NAME: _____ ( ) CLASS: _____

FAIRFIELDMETHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2014
SECONDARY 3 EXPRESS

MATHEMATICS 4016/01

Paper 1

Date: 2October 2014 **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
Paper 2	/ 100
Total	%

Setter: Miss ShamsiahZainalabidin

This question paper consists of 22 printed pagesincluding the cover page.

Name: _____ ( ) Class: _____

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 $= 4\pi r^2$

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

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

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

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

Sector area $= \frac{1}{2}r^2\theta$, where θ 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

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

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

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Answer **all** the questions.

1 **(a)** Evaluate $\frac{\sqrt{456.4}}{56.7+(3.56-2)^3}$, giving your answer correct to 2 significant figures.

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

(b) Express $4\frac{13}{40}$ as a percentage.

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

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2 **(a)** Find the fraction which is exactly halfway between $\frac{2}{7}$ and $\frac{5}{7}$.

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

(b) Write the following in ascending order.

$\sqrt[3]{10}$ $\frac{10}{3}$ $3.3333\dot{3}\dot{4}$

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

3 The population of America is approximately 9.72×10^8.

The population of Asia is approximately 4.30×10^9.

The mean height of the population of America is approximately 178 cm.

(a) Giving your answers in standard form, estimate

(i) the total height of the population of America,

(ii) the difference in population between America and Asia.

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

(ii) ..... [1]

(b) Express the population of America as a percentage of the population of Asia.

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

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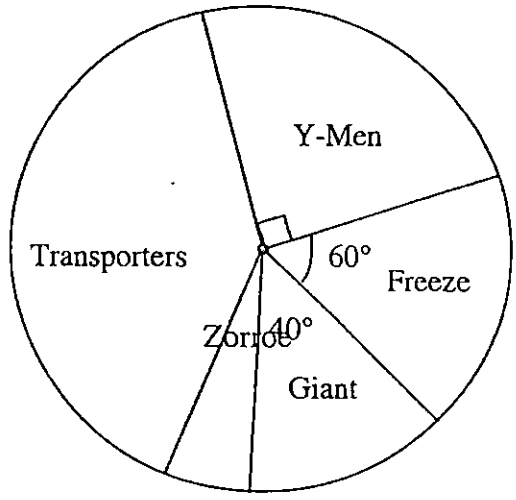
4 Solve $x(3x - 7) = 3 - 2x(4 - x)$.

Answer $x =$ ..... or $x =$ ..... [3]

5 In a survey, 108 adults were asked about their favouriteblockbuster movie. The results of the survey are shown in the pie chart.



(a) Express the number of adults who prefer Freezeas a percentage of the total number of adults.

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

(b) If there were 5 adults who like Zorroe, calculate the angle representing the number of adults wholikeTransporters.

Answer (b) ..... ° [2]

6 The temperature of an object at 0900 is – 5 °C.

At 15 00, the new temperature of the object is 15 °C.

(a) Find the difference between the two temperatures.

Answer (a) .....°C [1]

(b) Assuming that the temperature rises at a steady rate, findthe time when the temperature is 20.5 °C.

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

7 (a) Simplify $36x^5 \div (3x)^{-2}$.

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

(b) Given that $25^n \times 5^{-4} = 125^n$, find the value of n.

Answer(b) $n =$ ..... [2]

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8 **(a)** There are 24 blue balls and 35 yellow balls in a bag.

$x$blue balls are removed from the bag. The probability of drawing a blue ball at random from the bag is now $\frac{3}{10}$. Find the value of x.

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

(b) When A is decreased by 10% and then increased by 20%, it becomes B.

Express the ratio of $A : B$ in its simplest form.

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

9 A map is drawn to a scale of 1 :500 000. The distance between Town *A* and Town *B* on the map is 7.5 cm.

(a) Find the actual distance, in kilometres, between the two towns.

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

(b) Find, in square centimetres, the area of Town *A* on the map which represents an actual area of 7 500 km^2.

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

(c) Calculate the distance, in centimetres, which represents the distance between the two towns on a second map where the scale is 1 : 60 000.

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

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10 The following numbers are expressed as the product of prime factors,

$$2700 = 2^2 \times 3^3 \times 5^2 \quad \text{and} \quad 198 = 2 \times 3^2 \times 11.$$

Use these results to find

(a) thehighest common factor of 2700 and 198 as a product of its prime factors,

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

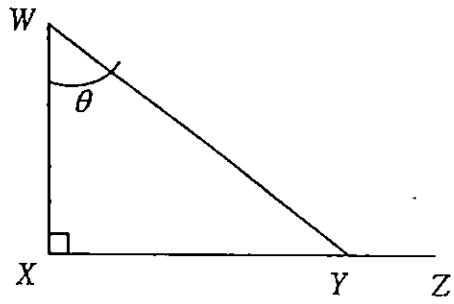
(b) the lowest common multiple of 2700 and 198 as a product of its prime factors,

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

(c) the smallest integer, k, such that $2700k$ is a perfect cube.

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

11 In the diagram below, XYZ is a straight line and $\sin\theta = \frac{4}{5}$.



Find the value of

(a) $\tan\theta$,

Answer (a) .... [1]

(b) $\sin(90°-\theta)$,

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

(c) $\cos\angle WYZ$.

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

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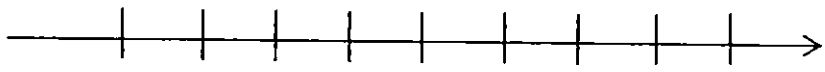
12 **(a)** Solve the inequality $5-2x<\frac{2x-5}{3}\leq 4$.

Show your solution on the number line below.

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



[1]

(b) Write down the largest prime number that satisfies $5-2x<\frac{2x-5}{3}\leq 4$.

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

13 **(a)** Without the use of calculator, evaluate

$$156789 \times 0.123456789 - 56789 \times 0.123456789.$$

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

(b) Given that $\frac{p^2+3q}{2r} = \frac{9p^2}{4}$, express p in terms of q and r.

Answer (b) ..... [3]

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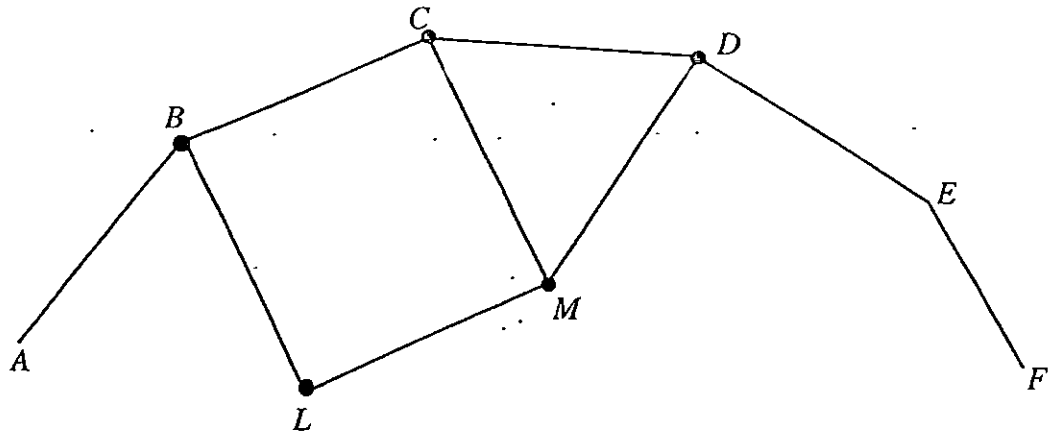
14 **(a)** The interior angle of a regular polygon is 170°. Calculate the number of sides of the polygon.

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

(b) *ABCDEF*... is part of a regular polygon which has interior angles of 151°. *CBLM* is a square.



Find

(i) $\angle MCD$,

(ii) $\angle MDE$,

(iii) $\angle BAC$.

Answer (b)(i) ..... ° [1]

(ii) ..... ° [1]

(iii) ..... ° [2]

15 (a) x is inversely proportional to the square root of y.

It is known that $x = 64$ for a particular value of y. Find the value of x when this value of y is increased by 300%.

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

(b) 3 painters take 15 days to paint the whole house.

(i) How long would it take 9 painters to paint the whole house?

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

(ii) How many more painters would be needed if the painting of the whole house is to be completed within 9 days?

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

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16 **(a)** Given that $a - b = 2.5$ and $a^2 - b^2 = 30$, find the value of $(a + b)^2$.

