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Student Name:	
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2014 YEAR 11 HALF YEARLY EXAMINATION

Mathematics Extension 1

General Instructions

- Reading time 5 minutes
- · Working time 1 hour
- · Write using black or blue pen
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- All necessary working should be shown in Questions 6-8

Total marks - 35

Section 1

5 marks

Attempt Questions 1-5

Allow 8 minutes for this section

Section 2

30 marks

Attempt Questions 6-7

Allow 52 minutes for this section

Preliminary Mathematics Extension 1

STANDARD INTEGRALS

$$\int x^{n} dx = \frac{1}{n+1} x^{n+1}, \ n \neq -1; \ x \neq 0, \text{ if } n < 0$$

$$\int \frac{1}{x} dx = \ln x, \ x > 0$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}, \quad a \neq 0$$

$$\int \cos ax \, dx = \frac{1}{a} \sin ax, \ a \neq 0$$

$$\int \sin ax \, dx = -\frac{1}{a} \cos ax, \ a \neq 0$$

$$\int \sec^2 ax \, dx = \frac{1}{a} \tan ax, \ a \neq 0$$

$$\int \sec ax \tan ax \, dx = \frac{1}{a} \sec ax, \ a \neq 0$$

$$\int \frac{1}{a^2 + x^2} dx \qquad \qquad = \frac{1}{a} \tan^{-1} \frac{x}{a}, \ a \neq 0$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} dx = \sin^{-1} \frac{x}{a}, \ a > 0, \ -a < x < a$$

$$\int \frac{1}{\sqrt{x^2 - a^2}} dx = \ln\left(x + \sqrt{x^2 - a^2}\right), \ x > a > 0$$

$$\int \frac{1}{\sqrt{x^2 + a^2}} dx = \ln\left(x + \sqrt{x^2 + a^2}\right)$$

NOTE: $\ln x = \log_e x$, x > 0

Section I

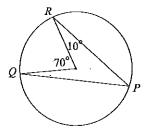
5 marks

Attempt Questions 1 - 5

Allow about 8 minutes for this section

Use the multiple-choice answer sheet for Questions 1-5

1 What is the value of $\angle RQP$?



- (A) 55°
- (B) 65°
- (C) 70°
- (D) 80°
- 2 What is the solution to the inequality $\frac{x-3}{x} > 0$?
 - (A) x < 0 and x < 3
 - (B) x < 0 and x > 3
 - (C) x > 0 and x < 3
 - (D) x > 0 and x > 3
- 3 Two boats A and B are out to sea. The cliff OT is 75 metres high where O is the point at the base of the cliff below T. The angle of elevation from A to T is 25° and the angle of elevation from B to T is 34°. The angle $\angle AOB = 120^\circ$. Which of the following are the correct expressions for OA and OB?
 - (A) $OA = \frac{\tan 25^{\circ}}{75}$ and $OB = \frac{\tan 34^{\circ}}{75}$
 - (B) $OA = \frac{75}{\tan 25^\circ}$ and $OB = \frac{75}{\tan 34^\circ}$
 - (C) $OA = 75 \tan 25^\circ$ and $OB = 75 \tan 34^\circ$
 - (D) $OA = 120 \tan 25^{\circ} \text{ and } OB = 120 \tan 34^{\circ}$

- 4 What is the acute angle between the lines 3x+4y-1=0 and 2x+3y-2=0?
 - (A) 3'11'
 - (B) 9°281
 - (C) 70°36°
 - (D) 86°491
- 5 What is the maximum value of $\cos\theta + 2\cos(\theta + 120^\circ)$?
 - (A) $2\sqrt{3}$
 - (B) $\sqrt{3}$
 - (C) $\frac{\sqrt{3}}{2}$
 - (D) $\frac{\sqrt{3}}{4}$

Section II

30 marks

Attempt Questions 6° 7

Allow about 52 minutes for this section

Answer each question in the appropriate writing booklet.

All necessary working should be shown in every question.

