC$
- . [2]

- 16 (a) Factorise
- $16x^2 - 24xy + 9y^2$
- completely. [2]

- (b) Given that
- $x^2 + y^2 = 40$
- and
- $xy = 12$
- , find the value of
- $(2x - 2y)^2$
- . [2]

- 17 The scale of Map A is 1 : 60 000.

- (a) A footpath of 2.52 km is represented by a line on Map A. [2]

Find, in centimetres, the length of the footpath on Map A.

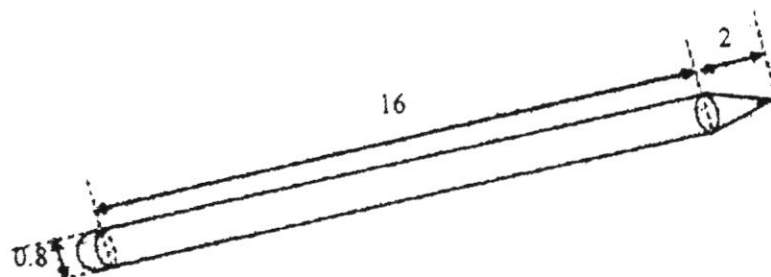
- (b) The area of a pond on Map A is
- 9.5 cm^2
- . [2]

Find, in square kilometres, the actual area of the pond.

- (c) The same footpath was represented by a length of 1.8 cm on Map B, which is drawn to a scale of 1 :
- n
- .

Find the value of n . [1]

18



The diagram above shows a pencil. It is made up of a hemisphere, a cylinder and a cone.

The cylinder has diameter of 0.8 cm and length of 16 cm. The cone has base diameter of 0.8 cm and height of 2 cm. Find

- (a) the slant height of the cone, [2]
 (b) the total surface area of the pencil. [3]

- 19 (a) Express as a single fraction in its simplest form

$$\frac{4}{x-2} + \frac{2}{2x+1}.$$
 [2]

- (b) Simplify $\frac{9a}{14b} + \frac{15a^2}{7b^2}.$ [2]

- (c) The area of a rectangle is $(36 - a^2) \text{ cm}^2$. One of its sides is $(12 - 2a) \text{ cm}$.
 Write down and simplify an expression, in terms of a , for the length of the other side of the rectangle. [2]

- 20 The radius of a small circle is $(p - 2q) \text{ cm}$.

The radius of a big circle is $(5p - 12q) \text{ cm}$.

The radius of the big circle is twice the radius of the small circle.

- (a) Write down a linear equation connecting p and q , and show that it can be reduced to $3p - 8q = 0$. [1]
 (b) The sum of the circumference of the two circles is $16\pi \text{ cm}$.
 Write down and simplify another linear equation connecting p and q , and show that it can be reduced to $3p - 7q = 4$. [1]
 (c) (i) Find the values of p and q . [3]

- (ii) Hence, find the radius of the small circle. [1]
- 21 Answer the whole of this question on a sheet of graph paper.

An object of temperature $y^{\circ}\text{C}$ was taken out of an oven. It is left to cool down to room temperature. After x minutes, the temperature is given by $y = -4x + 80$.

The table below shows some of the corresponding values of x and y .

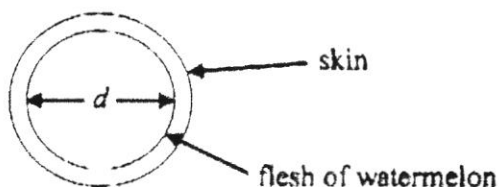
x	0	8	12
y	80	p	32

- (a) Find the value of p . [1]
- (b) State the temperature of the object when it was taken out of the oven. [1]
- (c) Use a scale of 1 cm to represent 1 unit on the horizontal x -axis for $0 \leq x \leq 12$ and a scale of 2 cm to represent 10 units on the vertical y -axis for $0 \leq y \leq 80$.
On your axes, draw the graph of $y = -4x + 80$ for $0 \leq x \leq 12$. [2]
- (d) Using your graph, find
- (i) the time taken for the object to reach a temperature of 56°C , [1]
 - (ii) the temperature of the object after being taken out of the oven for 9 minutes. [1]
- (e) (i) Write down the gradient of the graph. [1]
- (ii) Hence explain the significance of the gradient. [1]

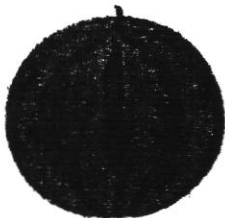
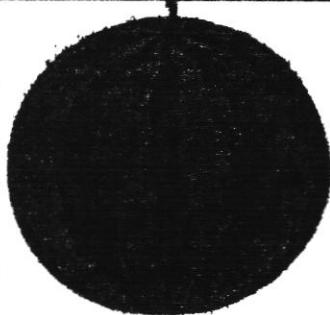
- 22 For Teachers' Day, the school is organising a fruit party. As part of the organizing committee, you are tasked to purchase watermelons for the teachers. The watermelons are also assumed to be spherical in shape.

