Candidate Name: _____

Class:	
Index No:	

Chong Boon Secondary School

Preliminary Examination 2016

Secondary 4 Express / 5 Normal Academic Mathematics

4016/01
4048/01

Paper 1

30 August 2016 (Tuesday) | **2 hours**

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Candidates answer on the Question Paper.

Write your name, class and candidate number on the cover sheet.
Write in dark blue or black pen.
You may use a soft 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.
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 the 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 of the marks for this paper is 80.

For Examiner's Use
80

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

$$\text{Area of } \Delta ABC = \frac{1}{2}bc\sin A$$

Arc length $= r\theta$, where θ is in radian

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions

1. (a) Calculate $\dfrac{2015^{\frac{1}{3}} + 3^2}{2.014 \times \sqrt{20.013}}$.

Write down the first four digits of your answer.

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

(b) Write your answer to **part (a)** correct to 3 significant figures.

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

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2. The first five terms of a sequence are $-2, 4, -8, 16, -32, \ldots$

(a) Write down the next two terms in the sequence.

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

(b) Find an expression, in terms of n, for the n th term of the sequence.

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

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3. A factory manufactures microchips.

In a particular month, the factory produced 6×10^{20} microchips. On inspection, 1.5×10^{19} of these microchips were found to be in good condition and the rest were faulty and had to be discarded.

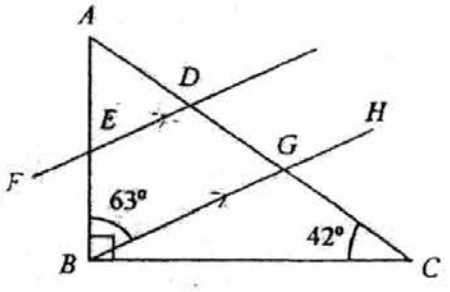
(a) Find the number of microchips that were faulty. Give your answer in standard form.

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

(b) Find the ratio of the number of microchips in good condition to the total number of microchips produced.

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

4. In the diagram, ABC is a right-angled triangle and DEF is parallel to HGB. Given that angle $ABC = 90°$, angle $GBA = 63°$ and angle $ACB = 42°$.



Calculate

(a) angle AEF,

Answer (a) .....° [1]

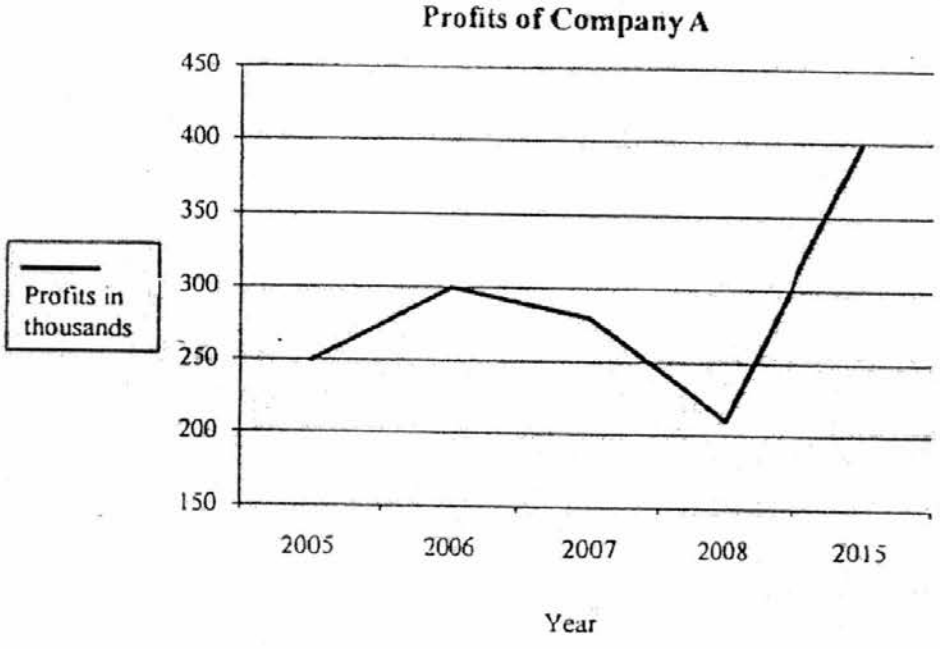
(b) angle ADE,

Answer (b) .....° [1]

(c) angle CGB.

Answer (c) .....° [1]

5. The line graph below shows the profits that company **A** has made over a few years.



Explain **one** way in which the graph is misleading.

Answer .....

.....

.....

..... [2]

6. Expand and simplify $x(2x-4y)-2(x-y)^2$.

Answer ..... [2]

---

7. The energy E in joules stored in an elastic band varies as the square of its extension d cm.

(a) The value of E is 100 when the extension of the elastic band is at a particular value. Find the new value of E when the extension of the elastic band is doubled.

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

(b) When the elastic band is extended by 3 cm, the energy stored is 243 joules. What is the extension when the stored energy is 108 joules?

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

8. $\varepsilon = \{x : x \text{ is an integer such that } 1 \leq x \leq 10\}$,

$A = \{x : x \text{ is a prime number}\}$,

$B = \{x : x \text{ is an odd number}\}$.

(a) List the elements in $A \cap B$.

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

(b) List the elements in $A \cup B$.

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

(c) Find the value $n(A \cup B)'$.

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

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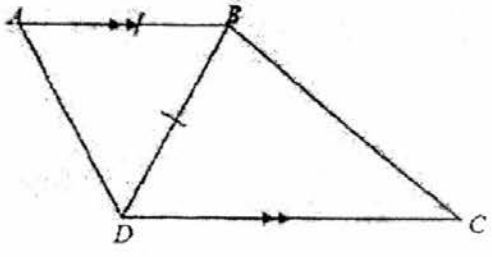
9. $ABCD$ is a quadrilateral such that AB is parallel to DC. $BA = BD$ and BD bisects angle ADC.



(a) Explain why triangle ABD is equilateral.

Answer .....

.....

..... [2]

(b) Given further that angle $DBC = 80°$, find reflex angle BCD.

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

10. Factorise the following completely

(a) $3a(b+c)-b-c$,

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

(b) $5r^2-20s^2$.

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

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11. (a) Two cylinders A and B have diameters $6x$ cm and $12x$ cm respectively. Initially, cylinder A contains water to a height of 45 cm and cylinder B is empty. If all the water from A is poured into B, calculate the height of water in B.

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

(b) A small traffic marker is geometrically similar to a large one, and the diameters of the two markers are 14 cm and 28 cm respectively.

(i) Write down the ratio of the total surface area of the small marker to that of the large one.

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

(ii) Find the weight of the large marker, in kilograms, if the small one weighs 0.8 kg.

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

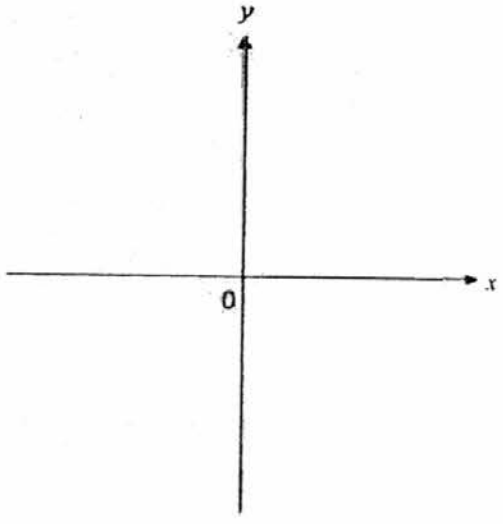
12. (a) Express $y = x^2 + 2x - 8$ in the form of $y = (x + p)(x + q)$.

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

(b) Hence, sketch $y = x^2 + 2x - 8$.

Answer (b)

[2]



13. (a) Express $y^2 + 11y - 15$ in the form $(y + a)^2 + b$.

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

(b) Hence solve the equation $y^2 + 11y - 15 = 0$, giving your answers correct to two decimal places.

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

14. Two stores advertise the same sofa set during the Great Singapore Sale.

STORE *A*

$1500 + 7% GST*

STORE *B*

- **Deposit of $220**
  plus 12 monthly instalments of $120
- **Price includes 7% GST***

**GST : Goods and Services Tax*

(a) Which store sells the sofa set at a lower price? Justify your answer.

Answer (*a*) Store ..... offers a lower price

[2]

(b) Calculate the amount of GST charged on the sofa set in Store *B*.

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

15. (a) Two of the interior angles of a pentagon are $(x + 80)°$ and $(3x + 10)°$, while the remaining interior angles are 110° each. Find the value of x.

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

(b) The diagram shows three sides AB, BC and CD of a regular polygon. Angle $CDB = 18°$.

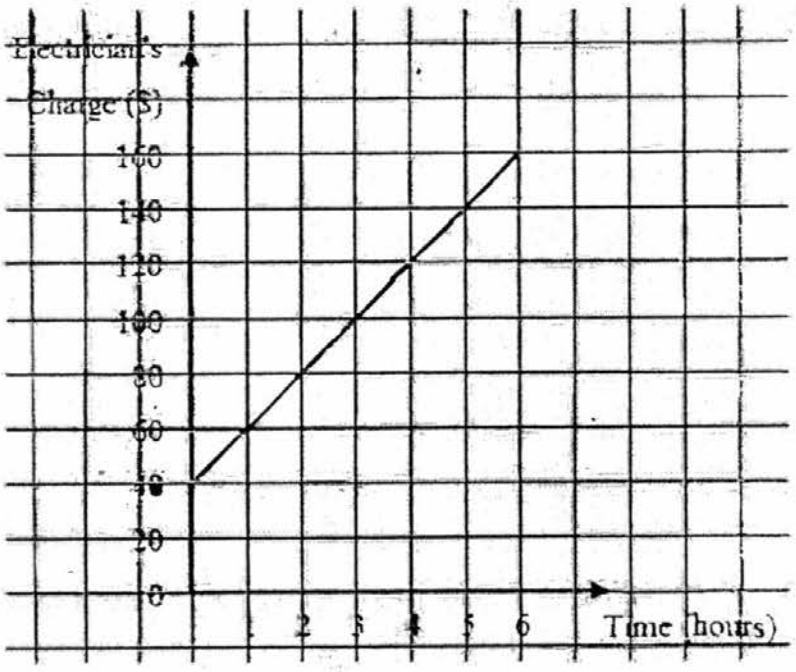
(i) Find the exterior angle of the polygon.

Answer (b)(i) .....° [1]

(ii) Calculate the number of sides of the polygon.

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

16. The graph shows the charges of an electrician, Mr Lim, to carry out repairs.



(a) If Mr Lim charged $100 for a particular repair, how long did it take?