Que	stion 6	(15 marks)	Marks
(a)	(i)	Find the acute angle between the lines $x - \sqrt{3}y + 3 = 0$ and $x - y + 6 = 0$.	2
	(ii)	Show that the two lines above and the line $\sqrt{3}x - y + 6 = 0$ form an isosceles triangle.	2
(b)	(i)	Sketch the graph of $y = 2x - 1 $	1
•	(ii)	Hence or otherwise, solve $ 2x-1 \le x-2 $	2
(c)	(i)	Show that $\frac{1-\cos 2\theta}{1+\cos 2\theta} = \tan^2 \theta$	2
	(ii)	Hence show that the exact value of $\tan 22.5^{\circ}$ is $\sqrt{2}-1$	1
(d)	Points	n external point to a circle and FX is a tangent touching the circle at F . D and E are on the circle such that DE produced meets FX at X . FX is and DE is 12 cm	
	(i)	Draw a diagram to show this information.	1
	(ii)	Calculate the length XE.	2

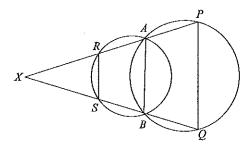
(e) Solve $\frac{4-x}{x^2+4} \ge 1$

2

Question 7 (15 marks)

Marks

(a) Two circles intersect at A and B. The straight lines PAR and QBS intersect at X. Let $\angle SRA = \theta^*$.



(i) Prove that $PQ /\!\!/ RS$.

2

(ii) Find BS if RX = 5, AR = 3 and SX = 4.

1

2

(b) (i) Let the acute angle between the lines y = 3x and y = 5x be θ . Show that $\tan \theta = \frac{1}{8}$.

(ii) What is the value of m if acute angle between the lines y = 3x and y = mx (m < 3) is also θ ?

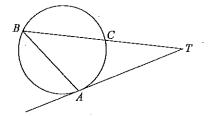
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- (c) Show that $\csc\theta + \cot\theta = \cot\frac{\theta}{2}$ by making the substitution $t = \tan\frac{\theta}{2}$.
- (d) Solve the inequality $\frac{4}{x-3} \le x$.

3

2

(e) A, B and C are three points on a circle. Chord BC produced meets the tangent at A in T. Prove $\angle ACT = \angle BAT$



(f) Solve $\sec^2 \theta + \tan \theta = 1$, where $180^\circ \le \theta \le 360^\circ$

2

End of paper

ACE Examination 2014

Year 11 Mathematics Extension 1 Half Yearly Examination

Worked solutions and marking guidelines

Section		, ··
	Solution	Criteria
1	$Q = 55^{\circ} + 25^{\circ} = 80^{\circ}$ $\angle RQP = 55^{\circ} + 25^{\circ} = 80^{\circ}$	1 Mark: D
٠.	$x^{2} \times \frac{x-3}{x} > 0 \times x^{2} \qquad x \neq 0$ $x(x-3) > 0$	
2	y 4 3 2 2 4 4 3 2 1 2 3 4 4 4 4 4 4 4 4 4 4 4 4 4	1 Mark: B
_	From the graph $x < 0$ and $x > 3$	
3	In $\triangle TOA$ In $\triangle TOB$ $\tan 25^\circ = \frac{75}{OA} \qquad \tan 34^\circ = \frac{75}{OB}$ $OA = \frac{75}{\tan 25^\circ} \qquad OB = \frac{75}{\tan 34^\circ}$	1 Mark: B

4	For $3x + 4y = 8$ then $m_1 = -\frac{3}{4}$ For $2x + 3y = 5$ then $m_2 = -\frac{2}{3}$ $\tan \theta = \left \frac{m_1 - m_2}{1 + m_1 m_2} \right $ $= \left \frac{-\frac{3}{4} - \frac{3}{3}}{1 + \frac{3}{4} \times -\frac{2}{3}} \right = \frac{1}{18}$ $\theta = 3.17983012$ $\approx 3^{\circ}11^{\circ}$	1 Mark: A
5	$\cos\theta + 2\cos(\theta + 120) = \cos\theta + 2[\cos\theta\cos120 - \sin\theta\sin120)]$ $= \cos\theta + 2[\cos\theta \times -\frac{1}{2} - \sin\theta \times \frac{\sqrt{3}}{2})]$ $= -\sqrt{3}\sin\theta$ Smallest value of $\sin\theta$ is -1 . Maximum value of $\cos\theta + 2\cos(\theta + 120^{\circ})$ is $\sqrt{3}$	1 Mark: B
Section	ıII	
6(a) (i)	For $x - y + 6 = 0$ then $m_1 = 1$. For $x - \sqrt{3}y + 3 = 0$ then $m_2 = \frac{1}{\sqrt{3}}$. $\tan \theta = \left \frac{m_1 - m_2}{1 + m_1 m_2} \right $ $= \left \frac{1 - \frac{1}{\sqrt{3}}}{1 + 1 \times \frac{1}{\sqrt{3}}} \right $ $= \left \frac{\sqrt{3} - 1}{\sqrt{3} + 1} \right $ $\theta = 15^*$	2 Marks: Correct answer. 1 Mark: Finds the gradient of the two lines.
<u>L</u>	1	

