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BEATTY SECONDARY SCHOOL
MID-YEAR EXAMINATION 2015

SUBJECT : Mathematics

LEVEL : Secondary 3 Express

PAPER : 4048 / 01

DURATION : 1 hour 15 min

SETTER : Mr Eric Koh

DATE : 13 May 2015

CLASS :	NAME :	REG NO :
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READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces on the top of this page.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer **all** questions.

If working is needed for any question, it must be shown with the answer.

Omission of essential working will result in loss of marks.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

The total number of marks for this paper is **50**.

For Examiner's Use
50

This paper consists of 12 printed pages (including this cover page)

[Turn over

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

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) Express 958 nanograms in grams, giving your answer in standard form.

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

- (b) The diameter of a circular organism is 7 micrometres.

(i) Express 7 micrometres in metres.

(ii) Find the area, in square metres, of the circular organism, giving your answer in standard form.

Answer (b)(i)..... m [1]

Answer (b)(ii)..... m² [1]

2. (a) Evaluate $\frac{0.11}{\sqrt[3]{1.52 \times 0.23^3}}$.

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

- (b) Evaluate $(4.43 \times 10^6) \div (1.23 \times 10^{-3} + 0.456)$, giving your answer in standard form.

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



[Turn over

3. (a) Simplify $\left(\frac{c^{-3}d}{c^2d^{-2}}\right)^{-5}$, expressing your answer in positive index form.

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

- (b) Given that $5^{-6} \div 5^p = 125^0$, find the value of $\frac{1}{2^p}$.

Answer (b) [2]

4. Solve the following equations.

(a) $3^x = 81$,

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

(b) $4^{x-3} \times 8^{3x-1} = 4$.

Answer (b)..... [2]

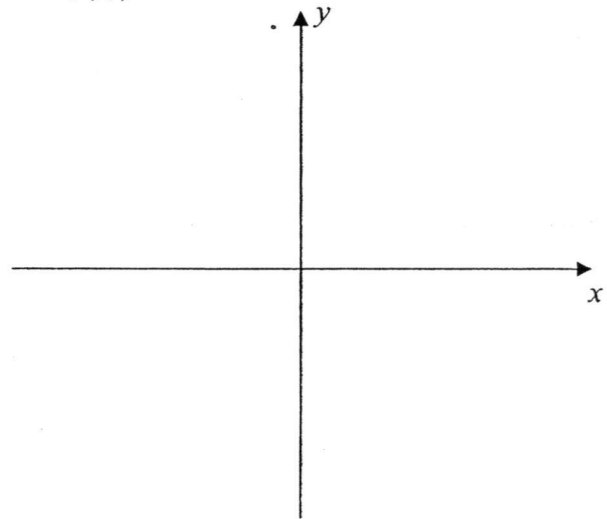
5.(a)(i) Sketch the graph of $y = (x+1)(3-x)$, showing clearly the intercepts on both axes.

(ii) Write down the equation of the line of symmetry.

(b)(i) Express $x^2 - 6x + 2$ in the form $(x-a)^2 + b$.

(ii) Sketch the graph of $y = x^2 - 6x + 2$, showing clearly the coordinates of the turning point.

Answer (a)(i)

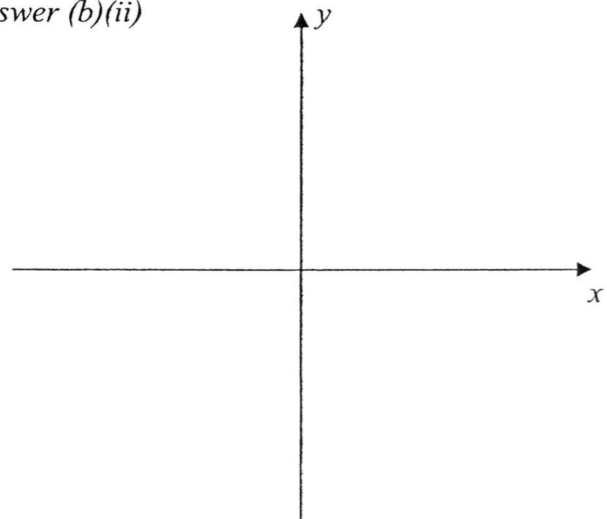


[2]

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

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

Answer (b)(ii)



[2]

3

[Turn over

6. Jane borrowed \$40 000 from a money lender which charged an interest of 8% per year, compounded monthly. She made a monthly payment of \$2800 at the end of each month. Find the amount she owed the bank after the third payment. Giving your answer correct to the nearest dollar.