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

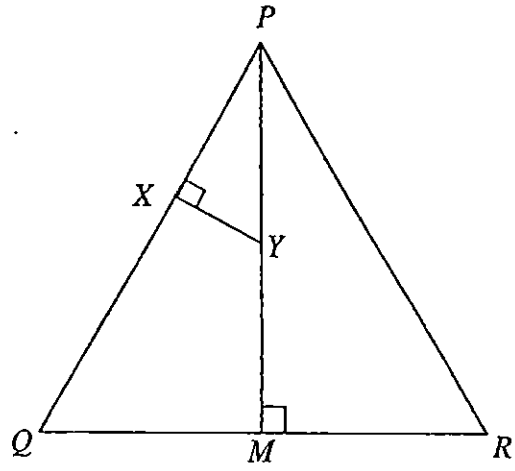
(b) Solve the simultaneous equations

$$4x + 4y = 16,$$

$$\frac{x-2y}{3} = 4.$$

Answer(b) $x =$ ....., $y =$ ..... [3]

17 **(a)** In the diagram, $\angle PQR = \angle PRQ$, PM is perpendicular to QR and XY is perpendicular to PQ. Given that $PQ = 13$ cm, $QR = 10$ cm and $PM = 12$ cm and $XY = 2.5$ cm,



(i) Prove that triangles XYP and MQP are similar.

.....

.....

.....

.....

.....

.....[1]

(ii) Find the length of QX.

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

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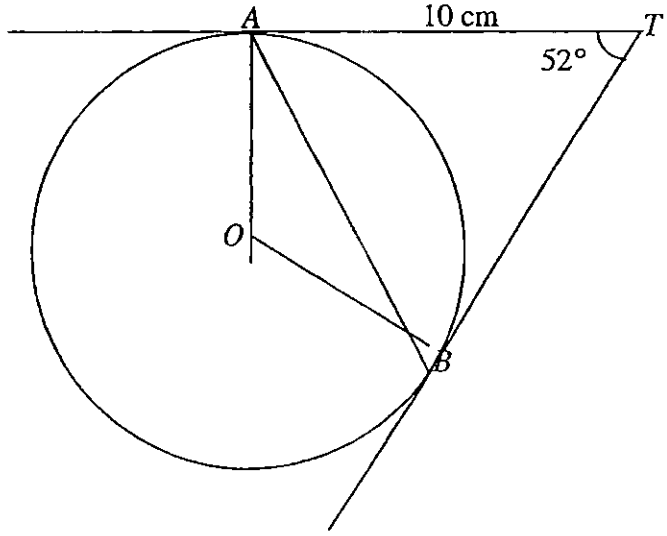
17 **(b)** The diagram shows a circle with centre O. TA and TB are tangents to the circle at A and B respectively. It is given thatangle $ATB = 52°$ and $AT = 10$ cm.



(i) Find the length BT.

Answer (b)(i)BT= .... cm [1]

(ii) Find the angle OTA.

Answer (b)(ii) $\angle OTA$= .....° [1]

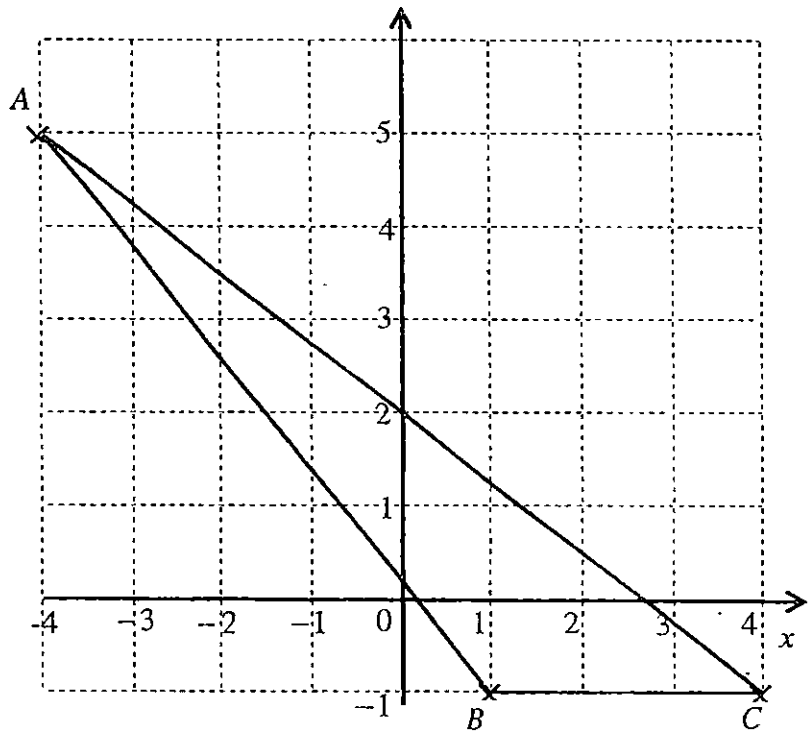
(iii) Explain why angle OAT is 90°.

Answer..... [1]

(iv) Find the radius of the circle.

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

18 The points$A$ (– 4, 5), B (1, – 1) and C(4, – 1) are shown in the diagram below.



Find

(a) the gradient of AC,

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

(b) the equation of the line which passes through (0, 4) and is parallel to AC,

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

(c) the length of AB,

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

(d) the area of triangle ABC.

Answer (d) ..... units^2 [1]

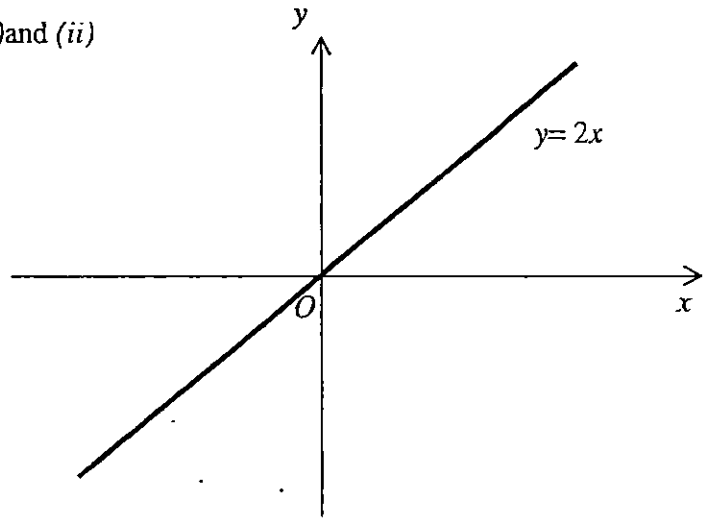
19 **(a)** The graph of the line $y = 2x$ is shown in the answer space.

On the diagram below, sketch and label the graph of

(i) $y = -2x$,

(ii) $y = 2x - 1$.

*Answer (a)(i)*and *(ii)*



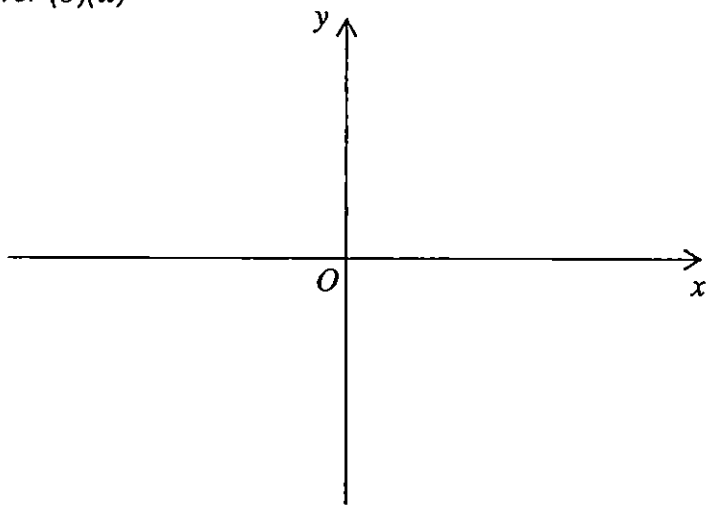
[2]

(b) (i) Express $x^2 + 4x - 19$ in the form $(x + p)^2 - q$.

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

(ii) Hence, sketch the graph of $x^2 + 4x - 19$, indicating the coordinates of the turning point and the y-intercept.

Answer (b)(ii)



[2]

20 (a) (i) Construct a quadrilateral $ABCD$ such that $AB = 10$ cm, $AD = 8$ cm,

$BC = 7$cm, $\angle ABC = 40°$ and $\angle BAD = 110°$. AB has already been drawn. [2]

(ii) Measure and write down the length of CD.