6(a) (ii)	For $\sqrt{3}x - y + 6 = 0$ then $m_i = \sqrt{3}$.	2 Marks: Correct answer. 1 Mark: Finds a gradient and uses angle between two lines formula.
	For $x-y+6=0$ then $m_2=1$.	
	$\tan \theta = \left \frac{m_1 - m_2}{1 + m_1 m_2} \right = \left \frac{\sqrt{3} - 1}{1 + \sqrt{3} \times 1} \right \text{ or } \theta = 15^{\circ}$	
	Isosceles triangle as two angles are equal (15°).	-
6(b) (i)	y = 2x - 1 $y = 2x - 1 $ $y = 3x - 1 $	1 Mark: Correct answer.
6(b)	Solve $ 2x-1 = x-2 $	2 Marks: Correct answer.
(ii)	2x-1=x-2 or $2x-1=-(x-2)$	ansnor.
Š	$x = -1$ $y = 2x - 1 $ $y = x - 2 $ $y = x - 2 $ From the graph $ 2x - 1 \le x - 2 $ for $-1 \le x \le 1$	1 Mark: Shows some understanding of the problem.
	Liour die Brabu 5x-1/2 x-5 101 -12x21	, ,

6(c) (i) LHS = $\frac{1 - (\cos^2 \theta - \sin^2 \theta)}{1 + (\cos^2 \theta - \sin^2 \theta)}$ = $\frac{(1 - \cos^2 \theta) + \sin^2 \theta}{(1 - \sin^2 \theta) + \cos^2 \theta}$ = $\frac{2 \sin^2 \theta}{2 \cos^2 \theta}$ = $2 \tan^2 \theta$ = RHS 6(c) (ii) $\tan \theta = \sqrt{\frac{1 - \cos 2\theta}{1 + \cos 45^\circ}}$ from part (i) $\tan 22.5^\circ = \sqrt{\frac{1 - \cos 45^\circ}{1 + \cos 45^\circ}}$ = $\sqrt{(1 - \frac{1}{\sqrt{2}})^2} \times (\sqrt{\frac{2}{\sqrt{2} + 1}})$ = $\sqrt{(\sqrt{2} - 1)^2} = \sqrt{2} - 1$ 6(d) (i) $FX^2 = DX \times XE$ (Square of the length of the tangent from an external point is equal to the product of the intercepts of the secant passing through this point) 8^2 = (x + 12) \times x 64 = $x^2 + 12x$ $x^2 + 12x - 64 = 0$ (x + 16) (x - 4) = 0 x = -16 as x is a length. x = 4 cm	6(c)	1 (20 -:-20)	2 Marks: Correct
$=\frac{(1-\cos^2\theta)+\sin^2\theta}{(1-\sin^2\theta)+\cos^2\theta}$ $=\frac{2\sin^2\theta}{2\cos^2\theta}$ $=2\tan^2\theta$ $=RHS$ $\frac{6(c)}{\tan 22.5^*} = \sqrt{\frac{1-\cos 2\theta}{1+\cos 2\theta}} \text{ from part (i)}$ $\tan 22.5^* = \sqrt{\frac{1-\cos 45^*}{1+\cos 45^*}}$ $=\sqrt{\left(1-\frac{1}{\sqrt{2}}\right)} \div \left(1+\frac{1}{\sqrt{2}}\right)$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}+1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}+1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}+1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}+1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}-1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}-1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{\frac{2}{\sqrt{2}-1}}$ $=\sqrt{\sqrt{2}-1} \times \sqrt{2} = $	(i)	LHS = $\frac{1 - (\cos \theta - \sin \theta)}{1 + (\cos^2 \theta - \sin^2 \theta)}$	
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$\frac{2 \cos^2 \theta}{2 \cos^2 \theta}$ $= 2 \tan^2 \theta$ $= RHS$ $\frac{6(c)}{1 + \cos 2\theta}$ $\tan \theta = \sqrt{\frac{1 - \cos 2\theta}{1 + \cos 45}}$ $= \sqrt{\left(1 - \frac{1}{\sqrt{2}}\right)} * \left(1 + \frac{1}{\sqrt{2}}\right)$ $= \sqrt{\left(\frac{\sqrt{2} - 1}{\sqrt{2}}\right)} \times \left(\frac{\sqrt{2}}{\sqrt{2} + 1}\right)$ $= \sqrt{\sqrt{2} - 1} \times \sqrt{\frac{2}{\sqrt{2}} - 1}$ $= \sqrt{(\sqrt{2} - 1)^2} = \sqrt{2} - 1$ $\frac{6(d)}{(i)}$ $\frac{F}{(i)}$ $\frac{8}{x}$ $\frac{8}{x}$ $\frac{1 \text{ Mark: Correct answer.}}$ $\frac{1 \text{ Mark: Correct answer.}}$ $\frac{1 \text{ Mark: Correct answer.}}$ $\frac{2 \text{ Marks: Correct answer.}}$ $\frac{1 \text{ Mark: Shows some understanding of the problem.}}$ $\frac{8^2 = (x + 12) \times x}{64 = x^2 + 12x}$ $\frac{64 = x^2 + 12x}{x^2 + 12x - 64 = 0}$ $\frac{(x + 16)(x - 4) = 0}{(x + 16)(x - 4) = 0}$ $\frac{x = -16 \text{ or } x = 4}{1 \text{ gnore } x = -16 \text{ as } x \text{ is a length.}}$,	
