

AS and A level Mathematics Practice Paper – Trigonometry – Mark scheme

Question	Scheme		Marks
1	$\cos^{-1}(-0.4) = 113.58 (\alpha)$ $3x - 10 = \alpha \Rightarrow x = \frac{\alpha + 10}{3}$ $x = 41.2$ $(3x - 10 =) 360 - \alpha (246.4\dots)$ $x = 85.5$ $(3x - 10 =) 360 + \alpha (=473.57\dots)$ $x = 161.2$	Awrt 114 Uses their α to find x . Allow $x = \frac{\alpha \pm 10}{3}$ not $\frac{\alpha}{3} \pm 10$ $360 - \alpha$ (can be implied by 246.4...) $360 + \alpha$ (Can be implied by 473.57...)	B1 M1 A1 M1 A1 M1 A1
			(7 marks)
2(a)	Way 1 $1 - \sin^2 x = 8\sin^2 x - 6\sin x$ E.g. $9\sin^2 x - 6\sin x = 1$ or $9\sin^2 x - 6\sin x - 1 = 0$ or $9\sin^2 x - 6\sin x + 1 = 2$ So $9\sin^2 x - 6\sin x + 1 = 2$ or $(3\sin x - 1)^2 - 2 = 0$ so $(3\sin x - 1)^2 = 2$ or $2 = (3\sin x - 1)^{2*}$	Way 2 $2 = (3\sin x - 1)^2$ gives $9\sin^2 x - 6\sin x + 1 = 2$ so $\sin^2 x + 8\sin^2 x - 6\sin x + 1 = 2$ so $8\sin^2 x - 6\sin x = 1 - \sin^2 x$ $8\sin^2 x - 6\sin x = \cos^2 x$ *	B1 M1 A1cso* (3)
2(b)	Way 1: $(3\sin x - 1) = (\pm)\sqrt{2}$ $\sin x = \frac{1 \pm \sqrt{2}}{3}$ or awrt 0.8047 and awrt -0.1381 $x = 53.58, 126.42$ (or 126.41), 352.06, 187.94	Way 2: Expands $(3\sin x - 1)^2 = 2$ and uses quadratic formula on 3TQ	M1 A1 dM1A1 A1 (5)
			(8 marks)

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3(a)	States or uses $\tan 2x = \frac{\sin 2x}{\cos 2x}$ $\frac{\sin 2x}{\cos 2x} = 5 \sin 2x \Rightarrow \sin 2x - 5 \sin 2x \cos 2x = 0 \Rightarrow \sin 2x(1 - 5 \cos 2x) = 0$	M1 A1 (2)
3(b)	$\sin 2x = 0$ gives $2x = 0, 180, 360$ so $x = 0, 90, 180$ $\cos 2x = \frac{1}{5}$ gives $2x = 78.46$ (or 78.5 or 78.4) or $2x = 281.54$ (or 281.6) $x = 39.2$ (or 39.3), 140.8 (or 141)	B1 for two correct answers, second B1 for all three correct. Excess in range – lose last B1 B1B1 M1 A1A1 (5)
		(7 marks)
4(a)	$3\sin^2 x + 7\sin x = \cos^2 x - 4; 0 \leq x < 360^\circ$ $3\sin^2 x + 7\sin x = (1 - \sin^2 x) - 4$ $4\sin^2 x + 7\sin x + 3 = 0$ AG	M1 A1* cso (2)
4(b)	$(4\sin x + 3)(\sin x + 1) \{= 0\}$ $\sin x = \frac{3}{4}, \sin x = -1$ ($ \alpha = 48.59\dots$) $x = 180 + 48.59$ or $x = 360 - 48.59$ $x = 228.59\dots$ or $x = 311.41\dots$ $\{\sin x = -1\} \Rightarrow x = 270$ Valid attempt at factorization and $\sin x = \dots$ Both $\sin x = \frac{3}{4}$ and $\sin x = -1$ Either $(180 + \alpha)$ or $(180 - \alpha)$ Both awrt 228.6 and awrt $x = 311.4$ 270	M1 A1 dM1 A1 B1 (5)
		(7 marks)

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<p>5(a)</p>	<p>(i) $9\sin(\theta + 60^\circ) = 4; 0 \leq \theta < 360^\circ$ (ii) $2\tan x - 3\sin x = 0; -\pi \leq x < \pi$</p> <p>$\sin(\theta + 60^\circ) = \frac{4}{9}$, so $(\theta + 60^\circ) = 26.3877\dots$ ($\alpha = 26.3877\dots$) So, $\theta + 60^\circ = \{153.6122\dots, 386.3877\dots\}$ and $\theta = \{93.6122\dots, 326.3877\dots\}$</p> <p align="center">Both answers are cso and must come from correct work</p>	<p align="center">M1 M1 A1 A1</p> <p align="right">(4)</p>
<p>5(b)</p>	<p>$2\left(\frac{\sin x}{\cos x}\right) - 3\sin x = 0$ $2\sin x - 3\sin x \cos x = 0$ $\sin x(2 - 3\cos x) = 0$</p> <p>$\cos x = \frac{2}{3}$ $x = \text{awrt}\{0.84, -0.84\}$ $\{\sin x = 0 \Rightarrow\} x = 0 \text{ and } -\pi$</p>	<p align="center">M1 A1 A1A1ft B1</p> <p align="right">(5)</p>
		<p align="right">(9 marks)</p>

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6(i)	$(\alpha = 56.3099\dots)$ $x = \{\alpha + 40 = 96.309993\dots\} = \text{awrt } 96.3$ $x - 40^\circ = -180 + "56.3099" \dots$ or $x - 40^\circ = -\pi + "0.983" \dots$ $x = \{-180 + 56.3099\dots + 40 = -83.6901\dots\} = \text{awrt } -83.7$	B1 M1 A1 (3)
6(ii)(a)	$\sin \theta \left(\frac{\sin \theta}{\cos \theta} \right) = 3 \cos \theta + 2$ $\left(\frac{1 - \cos^2 \theta}{\cos \theta} \right) = 3 \cos \theta + 2$ $1 - \cos^2 \theta = 3 \cos^2 \theta + 2 \cos \theta \Rightarrow 0 = 4 \cos^2 \theta + 2 \cos \theta - 1^*$	M1 dM1 A1 cso * (3)
6(ii)(b)	$\cos \theta = \frac{-2 \pm \sqrt{4 - 4(4)(-1)}}{8}$ or $4(\cos \theta \pm \frac{1}{4})^2 \pm q \pm 1 = 0$, or $(2 \cos \theta \pm \frac{1}{2})^2 \pm q \pm 1 = 0$, $q \neq 0$ so $\cos \theta = \dots$ One solution is 72° or 144° , Two solutions are 72° and 144° $\theta = \{72, 144, 216, 288\}$	M1 A1A1 M1A1 (5)
		(11 marks)

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	Source paper	Question number	New spec references	Question description	New AOs
1	C2 Jan 2013	4	5.7	Trigonometry	1.1b, 2.1, 2.4, 2.5
2	C2 2017	8	5.3 and 5.5	Solving trig equations	1.2, 2.1, 2.4; 1.1b
3	C2 2012	6	5.5 and 5.7	Trigonometry	1.1b, 2.1 and 2.4
4	C2 Jan 2011	7	5.5 and 5.7	Trigonometry	1.1a, 1.1b, 2.4, 2.5
5	C2 2014	7	5.5 and 5.7	Trigonometric equations	1.1b, 2.1, 2.4, 2.5
6	C2 2013	8	5.5 and 5.7	Trigonometric equations	1.1b, 2.4 and 2.5