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MATHEMATICAL FORMULAE

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

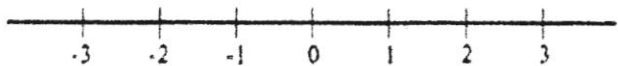
Answer **all** the questionsFor
Examiner's
Use

- 1 Evaluate $\frac{3.42}{22.5 \times 0.193}$, giving your answer in standard form.

Answer [1]

For
Examiner's
Use

- 2 (a) Solve the inequality $1 - 3x > 9$. Show your solution on the number line below.

Answer (a)  [1]

- (b) Hence, write down the greatest integer value of x which satisfies $1 - 3x > 9$.

Answer (b) $x =$ [1]

- 3 Each term in the sequence below is found by adding the same number to the previous term.

-1, 3, 7, 11, 15...

- (a) Write down the 8th term of the sequence.

Answer (a) [1]

- (b) Write down an expression, in terms of n , for the n th term.

Answer (b) [1]

For
Examiner's
UseFor
Examiner's
Use

Use

- 4 (a) 4.2×10^{-8} seconds can be written as k nanoseconds. Find the value of k .

Use

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

- (b) Given that the size of a photograph is 3.2 MB, how many photographs of the same quality can the memory card of a smartphone store if its storage capacity is 16 GB?

Answer (b) $\dots\dots\dots$ photographs [2]

- 5 Chris scored 23 out of 25 marks in his Science test and 28 out of 30 in his Mathematics test. In which test did Chris do better? Justify your answer.

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

For
Examiner'sFor
Examiner's

Use

Use

6 Written as a product of its prime factors, $120 = 2^3 \times 3 \times 5$.

(a) Write 210 as a product of its prime factors.

Answer (a) [1]

(b) Hence, find the highest common factor of 120 and 210.

Answer (b) [1]

7 The scale of a map is 2 cm : 1 km.

(a) Write this scale in the form 1 : n .

Answer (a) [1]

(b) Find the actual area in km^2 represented by an area of 10 cm^2 on the map.

Answer (b) km^2 [2]

For
Examiner's

For
Examiner's

Use

- 8 It takes 9 men to build a house in 40 days. How many men are needed if the same house is to be built in 15 days, assuming that they work at the same rate?

Use

Answer men [2]

- 9 Given that $\sqrt[3]{8^k} \times \frac{1}{8} = 8^k$, find k .

Answer $k =$ [3]For
Examiner'sFor
Examiner's

Use

10 (a) Simplify the following

(i) $2a^2b \times a^3b^{-1}$,

Use

Answer (a)(i) [1]

(ii) $\frac{12a^3bc}{(2abc)^3}$.

Answer (a)(ii) [2]

(b) Factorise $15p - 3pq - 10q + 2q^2$ completely.

Answer (b) [2]

For
Examiner's
Use11 A regular polygon has n sides. Its interior angle is 3 times the size of itsFor
Examiner's
Use

exterior angle.

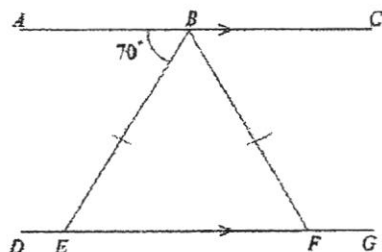
(a) Find the size of each exterior angle.

Answer (a)^o [1]

(b) Calculate the sum of interior angles.

Answer (b)^o [2]

12 In the diagram, which is not drawn to scale, the line AC and DG are parallel lines and $\angle ABE = 70^\circ$.



Find

(a) $\angle BEF$,

Answer (a)^o [1]

(b) $\angle BFG$.

Answer (b)^o [1]

For
Examiner's
Use

13 Lewis walks at an average speed of 0.5 m/s for 45 minutes.

For
Examiner's
Use

- (a) Convert 0.5 m/s to km/h.

Answer (a) km/h [1]

- (b) Calculate the distance covered by Lewis in km.

Answer (b) km [2]

- 14 Solve the following equations

(a) $2c^2 = 3c$,

Answer (a) $c =$ [2]

- (b) $2x^2 - 7x - 1 = 0$, giving your answers correct to 3 decimal places.

Answer (b) $x =$ [3]

For
Examiner's
Use

- 15 Expand and simplify $(3y - 1)^2 - y$.