(b) On the quadrilateral drawn, construct

(i) the perpendicular bisector of AB, [1]

(ii) the bisector of angle ABC. [1]

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

A _____ B

Answer (a)(ii) CD = ... cm [1]

~ End of Paper ~

Secondary 3 Express End-of-Year Examinations 2014

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Mathematics Paper 1 – Marking Scheme

Q	Solution	Marks Allocation
1a	0.3531 = 0.35 (2s.f.)	B1
1b	432.5 %	B1
2a	$\left(\frac{5}{7}-\frac{2}{7}\right)\div 2=\frac{3}{14}$ $\frac{2}{7}+\frac{3}{14}=\frac{1}{2}$	B1
2b	$\sqrt[3]{10}$, 3.3333, $\frac{10}{3}$, $3.\dot{3}\dot{4}$	B1
3ai	Total height of population of America $=9.72\times10^{8}\times178$ $=1.73016\times10^{11}$ cm $=1.73\times10^{11}$ cm (3 s.f)	B1 or B1 (accept either one of the ans)
3aii	Difference in population between America and Asia $=4.30\times10^{9}-9.72\times10^{8}$ $=3\,328\times10^{9}$ $=3.33\times10^{9}$	B1 or B1 (accept either one of the ans)
3b	% of Americans and of Asians $=\frac{9.72\times10^{8}}{4.30\times10^{8}}\times100\%$ = 22.6% (3 s f)	B1
4	$x(3x-7)=3-2x(4-x)$ $3x^{2}-7x=3-8x+2x^{2}$ $3x^{2}-2x^{2}-7x+8x-3=0$ $x^{2}+x-3=0$ a = 1, b = 1, c = -3 $x=\frac{-1\pm\sqrt{1^{2}-4(1)(-3)}}{2(1)}$ $=\frac{-1\pm\sqrt{13}}{2}$ $\approx 1.30278 \text{ or } -2.3028$ $=1.30\,(3\text{ s.f.})\text{ or }-2.30\,(3\text{ s.f.})$	M1 M1 A1 for both correct answers
5a	% of people who like Freeze $=\frac{60^{\circ}}{360^{\circ}}\times100\%$ $=16\frac{2}{3}\%$ or 16.7 % (3 s.f)	B1
5b	Angle to rep. people who like Zorroe $=\frac{5}{108}\times360^{0}$	M1

	$= 16\frac{2}{3}^\circ$ Angle to rep. people who like Transporters $= 360^\circ - 90^\circ - 60^\circ - 40^\circ - 16\frac{2}{3}^\circ$ $= 153\frac{1}{3}^\circ$	A1
6a	Difference in temp = 15°C – (– 5°C) = 20°C	
6b	Rate of change of temp. $= \frac{20}{1700 - 0900 \text{ hrs}} = \frac{20}{6}$ °C/h Temperature difference = [20.5 – (– 5°C)]= 25.5°C No. of hours to reach 25.5°C = $\frac{1}{\frac{20}{6}} \times 25.5$ = 7 h 39 mins New time = 0700 + 7 h 39 mins = 16 39	M1 A1 or B2 (for all correct steps and anwers)
7a	$36x^5 \div (3x)^{-2}$ $= 36x^5 \div \frac{1}{(3x)^2}$ $= 324x^7$	M1 for $(3x)^2 = 9x^2$
7b	$25^n \div 5^{-4} = 125^n$ $(5^2)^n \times 5^{-4} = (5^3)^n$ $5^{2n} \times 5^{-4} = 5^{3n}$ $2n - 4 = 3n$ $-4 = 3n - 2n$ $n = -4$	M1 – the pdt of both powers are correct A1
8a	$\text{P(blue ball)} = \frac{3}{10}$ $\frac{24 - x}{24 + 35 - x} = \frac{3}{10}$ $\frac{24 - x}{59 - x} = \frac{3}{10}$ $10(24 - x) = 3(59 - x)$ $240 - 10x = 177 - 3x$ $-7x = -63$ $x = 9$	M1 A1

8b	$\frac{A}{B}$ $=\frac{A}{1.08A}$ $=\frac{1}{1.08}$ $=\frac{25}{27}$	M1 A1
9a	Map : Actual 1 : 500 000 1 cm : 5 km 7.5 cm : $5 \times 7.5 = 37.5$ km	B1
9b	Map : Actual 1 cm : 5 km 1 cm^2 : 25 km^2 $1\times\frac{7500}{25}\text{ cm}^2$: $7\,500\text{ km}^2$ 300 cm^2 : $7\,500\text{ km}^2$	M1 for $1\times\frac{7500}{25}\text{cm}^2$ A1 for 300 cm^2
9c	Map : Actual 1 : 60 000 1 cm : 0.6 km $1\times\frac{37.5}{0.6}$ cm : 37.5 km 62.5 cm : 37.5 km	M1 for $1\times\frac{37.5}{0.6}$cm A1 for 62.5 cm
10a	HCF of 2700 and 198 $=2\times3^2$	B1
10b	LCM of 2700 and 198 $=2^2\times3^3\times5^2\times11$	B1
10c	$2700k$ = perfect cube $2^2\times5^2\times3^3\times k$ = perfect cube $k=2\times5$ $=10$	B1
11a	$\text{Sin}\,\theta=\frac{4}{5}=\frac{XY}{WY}$ $\text{WX}=\sqrt{5^2-4^2}=3$ $\tan\theta=\frac{XY}{WX}=\frac{4}{3}$	B1
11b	$\sin(90^\circ-\theta)=\frac{3}{5}$	B1
11c	$\cos\angle WYX=\frac{XY}{WY}=\frac{4}{5}$ $\cos\angle WYZ=-\frac{4}{5}$	B1
12a	$5-2x<\frac{2x-5}{3}\le4$	

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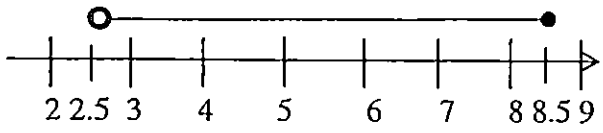
	$5-2x<\frac{2x-5}{3}$ or $\frac{2x-5}{3}\le 4$ $15-6x<2x-5$ $\quad 2x-5\le 12$ $-8x<-5-15$ $\quad 2x\le 17$ $x>\frac{-20}{-8}$ $\quad x\le 8\frac{1}{2}$ $x>2\frac{1}{2}$ $\therefore 2\frac{1}{2}<x\le 8\frac{1}{2}$  	} }M1 for both values of x }solved A1 A1
12b	7	B1
13a	$156789\times 0.1234567891-56789\times 0.1234567891$ $=0.1234567891(156789-56789)$ $=0.1234567891(100\ 000)$ $=12345\ 67891$	M1 B1
13b	$\frac{p^2+3q}{2r}=\frac{9p^2}{4}$ $4(p^2+3q)=18p^2r$ $4p^2+12q=18p^2r$ $4p^2-18p^2r=-12q$ $p^2(18r-4)=12q$ $p=\pm\sqrt{\frac{12q}{18r-4}}$ $=\pm\sqrt{\frac{6q}{9r-2}}$	M1 M1 A1
14a	Size of ext angle = 180° – 170° = 10° No. of sides of the polygon $=\frac{360^\circ}{10^\circ}$ $=36$	B1
14bi	$\angle MCD=151^\circ-90^\circ=61^\circ$	B1
14bii	$\angle MDE=151^\circ-[(180-61)/2]^\circ=91.5^\circ$	B1
14biii	$\angle BAC=(180^\circ-150^\circ)\div 2$ $=15^\circ$	M1 A1

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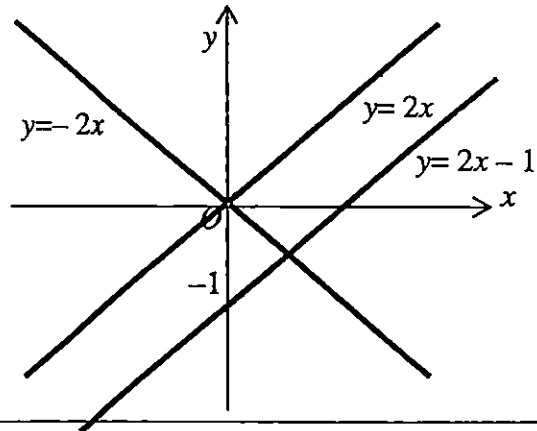
15a	$x=\frac{k}{\sqrt{y}}$ $64=\frac{k}{\sqrt{y}}$ $\therefore k=64\sqrt{y}$ equation is $x=\frac{64\sqrt{y}}{\sqrt{y}}$ For new $y=4y$ $x=\frac{64\sqrt{y}}{\sqrt{4y}}$ $=\frac{64\sqrt{y}}{2\sqrt{y}}$ $=32$	M1 A1 or B2
15bi	Painters : Days 3 : 15 9 : 5 Answer: 5 Days	 B1
15bii	Painters : Days 3 : 15 5 : 9 Extra painters = 5 – 3 = 2	 M1 A1 or B2
16a	$a^2-b^2=(a+b)(a-b)$ $30=(a+b)(2.5)$ $a+b=30\div 2.5$ $=12$ $(a+b)^2=12^2=144$	 M1 A1
16b	$4x+4y=16$ ---------- (1) $\frac{x-2y}{3}=4$ ---------- (2) From (2): $x-2y=12$ --------- (3) (1) ÷ 4: $x+y=4$ ---------- (4) (3) – (4): $x-2y-x-y=12-4$ $-3y=8$ $y=-\frac{8}{3}$ Sub $y=-\frac{8}{3}$ into (3): $x-2(-\frac{8}{3})=12$	 M1 A1

