6665 Core C3

Mark Scheme (Post standardisation)

Question Number	Scheme	Marks
1 (a)	Dividing by $\cos^2\theta$: $\dfrac{\sin^2\theta}{\cos^2\theta} + \dfrac{\cos^2\theta}{\cos^2\theta} \equiv \dfrac{1}{\cos^2\theta}$	M1
	Completion : $1 + \tan^2\theta \equiv \sec^2\theta$ (no errors seen)	A1 (2)
(b)	Use of $1 + \tan^2\theta = \sec^2\theta$: $2(\sec^2\theta - 1) + \sec\theta = 1$	M1
	[$2\sec^2\theta + \sec\theta - 3 = 0$]	
	Factorising or solving: $(2\sec\theta + 3)(\sec\theta - 1) = 0$	M1
	[$\sec\theta = -\frac{3}{2}$ or $\sec\theta = 1$]	
	$\theta = 0$	B1
	$\cos\theta = -\frac{2}{3}$; $\theta_1 = 131.8°$	M1 A1
	$\theta_2 = 228.2°$	A1√ (6)
	[A1ft for $\theta_2 = 360° - \theta_1$]	
		[8]

6665 Core C3
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2 (a)	(i) $6\sin x\cos x + 2\sec 2x\tan 2x$	M1A1A1 (3)
	or $3\ \sin 2x\ +\ 2\sec 2x\tan 2x$ [M1 for 6 sin *x*]	
(ii)	$3(x + \ln 2x)^2(1 + \frac{1}{x})$	B1M1A1 (3)
	[B1 for $3(x+\ln 2x)^2$]	
(b)	Differentiating numerator to obtain $10x - 10$	
	Differentiating denominator to obtain $2(x-1)$	
	Using quotient rule formula correctly:	
	To obtain $\frac{dy}{dx} = \frac{(x-1)^2(10x-10) - (5x^2 - 10x + 9)2(x-1)}{(x-1)^4}$	
	Simplifying to form $\frac{2(x-1)[5(x-1)^2 - (5x^2 - 10x + 9)}{(x-1)^4}$	
	$= \ -\frac{8}{(x-1)^3}$ * (c.s.o.)	
3 (a)	$\frac{5x+1}{(x+2)(x-1)} - \frac{3}{x+2}$	B1
	$= \frac{5x+1-3(x-1)}{(x+2)(x-1)}$	M1
	M1 for combining fractions even if the denominator is not lowest common	
	$= \frac{2x+4}{(x+2)(x-1)} = \frac{2(x+2)}{(x+2)(x-1)} = \frac{2}{x-1}$ *	M1 A1 cso (4)
	M1 must have linear numerator	
(b)	$y = \frac{2}{x-1} \Rightarrow xy - y = 2 \Rightarrow xy = 2 + y$	M1A1
	$f^{-1}(x) = \frac{2+x}{x}$ o.e.	A1 (3)
	$fg(x) = \frac{2}{x^2+4}$ (attempt) $[\frac{2}{"g"-1}]$	M1
	Setting $\frac{2}{x^2+4} = \frac{1}{4}$ and finding $x^2 = \ldots$; $x = \pm\ 2$	M1; A1 (3)
		[10]

6665 Core C3
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Question Number	Scheme	Marks
4 (a)	$f'(x) = 3e^x - \frac{1}{2x}$	M1A1A1 (3)
	$3e^x - \frac{1}{2x} = 0$	M1
	$\Rightarrow 6\alpha e^{\alpha} = 1 \quad \Rightarrow \alpha = \frac{1}{6}e^{-\alpha} \quad (*)$	A1 cso (2)
(c)	$x_1 = 0.0613..., \ x_2 = 0.1568.., \ x_3 = 0.1425..., \ x_4 = 0.1445....$	M1 A1 (2)
	[M1 at least x_1 correct, A1 all correct to 4 d.p.]	
(d)	Using $f'(x) = 3e^x - \frac{1}{2x}$ with suitable interval	
	e.g. $f'(0.14425) = -0.0007$	M1
	$f'(0.14435) = +0.002(1)$	
	Accuracy (change of sign and correct values)	A1 (2)
		[9]