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

(b) Another electrician, Mr Bala, charges $30 per hour, but does not have a fixed charge. Draw a line on the grid to represent Mr Bala's charges. [1]

(c) For a repair that is expected to take 3.5 hours, which electrician would charge less?

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

17. A bag contains 4 balls, numbered 1, 2, 3 and 4.
Two balls are taken from the bag at random, one after the other, **without replacement.**

(a) Draw the possibility diagram to represent the outcomes. [1]

Answer (a)

(b) Find, in its simplest form, the probability that

(i) the product of the two numbers is a square number,

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

(ii) one number is odd and another number is even,

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

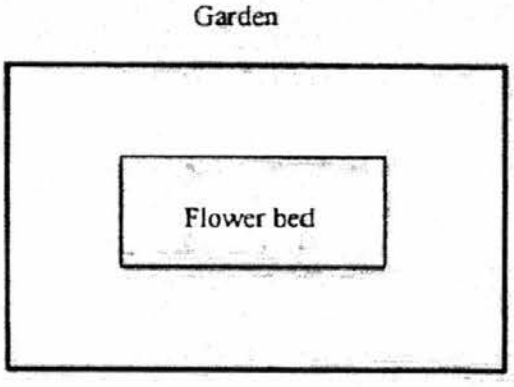
(iii) the sum of the numbers is more than 5,

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

(iv) one of the numbers is 1.

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

18. A rectangular garden with a flower bed is as shown below. The area of the garden is 15 m^2.



(a) If a flower bed occupies 23% of the garden, find the area of the flower bed.

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

(b) Given the length of the garden is $(x + 2)$ m, find its width in terms of x.

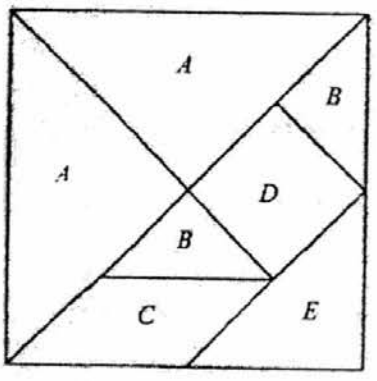
Answer (b) ..... [1]

(c) Given that the width of the garden is $\frac{9}{x}$ m, write an equation in x and use it to find the length of the garden.

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

19. The following tangram consists of 7 pieces that are cut from a square. It consists of:

A : Two large congruent triangles
B : Two small congruent triangles
C : One parallelogram
D : One square
E : One medium triangle



The total area is 56 cm^2. Calculate the area of

(a) parallelogram *C*,

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

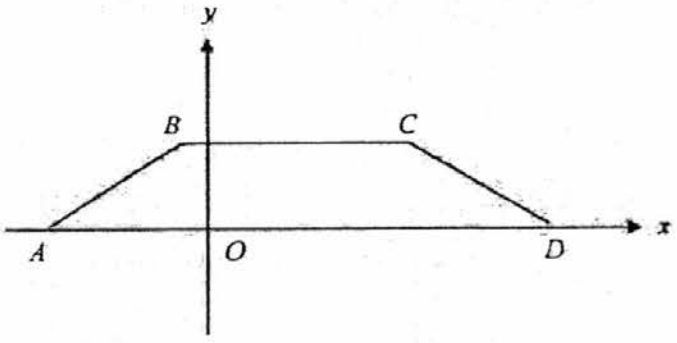
(b) square *D*,

Answer (b) ..... cm^2 [1]

(c) triangle *E*.

Answer (c) ..... cm^2 [1]

20. $ABCD$ is a trapezium in which the length of BC is 8 units.



If A is the point $(-4, 0)$, B is the point $(-1, 4)$ and the area of the trapezium is 48 square units, find

(a) the coordinates of the point C,

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

(b) the length of AB,

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

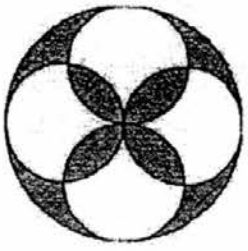
(c) the coordinates of the point D,

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

(d) sin $O\hat{A}B$, expressing your answer as a fraction.

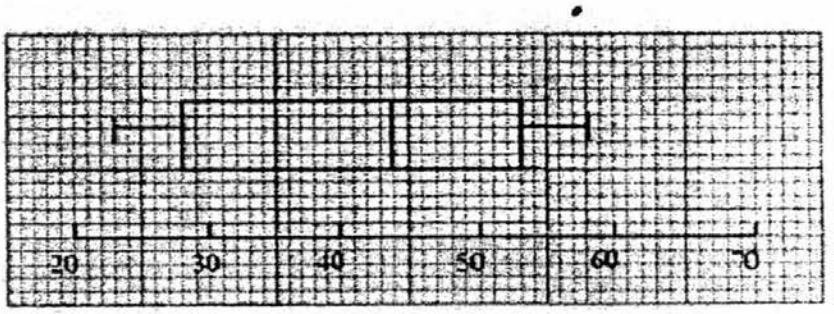
Answer (d) ..... [1]

21. The diagram shows a pattern formed by four identical circles inside a larger circle.
The radius of the larger circle is twice the radius of the smaller circles.
Find the shaded area if the radius of the larger circle is 5 cm.



Answer ..... cm^2 [5]

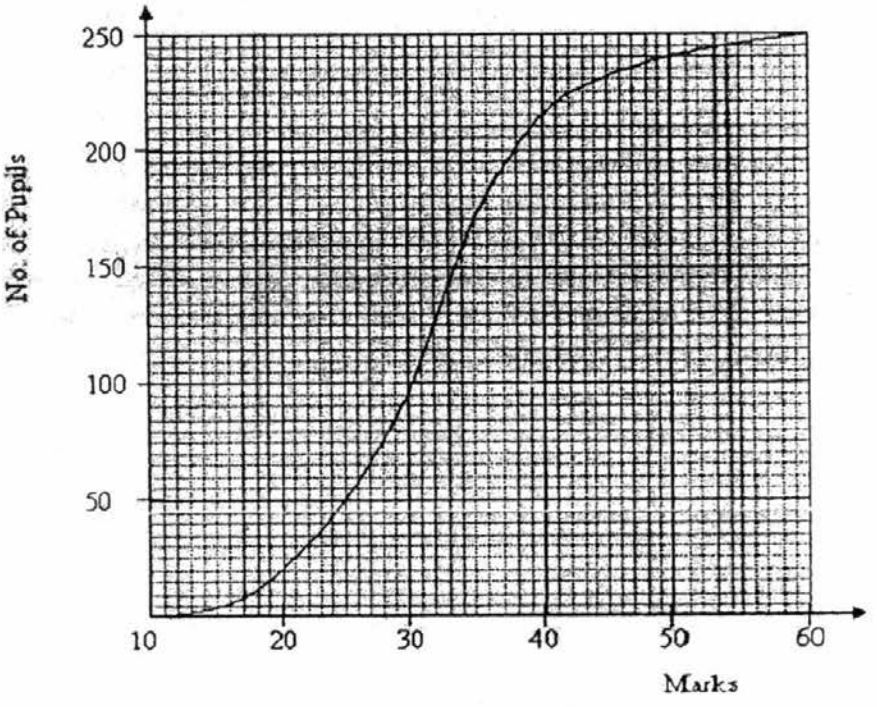
22. (a) The data below shows the marks of Class 4A in their recent Mathematics common test.



Calculate the interquartile range.

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

(b) The cumulative frequency graph represents the marks of the whole Secondary Four cohort in the recent Mathematics common test.



Use the graph to estimate the passing mark if only 42% of the cohort passed the Mathematics common test.

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

(c) Here are two statements comparing the marks of the cohort and Class 4A.
For each one, write down whether you agree or disagree.
Give a reason for each answer, stating clearly the statistical data used.

(i) On average, Class 4A did better than the whole Secondary Four cohort in the Mathematics common test.

Answer I ..... because .....

.....

..... [1]

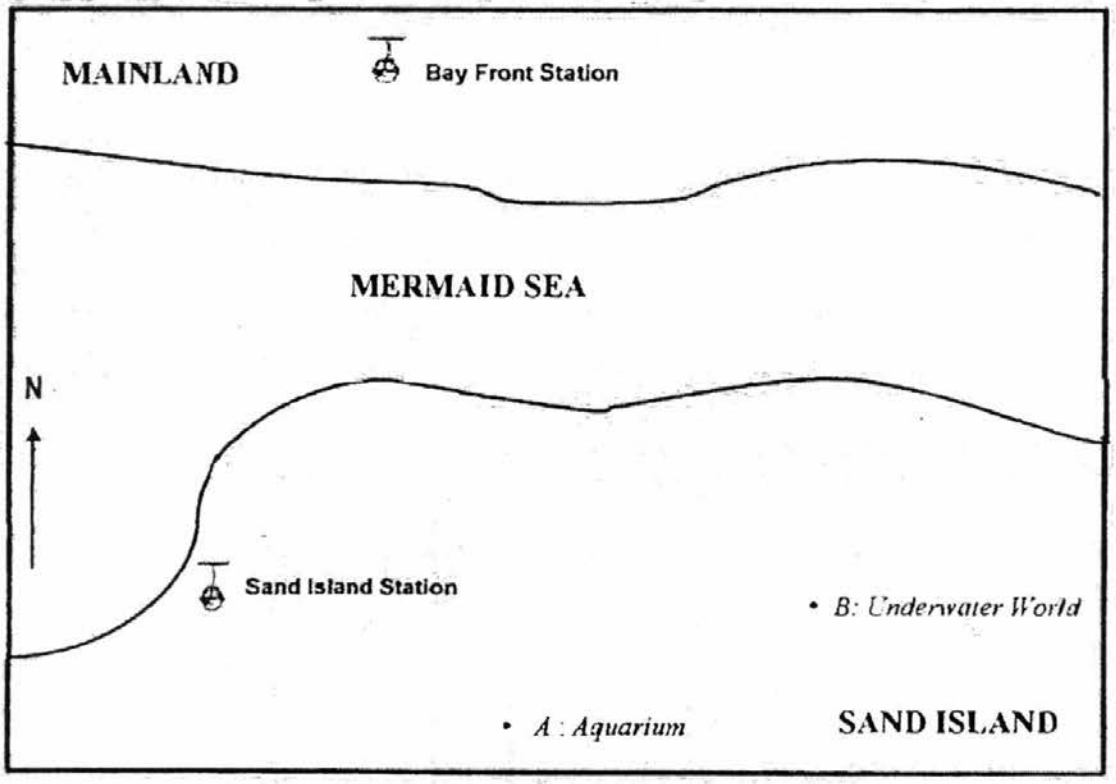
(ii) The Mathematics marks of the students in Class 4A have a wider spread than the whole Secondary Four cohort in the common test.