The diagram below shows the cross section of a watermelon.

The diameter of the flesh of the watermelon is d cm.



The table shows information on the various sizes of watermelons on sale.

Size			
	<i>Small</i>	<i>Medium</i>	<i>Large</i>
Diameter (d cm)	24	28	32
Price (\$)	4.10	5.80	7.60

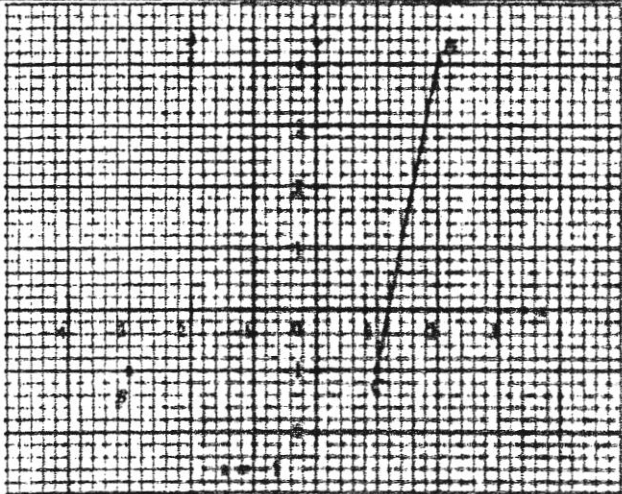
- (a) Given that the volume of the small watermelon is 7238.2 cm^3 and the volume of the medium watermelon is 11494 cm^3 , corrected to 5 significant figures, show that the volume of the large watermelon is 17157 cm^3 , corrected to 5 significant figures. [1]
- (b) Each teacher receives a cylindrical cup of watermelon juice of volume 500 cm^3 .
- (i) Find the maximum number of cups of juice which can be obtained from one large watermelon. [1]
- (ii) Given that the diameter of the cup is 7 cm and the water level of the juice is 1 cm from the brim of the cup, find the height of the cup. [2]
- (c) You have a budget of \$35.
Consider which size of watermelon gives the best value.
Find the maximum number of cups of juice that can be obtained with \$35. [5]

End of Paper

Marking Scheme for Sec 2 Express Mid-Year Examination 2017**Section A**

1		$30\%, 0.\dot{3}\dot{0}, \frac{1}{3}, 0.35$	
2	(a)	343.49	
	(b)	340	
3	(a)	$150 = 2 \times 3 \times 5^2$	
	(b)	$LCM = 2^2 \times 3^3 \times 5^2$ $= 2700$	
4		$AB^2 = 7.5^2$ $= 56.25$ $AC^2 + BC^2 = 7.1^2 + 2.4^2$ $= 56.17$ Since $AB^2 \neq AC^2 + BC^2$, by the converse of Pythagoras' Theorem, $\triangle ABC$ is not a right-angled triangle.	M1 for $AC^2 + BC^2$ Pythagoras must be spelt correctly.
5	(a)	$x^2 - (x-a)(x+a)$ $= x^2 - (x^2 - a^2)$ $= a^2$	
	(b)	$18750^2 - 18747 \times 18753$ $= 18750^2 - (18750 - 3)(18750 + 3)$ $= 3^2$ $= 9$	0 marks if no workings are shown
6	(a)	2	
	(b)	$\frac{2 \times 4 + 3 \times 7 + 4 \times 5 + 5 \times 8}{4 + 7 + 5 + 8}$ $= 3.71$	
7	(a)	$a = \frac{2\left(\frac{2}{3}\right) + 1}{3\left(\frac{2}{3}\right) - 1}$ $= 2\frac{1}{3}$	Correct substitution for $b = \frac{2}{3}$
	(b)	$p = \frac{2q+1}{3q-1}$ $p(3q-1) = 2q+1$ $3pq - p = 2q+1$ $3pq - 2q = 1+p$ $q(3p-2) = 1+p$ $q = \frac{1+p}{3p-2}$	Must write "b =". If not, -1m