Answer \$ [3]

7. Given that $x^2 - 6x + 1 = 0$, without solving for the value of x , find the value of each of the following expression.

(a) $x + \frac{1}{x}$,

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

(b) $\left(x - \frac{1}{x}\right)^2$.

Answer (b)..... [2]

8. (a) Solve the inequality

$$\frac{3x-11}{4} - \frac{7+4x}{6} \geq \frac{2-17x}{12} + x - 11.$$

Answer (a)..... [2]

- (b) Illustrate the solution with a number line.

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



9. $x = 6$ is a solution to the equation $x^2 + kx - 756 = 0$, where k is a constant.
(a) Find the value of k .

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

- (b) Hence, find the other solution to the equation $x^2 + kx - 756 = 0$.

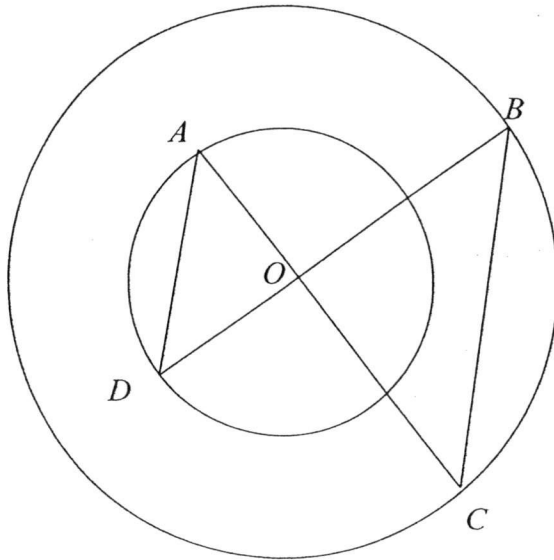
Answer (b)..... [2]

4

[Turn over]

10. In the diagram, O is the centre of two concentric circles. A and D lie on the circumference of the smaller circle. B and C lie on the circumference of the larger circle. AC and BD intersect at O . Prove that

- (a) $\triangle AOB$ and $\triangle DOC$ are congruent.
 (b) $\triangle ABD$ and $\triangle DCA$ are congruent.



Answer (a) _____

 _____ [2]

Answer (b) _____

 _____ [2]

11. (a) Simplify the following algebraic expressions.
 $2(3x + 2y) - 5(x - 2y)$

Answer (a)..... [2]

- (b) Express the following as a fraction in its lowest term.

$$\frac{1}{x-2} - \frac{3}{x^2 - x - 2}$$

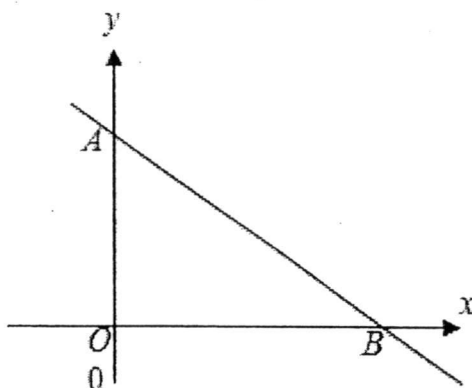
Answer (b)..... [2]

- (c) Factorise completely the following algebraic expression.

$$2a^2x - 3bx - 8a^2y + 12by$$

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

12. In the diagram, which is not to scale, the equation of the straight line is given as $3y + 2x = 12$.



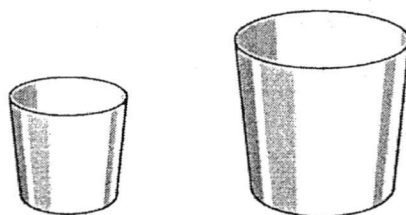
- (a) Find the gradient and y-intercept of the given line.

Answer (a) gradient = y intercept = [2]

- (b) Find the area of $\triangle AOB$.

