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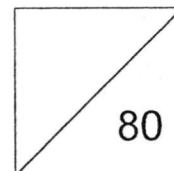
聖嬰中學

HOLY INNOCENTS' HIGH SCHOOL

Name of Student

Class

Index Number



END-OF-YEAR EXAMINATION 2015
SECONDARY 3 EXPRESS
MATHEMATICS PAPER 2

4048/02

Date: 5 Oct 2015

Duration: 2 h

Additional Materials: **4 writing papers**
1 graph paper

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

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

Do not use paper clips, glue or correction tape/fluid.

Answer **ALL** questions.

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

If working is needed for any question it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is **80**.

The use of an approved scientific calculator is expected, where appropriate.

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

For π , use either your calculator value or 3.142.

Set by: Mrs Chang Poh Joo

Vetted by: Ms Goh Lay Ching / Mdm Hayati

*This document consists of **9** printed pages (including cover page).*

(32

Mathematical Formulae

Compound interest

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

Geometry and Measurement

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

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

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

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

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

Trigonometry

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

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

Answer all the questions.

- 1 (a) Given that $L = \sqrt{\frac{2a}{b+4}}$,
- (i) find L when $a = -8$, $b = -5$, [1]
- (ii) express b in terms of L and a . [2]
- (b) Solve the equation $\frac{12}{x-2} = x-3$. [3]
- (c) Given that $10x = 8y$, find the ratio of $x : y$. [1]
- (d) After a discount of 5%, a television set cost \$6 500, inclusive of 7% Goods and Services Tax (GST).
Find the original selling price without GST, correct to the nearest dollar. [2]
-

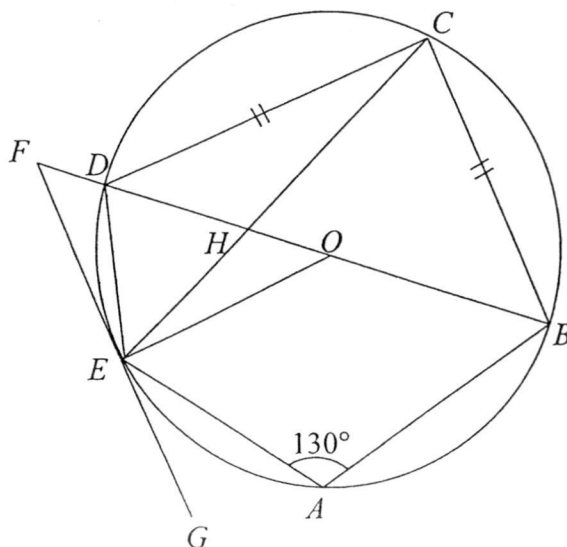
- 2 (a) Amos invested some money in a saving account.
The interest was compounded half-yearly at a rate of 4.5% per annum.
At the end of $3\frac{1}{2}$ years, there was \$9932.58 in his account.
How much did Amos invest in the account? [3]
- (b) After $3\frac{1}{2}$ years, Amos withdrew all his money from the savings account.
- (i) He decided to use \$5000 for a holiday trip to the United States of America.
The exchange rate between US dollars (US\$) and Singapore dollars (S\$) is
US\$1 = S\$ 1.22.
Calculate how many US dollars he received. [2]
- (ii) He used the rest of the money to invest in a bank which offers simple interest of $R\%$.
After 18 months, he withdrew all his money which amount to \$5240.87.
Calculate the value of R . [3]
-

- 3 In the diagram, O is the centre of the circle and points A, B, C, D and E lie on the circumference.

The tangent at E meets BD produced at F .

EC meets BD and H .

$BC = CD$ and $\angle EAB = 130^\circ$.



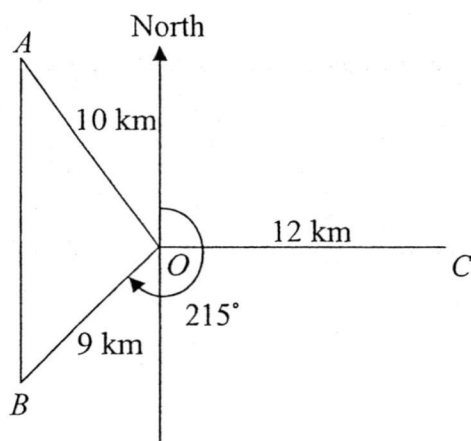
- (a) Stating your reasons clearly, find

- | | |
|---------------------------|-----|
| (i) reflex $\angle EOB$, | [1] |
| (ii) $\angle ECB$, | [1] |
| (iii) $\angle CBD$, | [1] |
| (iv) $\angle DOE$, | [2] |
| (v) $\angle OFE$. | [1] |

- (b) Is the line ED parallel to line BC ?

