

NAME: _____ ()

CLASS: _____



FAIRFIELD METHODIST SCHOOL (SECONDARY)

**END-OF-YEAR EXAMINATION 2016
SECONDARY 3 EXPRESS**

MATHEMATICS

4048/01

Paper 1

Date: 12 October 2016

Duration: 2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

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 .

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

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

The total number of marks for this paper is 80.

For Examiner's Use	
Paper 1	/ 80

Setter: Ms Michelle Tan

This question paper consists of 20 printed pages including the cover page.

Name: _____ () Class: _____

Answer all the questions.

1. The world's population is predicted to reach 0.097×10^{11} by 2050.

(a) 0.097×10^{11} can be expressed as n million. Find n .

Answer (a) $n =$ [1]

(b) The world's population was 7.2×10^9 in 2013. Find the predicted increase in the world's population from 2013 to 2050, giving your answer in standard form.

Answer (b) [1]

2. Given the recurring decimal number $p = 0.636363\dots$,

(a) without the use of a calculator, evaluate $100p - p$.

Answer (a) [1]

(b) Hence, write p as a fraction in its simplest form.

Answer (b) $p =$ [1]

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3. Given that the gradient of the line joining the points $A(-3, -7)$ and $B(4, r)$ is $\frac{3}{5}$.

(a) Find the value of r .

Answer (a) $r = \dots\dots\dots$ [2]

(b) Find the equation of the line passing through $C(-10, 2)$ and is parallel to the line AB .

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

4. (a) Make x the subject of the formula $m = \sqrt{\frac{5x}{p} - n^2}$

Answer (a) $\dots\dots\dots$ [2]

(b) Hence, find the value of x when $p = -2$, $n = 3$ and $m = -1$.

Answer (b) $x = \dots\dots\dots$ [1]

5. (a) Written as a product of its prime factors, $9720 = 2^x \times 3^y \times 5$.
Find the values of x and of y .

Answer (a) $x = \dots\dots\dots$, $y = \dots\dots\dots$ [1]

- (b) Written as a product of its prime factors, $1134 = 2 \times 3^4 \times 7$.
Find the smallest positive integer m such that $\frac{1134}{m}$ is a square number.

Answer (b) $m = \dots\dots\dots$ [1]

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6. The number of cases of dengue fever reported each week is recorded over a particular year.

No. of cases	$40 \leq x < 60$	$60 \leq x < 80$	$80 \leq x < 100$	$100 \leq x < 120$
Frequency	11	18	15	8

Calculate an estimate of the mean number of cases of dengue fever.

Answercases of dengue fever [2]

7. Each of the numbers 2, 6 and 7 are written on a card. One or two of these cards are drawn at random to form a one- or two-digit number. Find the probability of the number formed

(a) consists of two digits,

Answer (a) [1]

(b) is a prime number,

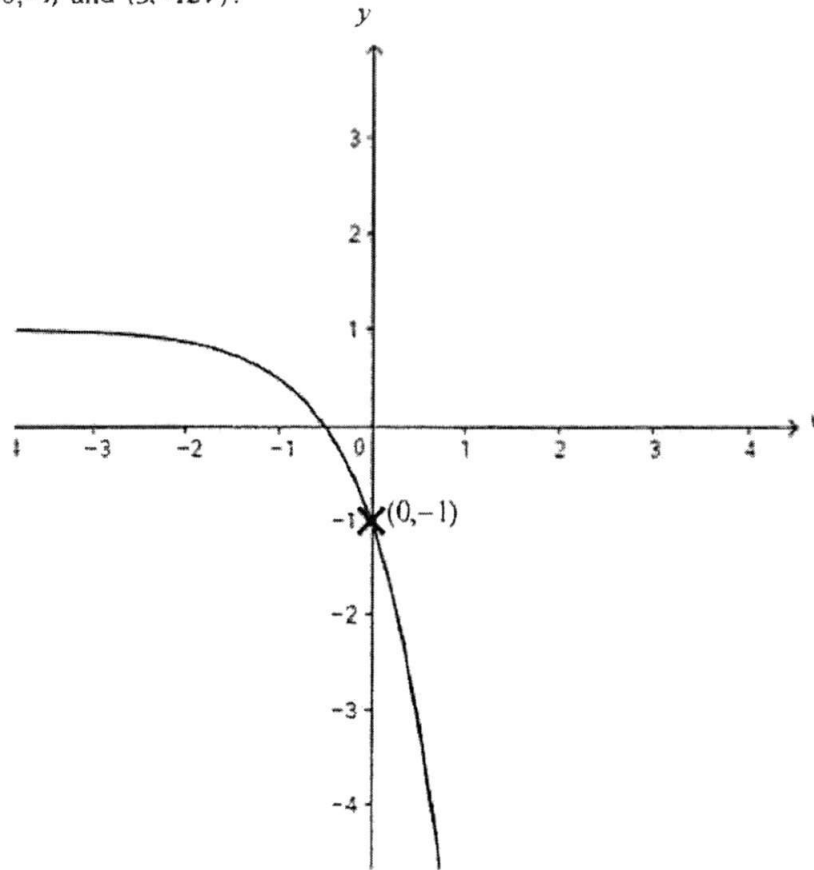
Answer (b) [1]

(c) is a multiple of 5.