	$x + \frac{16}{3} = 12$ $x = 6\frac{2}{3}$	A1
17ai	$\angle XPY = \angle MPQ$ (common angle) $\angle PXY = \angle PMQ$ (given) By AA Test, ΔXYP & ΔMQP are similar	B1
17aii	$\frac{XP}{PM} = \frac{XY}{QM}$ $\frac{XP}{12} = \frac{2.5}{10 \div 2}$ $XP = \frac{2.5 \times 12}{5}$ $= 6$ cm QX = 13 – 6 = 7 cm	M1 A1
17bi	$BT = AT = 10$ cm	B1
17bii	Angle $OTA = \frac{52°}{2} = 26°$	B1
17biii	Tangent perpendicular to the radius of circle	B1
17biv	Radius of circle = $10 \tan 26° = 4.88$ cm (3 s.f)	B1
18a	Gradient of $AC = \frac{-1-5}{4-(-4)} = -\frac{3}{4}$	B1
18b	$y = -\frac{3}{4}x + 4$ or $4y = -3x + 16$	B1
18c	$AB = \sqrt{(-4-1)^2 + (5+1)^2} = 7.81$ units (3 s.f.)	B1
18d	Area of triangle ABC $= \frac{1}{2} \times 3 \times 6$ $= 9$ units^2	B1
19ai & ii		B1 for each correct line drawn for i and ii. For (ii), must show y-intercept at -1 to get B1
19bi	$x^2 + 4x - 19 = (x+2)^2 - 19 - (2)^2$ $= (x+2)^2 - 19 - 4$ $= (x+2)^2 - 23$	B1
19bii	y	

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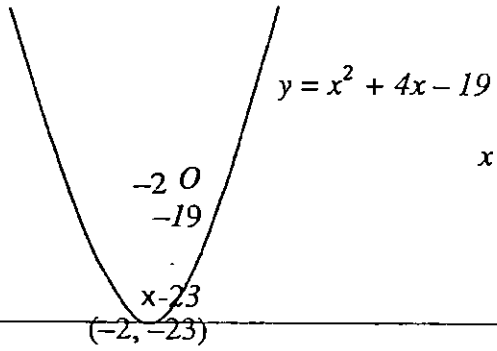
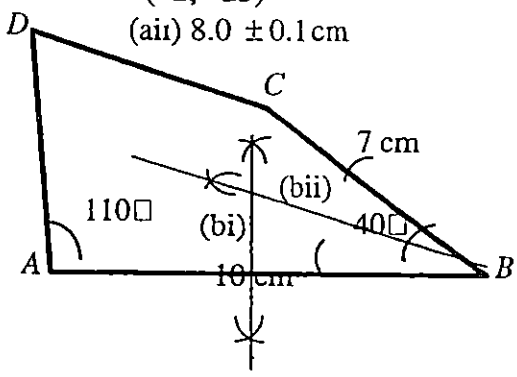
		P1 for correct turning pt. and y-intercept S1 for correct shape of the curve
20a & b	(aii) 8.0 ± 0.1 cm 	(aii) *AD*, *BC* – B1 for correct lengths Angles *ABC*&*BAD* – B1 for correct angles to form a quadrilateral. Minus 1 mark for 1 mistake (aii) B1 for correct length of *CD* (bi) B1 for correct construction of perpendicular bisector with construction lines (bii) B1 for correct construction of angle bisector with construction lines

Name Question 11 Index No.

Subject Class Date

(i)

x	1	1·5	2	2·5	3·2	M1
$\frac{y}{x}$	2·5	5·6	7·55	9·6	12·5	

M1 = Correct scale, axes and points plotted

G1 = Straight line drawn

(ii)(a) $\frac{y}{x} = a - bx^2$

$y = ax - bx^3$

$\frac{y}{x} = \frac{a}{a} - \frac{bx^2}{a}$

$\frac{y}{x} = \frac{b}{a}x + \frac{1}{a}$

$\frac{1}{a}$ = Y-intercept = 0·7

$a = 1·43$ B1

[Accept $1·67$ to $1·25$]

$\frac{b}{a}$ = gradient $= 4·0667$

$b = 4·0667 \times 1·43$

$b = 5·8$ B1

[Accept 5 to $6·1$]

(ii)(b) $y = 6x$

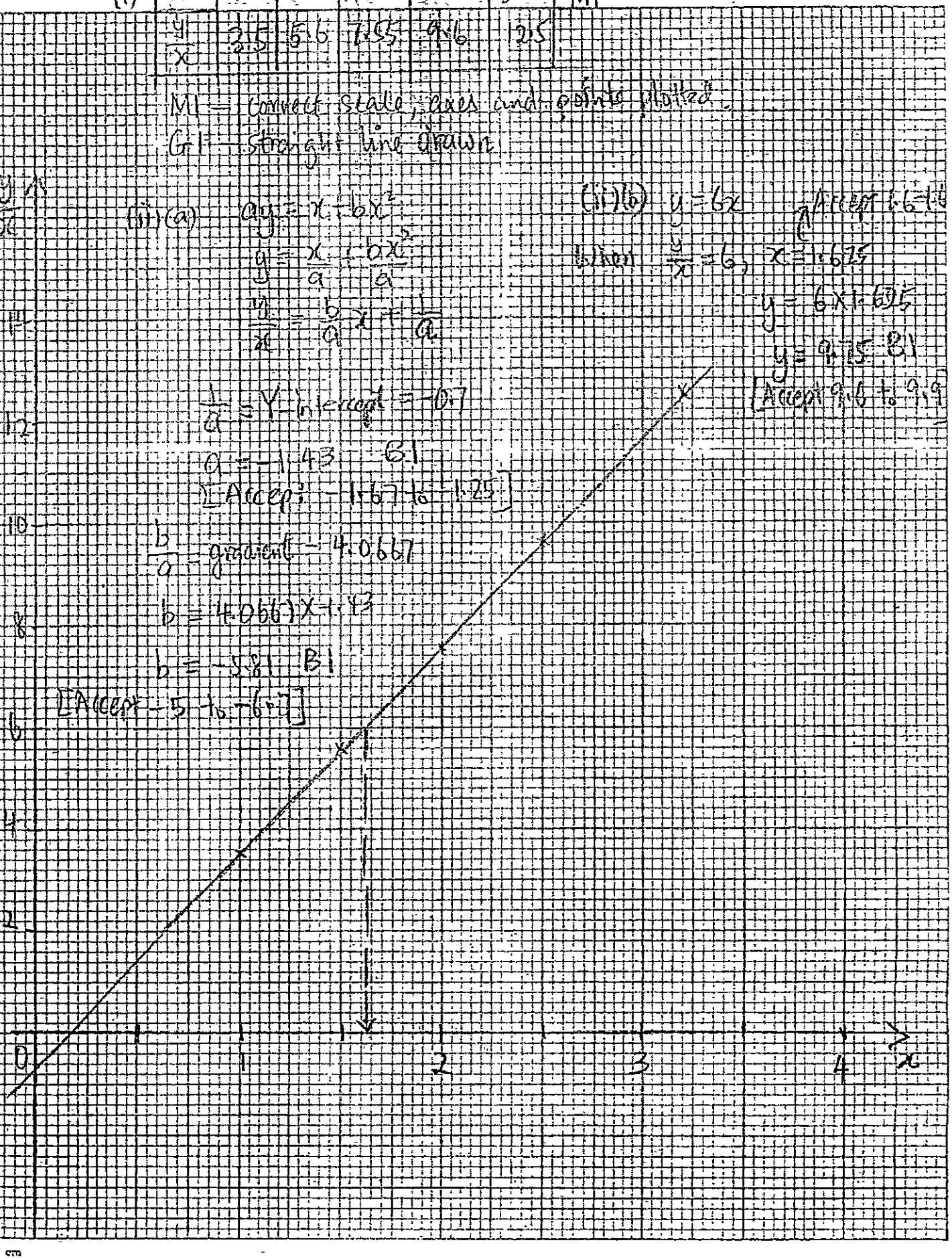
Accept $1·6 - 1·8$

$\frac{y}{x} = 6$, $x = 1·625$

$y = 6 \times 1·625$

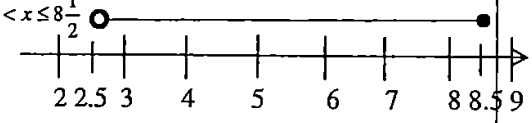
$y = 9·75$ B1

[Accept $9·6$ to $9·9$]