$ \begin{array}{c c} & = \text{RHS} \\ \hline 6(c) \\ (ii) & \tan\theta = \sqrt{\frac{1-\cos 2\theta}{1+\cos 2\theta}} \text{ from part (i)} \\ & \tan 22.5' = \sqrt{\frac{1-\cos 45'}{1+\cos 45'}} \\ & = \sqrt{\left(1-\frac{1}{\sqrt{2}}\right)} \times \left(1+\frac{1}{\sqrt{2}}\right) \\ & = \sqrt{\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)} \times \left(\frac{\sqrt{2}}{\sqrt{2}+1}\right) \\ & = \sqrt{\sqrt{2}-1} \times \frac{\sqrt{2}-1}{\sqrt{2}-1} \\ & = \sqrt{(\sqrt{2}-1)^2} = \sqrt{2}-1 \\ \hline 6(d) \\ (ii) & F \\ & & = \sqrt{\frac{1}{2}} = DX \times XE \text{ (Square of the length of the tangent from an external point is equal to the product of the intercepts of the secant passing through this point)} \\ & & & & & & & & \\ 8^2 = (x+12) \times x \\ & & & & & & \\ 64 = x^2 + 12x \\ & & & & & \\ x^2 + 12x - 64 = 0 \\ & & & & \\ (x+16)(x-4) = 0 \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & \\ & & & \\ & & & \\ & & \\ & & & \\ & \\ & & \\ & \\ & & \\ &$		$=\frac{2\sin^2\theta}{2\cos^2\theta}$	
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(ii) Example 1 in the length of the tangent from an external point is equal to the product of the intercepts of the secant passing through this point) $8^2 = (x+12) \times x$ $64 = x^2 + 12x$ $x^2 + 12x - 64 = 0$ $(x+16)(x-4) = 0$ $x = -16 \text{ or } x = 4$ Ignore $x = -16$ as x is a length.		12 X	
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6(e)	$(x^2+4) \times \frac{4-x}{(x^2+4)} \ge 1 \times (x^2+4)$ (x ² +4) is always positive	2 Marks: Correct answer.
Annound of the	$4-x \ge x^2 + 4$ $x^2 + x \le 0$ $x(x+1) \le 0$	1 Mark: Multiplies both sides of the inequality by
	3	(x^2+4) or finds a critical point.
	3 -2 -1 2 3 x	
2()	∴-1≤x≤0	2 Marks: Correct
7(a) (i)	$\angle SRA + \angle SRX = 180^{\circ}$ (straight line equals 180°) $\angle SRX = 180 - \theta$	answer.
	$\angle SRX = \angle ABS$ (exterior angle of a cyclic quadrilateral equals the interior opposite angle) $\angle ABS = 180 - \theta$ $\angle ABS = \angle QPA$ (exterior angle of a cyclic quadrilateral equals the interior opposite angle)	1 Mark: States an appropriate theorem used in the solution.
	$\angle QPA = 180 - \theta$ $\angle SRX = \angle QPA \text{ (both } 180 - \theta)$	
	∴ PQ # RS (corresponding angles are equal only when the two lines are parallel)	
7(a) (ii)	$AB \ /\!\!/ RS$ $\frac{BS}{SX} = \frac{AR}{RX}$ (family of parallel lines cuts the intercepts in proportion)	1 Mark: Correct answer.
	$\frac{BS}{4} = \frac{3}{5}$	
	$BS = \frac{12}{5}$	
7(b) (i)	For $y=5x$ then $m_1=5$, For $y=3x$ then $m_2=3$.	1 Mark: Correct answer.
	$\tan \theta = \frac{m_1 - m_2}{1 + m_1 m_2}$	
	$= \left \frac{5-3}{1+5\times 3} \right = \left \frac{2}{16} \right = \frac{1}{8}$	