Answer I ..... because .....

.....

..... [1]

23. The diagram below shows part a map of the Mainland and a holiday resort, Sand Island, which are connected by a cable car system. The scale is 1:15 000.



The actual distance between Bay Front Station on the Mainland and Sand Island Station on Sand Island is 1260 metres. It will take 12 minutes on a continuous ride from Bay Front Station to Sand Island Station.

(a) Calculate the speed of the cable car. Give your answer in metres per second.

Answer (b) ..... m/s [2]

The *Maritime Museum*, *C* is on a bearing of 030° from *Aquarium*, *A*, and 600 metres from the *Underwater World*, *B*.

(b) Mark out and label the position of *C* on the map above. [2]

(c) Calculate the actual distance, in kilometres, between *A* and *B*.

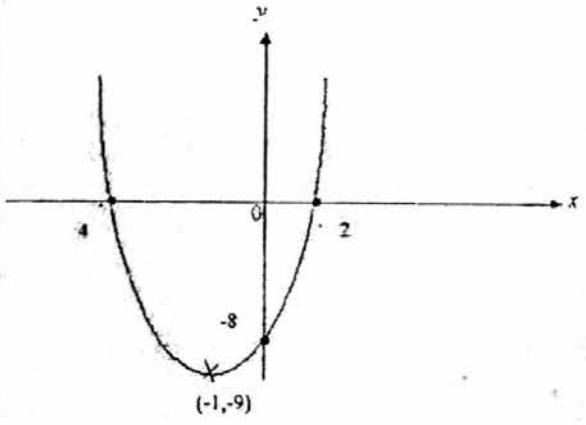
Answer (c) ..... km [2]

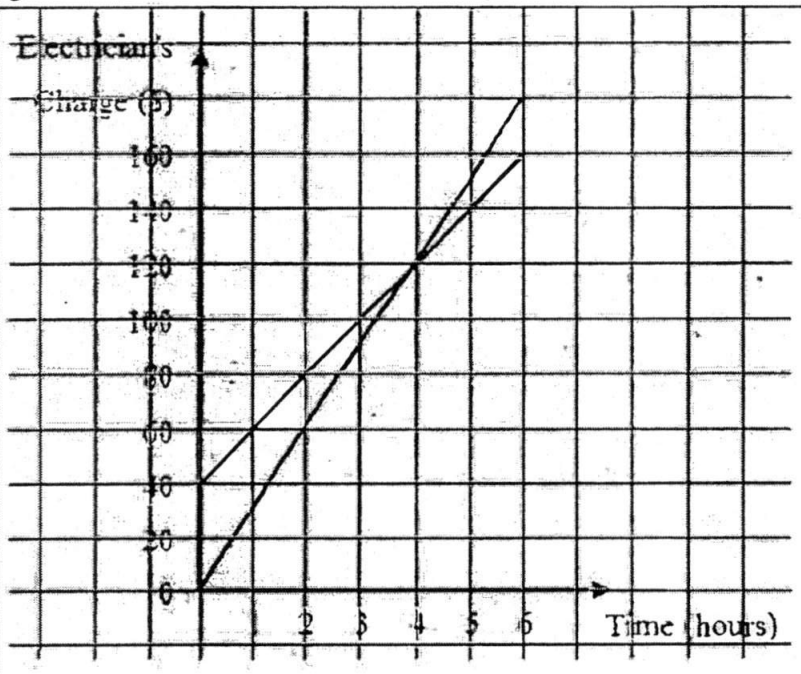
END OF PAPER

2016 4E 5N Preliminary Examination Paper 1 Marking Scheme

Qn	Solutions	Mark	Remark
1a	2.400	B1	
1b	2.40	B1	
2a	64, -128	B1	
2b	$(-2)^n$	B1	
3a	5.85×10^{20}	B1	
3b	1 : 40	B1	
4a	117°		
4b	69°	B1	
4c	111°	B1	
		B1	
5	<table><tr><td>Misleading Feature</td><td>Effect</td></tr><tr><td>Not all years are shown</td><td>Exaggerates the differences between the 2015 and 2008</td></tr><tr><td>Not all years are shown</td><td>This does not allow a good comparison or fair comparison of the profit made over the years</td></tr><tr><td>Unequal spacing of years</td><td>Profits could be very low or very high from 2009 to 2014. The trend is misrepresented.</td></tr><tr><td>Vertical axis does not start from 0</td><td>Rate of gain in profits appear steeper</td></tr></table>	B2	*Award B1 for misleading feature and B1 for the effect of this feature on the graph.*
6	$x(2x-4y)-2(x-y)^2 = 2x^2-4xy-2(x^2-2xy+y^2)$ $= 2x^2-4xy-2x^2+4xy-2y^2$ $= -2y^2$	M1 A1	
7a	$E = kd^2$ $100 = kd^2$ $k = \frac{100}{d^2}$ When d is doubled $E = k(2d)^2$ $E = \frac{100}{d^2}(2d)^2$ $E = 400$ *joules*	M1 A1	

7b	$243 = k(3)^2$ $k = 27$ $108 = 27d^2$ $d^2 = 4$ $d = 2cm$	M1 A1	
8a	{3, 5, 7}	B1	
8b	1, 2, 3, 5, 7, 9}	B1	
8c	4	B1	
9a	$\angle BAD = \angle BDA$ (base $\angle$s of isos. Δ) $= \angle BDC$ (DB bisects $\angle ADC$) $= \angle ABD$ (alt. $\angle$s) Since all 3 angles of ΔABD are equal, ΔABD is equilateral.	B2	*Award B1 for any two correct conditions stated*
9b	$\angle BCD = 180° - 80° - 60°$ $= 40°$ ($\angle$ sum of Δ) Hence, reflex $\angle BCD = 320°$	B1	
10a	$3a(b+c) - (b+c)$ $= (3a - 1)(b + c)$	B1	
10b	$5(r^2 4s^2)$ $= 5(r + 2s)(r - 2s)$	B1	
11a	Height of B $= \dfrac{\pi \times (3x)^2 \times 45}{\pi \times (6x)^2}$ $= 11.25$ cm	M1 A1	
11bi	$14^2 : 28^2$ $= 1 : 4$	B1	
11bii	$2^3 \times 0.8$ $=6.4$ kg	M1 A1	
12a	$y = (x+4)(x-2)$	B1	
12b		B2	*Award 1 mark for the correct shape and 1 mark for all the intercepts and minimum point*

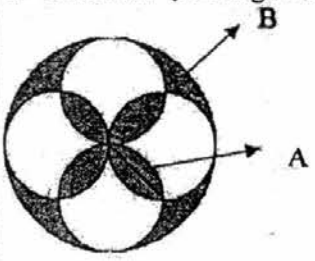
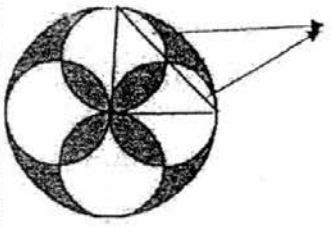
			
13a	$y^2+11y-15=y^2+11y+\left(\frac{11}{2}\right)^2-\left(\frac{11}{2}\right)^2-15$ $=\left(y+\frac{11}{2}\right)^2-45\frac{1}{4}$ or $\left(y+5\frac{1}{2}\right)^2-45\frac{1}{4}$		
13b	$\left(y+5\frac{1}{2}\right)^2=45\frac{1}{4}$ $\left(y+5\frac{1}{2}\right)=\pm\sqrt{45\frac{1}{4}}$ $y=1.23$ or -12.23	M1 (ecf) A1	*No mark if the students used the formula to solve or only answers were given*
14a	Store A offers a lower price because Price of LCD TV (Store A) $=\frac{107}{100}\times\$1500$ $=\$1605$ Price of LCD TV (Store B) $=\$220+12\times\$120$ $=\$1660$ Store A offers better deal since the cost of the TV set is lower at Store A.	B2	*Deduct one mark for any wrong answer of the prices*
14b	Amount of GST $=\frac{7}{107}\times\$1660=\$108.60$ (2 decimal places)	B1	
15a	$(x+80)+(3x+10)+3\times110=(5-2)\times180$ $4x+420=540$ $4x=120$ $x=30$	M1 A1	

15bi	Interior angle = 180 - 2×18 = 144° Exterior angle = 180° – 144° = 36°	B1	
15bii	Number of sides = 360 ÷ 36 = 10	B1	
16a	3	B1	
16b		B1	
16c	Mr Bala	B1	
17a		B1	

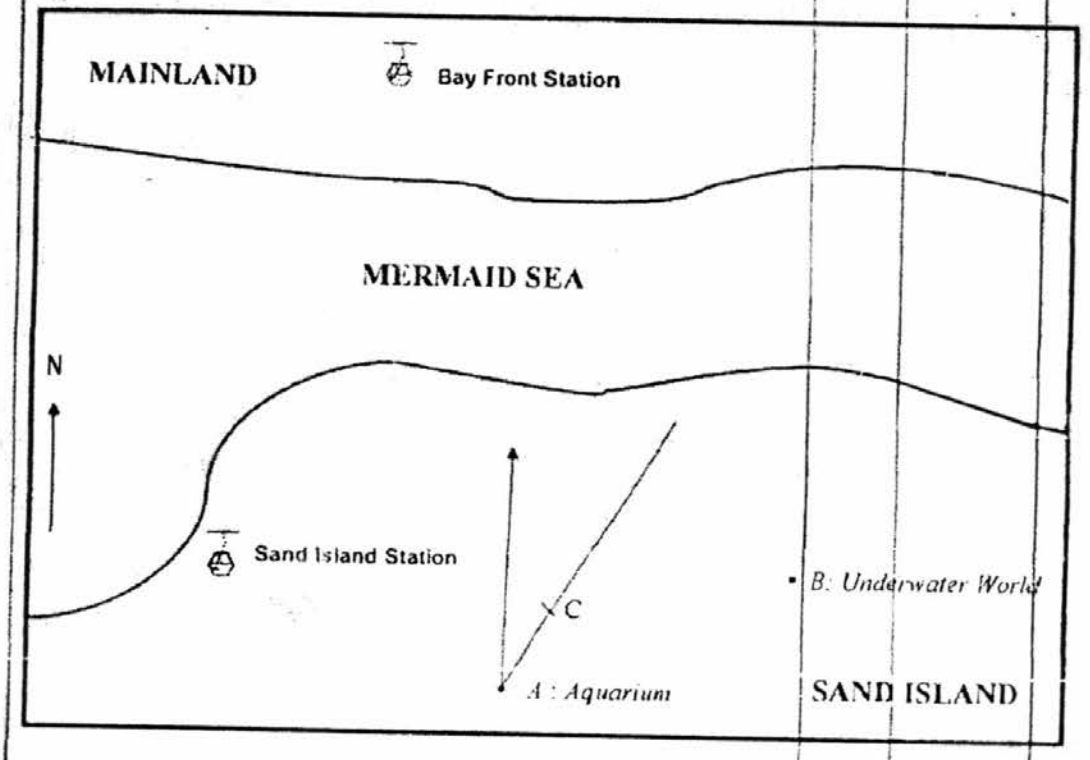
	1	2	3	4
1		(2, 1)	(3, 1)	(4, 1)
2	(1, 2)		(3, 2)	(4, 2)
3	(1, 3)	(2, 3)		(4, 3)
4	(1, 4)	(2, 4)	(3, 4)	