For
Examiner's
Use

Answer [2]

End of Paper 1

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Answer **all** the questions

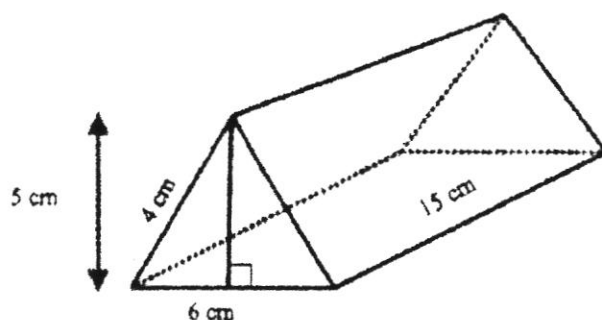
- 1 (a) y is directly proportional to $x^3 + 1$.
- (i) Given that when $y = 18$, $x = 2$, express y in terms of x . [2]
- (ii) Find the value of x when $y = 2\frac{1}{4}$. [1]
- (iii) Find the value of y when $x = 3$. [1]
- (b) s is inversely proportional to the square of t . The value of s is 15 for a particular value of t . If t increases by 150%, find the new value of s . [2]

- 2 (a) (i) Factorise $x^2 - 25$. [1]
- (ii) Hence, simplify $\frac{x^2 - 25}{x^2 - 3x - 10}$. [2]
- (b) Express as a single fraction in its simplest form $\frac{4-x}{(x+3)^2} - \frac{5}{(x+3)}$. [3]
- (c) Given that $x = \frac{3y-2z}{y+z}$, express y in terms of x and z . [2]
- (d) (i) Express $x^2 + 7x - 12$ in the form $(x+p)^2 + q$, where p and q are constants. [1]
- (ii) Hence, solve the equation $x^2 + 7x - 12 = 0$. [2]

- 3 $S = \{x : x \text{ is an integer and } 1 \leq x \leq 15\}$,
 $A = \{x : x \text{ is a prime number}\}$,
 $B = \{x : x \text{ is multiple of 4}\}$ and
 $C = \{x : x \text{ is factor of 12}\}$.
- (a) List the members of
- (i) $A \cup C$, [1]
- (ii) $A \cap B$. [1]
- (b) Find $n(C)$. [1]
- (c) Given $a \in B \cap C$.
 State all values of a . [2]

-
- 4 (a) A hybrid car uses 24 litres of fuel to travel a distance of 396 km.
Giving your answer in litres per 100 km, calculate the fuel consumption of the car. [2]
- (b) Joe's car has a fuel consumption of 10.1 litres per 100 km.
- (i) Calculate the distance he can travel on a full tank of 60 litres. [1]
- (ii) Petrol costs \$2.005 per litre.
Calculate how much, correct to the nearest cent, the petrol will cost Joe for a journey of 150 km. [3]
-
- 5 Andy won some money from a shopping mall lucky draw. He divides the money between personal spending, holiday and savings in the ratio 2: 3: 5 respectively.
- (a) He puts \$10000 into savings.
Calculate the total amount of money he won from the lucky draw. [1]
- (b) He is deciding on which bank to deposit this \$10000 for 5 years. Bank *X* offers a simple interest rate of 1.05% per annum and Bank *Y* offers an interest rate of 1.02% compounded annually. Which bank should Andy choose to yield a better interest? [4]
-
- 6 A farmer harvested apples, oranges and pears from his fruit farm. He harvested x number of apples. The number of oranges is four times the number of apples.
- (a) (i) Write down an expression, in terms of x , for the number of oranges that he harvested. [1]
- (ii) The number of oranges is twice the number of pears. Given that he harvested 200 pears more than apples, form an equation in x and solve for x . [2]
- (b) Hence, find the total number of fruits that the farmer harvested from his fruit farm. [2]
-

- 7 The diagram shows a chocolate in the shape of a triangular prism.



- (a) Calculate the volume of the chocolate. [2]

This chocolate is then melted and made into four pieces of spherical chocolate.

- (b) Show that the radius of the spherical chocolate is 2.38 cm, correct to 3 significant figures. [2]

The diagram below shows a plane view of a box holding four of the spherical chocolates. The box is in the shape of a cuboid and the chocolates just fit into the box.