Answer (b)units² [2]

13. The ratio of the **areas** of the bases of two geometrically similar buckets is 8 : 50.



smaller bucket

larger bucket

- (a) The **area** of the top of the smaller bucket is 240 cm^2 .

What is the **area** of the top of the larger bucket?

Answer (a) cm^2 [1]

- (b) Write down the ratio of the **heights** of the two buckets.

Answer (b) : [1]

- (c) Both buckets are filled with sand.
The **mass** of sand in the larger bucket is 25 kg.
Find the **mass** of sand in the smaller bucket.

Answer (c) kg [1]

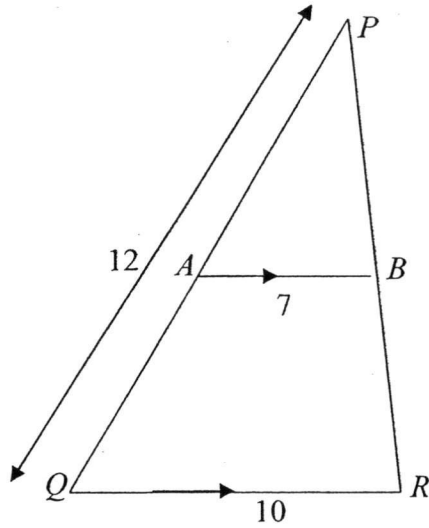
6

[Turn over

14. In the diagram, $QR = 10\text{ cm}$, $PQ = 12\text{ cm}$, $AB = 7\text{ cm}$ and AB is parallel to QR .

(a) Calculate the length of AQ .

(b) Find the ratio of $\frac{\text{area of } \triangle PAB}{\text{area of trapezium } ABRQ}$.



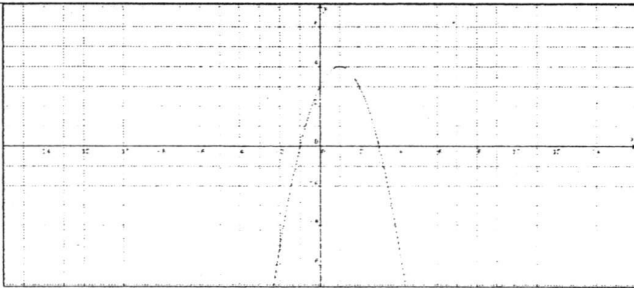
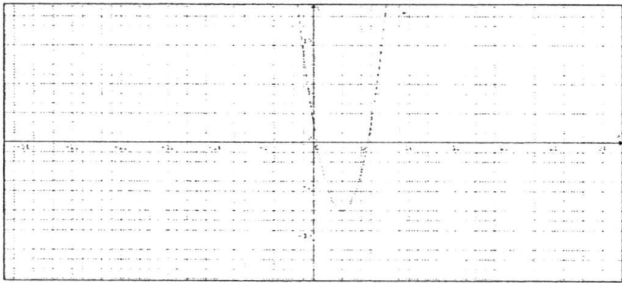
Answer (a)..... cm[2]

Answer (b)..... [2]

- End of Paper -

Beatty Secondary School
Mid Year Examination 2015
Mathematics Paper 1
Answer Key

Q1(a)	$9.58 \times 10^{-7} \text{ g}$
Q1(b)(i)	7 micrometres = $7 \times 10^{-6} \text{ m}$
Q1(b)(ii)	Area of circular organism = $3.85 \times 10^{-11} \text{ m}^2$
Q2(a)	7.86
Q2(b)	$9.69 \times 10^6 \text{ m}$
Q3(a)	$\frac{c^{25}}{d^{15}}$
Q3(b)	64
Q4(a)	$x = 4$
Q4(b)	$x = 1$

Q5(a)(i)	 Attempt at parabola through (0, 3) also through (-1, 0) and (3, 0) Turning point at (1, 4)
Q5(a)(ii)	$x = 1$
Q5(b)(i)	$(x - 3)^2 - 7$
Q5(b)(ii)	 Attempt at parabola through (0, 2) Turning point at (3, -7)
Q6	Balance carried forward = \$32 349.22 = \$32 349 (nearest dollars)
Q7(a)	$x + \frac{1}{x} = 6$
Q7(b)	32
Q8(a)	$x \geq -13\frac{5}{6}$
Q8(b)	