17bi	$\frac{2}{12} = \frac{1}{6}$	B1	
17bii	$\frac{8}{12} = \frac{2}{3}$	B1	
17biii	$\frac{4}{12} = \frac{1}{3}$	B1	
17biv	$\frac{6}{12} = \frac{1}{2}$	B1	

18a	Area = $23\% \times 15\ m^2$ $= \frac{23}{100} \times 15$ $= 3.45\ m^2$	M1 A1	
18b	$\frac{15}{x+2}$ m	B1	
18c	$\frac{15}{x+2} = \frac{9}{x}$ $9(x+2) = 15x$ $9x + 18 = 15x$ $6x = 18$ $x = 3$ Length = 2 + 3 = 5 m	 M1 A1	
19a	Area of A = 56 ÷ 4 = 14 cm^2 Area of B = 14 ÷ 4 = 3.5 cm^2 Area of 2B = area of C = 3.5 × 2 = 7 cm^2	M1 A1	
19b	Area of 2B = area of D = 3.5 × 2 = 7 cm^2	B1	
19c	Area of 2B = area of E = 3.5 × 2 = 7 cm^2	B1	
20a	C (7,4)	B1	
20b	$\sqrt{(4-0)^2 + (-1-(-4))^2} = 5$ units		
20c	$\frac{1}{2} \times (8 + AD) \times 4 = 48$ $8 + AD = 24$ $AD = 16$ D (12,0)	 M1 A1	
20d	$\frac{4}{5}$	B1	
21	8 shaded regions = Large circle – 4 semicircles – square + 4 semicircles – square Large circle – 2 squares $\pi 5^2 - \square 2[2(2.5)]^2$ $25\pi - 2 \times 5^2$ $25\pi - 50$ = 28.5 cm^2 (to 3 significant figures)	 M2 M1 M1 A1	Method 1

	Shaded area half leaf A = quadrant - triangle $\square\square\frac{1}{4}\times\pi\times(2.5)^2-\frac{1}{2}(2.5)^2$ $\square\square 4.9087-\square 3.125$ $\square\square 1.7837$ Shaded area of leaf = $2\times1.7837=3.5674$ Shaded area B $=\frac{1}{4}\times\pi 5^2-\frac{1}{2}\times\pi\times2.5^2-\frac{1}{2}\times\pi\times2.5^2+\square 3.5674$ $\square=\square 3.5674$ Total Shaded area = 8×3.5674 $\square=\square 28.5\ cm^2$ (to 3 significant figures)   Area of this unshaded region = area of leaf Total Area of shaded region = 4 × (area of quadrant – area of triangle) $=4\left(\frac{1}{4}\cdot\pi\times5^2-\frac{1}{2}\times5^2\right)$ $=4\left(\frac{25}{4}\pi-12.5\right)$ $=25\pi-50$ 28.5 cm^2 (to 3 significant figures)	M1 M1 M1 M1 A1 M2 M1 M1 A1	Method 2 Method 3
22a	25 marks	B1	
22b	33	B1	
22ci	I agree because Class 4A's median mark (44) is higher than the cohort's (32)	B1	
22cii	I agree because the interquartile range of the mathematics marks of Class A is higher than the cohort.	B1	
23a	Speed = $1260\div12\times60$ $=1.75$ m/s	M1 A1	
23b		B2	*Award 1 mark for*

			bearing of 30° accurately located and 1 mark for 4 cm from B
23c	1 cm : 15000 cm 5 cm : 75000 cm = 75000÷100000 = 0.75 km	M1 A1	



Candidate Name: _____

Class:	
Index No:	

Chong Boon Secondary School

Preliminary Examination 2016
Secondary 4 Express / 5 Normal (Academic)
Mathematics **4016/02**
Paper 2 **4048/02**

30 August 2016 (Tuesday)	**2 hour 30 minutes**

Additional Materials:

Writing Paper	6
Cover Page	1
Graph Paper	1

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, class and candidate number on all the work your hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft 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.
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.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

For Examiner's Use
100

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

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

Trigonometry

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

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

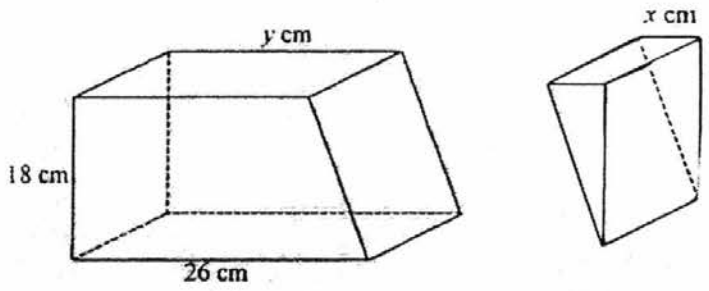
Statistics

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

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

Answer all the questions.

1. (a) A triangular prism is removed from a cuboid as shown in the diagram.



The cross-sectional area of the triangular prism is $5.625y$ cm^2.

(i) Form two equations in terms of x and y. [2]

(ii) Solve your simultaneous equations to find the value of x and of y. [2]

(iii) Calculate the volume of the triangular prism as a percentage of the volume of the cuboid. [2]

(b) Solve the equation $15 - 3x - 10x^2 = 0$, giving the answers correct to **four** decimal places. [3]

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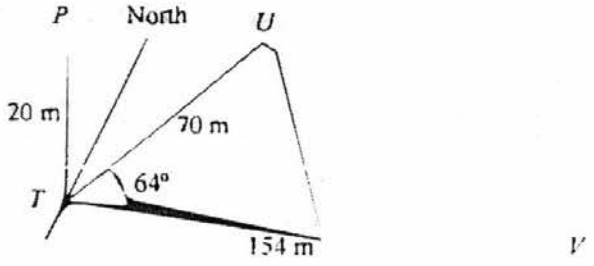
2. In the diagram, TUV represents a horizontal triangular field and TP represents a vertical flagpole. U is 70 m from T, V is due east of T and angle $UTV = 64°$.



(a) Calculate

(i) UV, [3]

(ii) the area of the triangular field TUV, correct to the nearest square metre, [2]

(iii) angle TVU, [2]

(iv) the bearing of T from U. [1]

(b) An ant is resting at a spot, S, along TV, where SU is the shortest distance of the ant from point U. Given that the height of the flagpole TP is 20 m, calculate the angle of elevation of P from S [3]

3. (a) A cafe sells three types of bubble tea. The number of cups of bubble tea sold on Friday, Saturday and Sunday during the first week of the June holidays and the selling price of one cup of the various types of bubble tea are as follows:

	Milk Tea	Jasmine Milk Tea	Fantasy Ice-blended
Friday	20	30	16
Saturday	38	46	28
Sunday	24	52	40
Selling price	\$1.50	\$2.50	\$3.00

(i) Write down a 3×3 matrix **B** to represent the quantity of bubble tea sold and a 3×1 matrix **S** to represent the selling price of one cup of the three types of bubble tea. [1]

(ii) Evaluate the matrix $\mathbf{P} = \mathbf{BS}$. [1]

(iii) State what the elements of **P** represent. [1]

(iv) Evaluate the matrix $\mathbf{T} = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix}\mathbf{P}$. [1]

(v) State what **T** represents. [1]

(b) During the second week, the cafe had a promotion by offering a 20% discount on all three types of bubble tea.

(i) Write down a new 3×1 matrix **D** to represent the new selling price of one cup of the three types of bubble tea. [1]

(ii) Under this promotion, the number of cups of bubble tea sold increased by 50% for all three days. Find the total amount of money collected on the second week. [2]

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4. (a) Simplify $\dfrac{9x^4}{8y^0} \div \dfrac{6x^5}{y^3}$. [2]

(b) Simplify $\dfrac{8-2x}{12+x-x^2}$. [2]

(c) Solve the inequality $\dfrac{3-2x}{5} \leq \dfrac{2x+5}{3} + 2$. [2]

(d) (i) Express $\dfrac{2}{x-2} - \dfrac{10}{4-x^2}$ as a single fraction in its simplest form. [2]

(ii) Solve the equation $\dfrac{2}{x-2} - \dfrac{10}{4-x^2} = 4$. [3]

5. **(a)** It is given that $\overrightarrow{PQ} = \begin{pmatrix} -10 \\ 24 \end{pmatrix}$.

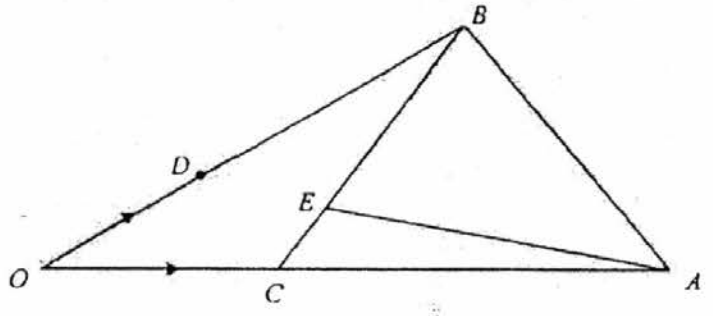
(i) Find $\left|\overrightarrow{PQ}\right|$. [2]

(ii) Given that P is the point $(6, -15)$, find the coordinates of the point Q. [2]

(iii) It is given that RS is parallel to PQ and it is one quarter as long as PQ.

Express $\overrightarrow{RS}$ as a column vector. [1]

(b)



In the diagram, $\overrightarrow{OC} = \mathbf{c}$, $\overrightarrow{OD} = \mathbf{d}$ and the point C divides OA in the ratio of 1 : 3.

The points D and E lies on OB and CB respectively such that $\frac{OD}{OB} = \frac{1}{4}$ and $BC = 5EC$.