- (c) Calculate the volume of empty space in the box. [3]

- 8 On 20 February 2017, Minister for Finance Mr Heng Swee Keat announced that the price of water will be increased by 30%, phased over two years, starting from 1 Jul 2017. The table below shows the total price of water inclusive of the tariff, water conservation tax, waterborne fee and sanitary appliance fee. (Price per cubic metre)

Amount of water consumption	Current Water price (\$/m ³)	From 1 July 2017 Water price (\$/m ³)	From 1 July 2018 Water price (\$/m ³)
First 40 m ³	\$2.10	\$2.39	\$2.74
Above 40 m ³	\$2.61	\$3.21	\$3.69

Note: All the prices are before 7% Goods and Services tax (GST).

- (a) Michelle and her family consumes a total of 25 m³ in the month of February 2017, calculate the total amount that she would need to pay including GST. [2]
- (b) If Michelle and her family consumes the same amount of water in July 2017, calculate the additional amount that she would need to pay including GST. [3]

End of Paper 2

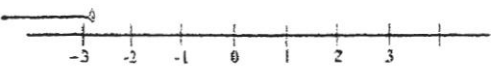


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Mid Year Examination 2017

Answer Key

Paper 1

1	7.88×10^{-1}			[1]
2(a)				
2(b)	$x = -3$			[2]
3(a)	27			
3(b)	$4n - 5$			[2]
4(a)	42			
4(b)	$\frac{16 \times 10^9}{3.2 \times 10^6}$ $= 5000$			[3]
5	$\frac{23}{25} \times 100\% = 92\%$ $\frac{28}{30} \times 100\% = 93.3\%$ Since $93.3\% > 92\%$, Chris did better in the mathematics test.			[2]
6(a)	$210 = 2 \times 3 \times 5 \times 7$			
6(b)	$HCF = 2 \times 3 \times 5 = 30$			[2]
7(a)	1:50000			
7(b)	$(1\text{cm})^2 : (0.5\text{km})^2$ $= 1 : 0.25\text{km}^2$ $= 10 : 2.5\text{km}^2$ Actual area = 2.5km^2			[3]



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8	Let m be the number of men. Let d be the number of days. $m = \frac{k}{d}$ $9 = \frac{k}{40}$ $k = 360$ $m = \frac{360}{d}$ $m = \frac{360}{15}$ $m = 24\text{men}$			[2]
9	$\sqrt[3]{8^k} \times \frac{1}{8} = 8^k$ $8^{\frac{k}{3}} \times 8^{-1} = 8^k$ $8^{\frac{k}{3}-1} = 8^k$ $\frac{k}{3} - 1 = k$ $k = -1.5 \text{ or } -1\frac{1}{2}$			[3]
10(a)(i) 10(a)(ii)	$2a^5$ $\frac{12a^3bc}{(2abc)^3}$ $= \frac{12a^3bc}{8a^3b^3c^3}$ $= \frac{3}{2b^2c^2}$			
10(b)				



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	$15p - 3pq - 10q + 2q^2$ $= (5 - q)(3p - 2q)$			[5]
11(a)	4 units $\rightarrow$ 180			
	1 unit $\rightarrow 45^\circ$			
11(b)	$\frac{360}{45} = 8$ $(8 - 2) \times 180 = 1080^\circ$			[3]
12(a)	$\angle BEF = 70^\circ$ (alt $\angle$)			
12(b)	$\angle BFE = 70^\circ$ (isos. Δ) $\angle BFG = 180 - 70 = 110^\circ$			[2]
13(a)	$0.5 \text{ m/s} = \frac{0.5 \div 1000}{1 \div 3600}$ $= 1.8 \text{ km/h or } 1\frac{4}{5} \text{ km/h}$			
13(b)	Distance = speed $\times$ time $1.8 \times \frac{45}{60} = 1.35 \text{ km or } 1\frac{7}{20} \text{ km}$			[3]
14 (a)	$2c^2 - 3c = 0$ $c(2c - 3) = 0$ $c = 0 \text{ or } c = 1\frac{1}{2}$			
14(b)	$x = 3.637$ (3dp) or -0.137 (3dp)			[5]