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

8	(a)	1 : 50 000	
	(b)	Area of map $= \frac{2.02}{0.5^2}$ $= 8.08\text{cm}^2$	
9	(a)	$8 - 4y^2 - 14y$ $= 2(4 - 2y^2 - 7y)$ $= 2(x + 4)(2x - 1)$	M1 given when final answer not in simplest form
	(b)	$8px - 15ay - 6py + 20ax$ $= 8px - 6py - 15ay + 20ax$ $= 2p(4x - 3y) + 5a(-3y + 4x)$ $= (2p + 5a)(4x - 3y)$	
10	(a)	74	
	(b)	Girls; their median of 86 marks is higher than the boys' median mark of 74 marks.	Accept answers if student compare mean, but not mode.
	(c)	$74.5 \times 31 - 75(30)$ $= 59.5$	
11	(a)	$\angle BGE = 180 - 126 \text{ (int. } \angle\text{s)}$ $= 54^\circ$ $\angle ABC = \angle BGE \text{ (alt. } \angle\text{s)}$ $= 54^\circ$	No reason/wrong reason: - 1 per part
	(b)	$\angle BCD = \angle CDE \text{ (alt. } \angle\text{s)}$ $= 43^\circ$ $\text{reflex } \angle CDE = 360 - 43 \text{ (}\angle\text{s at a pt.)}$ $= 317^\circ$	
12	(a)		1 mark for both correct points plotted
	(b)	$\text{Area} = 4 \times 5$ $= 20 \text{ units}^2$	
	(c)	0	
	(d)	$y = -1$	

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

13	(a)	<u>Under Scheme A:</u> $100\% \text{ ----- } \$2300$ $107\% \text{ ----- } \frac{107}{100} \times 2300$ $= \$2469$ <u>Under Scheme B:</u> $100\% \text{ ----- } \$2300$ $105\% \text{ ----- } \frac{105}{100} \times 2300$ $= \$2415$ New monthly salary = $\\$2415 + \\100 $= \$2515$ Andy should choose Scheme B. From above calculations, it is evident that he will receive more monthly salary from Scheme B.	M1 for calculating the new monthly salary for Scheme A and another M1 for Scheme B. A1 only with reasoning.
	(b)	Let Sarah's present monthly salary be \$x. <u>Under Scheme A:</u> $\text{New monthly salary} = \frac{107}{100}x$ <u>Under Scheme B:</u> $\text{New monthly salary} = \frac{105}{100}x + 100$ Since both schemes will give Sarah the same wage increase, it implies that, $\frac{107}{100}x = \frac{105}{100}x + 100$ $107x = 105x + 10000$ $2x = 10000$ $x = 5000$ Thus, her present monthly salary is \$5000.	First M1 for coming up with the expressions for Sarah's new monthly salary in terms in x. Second M1 for forming the equation.

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

Section B

1		<u>Substitution Method</u> $2x - 3y = 15 \quad \dots (1)$ $3x = 7y + 27.5 \quad \dots (2)$ From 2, $x = \frac{7y + 27.5}{3} \quad \dots (3)$ Sub (3) into (1), $2\left(\frac{7y + 27.5}{3}\right) - 3y = 15$ $2(7y + 27.5) - 9y = 45$ $14y - 9y = 45 - 55$ $y = -2$ $x = \frac{7(-2) + 27.5}{3}$ $x = 4 \frac{1}{2}$ $y = -2, x = 4 \frac{1}{2}$	Sub correctly into (1) Both x and y must be correct.
2	(a)	$\frac{72^\circ}{3} = 24^\circ$ $\frac{360^\circ}{24^\circ} = 15 \text{ sides}$	OR $\frac{360}{72} = 5$ $5 \times 3 = 15$
	(b)	$\text{Size of 1 int. } \angle = \frac{(15-2)180^\circ}{15}$ $= 156^\circ$	
3	(a)	$16x^2 - 24xy + 9y^2 = (4x)^2 - 2(4x)(3y) + (3y)^2$ $= (4x - 3y)^2$	M1: $(4x - 3y)(4x - 3y)$
	(b)	$(2x - 2y)^2 = 4(x - y)^2$ $= 4(x^2 + y^2 - 2xy)$ $= 4x^2 + 4y^2 - 8xy$ $= 4(40) - 8(12)$ $= 64$	
4	(a)	$\text{Length} = \frac{2.52}{0.6}$ $= 4.2 \text{ cm}$	
	(b)	$\text{Actual area} = 9.5 \times 0.36$ $= 3.42 \text{ km}^2$	
	(c)	$1.8 : 252\,000$ $1 : 140\,000$ $n = 140\,000$	