(i) Express each of the following, as simply as possible, in terms of **c** and/or **d**,

(a) $\overrightarrow{OA}$, [1]

(b) $\overrightarrow{CB}$, [1]

(c) $\overrightarrow{DA}$. [1]

(ii) Show that $\overrightarrow{DE} = \frac{1}{5}(4\mathbf{c} - \mathbf{d})$. [1]

(iii) Write down two facts about the points A, D and E. [2]

6. (a) (i) Express 9000 as a product of its prime factors. [1]

(ii) Given that $9000k = p^3$, where k and p are integers and p is as small as possible, find the value of k and of p. [1]

(iii) The lowest common multiple of two numbers is 9000.
The highest common factor of these two numbers is 500.
Both numbers are greater than 500.

Find the two numbers. [2]

(b) n is a positive integer.

(i) Write down an expression for the next odd number greater than $2n + 1$. [1]

(ii) Find and simplify an expression for the difference between the squares of these two odd numbers. [2]

(iii) Hence explain why the difference between the squares of two consecutive odd numbers is always a multiple of 8. [1]

---

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

The variables x and y are connected by the equation $y = 6 - \frac{x^2}{8} - \frac{4}{x}$.
Some corresponding values of x and y are given in the table below.

x	0.6	0.8	1	2	3	4	5	6	7
y	−0.71	0.92	1.88	k	3.54	3	2.08	0.83	−0.70

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

(b) Using a scale of 2 cm to 1 unit, draw a horizontal x-axis for $0 \le x \le 7$.
Using a scale of 4 cm to 1 unit, draw a vertical y-axis for $-1 \le y \le 4$.

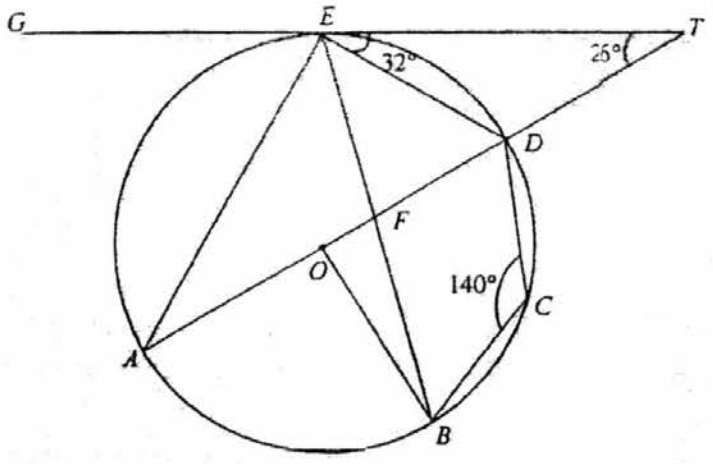
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the two solutions of $5 - \frac{x^2}{8} - \frac{4}{x} = 0$. [2]

(d) By drawing a tangent, find the gradient of the curve at (5, 2.08). [2]

(e) By drawing a suitable straight line on your graph, solve $3 - \frac{x^2}{8} - \frac{4}{x} + x = 0$ for $0 \le x \le 7$. [3]

8. **(a)**



The diagram shows a circle $ABCDE$ with centre O. GT is a tangent to the circle at the point E. The diameter AD is extended to meet the tangent at T.
Angle $DET = 32°$, angle $ETD = 26°$ and angle $BCD = 140°$.

(i) Find

(a) angle EAD, [2]

(b) angle EBD, [1]

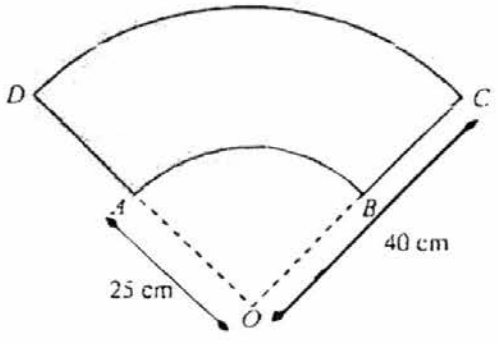
(c) angle BED, [1]

(d) reflex angle BOD. [1]

A point, P, is to be marked on the diagram, on the same side of AD as E, such that angle $BPD = 50°$.

(ii) Does the point P lie on the circumference of the circle, inside the circle or outside the circle? Give a reason for your answer. [1]

(b)



The diagram shows the coverage of a car windscreen wiper $ABCD$. AB and DC are arcs of circles centre O with radii 25 cm and 40 cm respectively. The perimeter of $ABCD$ is 121 cm.

(i) Show that angle $AOB = 1.4$ radians. [2]

(ii) Calculate the area of the windscreen that the car wiper wipes through. [2]

9. (a) The time taken by 100 students from School A to complete the 2.4 km run is shown in the table below.

Time (t minutes)	$6 \le t < 9$	$9 \le t < 12$	$12 \le t < 15$	$15 \le t < 18$	$18 \le t < 21$
Frequency	3	36	47	12	2

(i) What percentage of the students ran faster than 12 km/h? [2]

(ii) Calculate an **estimate** of

(a) the mean time, [1]

(b) the standard deviation. [1]

(iii) Explain why the mean time and standard deviation calculated in part **(a)(i)** and **(ii)** are estimates. [1]

The mean time for 100 students from School B to complete the 2.4 km run was 12.1 minutes and the standard deviation was 2.2 minutes.

(iv) Make **two** comparisons between the times for both schools. [2]

(b) A bag contains eight identical red flags and twelve identical green flags.
Two flags are selected at random without replacement.

(i) Draw a tree diagram to show the probabilities of the possible outcomes. [2]

A game is played by selecting two flags at random from the bag without replacement.

If two red flags are selected in the first attempt, 100 points will be awarded.
If one flag of each colour is selected, both flags are replaced and a second attempt is given.
If two red flags are selected in the second attempt, 75 points will be awarded.

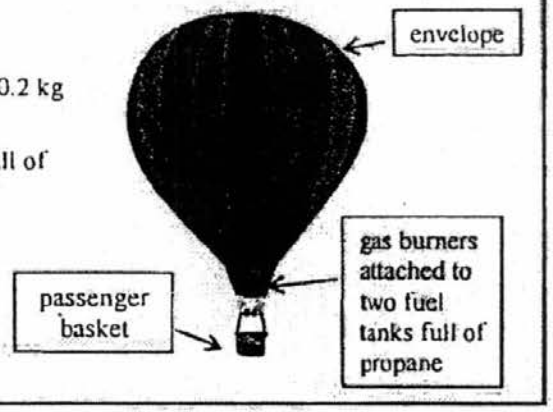
Find, as a fraction in its simplest form, the probability of

(ii) being awarded 100 points, [1]

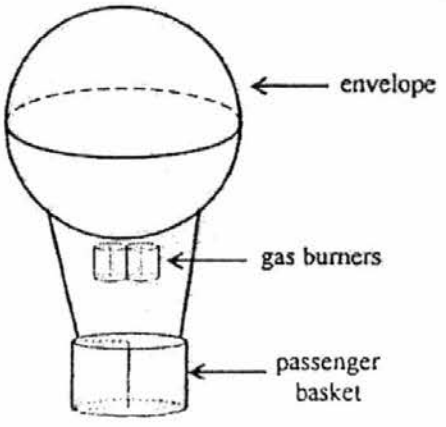
(iii) being awarded 75 points. [1]

10. Here is some information about a hot air balloon.

- volume of envelope: 2800 m^3
- mass of envelope: 63.5 kg
- mass of empty passenger basket: 60.2 kg
- mass of gas burners: 22.7 kg
- mass of two 75.7-litre fuel tanks full of propane: 123.4 kg



In this question the hot air balloon can be modelled as a **spherical envelope** with gas burners attached to two cylindrical fuel tanks full of propane. A cylindrical basket is attached to hold passengers.



(a) Show that the radius of the spherical envelope is 8.744 m, correct to three decimal places. [2]

(b) Calculate the surface area of the envelope. [2]

Useful information

- Density of propane: 493 kg/m^3
- 1000 kg is equivalent to 9.81 kN

(c) Calculate the mass, in kilograms, of an empty fuel tank. [4]

(d) The hot air balloon components consisting of the envelope, basket, gas burners, two fuel tanks full of propane and passengers can weigh at most 711 kg in order for the buoyant force to be able to completely lift the hot air balloon off the ground.

Calculate, in kN, the maximum weight of passengers allowed. [2]

Chong Boon Secondary School
2016 O Prelim Elementary Mathematics Paper 2
Marking Scheme

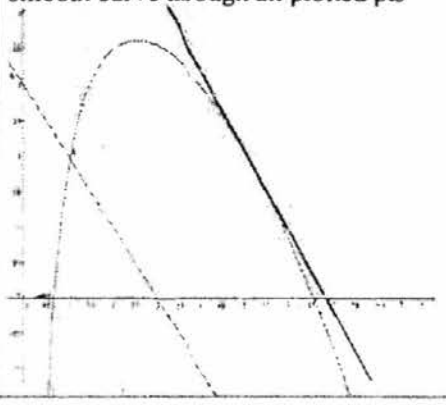
General comments:
Although there are 2 to 3 more challenging questions, most are still of O level standard with students achieving a full range of marks.