7

[Turn over

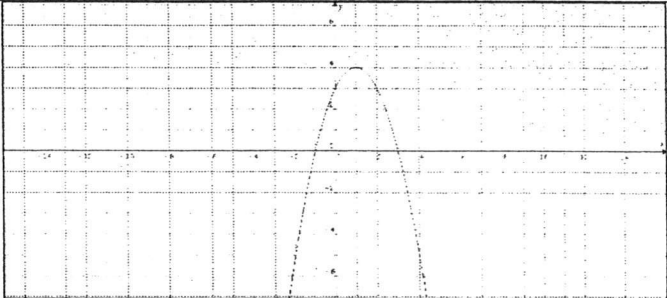
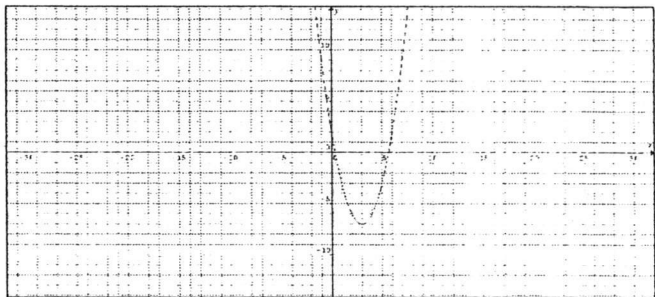
Q9(a)	$k = 120$
Q9(b)	-126
Q10(a)	Proving
Q10(b)	Proving

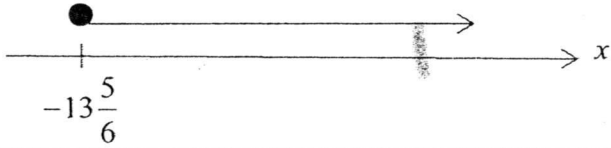
Q11(a)	$x + 14y$
Q11(b)	$\frac{1}{x+1}$
Q11(c)	$(2a^2 - 3b)(x - 4y)$
Q12(a)	gradient = $-\frac{2}{3}$, y-intercept = 4
Q12(b)	Area of $\triangle AOB = \frac{1}{2} \times 6 \times 4 = 12 \text{ units}^2$
Q13(a)	Area of the top of the larger bucket = 1500 cm^2
Q13(b)	2 : 5 (small: big) or 5 : 2 (big : small)
Q13(c)	Mass of sand in the smaller bucket = 1.6 kg
Q14(a)	AQ = 3.6 cm
Q14(b)	$\frac{\text{Area of } \triangle PAB}{\text{Area of trapezium ABRQ}} = \frac{49}{51}$

Beatty Secondary School
Mid Year Examination 2015
Mathematics Paper 1
Marking Scheme

Updated 14 May 2015

Q1(a)	$958 \text{ ng} = 958 \times 10^{-9} \text{ g}$ $= 9.58 \times 10^{-7} \text{ g}$	B1
Q1(b)(i)	$7 \text{ micrometres} = 7 \times 10^{-6} \text{ m}$	B1
Q1(b)(ii)	Area of circular organism $= \pi \times \left(\frac{7 \times 10^{-6}}{2} \right)^2$ $= 3.85 \times 10^{-11} \text{ m}^2$	B1
Q2(a)	7.86	B1
Q2(b)	$9.69 \times 10^6 \text{ m}$	B1
Q3(a)	$\left(\frac{c^2 d^{-2}}{c^{-3} d} \right)^5$ $= \frac{c^{10} d^{-10}}{c^{-15} d^5}$ $= c^{25} d^{-15}$ $= \frac{c^{25}}{d^{15}}$	B1
Q3(b)	$\frac{5^{-6}}{5^p} = 125^0$ $5^{-6} = 5^p \Rightarrow p = -6$ $\frac{1}{2^p} = \frac{1}{2^{-6}} = 64$	M1 A1
Q4(a)	$3^x = 81$ $3^x = 3^4 \Rightarrow x = 4$	B1
Q4(b)	$4^{x-3} \times 8^{3x-1} = 4$ $2^{2(x-3)} \times 2^{3(3x-1)} = 2^2$ $2x - 6 + 9x - 3 = 2$ $11x = 11$ $x = 1$	M1 A1