Justify your answer with clear working. [2]

4



A , B and C are three locations on the sea.

A rescue ship is resting at A .

A is 10 km from O .

B is 9 km from O on a bearing of 215° and is due south of A .

C is 12 km due east of O .

(a) Calculate

(i) the bearing of O from B , [1]

(ii) the angle BAO , [2]

(iii) the area of triangle ABO . [2]

(b) A helicopter is hovering 8500 m directly above O .

The rescue ship travels from A to B .

Find the greatest angle of elevation of the helicopter from the rescue ship. [3]

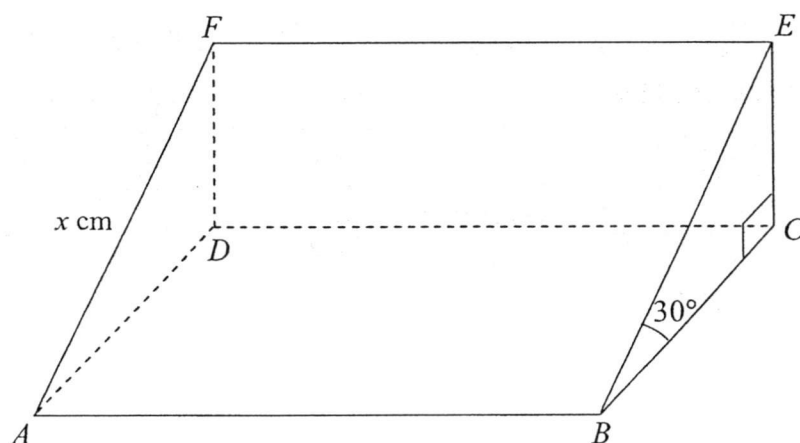
(c) At 09 00, a ship at C sends out a distress signal.

The rescue ship moves directly from B to C at a speed of 80 km/h.

Find the time that the rescue ship will reach C . [3]

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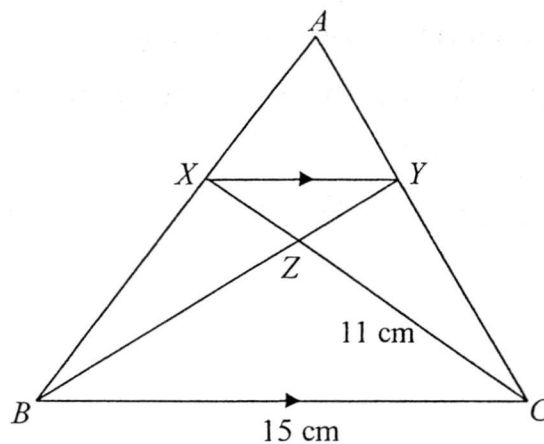
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The diagram shows a triangular prism in which $\angle EBC = 30^\circ$ and $AF = x$ cm. The length of AB is 1 cm less than 2 times the length of AF .

- (a) (i) Write down an expression, in terms of x , for the length of AB . [1]
- (ii) Using trigonometry, write down an expression, in terms of x , for the length of EC , giving your answer as a fraction in its lowest terms. [1]
- (b) The length of diagonal, AE , is 13 cm.
Form an equation in x and show that it reduces to $5x^2 - 4x - 168 = 0$. [3]
- (c) Solve the equation $5x^2 - 4x - 168 = 0$, giving your answer correct to **three** decimal places. [3]
- (d) Find the volume of the prism. [3]
-

- 6 (a) In triangle ABC , XY is parallel to BC .
 XC and BY meet at the point Z such that $ZC = 11$ cm and $BC = 15$ cm.
 It is given that $XB = 2AX$.



- (i) Prove that $\triangle AXY$ is similar to $\triangle ABC$. [2]
- (ii) Name another triangle which is similar to $\triangle XZY$. [1]
- (iii) Find the length of XY . [2]
- (iv) Given that the area of $\triangle AXY = 35 \text{ cm}^2$, find the area of $BCYX$. [2]
- (v) Find the ratio of $\frac{\text{area of } \triangle XYZ}{\text{area of } \triangle XYB}$. [1]
- (b) Figure 1 shows a solid cone A .
 The solid cone A is divided into two solids, X and Y , as shown in Figure 2.
 Solid X is similar to cone A and the volume of solid X and Y are 67.5 cm^3 and 245 cm^3 respectively.