For $y = 3x$ then $m_1 = 3$. For $y = mx$ then $m_2 = m$ 2 Marks: Correct answer. 1 Mark: Finds an equation for m 1 + 3m = 24 - 8m 1 1m = 23 $m = \frac{21}{11}$ 2 Marks: Correct answer. 1 Mark: Finds an equation for m 2 Marks: Correct answer. 1 Mark: Finds an equation for m 2 Marks: Correct answer. 1 Mark: Uses at least one correct t 1 Mark: Uses at least one correct t 1 Mark: Uses at least one correct t 2 Marks: Correct answer. 1 Mark: Uses at least one correct t 1 Mark: Uses at least one correct t 2 Marks: Correct answer. 2 Marks: Correct answer. 3 Marks: Correct answer. 4 Marks: Marks: Finds one correct region or makes significant progress. 4 Marks: Ma			
$\tan \theta = \frac{m_1 - m_2}{ 1 + m_1 m_2 }$ $\frac{1}{8} = \frac{3 - m}{ 1 + 3 \times m }$ $1 + 3m = 24 - 8m$ $1 \cdot 1m = 23$ $m = \frac{23}{11}$ $7(c) \text{If } \sin \theta = \frac{2t}{1 + t^2} \text{ then } \csc \theta = \frac{1 + t^2}{2t}$ $\text{If } \tan \theta = \frac{2t}{1 - t^2} \text{ then } \cot \theta = \frac{1 - t^2}{2t}$ $\text{LHS} = \csc \theta + \cot \theta$ $= \frac{1 + t^2}{2t} + \frac{1 - t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ $7(d) (x - 3)^2 \times \frac{4}{x - 3} \le x \times (x - 3)^2$ $(x - 3)(4 - x(x - 3)) \le 0$ $(x - 3)(4 - x)(1 + x) \le 0$ $(x - 3)(4 - x)(1 + x) \le 0$ $x - 3 = \frac{1}{2} + $		1	
$\frac{1}{8} = \begin{vmatrix} \frac{3-m}{1+3\times m} \\ 1+3m = 24 - 8m \\ 11m = 23 \\ m = \frac{23}{11} \end{vmatrix}$ $7(c) \text{If } \sin\theta = \frac{2t}{1+t^2} \text{ then } \cos\theta = \frac{1+t^2}{2t}$ $\text{If } \tan\theta = \frac{2t}{1-t^2} \text{ then } \cot\theta = \frac{1-t^2}{2t}$ $\text{LHS} = \csc\theta + \cot\theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan\frac{\theta}{2}}$ $= \cot\frac{\theta}{2} = \text{RHS}$ $7(d) (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3)(4-x(x-3)) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $x = \frac{1}{2} + \frac{1}$	()	$\tan \theta = \frac{m_1 - m_2}{m_1 - m_2}$	
$\frac{1}{8} = \frac{3-m}{1+3\times m}$ $1+3m = 24-8m$ $11m = 23$ $m = \frac{23}{11}$ 7(c) If $\sin \theta = \frac{2t}{1+t^2}$ then $\csc \theta = \frac{1+t^2}{2t}$ $If \tan \theta = \frac{2t}{1-t^2} then \cot \theta = \frac{1-t^2}{2t} LHS = \csc \theta + \cot \theta = \frac{1+t^2}{2t} + \frac{1-t^2}{2t} = \frac{2}{2t} = \frac{1}{t} = \frac{1}{\tan \frac{\theta}{2}} = \cot \frac{\theta}{2} = RHS 7(d) (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2 (x-3)(4-x(x-3)) \le 0 (x-3)(4+3x-x^2) \le 0 (x-3)(4-x)(1+x) \le 0 x = \frac{1}{2} + 1$		$\left 1 + m_1 m_2 \right $	
$1+3m=24-8m$ $11m=23$ $m=\frac{23}{11}$ $7(c) $		1 - 3 - m	equation for m
$11m = 23$ $m = \frac{23}{11}$ $7(c) \text{If } \sin \theta = \frac{2t}{1+t^2} \text{ then } \csc \theta = \frac{1+t^2}{2t}$ $2 \text{ Marks: Correct answer.}$ $1 \text{ If } \tan \theta = \frac{2t}{1-t^2} \text{ then } \cot \theta = \frac{1-t^2}{2t}$ $1 \text{ LHS} = \csc \theta + \cot \theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ $7(d) (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3)(4-x(x-3)) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $x = \frac{1}{2} + 1$	1	$\frac{8}{8} - \frac{1}{1+3\times m}$	
$m = \frac{23}{11}$ $7(c) \text{If } \sin \theta = \frac{2t}{1+t^2} \text{ then } \csc \theta = \frac{1+t^2}{2t}$ $\text{If } \tan \theta = \frac{2t}{1-t^2} \text{ then } \cot \theta = \frac{1-t^2}{2t}$ $\text{LHS} = \csc \theta + \cot \theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ $7(d) (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3)(4-x(x-3)) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $x = \frac{1+t^2}{2t}$ $= \frac{2 \text{ Marks: Correct answer.}}{2 \text{ Marks: Finds one correct region or makes significant progress.}}$ $1 \text{ Mark: Multiplies both sides of the inequality by }$ $(x-3)^2 \text{ or finds a critical point.}$	1	1+3m=24-8m	