Q5(a)(i)	 Attempt at parabola through (0, 3) also through (-1, 0) and (3, 0) Turning point at (1, 4)	M1 A1
Q5(a)(ii)	$x = 1$	B1
Q5(b)(i)	$(x - 3)^2 - 7$	B1
Q5(b)(ii)	 Attempt at parabola through (0, 2) Turning point at (3, -7)	M1 A1
Q6	1st month compound interest = $\\$40000 \left(1 + \frac{12}{100}\right)^1$ = \$40 266.67 Monthly payment = \$2800 Balance carried forward = \$37 466.67 2nd month compound interest = $\\$37466.67 \left(1 + \frac{12}{100}\right)^1$ = \$37 716.44 Monthly payment = \$2800 Balance carried forward = \$34 916.44 3rd month compound interest = $\\$34916.44 \left(1 + \frac{12}{100}\right)^1$ = \$35 149.22 Monthly payment = \$2800 Balance carried forward = \$32 349.22 = \$32 349 (nearest dollars)	M1 M1 A1

Q7(a)	$x^2 - 6x + 1 = 0$ $x + \frac{1}{x} = 6$	B1
Q7(b)	$\left(x - \frac{1}{x}\right)^2 = x^2 - 2 + \frac{1}{x^2}$ $= x^2 - 2 + \frac{1}{x^2} + 4 - 4$ $= \left(x + \frac{1}{x}\right)^2 - 4$ $= (6)^2 - 4$ $= 32$	M1 A1
Q8(a)	$\frac{3x-11}{4} - \frac{7+4x}{6} \geq \frac{2-17x}{12} + x - 11$ $\frac{9x-33-14-8x}{12} \geq \frac{2-17x+12x-132}{12}$ $x - 47 \geq -5x - 130$ $6x \geq -83$ $x \geq -13\frac{5}{6}$	M1 A1
Q8(b)		B1
Q9(a)	$x = 6$ $(6)^2 + 6k - 756 = 0 \Rightarrow k = 120$	B1
Q9(b)	Let α be the other roots of the equation. $x^2 + kx - 756 = 0$ $(x - 6)(x - \alpha) = 0$ $6\alpha = -756$ $\alpha = -126$	M1 A1
Q10(a)	$\angle AOB = \angle DOC \text{ (opp. } \angle \text{s)}$ $AO = DO \text{ (} O \text{ is the centre)}$ $OB = OC \text{ (} O \text{ is the centre)}$ $\triangle AOB \text{ and } \triangle DOC \text{ are congruent (SAS)}$	B1 B1
Q10(b)	$\angle ADB = \angle DAC \text{ (} \triangle ADO \text{ is an isos } \Delta, AO = DO)$ $AC = BD \text{ (} AO = OD, OB = OC)$ $\overline{AD} \text{ is the common line}$ $\triangle ABD \text{ and } \triangle DCA \text{ are congruent (SAS)}$	B1 B1

Q11(a)	$2(3x+2y)-5(x-2y)$ $= 6x+4y-5x+10y$ $= x+14y$	M1 A1
Q11(b)	$\frac{1}{x-2} - \frac{3}{x^2-x-2}$ $= \frac{1}{x-2} - \frac{3}{(x-2)(x+1)}$ $= \frac{x-2}{(x-2)(x+1)}$ $= \frac{1}{x+1}$	M1 A1
Q11(c)	$2a^2x-3bx-8a^2y+12by$ $= (2a^2-3b)x-(2a^2-3b)4y$ $= (2a^2-3b)(x-4y)$	M1 A1
Q12(a)	$3y+2x=12$ $y = -\frac{2}{3}x+4$ gradient = $-\frac{2}{3}$, y-intercept = 4	B1 B1
Q12(b)	When $x=0$, $y=4$ A (0, 4) When $y=0$, $x=6$ B (6, 0) Area of $\triangle AOB = \frac{1}{2} \times 6 \times 4 = 12 \text{ units}^2$	M1 A1
Q13(a)	Area of the top of the larger bucket = $\frac{25}{4} \times 240 = 1500 \text{ cm}^2$	B1
Q13(b)	2 : 5 (small: big) or 5 : 2 (big : small)	B1
Q13(c)	(their scale factor)³ seen Mass of sand in the smaller bucket = $\frac{8}{125} \times 25 = 1.6 \text{ kg}$	B1
Q14(a)	Using similar triangle $\frac{AP}{QP} = \frac{AB}{QR}$ $\frac{AP}{12} = \frac{7}{10}$ $AP = \frac{12 \times 7}{10} \Rightarrow AP = 8.4 \text{ cm}$ $AQ = 12 - 8.4 = 3.6 \text{ cm}$	M1 A1
Q14(b)	$\frac{\text{Area of } \triangle PAB}{\text{Area of } \triangle PQR} = \left(\frac{7}{10}\right)^2 = \frac{49}{100}$ $\frac{\text{Area of } \triangle PAB}{\text{Area of trapezium ABRQ}} = \frac{49}{51}$	M1 A1