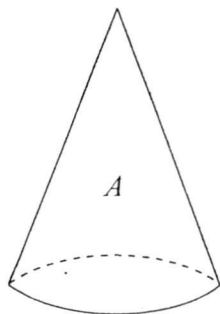


Figure 1

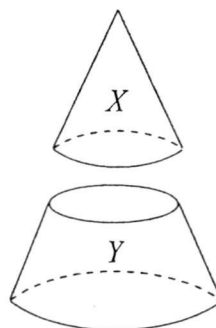


Figure 2

- (i) Find the ratio of the height of solid X to that of solid Y . [2]
- (ii) If the base area of solid X is 30 cm^2 , calculate the base area of solid cone A . [2]

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

The variables x and y are connected by the equation $y = 2x + \frac{18}{x^2}$.

Some corresponding values of x and y are given in the table below.

x	1	1.5	2	3	4	5	6
y	20	11	8.5	8	9.1	10.7	m

(a) Find the value of m . [1]

(b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $1 \leq x \leq 6$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $0 \leq y \leq 22$.

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

(c) Use your graph to find,

(i) the least value of $2x + \frac{18}{x^2}$, [1]

(ii) the range of values of x for which $2x + \frac{18}{x^2} \leq 10$. [1]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 3\frac{1}{2}$. [2]

(e) (i) On the same axes, draw the graph of the straight line $y = x + 10$ for $1 \leq x \leq 6$. [1]

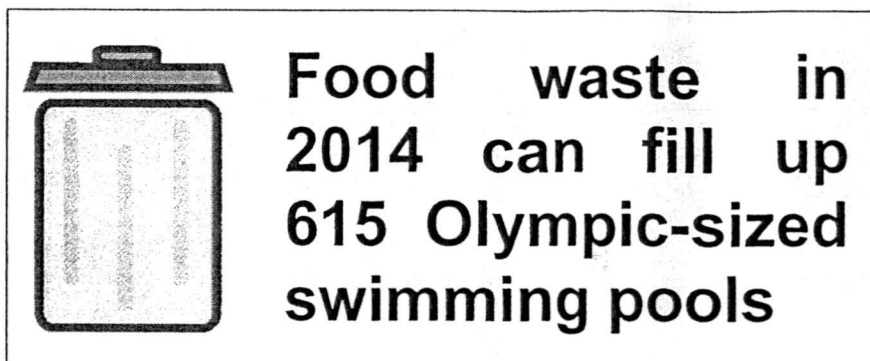
(ii) Write down the x coordinate of the point at which the two graphs intersect. [1]

(iii) Given that this value of x is a solution to the equation

$$x^3 + Ax^2 + Bx + 18 = 0,$$

find the value of A and of B . [2]

- 8 Here is a poster about food waste in Singapore.



The annual waste statistics from the National Environment Agency (NEA) showed that Singapore produced 789 000 tonnes of food waste in the year 2014.
The total population of Singapore was 5.47 million in 2014.

- (a) Express in standard form,
 (i) the total population of Singapore in 2014, [1]
 (ii) the mass, in kg, of food waste in 2014. [1]
 (1 tonne = 1000 kg)
- (b) Find the average mass, in kg, of food waste per individual in 2014. [1]
- (c) Given that the food waste in 2014 constitutes 23% of all the various types of waste generated.
Find the mass, in kg, of the total waste generated in 2014.
Express your answer in standard form. [2]

(d)

Useful information

- The completion of Phase II development of Semakau Landfill provides a capacity of 6,700 Olympic-sized swimming pools.
- Of the total waste generated, 13% are recycled, 83% incinerated* and the rest are sent to Semakau Landfill.

* Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.

Estimate the number of years in which Semakau Landfill will be completely filled with the waste.