7(c) If $\sin \theta = \frac{2t}{1+t^2}$ then $\csc \theta = \frac{1+t^2}{2t}$ If $\tan \theta = \frac{2t}{1-t^2}$ then $\cot \theta = \frac{1-t^2}{2t}$ LHS = $\csc \theta + \cot \theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= -\frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3)(4-x(x-3)) \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. 1 Mark: While the sum of the sides of the inequality by $(x-3)^2$ or finds a critical point.		11m = 23	
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If $\sin \theta = \frac{2t}{1+t^2}$ then $\cot \theta = \frac{1-t^2}{2t}$ LHS = $\csc \theta + \cot \theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t-t} = \frac{1}{t}$ $= -\frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3)(4-x(x-3)) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct t region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.	7(c)		2 Marks: Correct
LHS = $\csc\theta + \cot\theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.	1 (6)	If $\sin \theta = \frac{2t}{1+t^2}$ then $\csc \theta = \frac{1+t}{2t}$	answer.
LHS = $\csc\theta + \cot\theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.	ŀ	$2t$ $1-t^2$	436 1 77
LHS = $\csc\theta + \cot\theta$ $= \frac{1+t^2}{2t} + \frac{1-t^2}{2t}$ $= \frac{2}{2t} = \frac{1}{t}$ $= \cot\frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. I Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		If $\tan \theta = \frac{1}{1-t^2}$ then $\cot \theta = \frac{1}{2t}$	
$= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3) \begin{bmatrix} 4-x(x-3) \end{bmatrix} \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		$LHS = \csc\theta + \cot\theta$	1
$= \frac{2}{2t} = \frac{1}{t}$ $= \frac{1}{\tan \frac{\theta}{2}}$ $= \cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3) \begin{bmatrix} 4-x(x-3) \end{bmatrix} \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 3 Marks: Correct answer. 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		$-1+t^2$, $1-t^2$	
$=\frac{1}{\tan \frac{\theta}{2}}$ $=\cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		$=\frac{-2t}{2t}$	
$=\frac{1}{\tan \frac{\theta}{2}}$ $=\cot \frac{\theta}{2} = \text{RHS}$ 7(d) $(x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		$=\frac{2}{-}=\frac{1}{-}$	
$7(d) \qquad (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $(x-3)(4-x)(1$		24 1	
$7(d) \qquad (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $(x-3)(4-x)(1$		$=\frac{1}{\theta}$	
7(d) $ (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2 $ 3 Marks: Correct answer. $ (x-3) \times 4 \le x(x-3)^2 $		$\tan \frac{\pi}{2}$	
7(d) $ (x-3)^2 \times \frac{4}{x-3} \le x \times (x-3)^2 $ 3 Marks: Correct answer. $ (x-3) \times 4 \le x(x-3)^2 $	1	$=\cot\frac{\theta}{\theta}=RHS$	
$(x-3)^2 \times \frac{1}{x-3} \le x \times (x-3)^2$ $(x-3) \times 4 \le x(x-3)^2 \times x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		2	
$(x-3)\times 4 \le x(x-3)^2 x \ne 3$ $(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ 2 Marks: Finds one correct region or makes significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.	7(d)	$(x-3)^2 \times \frac{4}{} \le x \times (x-3)^2$	1
$(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$		1 3 3	answer.
$(x-3)[4-x(x-3)] \le 0$ $(x-3)(4+3x-x^2) \le 0$ $(x-3)(4-x)(1+x) \le 0$ one correct region or makes significant progress. I Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.			2 Marks: Finds
$(x-3)(4-x)(1+x) \le 0$ significant progress. 1 Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.			
progress. I Mark: Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.			
I Mark: Multiplies both sides of the inequality by $(x-3)^2 \text{ or finds a critical point.}$		$(x-3)(4-x)(1+x) \le 0$	-
Multiplies both sides of the inequality by $(x-3)^2$ or finds a critical point.		1 t 1	
sides of the inequality by $(x-3)^2$ or finds a critical point.		\ 4	
inequality by $(x-3)^2$ or finds a critical point.		2 -1 1 2 3 4 5 x	
$(x-3)^2 \text{ or finds a critical point.}$		-4+	inequality by
		\s\	
From the graph $-1 \le x < 3$ and $x \ge 4$		-12	critical point.
From the graph $-1 \le x < 3$ and $x \ge 4$		1	
		From the graph $-1 \le x < 3$ and $x \ge 4$	