Answer (c) [1]

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8. The sketch below shows the graph of $y = ka^x + 1$. The graph passes through the points $(0, -1)$ and $(3, -127)$.



Find

- (a) the value of k , and

Answer (a) $k = \dots\dots\dots$ [1]

- (b) a .

Answer (b) $a = \dots\dots\dots$ [2]

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9. A plantation has an area of 225 km^2 .

(a) A map has a scale of 1 cm to 5 km. Find the area on the map, in cm^2 , which represents the plantation.

Answer (a) cm^2 [2]

(b) On another map, the same plantation is represented by an area of 36 cm^2 and a river is represented by a length of 3 cm. Find the actual length, in km, of the river.

Answer (b) km [2]

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10. Solve $\frac{3}{m} = 2 + \frac{m}{2m-1}$, giving your answers to 2 decimal places.

Answer $m = \dots\dots\dots$ or $m = \dots\dots\dots$ [4]

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11. Given that $\frac{2-x}{4} \leq 3+x < 11$ and $0 < y < 5$, where x and y are integers, find

(a) the range of values of x ,

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

(b) the greatest possible value of $(x+y)^2$,

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

(c) the least possible value of $(x+y)(x-y)$.

Answer (c)..... [1]

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12. (a) Simplify $\left(\frac{x}{9}\right)^{-\frac{1}{2}} \times x^2$, leaving your answer in positive index form.

Answer (a) [2]

- (b) Given that $\frac{y^2 \times y^{\frac{1}{2}}}{\sqrt[4]{y^{2k}}} = 1$, find the value of k .

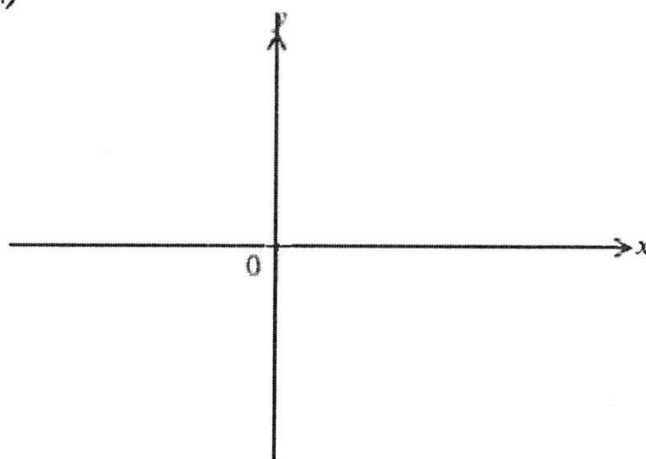
Answer (b) $k =$ [3]

13. (a) (i) Express $x^2 - 8x + 2$ in the form $(x + p)^2 + q$.

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

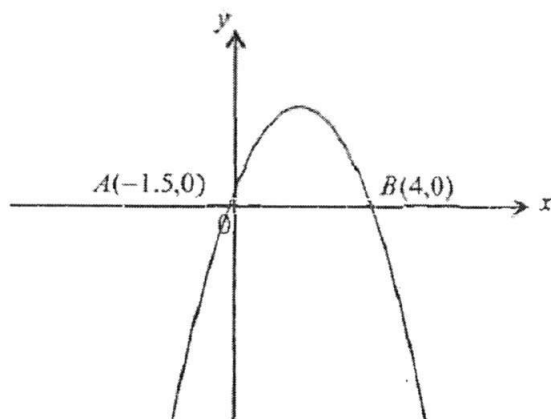
(ii) Hence, sketch the graph of $y = x^2 - 8x + 2$, indicating the coordinates of the turning point and the y -intercept.

Answer (a)(ii)



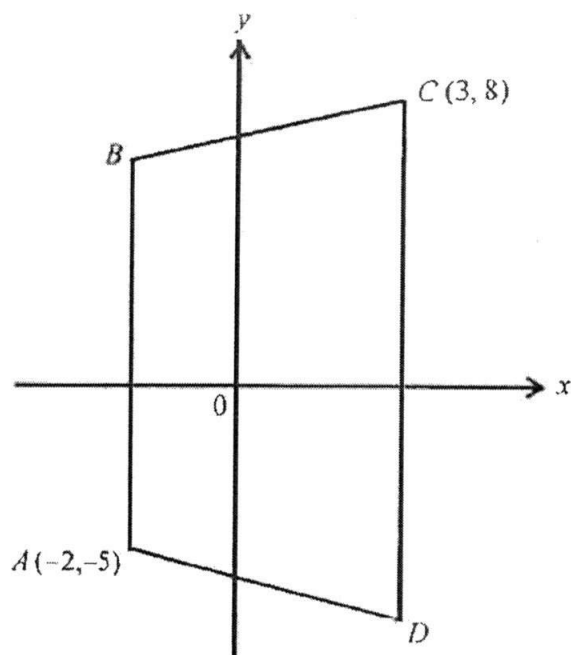
[2]

(b) The diagram below shows a quadratic curve. The equation of the curve is $y = p + qx - 2x^2$. Find the values of p and of q .