Justify your answer with calculations. [4]

– End of Paper –

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2015 Sec 3 Exp – E.Maths P2 Answers

Qn	Answer	Qn	Answer
1(ai)	4	6(ai)	$\angle XAY = \angle BAC$ (common angle) $\angle AXY = \angle ABC$ (corresponding angles) $\triangle AXY$ is similar to $\triangle ABC$ (AA Similarity test)
(aii)	$b = \frac{2a - 4L^2}{L^2}$ or $b = \frac{2a}{L^2} - 4$		
(b)	$x = 6$ or $x = -1$	(aii)	$\triangle CZB$
(c)	$x : y = 4 : 5$	(aiii)	$XY = 5$ cm
(d)	\$6394 (nearest dollar)	(aiv)	Area of $BCYX = 280$ cm ²
2(a)	\$8500.00 (to 2 d.p when accuracy is not stated)	(av)	By comparison using common height, $\frac{\text{area of } \triangle XYZ}{\text{area of } \triangle XYB} = \frac{YZ}{YB} = \frac{1}{4}$
(bi)	US\$4098.36 (to 2 d.p when accuracy is not stated)	(bi)	Height of X : Height of $Y = 3 : 2$
(bii)	$R = 4.17$ (do not include %)	(bii)	Base area of cone $A = 83\frac{1}{3}$ cm ²
3(ai)	reflex $\angle EOB = 260^\circ$	7(a)	$m = 12.5$
(aii)	$\angle ECB = 50^\circ$	(ci)	Min value is 7.9 [must be less than 8]
(aiii)	$\angle CBD = 45^\circ$	(cii)	$1.6 \leq x \leq 4.6$ (± 0.1)
(aiv)	$\angle DOE = 80^\circ$	(d)	Gradient of tangent = 1.16 (accept 0.7 to 1.7)
(av)	$\angle OFE = 10^\circ$	(eii)	x -coordinate = 1.5 (± 0.1) [Answer in coordinates are not accepted]
(b)	$\angle BDE = 50^\circ$ (angles in same segment) $\angle CBD = 45^\circ$ (from aiii) $\angle CBD \neq \angle BDE$ $\therefore$ Line ED is not parallel to line BC [can accept other method]	(eiii)	Equate the 2 line and curve $2x + \frac{18}{x^2} = x + 10$ $\frac{2x^3 + 18}{x^2} = x + 10$ $2x^3 + 18 = x^3 + 10x^2$ $x^3 - 10x^2 + 18 = 0$ Compare with $x^3 + Ax^2 + Bx + 18 = 0$, $A = -10$, $B = 0$
4(ai)	Bearing = 035°		
(aii)	$\angle BAO = 31.1^\circ$		
(aiii)	Area of $\triangle ABO = 41.1$ km ²	8(ai)	5.47×10^6
(b)	58.7°	(aii)	7.89×10^8 kg
(c)	09 14	(b)	144 kg
5(ai)	$AB = 2x - 1$	(c)	3.43×10^9 kg
(aii)	$BE = \frac{x}{2}$ or $BE = \frac{1}{2}x$	(d)	63 years
(c)	$x = 6.210$ or $x = -5.410$		
(d)	Volume of prism = 95.4 cm ³		

2015 Sec 3 End-of-Year Exam Math Paper 2

Qn	Answer Scheme	Marks
1(ai)	$L = \sqrt{\frac{2(-8)}{-5+4}} = 4$ [Do not accept -4 unless question requires you to take square root. Thus, if question is $L^2 = \frac{2a}{b+4}$, answer will be ± 4.]	A1
1(aii)	$L = \sqrt{\frac{2a}{b+4}}$ Square both sides : $L^2 = \frac{2a}{b+4}$ $L^2(b+4) = 2a$ $bL^2 = 2a - 4L^2$ $b = \frac{2a - 4L^2}{L^2} \quad \text{or} \quad b = \frac{2a}{L^2} - 4$	M1 for squaring both sides A1
1(b)	$\frac{12}{x-2} = x-3$ $(x-2)(x-3) = 12$ $x^2 - 5x + 6 = 12$ $x^2 - 5x - 6 = 0$ $(x-6)(x+1) = 0$ $x = 6 \text{ or } x = -1$	M1 for $x^2 - 5x + 6 = 12$ M1 for factorization A1 for both correct ans
1(c)	$10x = 8y$ $\frac{x}{y} = \frac{4}{5}$ $x : y = 4 : 5$	B1
1(d)	<u>Method 1 :</u> Let the original price be \$$x$ $\frac{95x}{100} \times 1.07 = 6500$ $x = \$6394 \text{ (nearest dollar)}$	M1 A1
	<u>Method 2 :</u> 107% represents \$6500 100% rep. $\frac{6500}{107} \times 100 = \\6074.766 [Price without GST] 95% represents \$6074.766 100% rep. $\frac{6074.766}{95} \times 100 = \\6394 [Price without discount] The original price is \$6394 (nearest dollars)	M1 A1