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15	$(3y-1)^2 - y$ $= 9y^2 - 6y + 1 - y$ $= 9y^2 - 7y + 1$			[2]
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Paper 2

1(a)(i)	$y = k(x^3 + 1)$ $18 = k(8 + 1)$ $k = 2$ $y = 2(x^3 + 1)$			
1(a)(ii)	$x = \frac{1}{2}$			
1(a)(iii)	$y = 56$			
1(b)	$s \propto \frac{1}{t}$ $t \rightarrow 2.5t$ $s \rightarrow \frac{1}{2.5^2} s$ New value of $s = 2.4$ or $2\frac{2}{5}$			[6]
2(a)(i)	$x^2 - 25$ $= (x + 5)(x - 5)$			
2(a)(ii)	$\frac{x^2 - 25}{x^2 - 3x - 10}$ $= \frac{(x + 5)(x - 5)}{(x + 2)(x - 5)}$ $= \frac{x + 5}{x + 2}$			



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2(b)	$\frac{4-x}{(x+3)^2} - \frac{5}{(x+3)}$ $= \frac{4-x-5(x+3)}{(x+3)^2}$ $= \frac{4-x-5x-15}{(x+3)^2}$ $= \frac{-6x-11}{(x+3)^2}$			
2(c)	$x = \frac{3y-2z}{y+z}$ $x(y+z) = 3y-2z$ $y = \frac{-2z-xz}{x-3}$			
2(d)(i)	$x^2 + 7x - 12$ $= \left(x + \frac{7}{2}\right)^2 - \left(\frac{7}{2}\right)^2 - 12$ $= \left(x + 3\frac{1}{2}\right)^2 - 24\frac{1}{4}$			[10]
2(d)(ii)	$x = 1.42 \text{ (3sf) or } -8.42 \text{ (3sf)}$			
3(a)(i)	$A \cup C = \{1, 2, 3, 4, 5, 6, 7, 11, 12, 13\}$			
3(a)(ii)	$A \cap B = \{ \} \text{ or } A \cap B = \emptyset$			
3(b)	$n(C') = 9$			
3(c)	Possible values of $a = 1, 2, 3$ and 6			[5]
4(a)	$396 \text{ km} \rightarrow 24 \text{ l}$ $1 \text{ km} \rightarrow \frac{2}{33} \text{ l}$ $100 \text{ km} \rightarrow \frac{2}{33} \times 100 = 6.06 \text{ l / 100 km (to 3 sf)}$			



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(b)(i)	594km (to 3 sf)			
(b)(ii)	$\frac{10.1}{100} \times 150 = 15.15\%$ $15.15 \times \$2.005$ $= \$30.37575$ $= \$30.38 \text{ (2dp)}$			[6]
5(a)	$5u \rightarrow 10000$ $10u \rightarrow 20000$ $\$20000$			
5(b)	Simple interest rate $= (10000 \times 1.05\% \times 5)$ $= \$525$ Compound interest $= \$520.51 \text{ (2dp)}$ Andy should choose Bank X to yield a better interest.			[5]
6(a)(i)	$4x$			
6(a)(ii)	$4x = 2(x + 200)$ $4x = 2x + 400$ $2x = 400$ $x = 200$			
6 (b)	$4x + (x + 200) + x$ $= 4 \times 200 + (200 + 200) + 200$ $= 1400$			[5]
7(a)	Volume of chocolate $= \frac{1}{2} \times 6 \times 5 \times 15$ $= 225\text{cm}^3$			



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7(b)	$225 \div 4 = 56.25$ $\frac{4}{3}\pi r^3 = 56.25$ $r = 23769...$ $r = 238 \text{ cm (to 3 sf)}$			
7(c)	Volume of cuboid $= 4.7538 \times 4.7538 \times 19.0152$ $= 429.717 \text{ cm}^3$ Volume of empty space in the box $= 429.717 - 225$ $= 204.717$ $= 205 \text{ cm}^3 \text{ (to 3 sf)}$			[7]
8(a)	$2.10 \times 2.5 \times 1.07$ $= 56.175$ $= \$56.18 \text{ (2dp)}$			
8(b)	$2.39 \times 2.5 \times 1.07$ $= 63.9325$ $63.9325 - 56.175$ $= 7.7575$ $= \$7.76 \text{ (2dp)}$			[5]