Answer (b) $p = \dots\dots\dots$, $q = \dots\dots\dots$ [2]

14. $ABCD$ is a trapezium where AB and CD are parallel to the y -axis. It is given that $A(-2, -5)$, $C(3, 8)$, AB is 12 units and the area of the trapezium is 65 square units.



Find

- (a) the coordinates of B ,

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

- (b) the coordinates of D ,

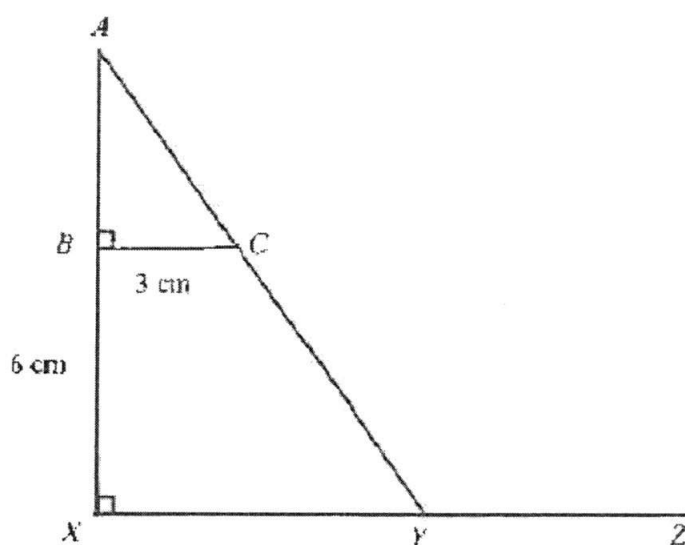
Answer (b) D (.....) [1]

- (c) length of AD .

Answer (c) units [2]

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15. The diagram below is made up of two similar right-angled triangles ABC and AXY . XYZ is a straight line. It is given that $BX = 6$ cm, $BC = 3$ cm and $BC : XY = 2 : 5$.



Giving your answers as a fraction in its lowest term, find

- (a) $\tan \angle BAC$,

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

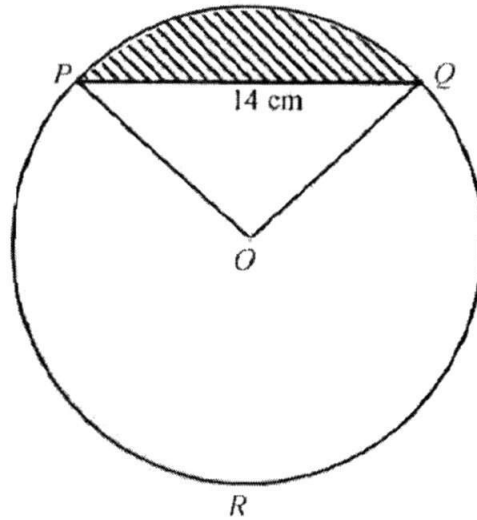
- (b) $\cos \angle AYZ$.

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

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16. The figure shows a circle with centre O , of radius 10 cm and $PQ = 14$ cm.



(a) Show that $\angle POQ = 1.55$ radians.

Answer (a)

[2]

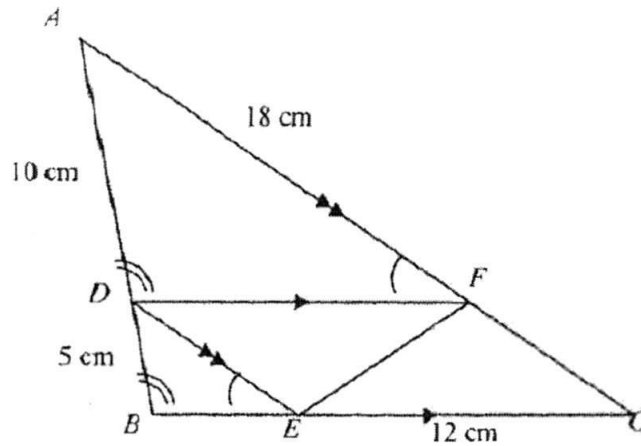
(b) Find the length of major arc PRQ .

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

(c) Find the area of the shaded region.