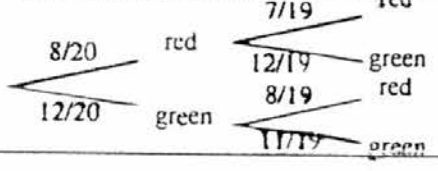
- 1 tick → 1 mark (except graph based on P2 & C1)
- ‖ A → accuracy of answer (1-2 occurrences minus 1 mark, >2 occurrences minus 2 marks)
  - not in 3sf or 1dp
  - rounding off when answer is exact
- ‖ Unit → incorrect or no units (>2 occurrences minus 1 mark)
- Many split the pages for workings when they should continue on the next page

Qns	Part	Solutions	Mark	Marker's Comments
1	ai	$x+y=26$ $\frac{1}{2}\times 18x = 5.625y$ *o.e.*	B1 B1	A number of students were not able to form the 2 equations.
	ii	$x=10, y=16$	B2	Some careless mistakes when solving
	iii	$\frac{\frac{1}{2}x}{x+y}\times 100\% = \frac{5}{26}\times 100\%$ *or* $\frac{1620}{8424}\times 100\%$ $=19.2\%\ (3sf)$	M1 A1	Many calculate the exact volumes and are able to get the correct answer. Those who got it wrong clearly do not know how to find volume of prism.
	b	$x=\frac{-(-3)\pm\sqrt{(-3)^2-4(15)(-10)}}{2(-10)}$ $=-1.3839$ *or* $1.0839\ (4dp)$	M1 A2	No working to show substitution of values → 0 mark Some did not leave in 4dp and lost 2 marks
2	ai	$UV=\sqrt{154^2+70^2-2(154)(70)\cos 64°}$ $=138.43=138m\ (3sf)$	M2 A1	No mark awarded when assume right angle. Some student's calculator are in Radian mode, resulting in loss of marks →need to remind students ‖A: not in 3sf
	ii	Area of triangle $=\frac{1}{2}\times 154\times 70\sin 64° = 4844.4$ $=4844m^2\ (nearest\ m^2)$	M1 A1	No A1 if not in nearest m^2
	iii	$\angle TVU=\sin^{-1}\left(\frac{70\sin 64°}{138.43}\right)$ *or* $\cos^{-1}\left(\frac{154^2+138.43^2-70^2}{2\times 154\times 138.43}\right)$ *or* $\sin^{-1}\left(\frac{4844.4}{\frac{1}{2}\times 154\times 138.43}\right)$ $=27.032=27.0°\ (1dp)$	M1 A1	‖A: not in 1dp

	iv	$180° + 26° = 206°$	B1	Ok
	b	$TS = 70\cos 64° = 30.685$ $Angle\ of\ elevation = \tan^{-1}\left(\frac{20}{30.685}\right) = 33.1°$	B1 M1A1	Average Some use 3sf for calculation Common mistake – misunderstood SU as TS.
	ai	$\mathbf{B} = \begin{pmatrix} 20 & 30 & 16 \\ 38 & 46 & 28 \\ 24 & 52 & 40 \end{pmatrix}$, $S = \begin{pmatrix} 1.50 \\ 2.50 \\ 3.00 \end{pmatrix}$	B1	Good. Those who did not state matrices B and S will not gain B1 Reject: $(1.50 \quad 2.50 \quad 3.00)$
	ii	$\begin{pmatrix} 20 & 30 & 16 \\ 38 & 46 & 28 \\ 24 & 52 & 40 \end{pmatrix}\begin{pmatrix} 1.50 \\ 2.50 \\ 3.00 \end{pmatrix} = \begin{pmatrix} 153 \\ 256 \\ 286 \end{pmatrix}$	A1	Reject: $\begin{pmatrix} 20 & 30 & 16 \\ 38 & 46 & 28 \\ 24 & 52 & 40 \end{pmatrix}(1.5 \quad 2.5 \quad 3)$
	iii	Amount collected from the sales of the 3 bubble teas for Fri, Sat and Sun respectively.	B1	Do not accept: cost, price, each day
	iv	$T = (1 \quad 1 \quad 1)\begin{pmatrix} 153 \\ 256 \\ 286 \end{pmatrix} = (695)$	A1	No bracket → no mark
	v	Total amount collected for the 3 days.	B1	Reject if 3 days is not stated
	bi	$\mathbf{D} = \begin{pmatrix} 1.20 \\ 2.00 \\ 2.40 \end{pmatrix}$	A1	ok
	ii	$(20 + 38 + 24) \times 1.5 \times 1.20$ $+ (30 + 46 + 52) \times 1.5 \times 2.00$ $+ (16 + 28 + 40) \times 1.5 \times 2.40$ $= \$(147.60 + 384 + 302.40) = \$834$	M1 A1	Accept matrix method Reject: $\begin{pmatrix} 183.6 \\ 307.2 \\ 343.2 \end{pmatrix}(1 \quad 1 \quad 1)$ *or* $\begin{pmatrix} 183.6 \\ 307.2 \\ 343.2 \end{pmatrix} = (834)$ *or* No A1 if answer left as (834) Some mixed up days with types of tea.
	a	$\frac{9x^4}{8y^0} \div \frac{6x^6}{y^3} = \frac{3y^3}{16x^2}$	B2	2 correct – B1 Accept x^{-2}, reject 8/1.5
	b	$\frac{2(4-x)}{(4-x)(3+x)} = \frac{2}{3+x}$	M1A1	Many had (x-4)(x+3) → from calculator reject $\frac{-2}{-(3+x)}$

	c	$\frac{3-2x}{5} \le \frac{2x+5+6}{3}$ $3(3-2x) \le 5(2x+11)$ $-46 \le 16x$ $x \ge -2\frac{7}{8}$ *o.e.*	M1 A1	Many forgot to change 2 to equivalent fraction. Common error, did not change inequality sign when dividing by "-ve" Many gave answer as $-2\frac{7}{8} \le x$
	di	$\frac{2}{x-2} - \frac{10}{(2+x)(2-x)}$ $= \frac{2(x+2)+10}{(x-2)(x+2)} = \frac{2(x+7)}{(x-2)(x+2)}$ *o.e.*	M1 A1	M1 – correct factorization Many unable to manage the "-ve" sign. No M1 if cross-method directly, B2 if correct final answer B0 if incorrect
	ii	$\frac{2(x+7)}{(x-2)(x+2)} = 4$ $2x^2 - 8 = x + 7$ $2x^2 - x - 15 = 0$ $(2x+5)(x-3) = 0$ $x = -2.5$ *or* 3	M1 M1 A1	Reject: (x-3)(x+2.5)=0, factorization cannot have decimals or fraction No working, no M1A1
5	ai	$\sqrt{(-10)^2 + 24^2} = 26$ *units*	M1A1	Some wrote -10^2 → incorrect answer
	ii	$\overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ} = \begin{pmatrix} 6 \\ -15 \end{pmatrix} + \begin{pmatrix} -10 \\ 24 \end{pmatrix}$ $= \begin{pmatrix} -4 \\ 9 \end{pmatrix}$ $Q = (-4, 9)$	M1 A1	Ok Some did not leave in coordinate form → no A1
	iii	$\overrightarrow{RS} = \frac{1}{4}\begin{pmatrix} -10 \\ 24 \end{pmatrix} = \begin{pmatrix} -2.5 \\ 6 \end{pmatrix}$	B1	Do not accept $\frac{1}{4}\begin{pmatrix} -10 \\ 24 \end{pmatrix}$
	bia	4c	B1	No vector symbol "~", 0 mark Some gave 3c → difficulty interpreting ratios
	b	- c + 4d	B1	Ok
	c	- d + 4c	B1	Ok

	bii	$\overrightarrow{DE} = \overrightarrow{DO} + \overrightarrow{OE}$ $= -d + \overrightarrow{OC} + \overrightarrow{CE}$ *or* $\overrightarrow{DE} = 3d - \frac{4}{5}\overrightarrow{CB}$ $= -d + c + \frac{1}{5}\overrightarrow{CB}$ $= 3d - \frac{4}{5}(-c + 4d)$ $= -d + c + \frac{1}{5}(-c + 4d)$ $= \frac{1}{5}(4c - d)$ *(shown)*	M1 A1	Average
	iii	Since $\overrightarrow{DE} = \frac{1}{5}\overrightarrow{DA}$ and D is a common point, $DA = 5DE$ (o.e.) and A, D &E are collinear.	B2	Minus 1m if show $\frac{\overrightarrow{DE}}{\overrightarrow{DA}}$ → vector cannot divide vector No A1 if did not show collinear No A1 if $\overrightarrow{DA} = 5\overrightarrow{DE}$ *(ref 2011 P2Q8, 2010 P2Q4 Cambridge Marker's report)*
6	ai	$9000 = 2^3 \times 3^2 \times 5^3$	B1	Ok
	ii	$9000k = p^3$ $k = 3$ *and smallest* $p = 30$	B1	Average, mostly have difficulty with p
	iii	$500 = 2^2 \times 5^3$ Two numbers are 1000 and 4500. (must be a multiple of $2^2 \times 5^3$, can only multiply by 2 or 3^2)	M1 A1	B2 Not good despite question similar to Practice Exam
	bi	$2n + 3$	B1	Ok
	ii	$(2n+3)^2 - (2n+1)^2$ $= 4n^2 + 12n + 9 - (4n^2 + 4n + 1)$ $= 8n + 8$ *or* $8(n+1)$	M1 A1	A few still expand wrongly; $4n^2 + 9$ & $4n^2 + 1$ If use $(2n+1)^2 - (2n+3)^2$, M1 for correct expansion but no A1 as difference is large - small
	iii	Since the difference is $8(n+1)$ where $(n+1)$ is an integer, it is always a multiple of 8.	B1	No B1 if bii incorrect except those taking small – large $= -8(n+1)$
7	a	$k = 3.5$	B1	Ok. No mark if not stated
	b	All 9 points plotted smooth curve through all plotted pts 	P2 C1	P1 for at least 6 correct Not recommended to draw beyond $0 \le x \le 7$. No C1 - If curve does not pass through all the points - Double lines - Not smooth

	c	$x = 0.81$ and 5.87 (accept $0.8 < x \le 0.9$ & $5.8 \le x \le 5.9$)	B2	A few took the x-intercepts as answers
	d	Draw tangent at $x = 5$, grad = - 1.09 (accept gradient from -1.29 to -0.875)	M1 A1	No mark if tangent does not touch curve at x = 5 **only** Tangent wrong → no A1 Grad from curve → estimate, not exact, to give in 3sf
	e	Suitable straight line : $y = -x + 3$ Draw line correctly $x = 1.03$ (accepts $1 < x \le 1.1$)	M1 M1 A1	Poor. A few were able to draw the line but did not state the solution.
8	aia	$\angle AED = 90°$ (*rt ∠ in semi – circle*) $\angle EAD = 180 - 90 - 32 - 26$ (*∠s sum of triangle*) $= 32°$ OR $\angle EAD = 32°$ (*∠ in alt. seg*)	M1 A1	Minus 1 m if >1 reason not stated or wrong reason Ok
	b	$\angle EBD = 32°$ (*∠s in same seg*)	√A1	Average
	c	$\angle BED = 180 - 140$ (*∠s in opp seg*) $= 40°$	A1	Average
	d	*reflex* $\angle BOD = 2 \times 140°$ (*∠ at ctr* $= 2\angle$ *at circumf*) $= 280°$	A1	Average
	aii	Since angle $BPD = 50° > 40°$, P is inside the circle (no reason → no mark)	A1	Poor, not able to use 40° which is angles in the same segment
	bi	$2\times(40 - 25) + 2\theta + 400 = 121$ $6\theta = 91$ Angle $AOB = 1.4$ (shown)	M1 A1	Good Do not accept verify meth, sub in 1.4 as this is a "show" question
	ii	$\frac{1}{2} \times 40^2 \times 1.4 - \frac{1}{2} \times 25^2 \times 1.4 = 682.5\ cm^2$	M1A1	Ok
9	ai	$t = \frac{2.4}{12} h = 12 \text{min}$ % faster than 12 *km/h* $= \frac{3+36}{100} \times 100\% = 39\%$	B1 A1	Many calculated 61%. Interpret curve incorrectly.
	iia	Mean = 12.7 min	B1	Accept 12.72; should be 3sf since it's an estimate.
	iib	S.D. = 2.35 min (3sf)	B1	Ok
	iii	Time given is grouped data & mid-value, which is an estimate, is used for calculation of mean & SD	B1	Poor as many explanations was not clear. Mid-value oe. Must be stated
	iv	Mean time for sch B < mean time for sch A → on average, students from sch B are faster S.D. of sch B < S.D. of sch A → timings of students from sch B is more consistent	A1 A1	Some compared but no conclusion → 0 m Higher mean ≠ better, must check context of question
	bi		B2 1 mistake Minus 1m	Minus 1 m when position of "colour" & "prob" are interchanged