cm x 24 cm

Name: _____ ( ) Class: _____

Q	Solution		
1a	0.35 (2s.f.)	13a	0.12345.67891
1b	432.5 %	13b	$p=\pm\sqrt{\frac{6q}{9r-2}}$
2a	$\frac{1}{2}$	14a	36
		14bi	61°
2b	$\sqrt[3]{10}$, 3.3333, $\frac{10}{3}$, $3.\dot{3}\dot{4}$	14bii	91.5°
		14biii	15°
3ai	1.73016×10^{11} cm OR 1.73×10^{11} cm *(3 s.f)*	15a	32
		15bi	5 Days
3aii	3.328×10^{9} or 3.33×10^{9}	15bii	$5-3=2$
3b	22.6% (3 s.f)	16a	144
4	1.30 (3 s f.) or – 2.30 (3 s.f.)	16b	$x=6\frac{2}{3}$, $y=-\frac{8}{3}$
5a	$16\frac{2}{3}\%$ or 16.7 % (3 s.f)	17ai	$\angle XPY=\angle MPQ$ (common angle) $\angle PXY=\angle PMQ$ (given) By AA Test, ΔXYP & ΔMQP are similar
5b	$153\frac{1}{3}^{\circ}$		
6a	20°C		
6b	16 39	17aii	7 cm
7a	$324x^{7}$	17bi	10 cm
7b	$n=-4$	17bii	26°
8a	$x=9$	17biii	Tangent perpendicular to the radius of circle
8b	$\frac{25}{27}$	17biv	4.88 cm (3 s.f)
9a	37.5 km	18a	$-\frac{3}{4}$
9b	300 cm^2	18b	$y=-\frac{3}{4}x+4$ or $4y=-3x+16$
9c	62 5 cm	18c	7.81 units
10a	2×3^{2}	18d	9 $units^2$
10b	$2^{2}\times3^{3}\times5^{2}\times11$	19bi	$(x+2)^{2}-23$
10c	10	20 (aii)	8.0 ± 0.1 cm
11a	$\frac{4}{3}$ 11b) $\frac{3}{5}$ 11c) $-\frac{4}{5}$		
12a	$2\frac{1}{2}<x\leq8\frac{1}{2}$ 		
12b	7		

Name: _____ ( ) Class: _____

NAME: _____ ( ) CLASS: _____

FAIRFIELD METHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2014
SECONDARY 3 EXPRESS

MATHEMATICS **4016/02**

Paper 2

Date: 3 October 2014 **Duration: 2 hours 30 minutes**

Additional Materials: Answer Paper
Graph papers

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: MdmHaliza and Mr Alester Tan

This question paper consists of 11 printed pagesincluding the cover page.

Name: _____ ( ) Class: _____

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

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

Sector area = $\frac{1}{2}r^2\theta$, where θ 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

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

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

Name: _____ ( ) Class: _____

Answer **all** the questions.

1 **(a)** **(i)** Factorise $(4x+y)^2-16y^2$. [1]

(ii) Hence, simplify $\dfrac{4x^2-11xy+6y^2}{(4x+y)^2-16y^2}$. [2]

(b) Given that $y=x\left(\sqrt{\dfrac{W}{W+3}}\right)$, express W in terms of x and y. [3]

(c) Solve the equation $\dfrac{x+5}{x}=3-\dfrac{2x-4}{x+3}$. [3]

---

2 Trevor wishes to buy a new car which is priced in the showroom at $120000.

(a) If he pays cash, he will be given a discount. Calculate the percentage discount if he only needs to pay $98400. [2]

(b) Trevor trades in his old car for $44280 and borrows the remaining amount of $75720 from a finance company which charges an interest at the rate of 2.8% per year. If Trevor wishes to pay the loan in 10 years, calculate

(i) the interest he has to pay for the loan, [2]

(ii) the amount he has to pay each month to the finance company, giving your answer to the nearest dollar. [2]

(c) The new car priced at $120 000, decreases its value by 18% after1 year. At the end of the second year, its value decreases a further 15%.
Calculate the value of the car at the end of the second year. [2]

---

3 **(a)** The frequency table below shows the heights of students in a group.

Height ($h$cm)	**Frequency (f)**
$140 < h \leq 150$	10
$150 < h \leq 160$	30
$160 < h \leq 170$	50
$170 < h \leq 180$	32
$180 < h \leq 190$	5

(i) **On a piece of graph paper**, construct a histogram to represent the heights of students. [2]

(ii) Find the percentage of students who are taller than 160 cm. [1]

(iii) Calculate an estimate of the mean height of the students. [2]

(b) Another group of 24 students have their heights taken and recorded in the stem-and-leaf diagram.

Stem	**Leaf**
14	6 6 9 9
15	1 1 5 6 9
16	3 3 3 4 7
17	0 0 3 4 5 9
18	1 1 4 5

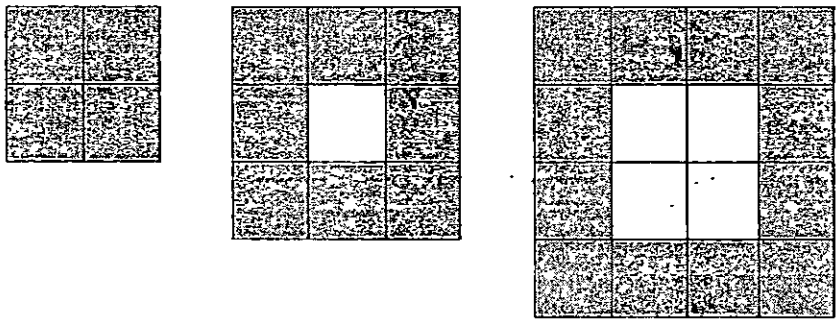
Key: 14|3 means 143 cm

(i) Find the median height. [1]

(ii) Find the modal height. [1]

Name: _____ ( ) Class: _____

4 Small squares are used to form a series of big squares as shown below.



(a) Find the values of p, q, r and s in the table below. [2]

Length of side of big square (n)	Number of shaded squares (S)	Number of unshaded squares (U)
2	4	0
3	8	1
4	p	q
5	r	s

(b) Write down the formula, in terms of n, for

(i) S, the number of shaded squares, [1]

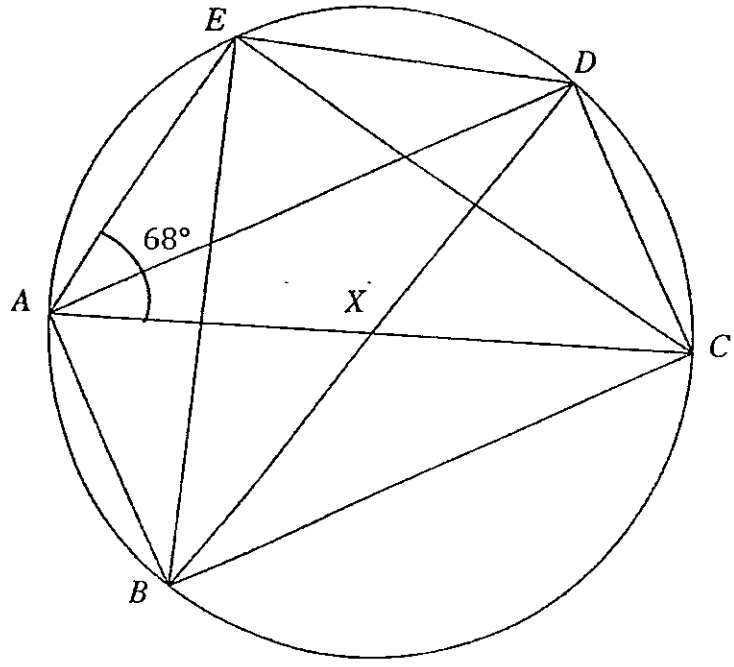
(ii) U, the number of unshaded squares. [1]

(c) How many shaded squares, S, and unshaded squares, U, are there if the lengths of the side of the big square is 101? [2]

(d) Explain why there cannot be 314 shaded squares to form one of the patterns. [1]

Name: _____ ( ) Class: _____

5 (a)



The points A, B, C, D and E lie on a circle. AC is a diameter of the circle.

AD bisects $\angle CAE$ $\angle CAE = 68°$.

(i) Giving your reasons, write down

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

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

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

(d) $\angle CBD$. [1]

(ii) It is given that BD is parallel to AE and that BD cuts AC at X.

[You **must not** assume that X is the centre of the circle.]