Answer (c).....cm² [3]

17. In the diagram, DF is parallel to BC and AC is parallel to DE . The points D , E and F lie on the line AB , BC and AC respectively. Given that $DB = 5$ cm, $AD = 10$ cm, $EC = 12$ cm and $AF = 18$ cm.



- (a) Prove that $\triangle ADF$ is similar to $\triangle ABC$.

Answer (a)

.....

.....

.....

.....

.....

.....

[2]

- (b) Prove that $\triangle CEF$ is congruent to $\triangle DFE$.

Answer (b)

.....

.....

.....

.....

.....

.....

[2]

Name: _____ ()

Class: _____

17. (c) Find
(i) the length of BC ,

Answer (c)(i).....cm [1]

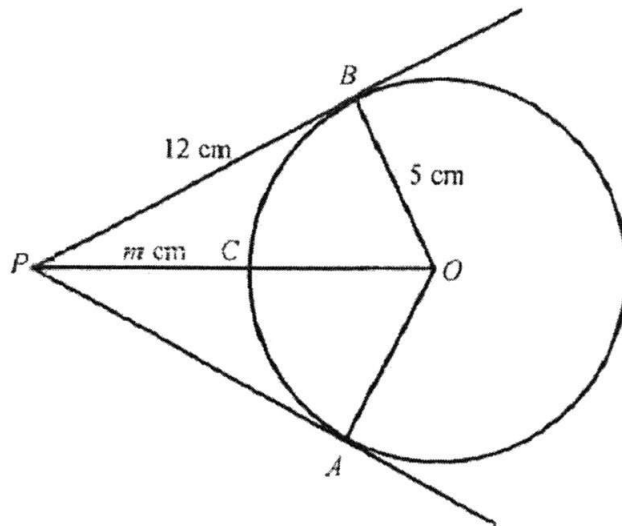
- (ii) $\frac{\text{area of } \triangle DBE}{\text{area of parallelogram } DECF}$

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

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18. In the diagram, PA and PB are tangents to the circle with centre, O . PCO is a straight line where C is a point on the circle.



Find

- (i) the value of m , where $PC = m$ cm,

Answer (i) $m = \dots\dots\dots$ [2]

- (ii) the angle BPA .

Answer (ii) $\dots\dots\dots^\circ$ [2]

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19. The price of 1 litre of Shell FuelSave 95 petrol in Singapore costs S\$1.89.
- (a) Shell rewards loyal customers with privilege cards, a 14% discount. Andy uses the privilege card to pump x litres of petrol at Shell. Find the value of x if he paid \$56.89 for his petrol bill.

Answer (a) $x = \dots\dots\dots$ [2]

- (b) The same type of petrol in Johor Bahru costs RM1.75 per litre. Using your answer from (a), calculate the total amount of money that Andy has to pay if he pumps x litres of petrol at Shell in Johor Bahru.

Answer (b) RM $\dots\dots\dots$ [1]

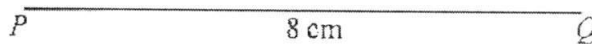
- (c) There is a compulsory toll of RM20 for Singapore vehicles going in to Johor Bahru. Given that the exchange rate is S\$1=RM2.92, find the percentage savings that Andy will have if he pumps x litres of petrol in Johor Bahru.

Answer (c) $\dots\dots\dots\%$ [2]

20. Show your construction lines clearly, using a ruler, compasses and a protractor. The line PQ has been drawn for you.

- (a) Construct a parallelogram $PQRS$ such that $PQ = RS = 8$ cm,
 $PS = QR = 9$ cm, and $\angle PQR = 70^\circ$. [2]
- (b) Find the two possible positions of A and label them A_1 and A_2 , if
 $RA = 9.4$ cm and $\angle SPA = 120^\circ$. [1]
- (c) On the parallelogram $PQRS$, construct
 - (i) the angle bisector of $\angle PSR$. [1]
 - (ii) the perpendicular bisector of the line PS . [1]
- (d) Label the point Y where the perpendicular bisector and the angle bisector meet and measure the length of PY .
- (e) Complete the statement about point Y below.
 The lines and are equidistant from the point Y . [1]

Answer (a), (b), (c)(i) and (c)(ii)



Answer (d) $PY = \dots\dots\dots$ cm [1]