	ii	$P(100\ pts) = \frac{8}{20} \times \frac{7}{19} = \frac{14}{95}$	B1	Ok
	iii	$P(75\ pts) = \left(\frac{8}{20} \times \frac{12}{19} + \frac{12}{20} \times \frac{8}{19}\right) \times \frac{14}{95} = \frac{672}{9025}$	B1	Poor. Many add 14/95 instead of multiplying
10	a	$\frac{4}{3}\pi r^3 = 2800$ $r = \sqrt[3]{\frac{2800 \times 3}{4\pi}} = 8.744m$	M1 A1	Good. If verify, ie sub r = 8.744 → 0m
	b	$S.A. = 4\pi(8.744)^2$ $= 960.793 = 961m^2\ (3sf)$	M1 A1	Good. ||A if not 3sf
	c	$M = DV = 493 \times \left(75.7 \times \frac{1000}{100^3}\right)$ *mass 75.7l fuel* $= 37.3201\ kg$ Mass of empty fuel tank = $\frac{1}{2} \times (123.4 - 2 \times 37.3201) = 24.3799\ kg$	M2 M1A1	M1 for conversion of ltr to m^3 $\frac{1000}{100^3}$ Poor ||A : 24.4 when answer is exact
	d	Let W kg be max. mass of passengers. $63.5 + 60.2 + 22.7 + 123.4 + W \le 711$ $W \le 441.2\ kg$ $W \le \frac{441.2}{1000} \times 9.81\ kN$ $Max.wt = 4.328172\ kN$	M1 A1	B1 – 441.2 kg Many did not use inequality which is ok but finial answer must be exact. No mark if round of to 3sf

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GAN ENG SENG SCHOOL
Preliminary 1 Examination 2016

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS
Paper 1

4048/01 (Sec 4)

4016/01 (Sec 5)

Sec 4 Express / 5 Normal (Academic)

04 May 2016
2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft 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.
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.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 80.

	For Examiner's Use
Total	80

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

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

Arc length $= r\theta$, where θ is in radians

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

Trigonometry

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

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

Statistics

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

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

Answer all the questions

1 Simplify $\frac{7p}{4} - \frac{3(4-5p)}{6}$.

Answer _____ [2]

2 Write the following in order of size, in ascending order.

$$\frac{19}{37} \quad \sqrt{0.69} \quad 0.79^{\frac{2}{5}} \quad 0.75^2$$

Answer _____ , _____ , _____ , _____ [2]

3 Factorise fully $2x^3 - x^2 + 2 - 4x$.

Answer _____ [2]

4 The sine of an angle is 0.649.
Give the possible value(s) for the angle.

Answer _____ [2]

5 (a) Simplify $\left(\frac{5}{x}\right)^{-2}$

(b) Solve $4^n = \sqrt{32}$.

Answer (a) _____ [1]

(b) $n =$ _____ [1]

---

6 A map is drawn to a scale of 1:50 000.

(a) Calculate the actual distance, in kilometers, represented by 1 cm on the map.

(b) Two towns are 20 km apart. Calculate, in centimeters, their distance apart on the map.

(c) Calculate, in square kilometers, the actual area of a housing estate which has an area of 50 cm^2 on the map.

Answer (a) _____ km [1]

(b) _____ cm [1]

(c) _____ km^2 [2]

7 (a) Solve the inequality $\frac{1-3y}{4} > y-5$.

(b) Hence write down all the integer values of y which satisfy both the inequalities $\frac{1-3y}{4} > y-5$ and $2y+1 \geq 0$.

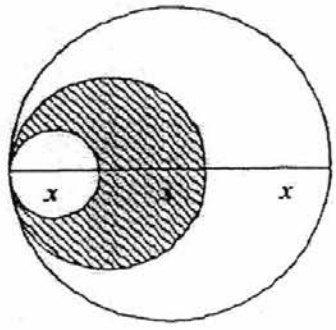
Answer (a) _____ [2]

(b) $y =$ _____ [1]

8 Mr Goh invested $20 000 with an investment company which pays compound interest of 1.75% per annum compounded half-yearly. Find the total interest earned at the end of 3 years.

Answer $ _____ [3]

9 The figure shows three circles of diameters x cm, $2x$ cm and $3x$ cm. Find the ratio of the area of the shaded part to that of the unshaded part.



Answer _____ [3]

10 Find the value of t if $\frac{2(3x-1)}{x^2-1}$ can be expressed in the form of $\frac{4}{x+1}+\frac{t}{x-1}$.

Answer $t =$ _____ [4]

11 (a) Make r the subject of the formula in $2m = \frac{5-r}{4r+m}$.

(b) Evaluate $\frac{2^{n+3} \times 2}{5(2^{n-1})}$, giving your answer as a fraction.

Answer (a) _____ [2]

(b) _____ [2]

---

12 (a) Written as a product of its prime factors, $1350 = 2^x \times 3^y \times 5^2$.

Find the values of x and y.

(b) Find the smallest positive integer k such that $\frac{1350}{k}$ is a square number.

Answer (a) $x=$ _____ $y=$ _____ [2]

(b) _____ [1]

13 Singapore's Mass Rapid Transit (MRT) is 138m long and its average speed is 80 km/h.

(a) Change 80 km/h into m/s.

Answer (a) _____ m/s [1]

(b) There is a 3.2 km tunnel between Braddell and Bishan MRT station. Calculate the least time taken for the train to pass completely through the tunnel.
Give your answer in minutes and seconds, to the nearest second.
(Source: http://www.urbanrail.net/as/sing/singapore.htm)

Answer (b) _____ [3]

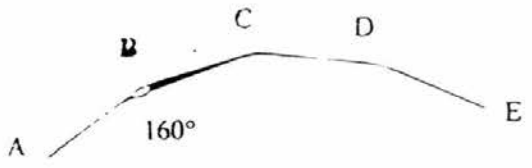
---

14 y is inversely proportional to x^3. It is known that $y = 108$ for a particular value of x.
Find the value of y when this value of x is increased by 200%.

Answer _____ [3]

15 (a) $ABCDE$ .. is part of a regular polygon which has interior angles of 160°.
Find the number of sides of the polygon.

(b) Calculate $\angle BCE$.



Answer (a) _____ [1]

~~(b) $\angle BCE =$ _____ [1]~~

(b) Explain briefly why the interior angle of a regular polygon cannot be 130°.

Answer (b)

[1]

16 The first five terms in a sequence are as follows:

5, 12, 19, 26, 33,

(a) Write down the next 2 terms.

Answer (a) _____ , _____ [1]

(b) Andy gave the expression $33 + 7(n - 5)$ for the nth term in the sequence.
Explain how he might have obtained this expression.

Answer (b)

[1]

(c) Explain whether 110 is a term in this sequence.

Answer (c)

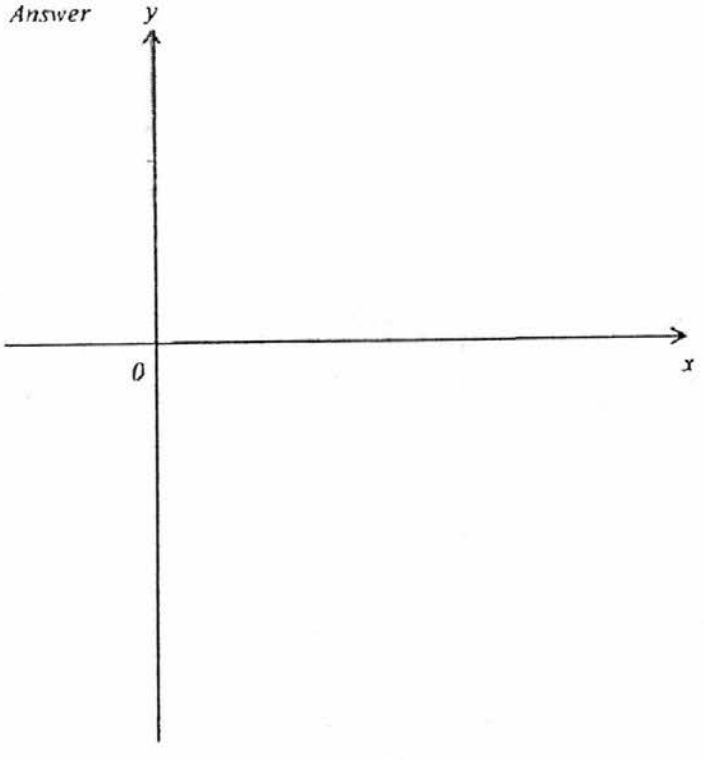
[1]

17 (a) Express $x^2 - 9x - 5$ in the form $(x-a)^2 + b$.

Answer (a) _____ [2]

(b) Hence, sketch the graph of $y = x^2 - 9x - 5$ indicating clearly the coordinates of the turning point.

Answer

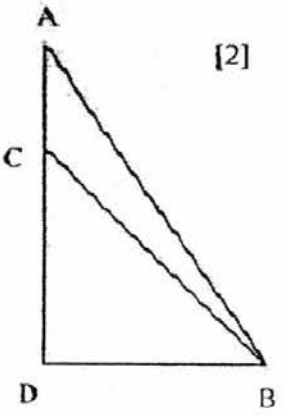


[2]

18 In the diagram, ACD is a straight line, $CD = 8$ cm, $BD = 6$ cm and $BC = 10$ cm.

(a) Explain why $\angle CDB$ is a right angle.

Answer [2]



(b) Write down the value of $\sin(90° - \angle DCB)$.

(c) Write down the value of $\cos \angle ACB$.

(d) Given that area of triangle ACB is $9cm^2$, find the length of AC.