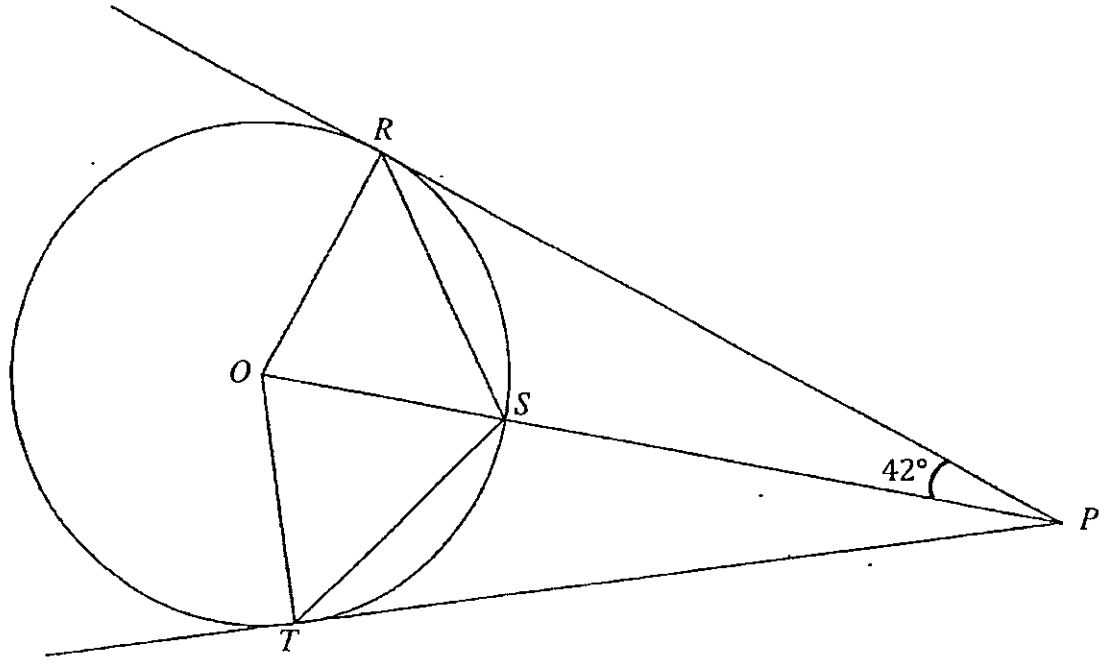
Prove that triangle DAX is isosceles. [2]

(iii) Find $\angle BDC$. [1]

(iv) Hence or otherwise prove that X is the centre of the circle. [1]

Name: _____ ( ) Class: _____

5 (b) The diagram shows a circle RST, with centre O. PR and PT are tangents to the circle. ST and SR are chords. $\angle RPO = 42°$.



Giving your reasons, write down

(i) $\angle ROP$, [2]

(ii) $\angle TSR$, [1]

(iii) the obtuse angle formed by chord ST and tangent PT. [1]

---

6 Alan cycles from Johor Baru to Kota Tinggi in Malaysia. He travels for 30 km at a constant speed of x km/h.

(a) Write down an expression, in terms of x, for the time, in hours, that he took to travel from Johor Baru to Kota Tinggi. [1]

He then walks another 5km to a campsite at a constant speed of $(x - 20)$ km/h.

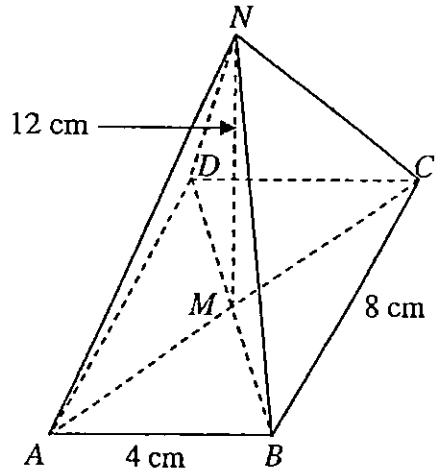
(b) Write down an expression, in terms of x, for the time, in hours, that he took to walk to the campsite. [1]

(c) Given that the time taken to cycle from Johor Baru to Kota Tinggi takes 11 minutes longer than the time taken to walk to the campsite, form an equation in x and show that it reduces to $11x^2 - 1720x + 36000 = 0$. [3]

(d) Solve the equation, giving both answers correct to two decimal places. [3]

(e) Calculate the average speed, in km/h, that Alan took for the whole journey. [2]

7 **(a)** The diagram below is a right pyramid with a horizontal rectangular base $ABCD$ of lengths 4 cm by 8 cm.
N is 12 cm vertically above point M.



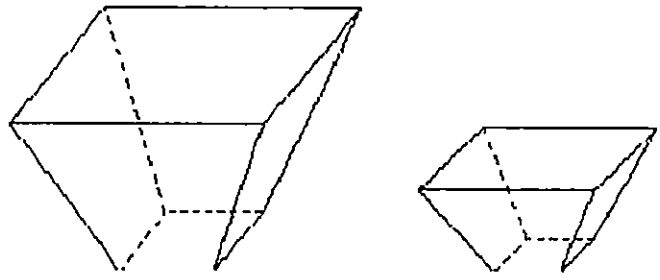
(i) Find the length of BD. [2]

(ii) Find the length of NB. [2]

(iii) Calculate $\angle NDB$. [2]

(iv) Calculate $\angle BNC$. [2]

(b) The diagrams below showtwo open troughswhich are geometrically similar. The ratio of theareas of the bases is 9 : 4.



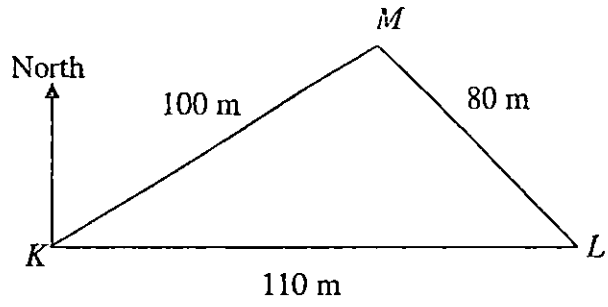
(i) The area of the top of the bigger trough is 351cm^2. Find the area of the top of thesmaller trough. [1]

(ii) Write down the ratio of the depth of the bigger trough to the depth of the smaller trough. [1]

(iii) Both troughs are filled with water to the brim. The mass of water in the larger trough is 36 kg. Find the mass of water in the smaller trough. [2]

Name: _____ ( ) Class: _____

8 K, L and M are three points on the ground. L is 110 m due east of K.
$KM = 100$ m and $ML = 80$ m.



(a) Calculate

(i) $\angle KML$, [3]

(ii) $\angle MKL$, [2]

(iii) the area of ΔKLM, [2]

(iv) the bearing of K from M. [2]

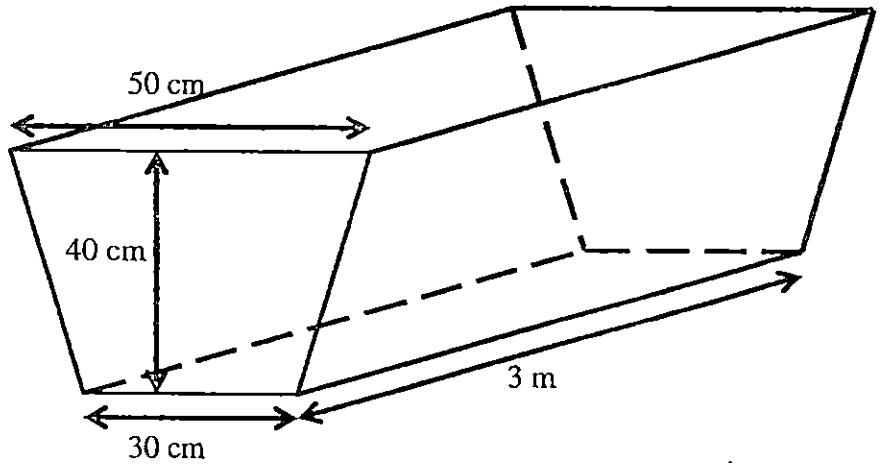
(b) A vertical mast of 20 m stands at point M.

Calculate

(i) the shortest distance from M to KL, [2]

(ii) the greatest angle of elevation of the top of the mast to a man walking along KL. [2]

9 A hot water tank is in the shape of a prism whose cross-section is a trapezium. The lengths of the parallel sides of the trapezium are 50cm and 30cm respectively. The height of the trapezium is 40 cm and the tank is 3 m long.



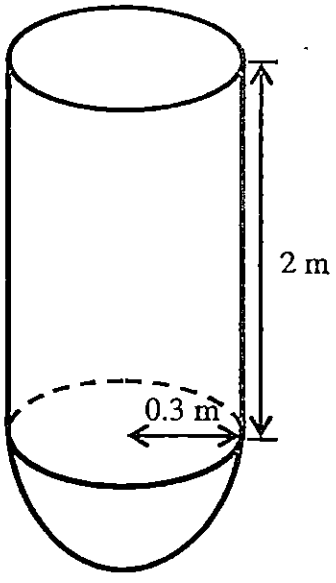
The tank is full of water.

(a) Calculate the amount of water in the tank in litres. [3]

(b) The water drains from the tank at a rate of 0.3 l per second.

Calculate the time, in minutes and seconds, to empty the tank. [2]

(c)



All of the water from the tank runs into a container. The container is made by joining a hemisphere of radius 0.3 m to an open cylinder of radius 0.3 m and height 2 m.