~ End of Paper ~

2016 Sec 3Exp EOY P1 Answer Key		14(c)	5.10 units (to 3sf)
1(a)	$n = 9700$	15(a)	$\frac{3}{4}$
1(b)	2.5×10^9	15(b)	$-\frac{3}{5}$
2(a)	63	16(a)	Let R be the midpoint of PQ . $PR = RQ = 7$ cm $\sin \angle POR = \frac{7}{10}$ $\angle POR = \sin^{-1}\left(\frac{7}{10}\right)$ $\angle POQ = 2 \times \angle POR = 2 \times \sin^{-1}\left(\frac{7}{10}\right) = 1.55$ radians (to 3sf)
2(b)	$p = \frac{7}{11}$	16(b)	47.3 cm (3 s.f.)
3(i)	$r = -\frac{14}{5}$ or $r = -2\frac{4}{5}$ or $r = -2.8$	16(c)	27.5 cm ² (3 s.f.)
3(ii)	$y = \frac{3}{5}x + 8$	17(a)	$\angle ADF = \angle ABC$ (corr. \angle s, $DF \parallel BC$) $\angle DAF = \angle BAC$ (common angle) Or $\angle AFD = \angle ACB$ (corr. \angle s, $DF \parallel BC$) $\therefore \triangle DAF$ is similar to $\triangle ABC$ by AA Similarity Test
4(a)	$x = \frac{p(m^2 + n^2)}{5}$	17(b)	$\angle DFE = \angle CEF$ (alt. \angle s, $DF \parallel CE$) $\angle DEF = \angle CFE$ (alt. \angle s, $DE \parallel CF$) EF is common side $\therefore \triangle CEF \cong \triangle DFE$ by ASA Congruence Test
4b	-4	17(c)(i)	18 cm
5(a)	$x = 3, y = 5$	17(c)(ii)	$\frac{1}{4}$
5(b)	$m = 14$	18(a)(i)	$m = 8$
6	77.7 (to 3sf) or $\frac{1010}{13}$ or $77\frac{9}{13}$	18(a)(ii)	45.2° (to 1 dp)
7(a)	$\frac{2}{3}$	19(a)	35.0
7(b)	$\frac{1}{3}$	19(b)	RM61.25
7(c)	0	19(c)	51.1% (to 3sf)
8(a)	$k = -2$	20(a)-(c)(iii)	
8(b)	$a = 4$	20(d)	5.5 cm (± 0.1)
9(a)	9 cm ²	20(e)	PS and SR
9(b)	7.5 km		
10	$m = 0.54$ or $m = -1.87$		
11(a)	$-2 \leq x < 8$		
11(b)	121		
11(c)	-16		
12(a)	$3x^{\frac{3}{2}}$ or $3x^{1.5}$ or $3x^{\frac{1}{2}}$		
12(b)	$k = 9$		
13(a)(i)	$(x - 4)^2 - 14$		
13(a)(ii)			
13(b)	$p = 12, q = 5$		
14(a)	$B(-2, 7)$		
14(b)	$D(3, -6)$		

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FAIRFIELD METHODIST SCHOOL (SECONDARY)

**END-OF-YEAR EXAMINATION 2016
SECONDARY 3 EXPRESS**

MATHEMATICS

4048/02

Paper 2

Date: 10 October 2016

Duration: 2 hours 30 minutes

Additional Materials: Answer Paper
 Graph paper

READ THESE INSTRUCTIONS FIRST

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

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 .

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 100.

Setter: Mdm Haliza and Mrs Lynn Pang

This question paper consists of 13 printed pages including the cover page.

Answer all the questions.

1 (a) (i) Factorise $2x^2 - 7x + 3$. [1]

(ii) Hence, simplify $\frac{2x^2 - 7x + 3}{x^2 - 9}$. [2]

(b) Express as a single fraction in its simplest form,

$$\frac{4}{x-3y} - \frac{1}{6y-2x} \quad [3]$$

(c) A formula is given as $r = \frac{s+3}{1-2s}$.

(i) Find the value of r when $s = -2$. [1]

(ii) Express s in terms of r . [2]

(d) Solve the equation $1 - \frac{4m+2}{2m} = \frac{5}{m}$. [3]

- 2 (a) Matthew has \$20 000 to invest in Company A or Company B. Company A offers 3.8% per annum simple interest while Company B offers 3.5% per annum compound interest, compounded half-yearly.

Matthew wishes to invest the money for a period of 5 years.

Which company should he invest in? Explain your answer. [3]

- (b) The cost of making a particular washing machine is divided between materials, wage and other miscellaneous costs in the ratio 4 : 3 : 2. The material cost used for a washing machine is \$600.

(i) What is the total cost of making a washing machine? [1]

(ii) Due to a new minimum wage regulation, the wage was raised by 10%.

Express, correct to one decimal place, the new wage as a percentage of the new total cost. [4]

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- 2 (c) In 2014, Mrs Lee earned a gross annual salary of \$84 000. Of this \$84 000, the amount that will not be subjected to income tax includes her donation of 5% of her gross annual salary to charity, an annual relief amount of \$10 000 for looking after her mother who in turn looks after her children and her annual Central Provident Fund (CPF) contributions which amounted to \$16 800. By referring to the Income Tax table below, find Mrs Lee's income tax payable for 2014. [3]

Chargeable Income	Income Tax Rate (%)	Gross Tax Payable
First \$20,000	0	0
Next \$10,000	2	200
First \$30,000	-	200
Next \$10,000	3.50	350
First \$40,000	-	550
Next \$40,000	7	2,800
First \$80,000	-	3,350
Next \$40,000	11.5	4,600

[chargeable income refers to the annual gross income less all donations and relief for the same year]

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- 3 The stem and leaf diagram below shows the scores of 21 students in a Mathematics class test. The full mark of the test is 60 marks.