2(a)	$9932.58 = P \left(1 + \frac{4.5}{100} \right)^7$ $9932.58 = P(1.0225)^7$ $P = \frac{9932.58}{(1.0225)^7}$ $P = \$8500.00$	M1 M1 for manipulation (allow e.c.f.) A1 Deduct mark under accuracy if not given to 2 dp
2(bi)	$\text{S\$ } 1.22 = \text{US\$ } 1$ $\text{S\$ } 50000 = \text{US\$ } \frac{1}{1.22} \times 5000$ $= \text{US\$ } 4098.36$	M1 for $\frac{500}{1.22}$ A1 (to 2 d.p)
2(bii)	Amount left = $\$9932.58 - \$5000 = \$4932.58$ Interest earned = $\$5240.87 - \$4932.58 = \$308.29$ $4932.58 \times R\% \times \frac{18}{12} = 308.29$ $R = \frac{308.29}{4932.58} \times \frac{12}{18} \times 100$ $R = 4.17$	M1 for interest earned M1 for correct use of simple interest formula A1 [deduct under presentation if % is written]
3(ai)	$\text{reflex } \angle EOB = 130^\circ \times 2 \text{ (} \angle \text{ at centre} = 2 \angle \text{ at circumference)}$ $= 260^\circ$	B1
3(aii)	$\angle ECB = 180^\circ - 130^\circ \text{ (angles in opposite segment)}$ $= 50^\circ$	B1
3(aiii)	$\angle CBD = (180^\circ - 90^\circ) \div 2 \text{ (isosceles triangle, } BC = CD)$ $= 45^\circ$	B1
3(aiv)	<u>Method 1 :</u> $\angle DCE = 90^\circ - 50^\circ \text{ (right angle in semicircle)}$ $= 40^\circ$ $\angle DOE = 40^\circ \times 2 \text{ (} \angle \text{ at centre} = 2 \angle \text{ at circumference)}$ $= 80^\circ$ <u>Method 2 :</u> $\angle BOE = 360^\circ - 260^\circ \text{ (angles at a point)}$ $= 100^\circ$ $\angle DOE = 180^\circ - 100^\circ \text{ (angles on a straight line)}$ $= 80^\circ$	M1 A1 M1 A1 [accept other methods]
3(av)	$\angle OFE = 180^\circ - 90^\circ - 80^\circ \text{ (tangent } \perp \text{ radius)}$ $= 10^\circ$	B1
3(b)	$\angle BDE = 50^\circ \text{ (angles in same segment)}$ $\angle CBD = 45^\circ \text{ (from aiii)}$ $\angle CBD \neq \angle BDE$ Conclude : Line ED is NOT parallel to line BC.	M1 A1 Deduct 1 m if no proper conclusion

4(ai)	035°	B1
4(aii)	$\frac{\sin \angle BAO}{9} = \frac{\sin 35^\circ}{10}$ $\angle BAO = \sin^{-1}\left(\frac{9 \sin 35^\circ}{10}\right)$ $\angle BAO = 31.07^\circ$ $\angle BAO = 31.1^\circ$	M1 A1
4(aiii)	$\angle AOB = 180^\circ - 35^\circ - 31.07^\circ = 113.93^\circ$ $\text{Area of } \triangle ABO = \frac{1}{2}(10)(9)\sin 113.93^\circ$ $= 41.1318$ $= 41.1 \text{ km}^2$	M1 A1
4(b)	Let X be the point such that $\angle AXO = 90^\circ$ $\sin 31.07^\circ = \frac{XO}{10}$ $XO = 5.1608$ $\tan \angle HXO = \frac{8.5}{XO}$ $\tan \angle HXO = \frac{8.5}{5.1608}$ $\angle HXO = 58.7^\circ$	M1 for XO [May use $\sin 35^\circ$] $\sin 35^\circ = \frac{XO}{9}$ $XO = 5.162$ M1 [May use $XO = 5.162$] $\tan \angle HXO = \frac{8.5}{5.162}$ A1
	<u>Alternative method to find shortest distance using area of triangle [Not recommended as need to find AB, and the question is only 3 marks for the whole part.]</u> $\frac{AB}{\sin 113.93^\circ} = \frac{10}{\sin 35^\circ}$ $AB = 15.935$ Let X be the point such that $\angle AXO = 90^\circ$ $\frac{1}{2} \times 15.935 \times XO = 41.1318$ $XO = 5.1624 \text{ km}$ $\tan \angle HXO = \frac{8.5}{5.1624}$ $\angle HXO = 58.7^\circ$	