(i) Calculate the total curved surface area of the container in square metres.

[3]

(ii) Calculate the height of the water level in the container in metres.

[3]

Name: _____ ( ) Class: _____

10 **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, correct to the nearest whole number, where

$$y = 3x^2 + \frac{80}{x} - 40$$

x	1	1.5	2	3	4	5	6	8
y	43	20	12	14	28	51	81	p

(a) Find value of p. [1]

(b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x-axis for $1 \le x \le 8$.

Using a scale of 1 cm to represent 10 units, draw a vertical y-axis for $0 \le y \le 180$.

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 solutions of $y = 20$. [2]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 6$. [3]

(e) (i) On the same axes, draw the line $y = 2x + 30$ for $1 \le x \le 8$. [1]

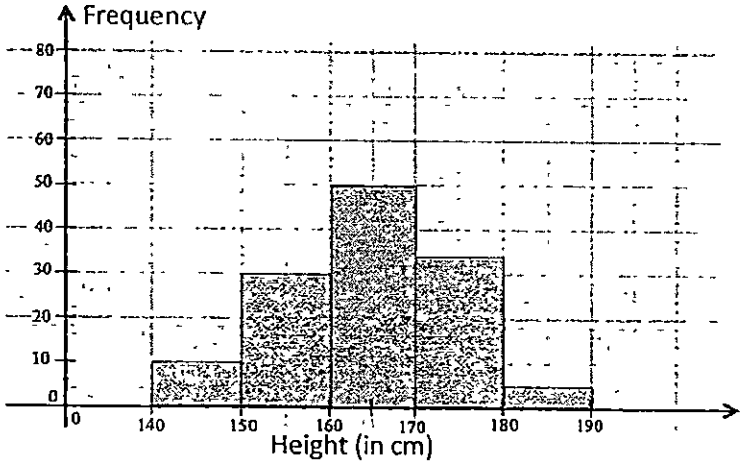
(ii) Estimate the range of values of x for which $3x^2 + \frac{80}{x} - 40 \le 2x + 30$. [1]

~End of Paper~

Marking Scheme

Sec 3 Express Mathematics EOY Examination 2014 Paper 2

1(a)(i)	$(4x+y)^2-16y^2$ $=(4x+y-4y)(4x+y+4y)$ $=(4x-3y)(4x+5y)$	 B1
(ii)	$\frac{4x^2-11xy+6y^2}{(4x+y)^2-16y^2}$ $=\frac{(4x-3y)(x-2y)}{(4x-3y)(4x+5y)}$ $=\frac{x-2y}{4x+5y}$	 M1 (Factorise numerator) A1
(b)	$y=x\left(\sqrt{\frac{W}{W+3}}\right)$ $y^2=\frac{x^2W}{W+3}$ $y^2W+3y^2=x^2W$ $W(y^2-x^2)=-3y^2$ $W=\frac{-3y^2}{y^2-x^2}$ or $\frac{3y^2}{x^2-y^2}$	 M1 (Remove sq. root) M1 (Factorise) A1
(c)	$\frac{x+5}{x}=3-\frac{2x-4}{x+3}$ $\frac{x+5}{x}=\frac{3x+9-2x+4}{x+3}$ $x^2+8x+15=x^2+13x$ $15=5x$ $x=3$	 M1 (Form single fractions) M1(Remove denominator) A1
2(a)	$120000-98400=\$21600$ $\frac{21600}{120000}\times 100\%$ $=18\%$	 M1 – converting to % A1
(bi)	$\frac{2.8}{100}\times 75720$ $=\$2120.16$ $\$2120.16\times 10=\$21201.60$	 M1 – Finding interest per year A1

(bii)	$\frac{21201.60+75720}{10\times12}$ $=\$807.68$ $=\$808$ (*nearest dollar*)	M1–show able to find amount payable over 120 months. A1
(c)	$120000\times0\ 82=\$98400$ $98400\times0.85=\$83640$	M1 – multiply to find 82% of new car price A1
3(ai)		Scale: 1 Graph drawn correctly: 1
(aii)	$50+32+5=87$ $\frac{87}{127}\times100\%=68.5\%(3sf)$	B1
(aiii)	$\frac{(145\times10)+(155\times30)+(165\times50)+(175\times32)+(185\times5)}{127}$ $=\frac{20875}{127}$ $=164.37$ $=164(3s.f)$	M1 – show using mid-value of each class to find total height (numerator) A1
(bi)	163.5 cm	B1
(bii)	163 cm	B1
4(a)	$p=12,\ q=4$ $r=16,\ s=9$	B1 (p and q) B1 (r and s)
(b)(i)	$S=4(n-1)$ or $4n-4$	B1
(ii)	$U=(n-2)^2$	B1
(c)	$S=4(101)-4=400$ $U=(101-2)^2=9801$	B1 B1
(d)	Since 314 is not a multiple of 4, it cannot be one of the patterns for S.	B1
5(ia)	$\angle AEC=90°(\angle$ in semi – circle)	B1

(ib)	$\angle ACE = 180 - 90 - 68 = 22°$	B1
(ic)	$\angle EDC = 180 - 68 = 112°$ ($\angle$s in opp. segments)	B1
(id)	$\angle DAC = 68 \div 2 = 34°$ (AB *bisects* $\angle CAE$) $\angle DBC = \angle DAC = 34°$ ($\angle$s in the same segment)	B1
5(aii)	$\angle DAX = 34°$ $\angle AXD = 180 - 68 = 112°$ (*corr* $\angle$, $AE // BD$) $\angle ADX = 180 - 112 - 34 = 34°$ *or alt* $\angle s$, $\angle EAX = \angle ADX$ $\therefore$ Triangle DAX is isosceles.	} }B1 – able to show two sides are equal } } S1 – show statement
5(aiii)	$\angle ADX = 34°$ $\angle BDC = 90 - 34 = 56°$	B1
5(aiv)	$\angle BXC = \angle AXD = 112°$ (vert. opp. $\angle s$) $\angle BDC = 56°$ Since $\angle BXC$ at X is twice as big as $\angle$BDC at circumference, X is centre of circle. *or* $\angle DCX = 56, \angle DXA = 112°$	B1 – explain using angle at centre = 2 angle at circumference and show angle values.
5(bi)	$\angle PRO = 90°$ (tan $\perp$ rad) $\angle ROP = 180 - 90 - 42 = 48°$	B1 – show (tan $\perp$ rad). B1
5(bii)	$\angle OSR = (180 - 48) \div 2 = 66°$ $\angle TSR = 66 \times 2 = 132°$	B1
5(biii)	$\angle OTS = 66°$ *Obtuse* $\angle = 66 + 90 = 156°$	B1
6(a)	$\frac{30}{x}$ h	B1
(b)	$\frac{5}{x-20}$ h	B1
(c)	$\frac{30}{x} - \frac{5}{x-20} = \frac{11}{60}$ $\frac{30x - 600 - 5x}{x(x-20)} = \frac{11}{60}$ $1500x - 36000 = 11x^2 - 220x$ $11x^2 - 1720x + 36000 = 0$ (Shown)	M1 M1 (remove denominator) AG1

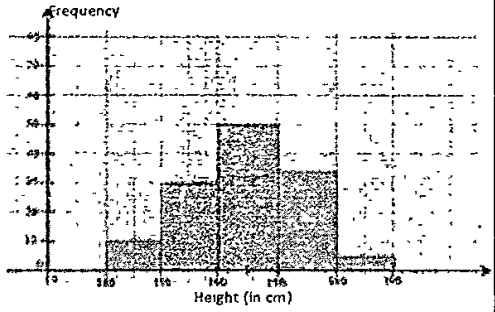
(d)	$x=\dfrac{-(-1720)\pm\sqrt{(-1720)^2-4(11)(36000)}}{2(11)}$ $=\dfrac{1720\pm\sqrt{1374400}}{22}$ $=131.470$ or 24.893 $=131.47$ or 24.89 (to 2 dec. pl.)	M1 A1, A1
(e)	Reject x= 131.47 as speed exceeds that of bicycle. Average speed $=30\div\left(\dfrac{30}{24.893}+\dfrac{5}{4.893}\right)$ $=\dfrac{30}{2.2270}$ $=13.471$ $=13.5$ km/h (to 3 s.f.)	M1 A1
7(a)(i)	$BD=\sqrt{4^2+8^2}$ $=\sqrt{80}$ $=8.9443$ $=8.94$ cm (to 3 s.f.)	M1 A1
(ii)	$NB=\sqrt{12^2+\dfrac{1}{2}\sqrt{80}}$ $=\sqrt{164}$ $=12.806$ $=12.8$ cm (to 3 s.f.)	M1 A1ft
(iii)	$\angle NDM=\sin^{-1}\left(\dfrac{12}{\frac{1}{2}\sqrt{80}}\right)$ or $\cos^{-1}\left(\dfrac{\sqrt{10}}{\sqrt{164}}\right)$ $=69.561$ $=69.6°$ (to 1 dec. pl.)	M1 A1ft
(iv)	Let x be the mid - point of BC. $\angle BNX=\sin^{-1}\left(\dfrac{4}{\sqrt{164}}\right)$ $=18.201$ $\angle BNC=18.201\times2$ $=36.402$ $=36.4°$ (to 1 dec. pl.)	M1 A1