**BEATTY SECONDARY SCHOOL
MID-YEAR EXAMINATION 2015**

SUBJECT : Mathematics

LEVEL : Sec 3 Express

PAPER : 4018 / 2

DURATION : 1 hour 30 minutes

SETTER : Mr Bernard Lee

DATE : 18 May 2015

CLASS :	NAME :	REG NO :
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READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces on the top of this page.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

Answer **all** questions.

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Omission of essential working will result in loss of marks.

Calculators should be used where appropriate.

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

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

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

The total number of marks for this paper is **50**.

This paper consists of 5 printed pages (including this cover page)

[Turn over

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

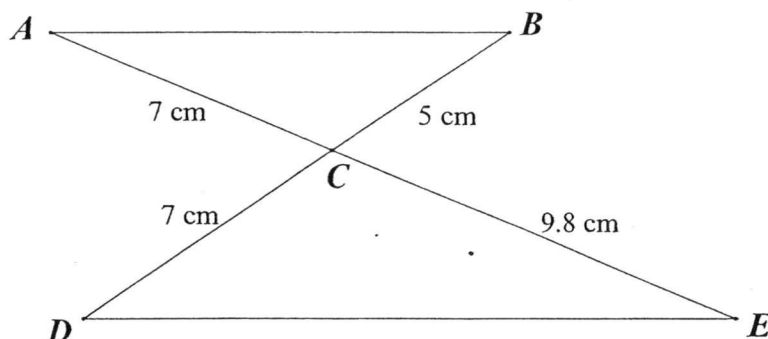
Statistics

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

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

1. Determine if 2^{400} or 5^{200} is greater. Explain your answer. [2]
2. It is given that $A(3, -8)$ and $B(-2, 2)$.
 - (a) Calculate the length of AB . [2]
 - (b) Find the equation of the line that passes through A and B . [3]
 - (c) $C(1, k)$ is on the line AB . Find the value of k . [2]
3. By completing the square, solve the equation $x^2 - 8x = 4$ [3]
4. Solve the equation $\frac{6}{1-x} - \frac{3}{x+2} = 2$. [4]
5.
 - (a) Solve the inequality $3x - 5 \leq x + 4 < 16 - 3x$ [3]
 - (b) Hence, write down the largest value of x if x is a prime number. [1]
6. Danny needs to reach Pasir Ris, which is 30 km away. He wants to ride his bicycle for x km before taking a taxi to minimise his taxi fare. His average cycling speed is 10 km/h and the taxi's average speed is 80 km/h.
 - (a) Given that Danny must reach Pasir Ris within one hour, form an inequality in x . [1]
 - (b) Solve the inequality in (a) to find the minimum distance that he should travel by taxi in order to reach Pasir Ris on time. [3]

7. In the diagram below, $AC = CD = 7$ cm, $BC = 5$ cm and $CE = 9.8$ cm. AE and BD are straight lines.



- (a) Name a pair of similar triangles and prove that they are similar. [3]
- (b) Show that lines AB and DE are parallel. [1]
- (c) Given that $AB = 15$ cm, calculate the length of DE . [2]
8. Mark has a budget of \$120 to buy cupcakes for his colleagues.
- (a) Given that the price of each cupcake is \$ x , write down an expression in x for the number of cupcakes that he can buy. [1]
- (b) At the shop, he discovers that the price of each cupcake has risen by \$0.50. Write down and simplify an expression in x for the number of cupcakes he can buy now. [1]
- (c) Due to the increase in price, Mark could only buy 6 fewer cupcakes. Form an equation in x and show that it reduces to $2x^2 + x - 20 = 0$. [3]
- (d) Solve the equation $2x^2 + x - 20 = 0$, giving your answers to 1 decimal place. [2]
- (e) Using your answer in (d), calculate the number of cupcakes he could afford before the increase in price. [1]