4(c)	$\angle BOC = 35^\circ + 90^\circ = 125^\circ$ $BC^2 = 9^2 + 12^2 - 2(9)(12)\cos 125^\circ$ $BC = 18.678$ $\text{Time} = \frac{18.678}{80}$ $= 14 \text{ mins}$ Time for rescue ship to reach C = 09 14	M1 for cosine rule M1 for distance/speed A1
5(ai)	$AB = 2x - 1$	B1
(ii)	$\sin 30^\circ = \frac{EC}{x}$ $\frac{1}{2} = \frac{EC}{x}$ $EC = \frac{x}{2}$	B1 [accept $\frac{1}{2}x$]
5(b)	$AE^2 = AB^2 + BE^2$ $13^2 = (2x - 1)^2 + x^2$ $169 = 4x^2 - 4x + 1 + x^2$ $5x^2 - 4x + 1 - 169 = 0$ $5x^2 - 4x - 168 = 0$	M1 for Pythagoras' Theorem M1 for correct expansion A1
5(c)	$5x^2 - 4x - 168 = 0$ $x = \frac{4 \pm \sqrt{(-4)^2 - 4(5)(-168)}}{2(5)}$ $x = \frac{4 \pm \sqrt{3376}}{10}$ $x = 6.2103 \text{ or } x = -5.4103$ $x = 6.210 \text{ or } x = -5.410$ [This part will be given zero mark if pupils simply used calculator to get the final values of x.]	M1 for correct substitution into quadratic equation A2 [deduct under accuracy if not to 3 d.p]

5(d)	$\cos 30^\circ = \frac{BC}{x}$ $BC = x \cos 30^\circ = 6.2103 \cos 30^\circ = 5.3782$ Volume of prism = area of $\triangle BCE \times \text{length } AB$ $= \left(\frac{1}{2} \times 5.3782 \times 6.2103 \times \sin 30^\circ\right) \times [2(6.2103) - 1]$ $= 95.4 \text{ cm}^3 \text{ (3 s.f.)}$ [Pupils are reminded to use values of x with 4 d.p. (1 more degree of accuracy with respect to part c) for the calculation in this part, as it affects the degree of accuracy in the final answer.]	M1 to find BC Accept other methods M1 for correct substitution into volume of prism [For area of $\triangle BCE$, may use any formula for area of $\triangle$] A1
6(ai)	$\angle XAY = \angle BAC$ (common angle) <i>[Do not write "given"]</i> $\angle AXY = \angle ABC$ (corresponding $\angle$ s) $\triangle AXY$ is similar to $\triangle ABC$ (AA Similarity test)	M1 for 2 pairs of angles with correct reasons A1 to conclude with AAA test being stated
6(aii)	$\triangle CZB$ is similar to $\triangle XZY$	B1
6(aiii)	$\frac{XY}{BC} = \frac{AX}{AB} = \frac{1}{3}$ $\frac{XY}{15} = \frac{1}{3}$ $XY = 5 \text{ cm}$	M1 A1
6(aiv)	$\frac{\text{area of } \triangle AXY}{\text{area of } \triangle ABC} = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$ $\frac{35 \text{ cm}^2}{\text{area of } \triangle ABC} = \frac{1}{9}$ Area of $\triangle ABC = 9 \times 35 = 315 \text{ cm}^2$ Area of $BCYX = 315 - 35 = 280 \text{ cm}^2$	M1 for squaring ratio A1
6(av)	By comparison using common height, $\frac{\text{area of } \triangle XYZ}{\text{area of } \triangle XYB} = \frac{YZ}{YB} = \frac{1}{4}$	B1 Answer must be given as a fraction