Stem	Leaf
2	5 7 9
3	0 1 y 2 3 9
4	2 4 5 6 6 x 9
5	0 1 3 6 6

Key: 2|5 represents 25 marks

- (a) Given that the modal score is 46 marks, and the mean score is 41 marks, find
- (i) the value of x and, [1]
 - (ii) the value of y . [2]
- (b) Find the median score. [1]
- (c) What is the percentage of students who scored 42 marks and above? [1]
- (d) It was discovered that one of the questions had error and thus all the students were given 1 more mark. Explain how the median and mean have been affected by the error. [2]

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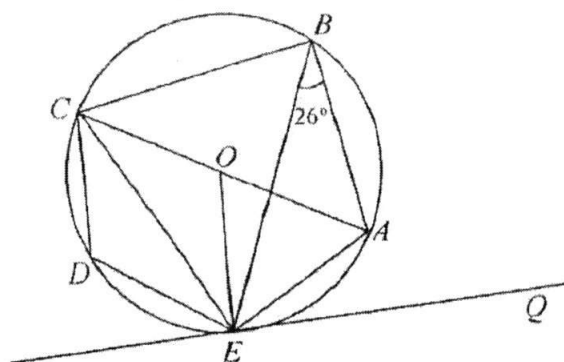
Class: _____

- 4 (a) The sequence of numbers 1, 5, 11, 19, 29, ... can also be expressed in the form:

Term, n	Number	Pattern
1	1	$1^2 + 0$
2	5	$2^2 + 1$
3	11	$3^2 + 2$
4	19	$4^2 + 3$
5	29	

- (i) Find the pattern for the 5th term. [1]
- (ii) Find an expression, in terms of n , for the n th term. [1]
- (iii) Find the value of the 111th term of the sequence. [1]
- (iv) For which term will the number 271 appear in the sequence? [2]
- (v) Explain why 56 is not a member of the above sequence? [1]
- (b) Write down an expression in terms of n , for the n th term of the sequence
4, 7, 10, 13, 16 ... [1]

5 (a)



The points A , B , C , D and E lie on a circle, centre O . AC is a diameter of the circle. EQ is a tangent to the circle at E and $\angle ABE = 26^\circ$.

(i) Stating your reasons clearly, find

(a) $\angle ACE$, [1]

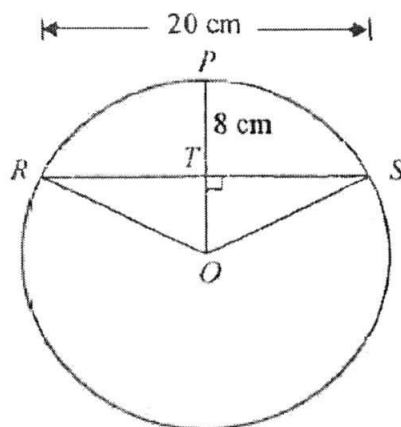
(b) $\angle CBE$, [1]

(c) $\angle CDE$, [1]

(d) $\angle AEQ$. [2]

(ii) Given that $\angle AEB = 38^\circ$, determine whether the lines EO and AB are parallel. Give a reason for your answer. [2]

(b) The perpendicular bisector of a chord, RS , cuts it at T and the circumference of the circle at P . If $RS = 20$ cm and $TP = 8$ cm, find the radius of the circle.

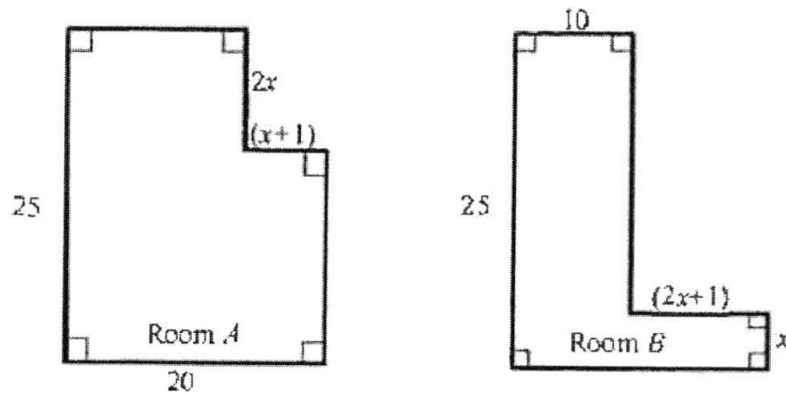


[2]

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- 6 The diagram below, not drawn to scale, shows the layout of two rooms, *A* and *B*. All dimensions are given in metres.