Let $\angle CAT = x^{\circ}$ and $\angle CTA = y^{\circ}$ $\angle CAT = \angle ABC$ (angle between a tangent and a chord at the point of contact is equal to the opposite angle in the alternate segment) In $\triangle BTA$ $\angle BAT + \angle ABT + \angle BTA = 180^{\circ}$ (angle sum of a triangle) $\angle BAT = 180 - x - y$ In $\triangle CAT$ $\angle ACT + \angle CAT + \angle CTA = 180^{\circ}$ (angle sum of a triangle)	
$\angle ACT + x + y = 180^{\circ}$ $\angle ACT = 180 - x - y$	
$\therefore \angle ACT = \angle BAT \text{ (both } 180 - x - y)$	
7(f) $\sec^2 \theta + \tan \theta = 1$ 2 Marks: Correlative answer.	ct
$(1+\tan^2\theta)+\tan\theta=1$	
$\tan^2 \theta + \tan \theta = 0$ 1 Mark: Uses	
$\tan \theta (\tan \theta + 1) = 0$ $\sec^2 \theta = 1 + \tan \theta$ or find at least	²θ
$\therefore \tan \theta = 0 \text{ or } \tan \theta = -1$ $\therefore \theta = 180^{\circ}, 315^{\circ} \text{ or } 360^{\circ}$ one solution.	