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6(bi)	$\frac{V_x}{V_A} = \frac{67.5}{67.5 + 245} = \frac{67.5}{312.5}$ $\frac{V_x}{V_A} = \frac{27}{125}$ $\frac{H_x}{H_A} = \sqrt[3]{\frac{27}{125}} = \frac{3}{5}$ $\frac{H_x}{H_A} = \frac{3}{5}$ Height of X : Height of Y = 3 : 5	M1 for $\frac{27}{125}$ or $\frac{67.5}{312.5}$ A1 Answer must be given as a ratio
6(bii)	$\frac{Area_x}{Area_A} = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$ $\frac{30cm^2}{Area_A} = \frac{9}{25}$ $Area\ of\ cone\ A = \frac{30 \times 25}{9} = 83\frac{1}{3}\ cm^2$	M1 for $\frac{9}{25}$ A1
7(a)	$m = 12.5$	B1
7(b)	Correct axis and scale [origin must be labelled] Correct plotted points Smooth curve through all points with labelled curve	G3 The curve and the line must be labelled. Otherwise deduct under overall presentation.
7(c)(i)	Min value is 7.9 [must be less than 8] [Answer in coordinates are not accepted]	G1
7(c)(ii)	Draw line $y = 10$ on graph paper $1.6 \leq x \leq 4.6$ (± 0.1)	G1
7(d)	Draw tangent line at $x = 3.5$ on graph paper Gradient = 1.16 (accept 0.7 to 1.7)	G1 G1
7(ei)	Drawing of straight line $y = x + 10$ on graph paper	G1
7(e)(ii)	x-coordinate = 1.5 (± 0.1) [Answer in coordinates are not accepted]	G1
7(e)(iii)	Equate the 2 line and curve $2x + \frac{18}{x^2} = x + 10$ $2x^3 + 18 = x^3 + 10x^2$ $x^3 - 10x^2 + 18 = 0$ Compare with $x^3 + Ax^2 + Bx + 18 = 0$, $A = -10, B = 0$	M1 for equating the line and the curve A1 [both answers must be correct]

8(ai)	Total population = 5.47×10^6	B1
8(aii)	Mass of food waste = $789\,000 \times 1000 = 7.89 \times 10^8 \text{ kg}$	B1
8(b)	Av. mass of food waste = $\frac{7.89 \times 10^8}{5.47 \times 10^6} = 144 \text{ kg per indiv.}$	B1 Can accept $1.44 \times 10^2 \text{ kg}$
8(c)	Mass of all waste generated in 2014 $= \frac{7.89 \times 10^8}{23} \times 100 = 3.43 \times 10^9 \text{ kg}$	M1 A1
8(d) More pupils seen to use this method	<u>Method 1 (Using comparison using mass)</u> Mass with 4% of total waste sent to landfill $= 3.43 \times 10^9 \times 4\%$ $= 1.372 \times 10^8 \text{ kg}$ Mass of waste per swimming pool $= \frac{7.89 \times 10^8 \text{ kg}}{615 \text{ pools}} = 1.2829 \times 10^6 \text{ kg per swimming pool}$ Capacity of Semakau Landfill $= 6700 \times 1.2829 \times 10^6$ $= 8.5954 \times 10^9 \text{ kg}$ Number of years Semakau Landfill will be filled up $= \frac{8.5954 \times 10^9}{1.372 \times 10^8} = 62.6 \approx 63 \text{ years}$	M1 M1 M1 A1
8(d)	<u>Method 2 (Using number of Olympic pools)</u> Mass with 4% of total waste sent to landfill $= 3.43 \times 10^9 \times 4\%$ $= 1.372 \times 10^8 \text{ kg}$ Mass of waste per swimming pool $= \frac{7.89 \times 10^8 \text{ kg}}{615 \text{ pools}} = 1.2829 \times 10^6 \text{ kg per swimming pool}$ Number of pools to contain waste sent to landfill in 2014 $= \frac{1.372 \times 10^8}{1.282 \times 10^6} = 107.02 \text{ pools}$ Number of years Semakau Landfill will be filled up $= \frac{6700}{107.02} = 62.6 \approx 63 \text{ years}$	M1 M1 M1 A1

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8(d)	<u>Method 3 (Using number of Olympic pools)</u> Number of pools to contain total waste generated in 2014 $= \frac{615}{23} \times 100 = 2673.9 \text{ pools}$ Number of pool with 4% of total waste sent to landfill $= 2673.9 \times 4\%$ $= 106.956 \text{ pools}$ Number of years Semakau Landfill will be filled up $= \frac{6700}{106.956} = 62.6 \approx 63 \text{ years}$	M1 M1 M1, A1
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