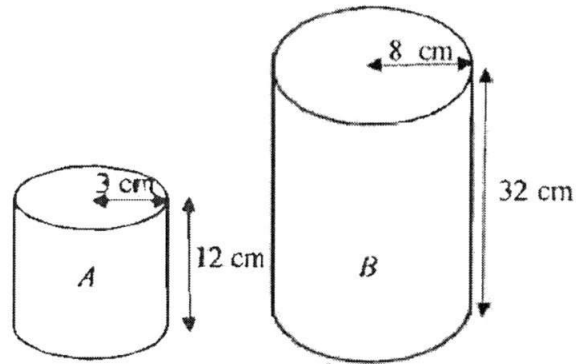


- (a) Write down an expression, in terms of x , for the area of Room *A* and show that that it reduces to $-2x^2 - 2x + 500$. [1]
- (b) Write down an expression, in terms of x , for the area of Room *B* and show that that it reduces to $2x^2 + x + 250$. [1]
- (c) A contractor was hired to lay tiles in Room *B*. The cost for tiling was \$25 per square metre.
- (i) Find in terms of x , the cost of tiling Room *B*. [1]
- (ii) If the cost of tiling Room *B* is \$7 500, form an equation in terms of x , and show that it reduces to $2x^2 + x - 50 = 0$. [1]
- (iii) Hence, find the value of x . [3]
- (iv) Using the value of x from (iii), find the cost of tiling Room *A*. [1]

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- 7 The diagrams, not drawn to scale, show two solid cylinders with their dimensions. These cylinders are made with the same material.



- (a) Show that cylinders A and B are similar. [2]
- (b) Find the ratio of the total surface area of cylinder B to that of cylinder A . [1]
- (c) Given that cylinders A and B are similar to another cylinder C with a height of 4.5 cm. Find the curved surface area of cylinder C . [2]
- (d) If the mass of A is 360 g, find the mass of B in kg, leaving your answer in 3 decimal places. [2]

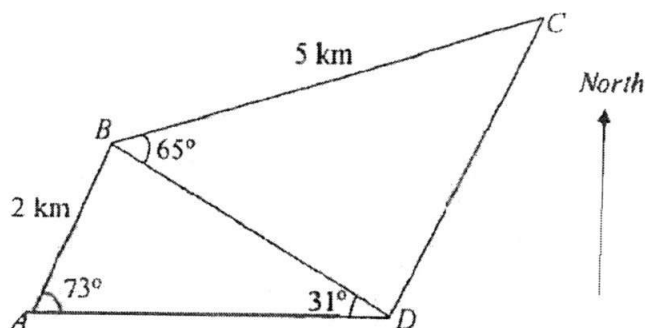
Name: _____ ()

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8 A, B, C and D are four points on a field.

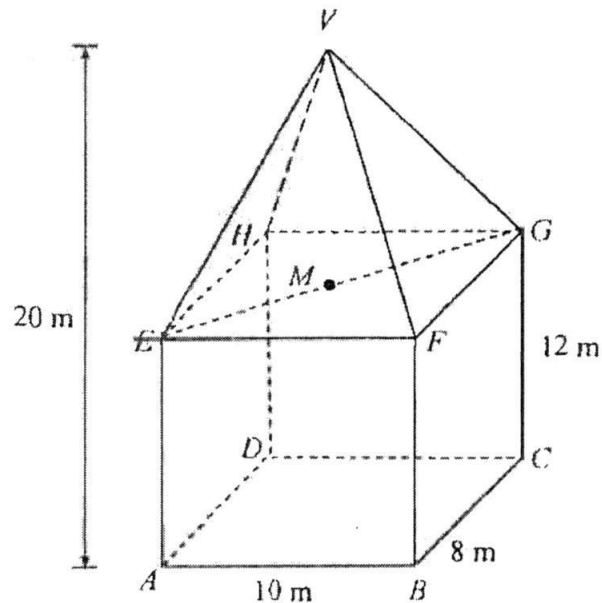
Angle DAB is 73° , angle ADB is 31° , angle DBC is 65° , AB is 2 km and BC is 5 km.

D is due east of A .



- (a) Show that $BD = 3.714$. [2]
- (b) Calculate
- (i) CD , [3]
 - (ii) the area of triangle BCD , [2]
 - (iii) the shortest distance from D to BC , [2]
 - (iv) the bearing of B from D . [1]

- 9 A simplified diagram of a building is shown below. It is 20 m tall. $ABCD$ represents the rectangular floor of the building. E , F , G and H are vertically above A , B , C and D respectively. V represents the vertex of the roof in the shape of a pyramid. M is the midpoint of EG . It is given that $AB = 10$ m, $BC = 8$ m and $CG = 12$ m.