Answer (b) _____ [1]

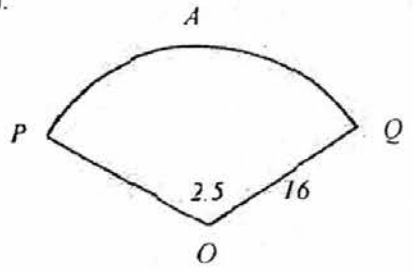
(c) $\cos \angle ACB =$ _____ [1]

(d) _____ cm [1]

19 $OPAQ$ is a sector of a circle with centre O and radius 16 cm. The angle at the centre is 2.5 radians.

(a) Calculate the length of the arc PAQ.

(b) Write down an expression, in terms of π, for the reflex angle POQ.



Answer (a) _____ [1]

(b) $\angle POQ =$ _____ [1]

---

20 Sets P and Q are shown in the venn diagram below.

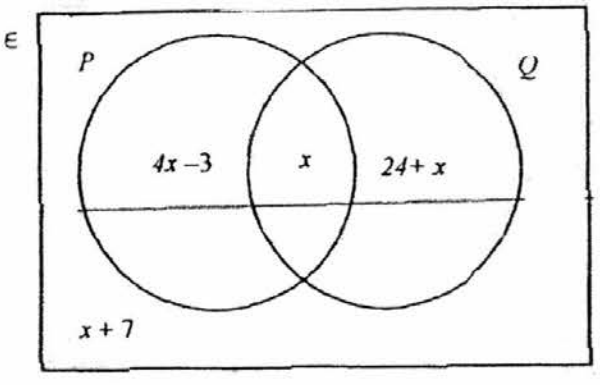
Given that $n(P) = n(Q)$,

calculate

(a) the value of x,

(b) the value of $n(P \cup Q)$,

(c) the value of $n(P' \cup Q')$.

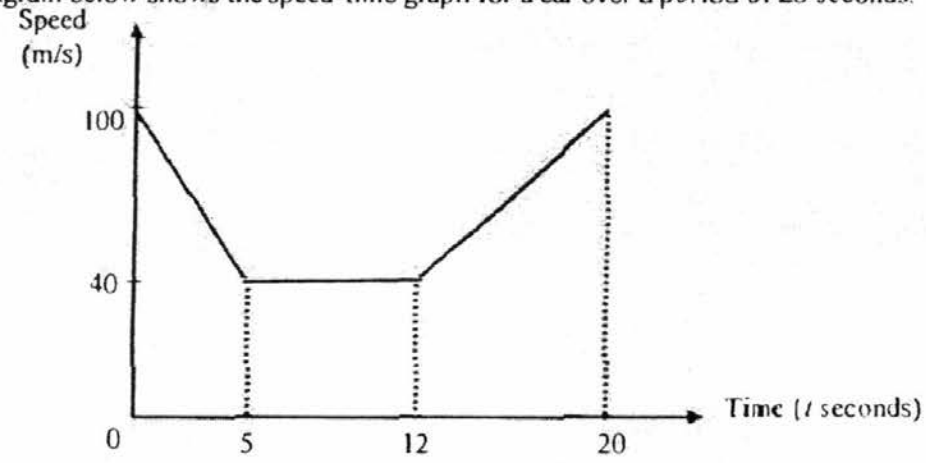


Answer (a) $x =$ _____ [1]

(b) _____ [1]

(c) _____ [1]

21 The diagram below shows the speed-time graph for a car over a period of 20 seconds.



(a) Find

(i) the speed of the car at time $t = 2$,

(ii) the total distance travelled in the 20 seconds,

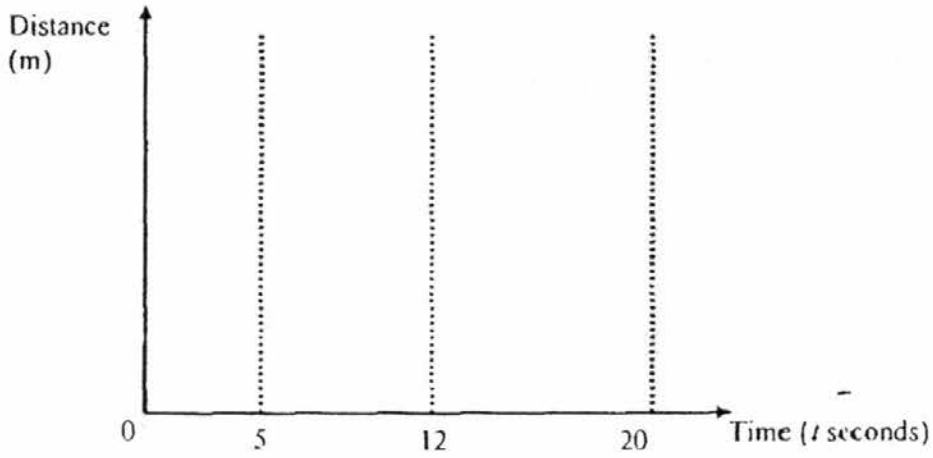
(iii) the acceleration when time $t = 15$

Answer (a) _____ [1]

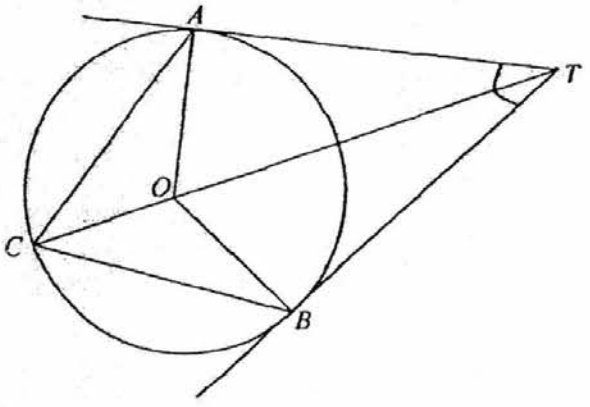
(b) _____ [2]

(c) _____ [1]

(b) Sketch the distance-time graph for the same journey. [3]



22 In the diagram, TA and TB are tangents to the circle ABC whose centre is O. It is given that TOC is a straight line.



(a) Prove that ΔACT is congruent to ΔBCT.

Answer (a)

[2]

(b) Given that $\angle ATB = 72°$, calculate

(i) $\angle AOB$,

(ii) $\angle CAO$.

Answer (b)(i) $\angle AOB =$ _____ [1]

(b)(ii) $\angle CAO =$ _____ [1]

23 The number of yellow M&Ms, blue M&Ms and green M&Ms in a packet of M&Ms are in the ratio $2 : 7 : x$. The probability of drawing a green M&M from the packet at random is 0.4. What is the total number of M&Ms in the packet?

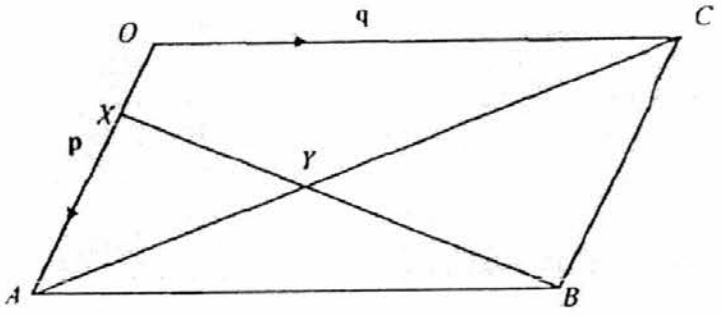
Answer _____ [2]

---

24 The matrices $A = \begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & a \\ 0 & b \end{pmatrix}$ are such that $AB = A^2$. Find the values of a and b.

Answer _____ [2]

25 $OABC$ is a parallelogram such that $\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OC} = \mathbf{q}$. X is a point on OA such that $3XA = 2OA$ and the diagonal AC cuts the line XB at Y.



Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$

(a) $\overrightarrow{AC}$,

(b) $\overrightarrow{XB}$,

(c) $\overrightarrow{YC}$.

Answer (a) _____ [1]

(b) _____ [1]

(c) _____ [2]

~ End of Paper ~

2016 GESS Prelim 1 EM Paper 1

1 $\frac{17p-8}{4}$

2 $\frac{19}{37}$ 0.75^2 $\sqrt{0.69}$ $0.79^{\frac{5}{5}}$

3 $(2x-1)(x^2-2)$

4 $\theta = 0.706,\ 2.44$ *or* $40.5°,\ 139.5°$

5 (a) $\frac{x^2}{25}$

(b) $n = \frac{5}{4}$

6 (a) $1cm$ *rep* $0.5km$

(b) $20 \div 0.5 = 40cm$

(c) $50cm^2$ *rep* $12.5km^2$

7 (a) $y < 3$

(b) $y = 0, 1, 2$

8 *Interest* = \$1073.24 (2*d.p.*)

9 1 : 2

10 $t = 2$

11 (a) $r = \frac{5-2m^2}{8m+1}$

(b) $\frac{8}{5}$

16 (a) 40, 47

(c) As $n = 16$ is a positive integer, 110 is a term in the sequence.

17 (a) $\left(x-\frac{9}{2}\right)^2 - \frac{101}{4}$

(b) Min point = $\left(\frac{9}{2}, -\frac{101}{4}\right)$

18 (a) $BC^2 = CD^2 + DB^2$

By converse of Pythagoras Theorem, $\angle CDB = 90°$ as it is opposite the longest side CB.

(b) $\frac{4}{5}$

(c) $-\frac{4}{5}$

(d) 3 cm

19 (a) 40 cm

(b) $(2\pi - 2.5)$ *rad*

20 (a) 9

(b) 75

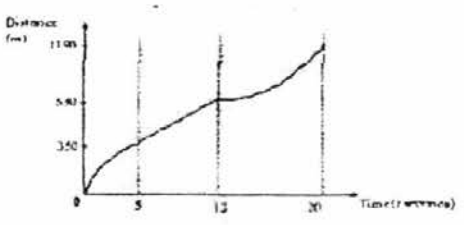
(c) 82

21 (ai) $76\ m/s$

(ii) $1190m$

(iii) $7.5\ m/s^2$

(b)



12 (a) $x = 1, \quad y = 3$

(b) 6

13 (a) $22.2 m/s \quad (3sf)$

(b) 2 min 31 sec (*least nearest* sec)

14 4

15 (a) 18

(b) 150°

(c) Number of sides $= \dfrac{360°}{50°} = 7.2$

Hence, the interior angle cannot be 130° as the number of sides must be a positive integer.

22 (a) SAS congruency

(b) $\angle AOB = 108°$

(c) $\angle CAO = 27°$

23 6

24 a = 0, b = 3

25 (a) $\overrightarrow{AC} = -p + q$

(b) $\overrightarrow{XB} = \dfrac{2}{3}p + q$

(c) $\overrightarrow{YC} = \dfrac{3}{5}\overrightarrow{AC}$

$= \dfrac{3}{5}(-p + q)$