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

The variables x and y are connected by the equation $y = -3x^2 + 2x + 8$. Some corresponding values are given in the following table.

x	-3	-2	-1	0	1	2	3	4
y	-25	a	3	8	7	0	-13	-32

- (a) Calculate the value of a . [1]
- (b) Using a scale of 2 cm to represent 1 unit on the x -axis and 2 cm to represent 5 units on the y -axis, draw the graph of $y = -3x^2 + 2x + 8$ for the range $-3 \leq x \leq 4$. [3]
- (c) From your graph,
- (i) estimate the roots to the equation $-3x^2 + 2x + 8 = 0$. [1]
- (ii) estimate the coordinates of the turning point. [1]
- (d) By drawing a tangent, estimate the gradient of the graph at $x = 2$. [2]
- (e) By drawing a suitable line, estimate the solution of
- (i) $-3x^2 + 2x + 8 = -15$ [2]
- (ii) $-3x^2 + 2x + 8 = x + 2$ [2]

~ End of Paper ~

Beatty Secondary School
 Sec 3 Express Mathematics Paper 2
 Mid-Year Examination 2015
Answers

1	5^{200}
2(a)	11.2 units
2(b)	$y = -2x - 2$
2(c)	-4
3	-0.472 or 8.47 (to 3sf)
4	$-\frac{1}{2}$ or $x = -5$
5(a)	$x < 3$
5(b)	2
6(a)	$\frac{x}{10} + \frac{30-x}{80} \leq 1$
6(b)	$22\frac{6}{7}$
7(a)	$\frac{AC}{CE} = \frac{7}{9.8} = \frac{5}{7}$ $\frac{BC}{CD} = \frac{5}{7}$ $\therefore \frac{AC}{CE} = \frac{BC}{CD}$ $\angle ACB = \angle DCE \text{ (vert opp } \angle \text{s)}$
7(b)	Since $\triangle ABC$ is similar to $\triangle EDC$, $\angle ABC = \angle CDE$, so AB and DE are parallel (alt $\angle$ s)
7(c)	21 cm

8(a)	$\frac{120}{x}$
8(b)	$\frac{240}{2x+1}$
8(c)	$\frac{120}{x} - \frac{240}{2x+1} = 6$ $120(2x+1) - 240x = 6x(2x+1)$ $240x + 120 - 240x = 12x^2 + 6x$ $12x^2 + 6x - 120 = 0$ $2x^2 + x - 20 = 0 \text{ (shown)}$
8(d)	2.9 or -3.4 (to 1dp)
8(e)	41
9(a)	$a = -8$
9(b)	Graph
9(c)(i)	$x = -1.35 (\pm 0.05)$ or 2
9(c)(ii)	(0.3, 8.25) Accept x-coordinate 0.2 to 0.4 Accept y-coordinate 8.1 to 8.5
9(d)	Gradient = 10 (± 1)
9(e)(i)	$x = -2.4$ or $x = 3.1$ (Accept ± 0.1)
9(e)(ii)	$x = 1.6$ or $x = -1.3$ (Accept ± 0.1)