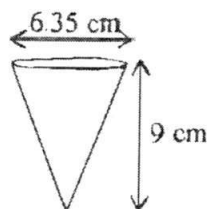
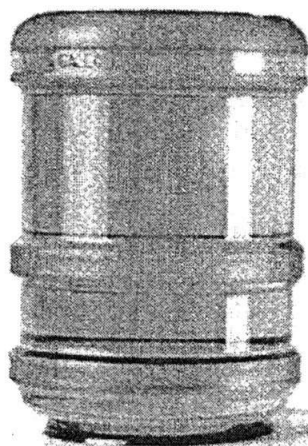


Calculate

- | | | |
|-----|---|-----|
| (a) | AC , | [1] |
| (b) | $\angle VEM$, | [2] |
| (c) | AG , | [1] |
| (d) | $\angle AGD$, | [2] |
| (e) | the angle of depression of B from V . | [2] |

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- 10 The figure below shows a 22.7 litre cylindrical bottle and the conical paper cup used by a company in its water dispenser. The cup has diameter of 6.35 cm and a height of 9 cm.



(Take $\pi = 3.142$)

- (a) Calculate the volume of one conical cup. [2]
- (b) Calculate the number of conical cups required for one cylindrical bottle. [2]
- (c) The conical cups are sold in packets of 5000. Calculate the area of paper required to make 5000 conical cups. [4]
- (d) The company decides to switch to a different shaped paper cup that looks like a frustum, as shown in the figure below. The frustum has slanted edges that are parallel to the conical cup and the diameter of the base of the frustum is the same as the diameter of the mouth of the conical cup. It also has the same volume as the conical cup.



Will the height of the new cup be the same as the conical cup? Use a suitable model and justify your answer with calculations. [3]

Name: _____ () Class: _____

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

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

$$y = 1 - 2^x.$$

x	-2	-1	0	0.5	1	1.5	2	2.5
y	p	0.5	0	-0.4	-1	-1.8	-3	-4.66

- (a) Find value of p . [1]
- (b) Using a scale of 4 cm to represent 1 unit on the x -axis, and 2 cm to represent 1 unit on the y -axis, draw the graph of $y = 1 - 2^x$ for $-2 \leq x \leq 2.5$. [3]
- (c) Use your graph to find
- (i) the value of y when $x = -1.5$, [1]
- (ii) the value of x when $y = -2.2$. [1]
- (d) By drawing a tangent, find the gradient of the curve at the point where $x = 2$. [2]
- [2]
- (e) Use the graph to solve the equation $2^x + 2x - 2 = 0$. [2]

~ End of Paper ~

Answer Key for Sec 3 Express EOY Mathematics Paper 2 2016

QN	Answer	QN	Answer
1(ai)	$(2x-1)(x-3)$	3(d)	New median score is still at the 11 th score and thus new median is 45 marks. Median and mean values will be affected. <ul style="list-style-type: none"> • Mean value is increased by 1 mark and • its median value is also increased by 1 mark
1(aii)	$\frac{2x-1}{x+3}$	4(a)(i)	5 th term = $5^2 + 4$
1(b)	$\frac{9}{2(x-3y)}$	4(a)(ii)	$n^2 + (n-1)$
1(c)(i)	$\frac{1}{5}$ OR 0.2	4(a)(iii)	12431
1(c)(ii)	$s = \frac{r-3}{1+2r}$	4(a)(iv)	$n = 16$.
1(d)	$m = 0$ (reject) or -6	4(a)(v)	$n^2 + (n-1) = 56$ $n^2 + n - 57 = 0$ The solution for n will not be an integer, thus 56 cannot be a member of the sequence.
2(a)	Company A is = \$23800 Company B is = \$23788.89 He should invest in Company A since the total amount is greater	4(b)	$3n + 1$
2(b)(i)	\$1350	5a(i)(a)	$\angle ACE = 26^\circ$ (angles in the same segment)
2(b)(ii)	35.5% (to 1 d.p.)	5a(i)(b)	$\angle CBE = 90 - 26 = 64^\circ$ (angle in a semicircle)
2(c)	\$1460	5a(i)(c)	$\angle CDE = 180 - 64 = 116^\circ$ (angles in opp. seg)
3(ai)	$x = 6$	5a(i)(d)	$\angle CAE = 64^\circ$ (angles in the same segment) $\angle AEQ = 90 - 64$ (tan \perp rad) $= 26^\circ$ Or $\angle AEQ = 26^\circ$ (angle in alt. segment)
3(aii)	$y = 1$	5a(v)	$\angle OEB = 64 - 38 = 26^\circ$ $\therefore \angle OEB = \angle ABE = 26^\circ$ Hence, lines EO and AB are parallel since $\angle OEB$ and $\angle ABE$ are alternate angles.