6665 Core C3
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Question Number	Scheme	Marks
5 (a)	$\cos 2A = \cos^2 A - \sin^2 A$ (+ use of $\cos^2 A + \sin^2 A \equiv 1$)	M1
	$= (1 - \sin^2 A); - \sin^2 A = 1 - 2\sin^2 A$ (*)	A1 (2)
(b)	$2\sin 2\theta - 3\cos 2\theta - 3\sin\theta + 3 \equiv 4\sin\theta\cos\theta; -3(1 - 2\sin^2\theta) - 3\sin\theta + 3$	B1; M1
	$\equiv 4\sin\theta\cos\theta + 6\sin^2\theta - 3\sin\theta$	M1
	$\equiv \sin\theta(4\cos\theta + 6\sin\theta - 3)$ (*)	A1 (4)
(c)	$4\cos\theta + 6\sin\theta \equiv R\sin\theta\cos\alpha + R\cos\theta\sin\alpha$	
	Complete method for R (may be implied by correct answer)	
	[$R^2 = 4^2 + 6^2$, $R\sin\alpha = 4$, $R\cos\alpha = 6$]	M1
	$R = \sqrt{52}$ or 7.21	A1
	Complete method for α ; $\alpha = 0.588$ (allow 33.7°)	M1 A1 (4)
(d)	$\sin\theta\,(4\cos\theta + 6\sin\theta - 3) = 0$	M1
	$\theta = 0$	B1
	$\sin(\theta + 0.588) = \dfrac{3}{\sqrt{52}} = 0.4160..$ (24.6°)	M1
	$\theta + 0.588 = (0.4291),\ 2.7125$ [or $\theta + 33.7^{\circ} = (24.6^{\circ}),\ 155.4^{\circ}$]	dM1
	$\theta = 2.12$ cao	A1 (5)
		[15]

6665 Core C3
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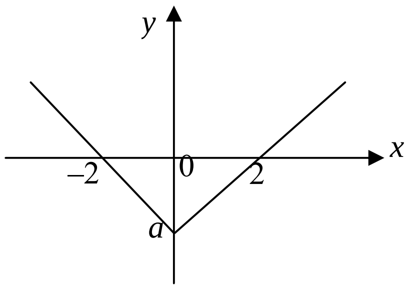
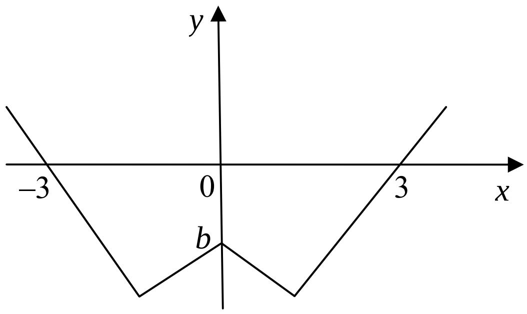
Question Number	Scheme		Marks
6. (a)		Translation ← by 1	M1
		Intercepts correct	A1 (2)
(b)		$x \geq 0$, correct "shape"	B1
		[provided not just original]	
		Reflection in y-axis	B1√
		Intercepts correct	B1 (3)
(c)	$a = -2,\quad b = -1$		B1 B1 (2)
(d)	Intersection of $y = 5x$ with $y = -x - 1$		M1A1
	Solving to give $x = -\frac{1}{6}$		M1A1 (4)
			[11]
	[Notes: (i) If both values found for $5x = -x - 1$ and $5x = x - 3$, or solved algebraically, can score 3 out of 4 for $x = -\frac{1}{6}$ and $x = -¾$; required to eliminate $x = -¾$ for final mark. (ii) Squaring approach: M1 correct method, $24x^2 + 22x + 3 = 0$ (correct 3 term quadratic, any form) A1 Solving M1, Final correct answer A1.]		

6665 Core C3

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7 (a)	Setting $p = 300$ at $t = 0 \Rightarrow \; 300 = \dfrac{2800a}{1+a}$	M1
	(300 = 2500a); a = 0.12 (c.s.o) *	dM1A1 (3)
(b)	$1850 = \dfrac{2800(0.12)e^{0.2t}}{1+0.12e^{0.2t}}$; $e^{0.2t} = 16.2...$	M1A1
	Correctly taking logs to $0.2\,t = \ln k$	M1
	$t = 14$ (13.9..)	A1 (4)
(c)	Correct derivation:	
	(Showing division of num. and den. by $e^{0.2t}$; using a)	B1 (1)
(d)	Using $t \to \infty$, $e^{-0.2t} \to 0$,	M1
	$p \to \dfrac{336}{0.12} = 2800$	A1 (2)
		[10]