Beatty Secondary School
Sec 3E MYE 2015 Paper 2
Solutions

1.	$2^{400} = 4^{200} \dots$ [M1] Hence, 5^{200} is greater. ... [A1]	2
2(a)	Length = $\sqrt{(2+8)^2 + (3+2)^2} \dots$ [M1] = 11.2 units (to 3sf) [A1]	2
2(b)	Gradient of $AB = \frac{2+8}{-2-3} = -2 \dots$ [M1] When $x = 3, y = -8, m = -2,$ $-8 = -2(3) + c \dots$ [M1 for substitution] $c = -2$ $\therefore y = -2x - 2 \dots$ [A1]	3
2(c)	When $x = 1, y = k,$ $k = -2(1) - 2 \dots$ [M1] $= -4 \dots$ [A1]	2
3.	$x^2 - 8x = 4$ $\left(x - \frac{8}{2}\right)^2 - \left(\frac{8}{2}\right)^2 = 4 \dots$ [M1] $(x - 4)^2 = 20$ $x - 4 = \pm\sqrt{20} \dots$ [M1 for $\pm\text{sqrt}$] $x = \pm\sqrt{20} + 4$ $= -0.472 \text{ or } 8.47 \text{ (to 3sf)} \dots$ [A1]	3
4	$\frac{6}{1-x} - \frac{3}{x+2} = 2$ $6(x+2) - 3(1-x) = 2(1-x)(x+2) \dots$ [M1] $6x+12-3+3x = -2x^2-2x+4$ $\dots$ [M1 for expansion] $2x^2+11x+5=0$ $(2x+1)(x+5)=0 \dots$ [M1] $x = -\frac{1}{2} \text{ or } x = -5 \dots$ [A1]	4

5(a)	$3x - 5 \leq x + 4 < 16 - 3x$ [M1] $3x - 5 \leq x + 4$ and $x + 4 < 16 - 3x$ $2x \leq 9$ and $4x < 12$ $x \leq 4.5$ and $x < 3$ [A1 for either one correct] $\therefore x < 3$ [A1]	3
5(b)	2 [B1]	1
6(a)	$\frac{x}{10} + \frac{30-x}{80} \leq 1$ [B1]	1
6(b)	$\frac{x}{10} + \frac{30-x}{80} \leq 1$ $8x + 30 - x \leq 80$ [M1] $7x \leq 50$ $x \leq 7\frac{1}{7}$ [A1] $\therefore$ Minimum distance that he needs to travel by taxi is $30 - 7\frac{1}{7} = 22\frac{6}{7}$ km. [A1]	3
7(a)	$\frac{AC}{CE} = \frac{7}{9.8} = \frac{5}{7}$ $\frac{BC}{CD} = \frac{5}{7}$ $\therefore \frac{AC}{CE} = \frac{BC}{CD}$ [B1] $\angle ACB = \angle DCE$ (vert opp $\angle$ s) [B1] $\triangle ABC$ is similar to $\triangle EDC$ (SAS) [B1] (for correct naming of Δ s)	3
7(b)	Since $\triangle ABC$ is similar to $\triangle EDC$, $\angle ABC = \angle CDE$, so AB and DE are parallel (alt $\angle$ s) [B1]	1
7(c)	$\frac{DE}{15} = \frac{7}{5}$ [M1] $DE = 21$ cm [A1]	2

8(a)	$\frac{120}{x}$ [B1]	1
8(b)	$\frac{120}{x+0.5} = \frac{240}{2x+1}$ [B1] (need to see $\frac{240}{2x+1}$)	1
8(c)	$\frac{120}{x} - \frac{240}{2x+1} = 6$ [M1] o.e. $120(2x+1) - 240x = 6x(2x+1)$ [M1] $240x + 120 - 240x = 12x^2 + 6x$ $12x^2 + 6x - 120 = 0$ $2x^2 + x - 20 = 0$ (shown) } [A1]	3
8(d)	$2x^2 + x - 20 = 0$ $x = \frac{-1 \pm \sqrt{1^2 - 4(2)(-20)}}{2(2)}$ [M1] $= 2.922$ or -3.422 $= 2.9$ or -3.4 (to 1 dp) [A1]	2
8(e)	$\frac{120}{2.922} = 41$ (to nearest whole number) [B1]	1
9(a)	$a = -8$ [B1]	1
9(b)	Graph [G3 for smooth Graph, correct Axes, correct Points]	3
9(c)(i)	$x = -1.35 (\pm 0.05)$ or 2 [B1]	1
9(c)(ii)	$(0.3, 8.25)$ [B1] Accept x-coordinate 0.2 to 0.4 Accept y-coordinate 8.1 to 8.5	1
9(d)	Suitable tangent [M1] Gradient = 10 (± 1) [A1]	2
9(e)(i)	Draw line $y = -15$ [B1] $x = -2.4$ or $x = 3.1$ [B1] (Accept ± 0.1)	2
9(e)(ii)	Draw line $y = x + 2$ [M1] $x = 1.6$ or $x = -1.3$ [A1] (Accept ± 0.1)	2