7(b)(i)	Area of smaller trough $= \frac{4}{9} \times 351$ $= 156\ \text{cm}^2$	B1
(ii)	3 : 2	B1
(iii)	Mass of water in the smaller trough $= \left(\frac{2}{3}\right)^3 \times 36$ $= 10\frac{2}{3}$ or 10.7 (to 3 s.f.) kg	M1 A1
8(a)(i)	$\cos \angle KML = \frac{100^2 + 80^2 - 110^2}{2(100)(80)}$ $=$ $\angle KML = 74.41$ $= 74.4°$ (to 1 dec. pl.)	M1 M1 A1
(ii)	$\frac{\sin \angle MKL}{80} = \frac{\sin 74.41}{110}$ $\sin \angle MKL = \frac{\sin 74.41}{110} \times 80$ $= 0.70072$ $\angle MKL = 44.48$ $= 44.5°$ (to 1 dec. pl.)	M1 A1
(iii)	Area of $\Delta KLM = \frac{1}{2}(110)(100)\sin(44.48)°$ $= 3853.631\text{m}^2$ $= 3850\ \text{m}^2$ (to 3 s.f.)	M1 A1
(iv)	$\angle NKM = 90 - 44.48 = 45.515°$ Bearing of K from M = 360-(180-45.515) = 225.515 = 225.5° (to 1 dec. pl.)	M1 A1
8(b)(i)	Let the shortest distance from M to KL be MP. $\sin 44.48° = \frac{MP}{100}$ $MP = 100 \sin 44.48°$ = 70.066 = 70.1 m (to 3 s.f.) (or use area of ΔKML to find MP)	M1 A1

(ii)	Let the greatest angle of elevation be θ. $\tan\theta = \frac{20}{70.066}$ $\theta = 15.931$ $= 15.9°$ (to 1 dec. pl.)	 M1 A1
9(a)	$Area\ of\ trapezium = \frac{1}{2}(50+30)\times 40$ $= 1600cm^2$ $Volume\ of\ prism = 1600\times 300$ $= 480000cm^3$ $Amount\ of\ water = 480000ml$ $= 480l$	M1 M1 A1
(b)	$Rate = \frac{480}{0.3}$ $= 1600s$ $= 26\min 40s$	M1 A1
(ci)	Using pi = 3.142 $Curved\ surface\ area\ of\ hemisphere = 2\pi r^2$ $= 2\times 3.142\times 0.3^2$ $= 0.56556m^2$ $Curved\ surface\ area\ of\ cylinder = 2\pi r\times h$ $= 2\times 3.142\times 0.3\times 2$ $= 3.7704m^2$ $Curved\ surface\ area\ of\ container = 0.56556+3.7704$ $= 4.33596$ $= 4.34m^2$ $(3s.f.)$	M1 – finding surface area of hemisphere M1 – finding surface area of cyclinder A1
	Using caculator pi $Curved\ surface\ area\ of\ hemisphere = 2\pi r^2$ $= 2\times\pi\times 0.3^2$ $= 0.565486677m^2$ $Curved\ surface\ area\ of\ cylinder = 2\pi r\times h$ $= 2\times\pi\times 0.3\times 2$ $= 3.769911184m^2$ $Curved\ surface\ area\ of\ container = 0.565486677+3.769911184$ $= 4.335397861$ $= 4.34m^2$ $(3s.f.)$	M1 – finding surface area of hemisphere M1 – finding surface area of cyclinder A1

(cii)	Using pi = 3.142 $Volume = 480000cm^3$ $Volume\ of\ hemisphere = \frac{2}{3}\pi r^3$ $= \frac{2}{3} \times 3.142 \times 30^3$ $= 56556cm^3$ $\text{Re}maining\ amount\ of\ water = 480000 - 56556$ $= 423444cm^3$ $depth\ of\ water = (\frac{423444}{\pi r^2}) + 30cm$ $= (\frac{423444}{3.142 \times 30^2}) + 30cm$ $= 149.74 + 30$ $= 179.74cm$ $= 1.80m$	M1 - finding volume of hemisphere M1 - finding depth of water in cylinder $(\frac{423444}{\pi r^2})$ A1
	Using calculator pi $Volume = 480000cm^3$ $Volume\ of\ hemisphere = \frac{2}{3}\pi r^3$ $= \frac{2}{3} \times \pi \times 30^3$ $= 56548.66776cm^3$ $\text{Re}maining\ amount\ of\ water = 480000 - 56548.66776$ $= 423451.3322cm^3$ $depth\ of\ water = (\frac{423451.3322}{\pi r^2}) + 30cm$ $= (\frac{423451.3322}{\pi \times 30^2}) + 30cm$ $= 149.7652726 + 30$ $= 179.7652726cm$ $= 1.80m$	M1 - finding volume of hemisphere M1 - finding depth of water in cyclinder $(\frac{423444}{\pi r^2})$ A1

Secondary 3 Express Mathematics EOY Examination 2014 Paper 2

1ai	$(4x-3y)(4x+5y)$	5bi	$\angle ROP = 48°$
1aii	$\frac{x-2y}{4x+5y}$	5bii	$\angle TSR = 132°$
1b	$W = \frac{-3y^2}{y^2-x^2}$ or $\frac{3y^2}{x^2-y^2}$	5biii	$Obtuse\angle = 156°$
1c	$x=3$	6a	$\frac{30}{x}$ h
2a	18%	6b	$\frac{5}{x-20}$ h
2bi	\$21 201.60	6c	$\frac{30}{x}-\frac{5}{x-20}=\frac{11}{60}$
2bii	\$808		$\frac{30x-600-5x}{x(x-20)}=\frac{11}{60}$
3ai			$1500x-36000=11x^2-220x$ $11x^2-1720x+36000=0$ (Shown)
		6d	$x=131.47$ or 24.89 (to 2 dec. pl.)
3aii	68.5%(3*sf*)	6e	Average speed = 15.7 km/h (to 3 s.f
3aiii	164	7ai	$BD = 8.94$ cm (to 3 s.f.)
3bi	163.5 cm	7aii	$NB = 12.8$ cm (to 3 s.f.)
3bii	163 cm	7aiii	$\angle NDM = 69.6°$ (to 1 dec. pl.)
4a	$p=12, q=4$ $r=16, s=9$	7aiv	$\angle BNC = 36.4°$ (to 1 dec. pl.)
4bi	$S=4(n-1)$ or $4n-4$	7bi	Area of smaller trough = 156 cm^2
4bii	$U=(n-2)^2$	7bii	3:2
4c	$S=4(101)-4=400$ $U=(101-2)^2=9801$	8ai	$\angle KML = 74.4°$ (to 1 dec. pl.)
4d	Since 314 is not a multiple of 4, it cannot be one of the patterns for *S*.	8aii	$\angle MKL = 44.5°$ (to 1 dec. pl.)
5ia	$\angle AEC = 90°$($\angle$ in semi − circle)	8aiii	Area = 3850 m^2 (to 3 s.f.)
5ib	$\angle ACE = 22°$	8aiv	Bearing = 225.5° (to 1 dec. pl.)
5ic	$\angle EDC = 112°$($\angle$s in opp. segments)	8bi	$MP = 70.1$ m (to 3 s.f.)
5id	$\angle DBC = 34°$($\angle$s in the same segment)	8bii	$\theta = 15.9°$ (to 1 dec. pl.)
5aii	$\angle DAX = 34°$ $\angle AXD = 180-68=112°$(*corr* $\angle$, *AE* // *BD*) $\angle ADX = 180-112-34=34°$ *or alt* $\angle$*s*, $\angle EAX = \angle ADX$ ∴ Triangle *DAX* is isosceles.	9a	480*l*
		9b	26 min 40s
		9ci	4.34 m2
		9cii	1.80 m
5aiii	$\angle BDC = 56°$	10a	p = 162
5aiv	$\angle BXC = \angle AXD = 112°$(vert. opp. $\angle$s) $\angle BDC = 56°$ Since $\angle BXC$ at *X* is twice as big as $\angle$BDC at circumference, *X* is centre of circle.	10c	$x = 1.45\pm0.1$ and 3.55 ± 0.1
		10d	Gradient = 32.9 ± 0.2
		10eii	$1.15\pm0.1 \le x \le 4.55\pm0.1$

10a	p= 162	10d	Gradient = 32.9 ±0.2
10c	x = 1.45±0.2 and 3.55±0.2	10eii