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

5	(a)	By Pythagoras' Theorem, Slant height of the cone = $\sqrt{(0.4^2 + 2^2)}$ $= \sqrt{4.16}$ $= 2.04$ (3sf)	
	(b)	Total surface of pencil $= \frac{1}{2}[4\pi(0.4)^2] + \pi(0.8)(16) + \pi(0.4)(\sqrt{4.16})$ $= 43.78$ $= 43.8 \text{ cm}^2$ (3sf)	M1 for adding all three areas
6	(a)	$\frac{4}{x-2} + \frac{2}{2x+1}$ $= \frac{4(2x+1) + 2(x-2)}{(x-2)(2x+1)}$ $= \frac{8x+4+2x-4}{(x-2)(2x+1)}$ $= \frac{10x}{(x-2)(2x+1)}$	
	(b)	$\frac{9a}{14b} \div \frac{15a^2}{7b^2}$ $= \frac{9a}{14b} \times \frac{7b^2}{15a^2}$ $= \frac{3b}{10a}$	
	(c)	$\frac{36-a^2}{12-2a}$ $= \frac{(6+a)(6-a)}{2(6-a)}$ $= \frac{6+a}{2}$ $= 3 + \frac{a}{2}$	
7	(a)	$2(p-2q) = 5p-12q$ $2p-4q = 4p-12q$ $3p-8q = 0$ (shown)	
	(b)	$2\pi(p-2q) + 2\pi(5p-12q) = 16\pi$ $2\pi[(p-2q) + (5p-12q)] = 2\pi(8)$ $p-2q + 5p-12q = 8$ $6p-14q = 8$ $3p-7q = 4$ (shown)	

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

	(c) $3p - 8q = 0$... (1) (i) $3p - 7q = 4$... (2) (1) - (2), $-8q - (-7q) = 0 - 4$ $-q = -4$ $q = 4$ Substitute $q = 4$ into Equation (1), $3p - 8(4) = 0$ $3p = 32$ $p = 10\frac{2}{3}$	
	(c) Radius of small circle (ii) $= p - 2q$ $= 10\frac{2}{3} - 2(4)$ $= 2\frac{2}{3}$	
8	(a) $p = 48$	
	(b) 80°C	
	(c) Refer to graph	[1m] for 3 points plotted correctly [2m] for correct line drawn - 1 for wrong scale
	(d) 6 min (i)	
	(d) 44°C (ii)	
	(e) -4 (i)	
	(e) The temperature drops/decreases by 4°C per minute. (ii)	
9	(a) Vol of large watermelon $= \frac{4}{3}\pi(16)^3$ $= 17157.28$ $= 17157\text{ cm}^3$ (shown)	
	(b) <u>Large watermelon:</u> (i) $\text{No. of cups} = \frac{17157}{500}$ ≈ 34	
	(b) Height $= \frac{500}{\pi(3.5)^2} \times 1$ (ii) $= 14.0\text{ cm}$	M1 for the right fraction
	(c) <u>Small watermelon</u>	

Marking Scheme for Sec 2 Express Mid-Year Examination 2017

$1 \text{ cm}^3 \text{ cost} = \frac{4.10}{7238.2}$ $= \$0.000566$ <u>Medium watermelon</u> $1 \text{ cm}^3 \text{ cost} = \frac{5.80}{11494}$ $= \$0.000505$ <u>Large watermelon</u> $1 \text{ cm}^3 \text{ cost} = \frac{7.60}{17157}$ $= \$0.000442$ Large watermelon is the best value as it cost the least for 1 cm³ of watermelon. 4 large watermelons cost = $35 - (7.60 \times 4)$ $= \$5.40$ With \$5.40, I still can buy 1 small watermelon. The budget allows me to buy 4 large watermelon and 1 small watermelon. $\text{No. of cups} = \frac{17157 \times 4 + 7238.2}{500}$ $= 151.7$ $= 151$	M1 for comparing all 3 sizes of watermelon M1 – seen or implied that large watermelon has the best value. M1 – seen or implied in the next step that the student has chosen 4 large and 1 small. A1 not accepted if students find number of cups per watermelon, then add it up.
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