Oxford Revise | Edexcel A Level Maths | Answers

- Method (**M**) marks are awarded for showing you know a method and have attempted to apply it.
- Accuracy (**A**) marks should only be awarded if the relevant M marks have been awarded.
- Unconditional accuracy (**B**) marks are awarded independently of M marks. They do not rely on method.
- The abbreviation **o.e.** means 'or equivalent (and appropriate)'.

Please note that:

- efficient use of advanced calculators is expected
- inexact numerical answers should be given to three significant figures unless the question states otherwise; values from statistical tables should be quoted in full
- when a value of g is required, it is taken as $g = 9.8\,\text{m s}^{-2}$ unless stated otherwise in the question.

Chapter 15 Trigonometric identities and equations

Question	Answer	Extra information	Marks
15.1	$\tan x = \frac{1}{3}$ Hence $x = 18.4°$ or $198.4°$	Use of tan identity One correct solution Second correct solution	M1 A1 A1
	Total		**3 marks**

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Question	Answer	Extra information	Marks
15.2	$1 - \sin^2 x = 1 - \sin x$ $\sin^2 x - \sin x = 0 \Rightarrow \sin x(\sin x - 1) = 0$ $\sin x = 0$ or 1 Hence $x = 0, \frac{\pi}{2}, \pi, 2\pi, \frac{5\pi}{2}, 3\pi, 4\pi$	Use of $\sin^2 x$ identity Attempting to factorise or solve quadratic Correct solutions for $\sin x$ All correct values required	M1 M1 A1 A1
	Total		**4 marks**
15.3	$(\tan x - 2)(\tan x - 1) = 0$ $\tan x = 2$ or 1 Hence $x = 225°, 243.4°, 405°, 423.4°$	Identifying quadratic in $\tan x$ and attempting to solve Both values for $\tan x$ All correct values required	M1 A1 A1
	Total		**3 marks**
15.4 (a)	$\sin^2 x + \left(\frac{2}{3}\right)^2 = 1 \Rightarrow \sin^2 x = \frac{5}{9}$ $\sin x = -\frac{\sqrt{5}}{3}$	Use of identity Correct solution	M1 A1
15.4 (b)	$\tan x = \frac{-\frac{\sqrt{5}}{3}}{\frac{2}{3}}$ $= -\frac{\sqrt{5}}{2}$	Use of identity Correct solution	M1 A1
	Total		**4 marks**

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Question	Answer	Extra information	Marks
15.5	$4\tan(3x-1)=1$ $\tan(3x-1)=\frac{1}{4}$ Hence $3x-1=0.245$ Also, $3x-1=3.387, 6.528, 9.670, 12.811, 15.953$ $x=0.42, 1.46, 2.51, 3.56, 4.60, 5.65$	Use of identity Principal solution Correct method to find at least one more solution All solutions correct	M1 A1 M1 A1
	Total		**4 marks**
15.6 (a)	$\cos 15° = \cos(60° - 45°)$ $= \cos 60° \cos 45° + \sin 60° \sin 45°$ $= \frac{1}{2}\times\frac{\sqrt{2}}{2}+\frac{\sqrt{3}}{2}\times\frac{\sqrt{2}}{2}$ $= \frac{\sqrt{2}+\sqrt{6}}{4} = \frac{\sqrt{6}+\sqrt{2}}{4}$	Use of identity Use of exact trig values Correct answer	M1 M1 A1
15.6 (b)	$\cos^2(82.5°) - \sin^2(82.5°) = \cos(2\times 82.5) = \cos 165°$ $\cos 165° = -\cos 15°$ $\cos^2(82.5°) - \sin^2(82.5°) = -\frac{\sqrt{6}+\sqrt{2}}{4}$	Use of double angle formula Use of given identity for cosine Correct answer	M1 M1 A1
	Total		**6 marks**

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Question	Answer	Extra information	Marks
15.7	$5(1 + \tan^2 x) + \tan x - 6 = 0$	Use of identity	M1
	$5\tan^2 x + \tan x - 1 = 0$	Forming a three-term quadratic	M1
	Hence $\tan x = \frac{-1 \pm \sqrt{21}}{10}$	$\tan x$ values. Accept as decimals to a suitable degree of accuracy.	A1
	$x = 19.7°, -160.3°, -29.2°, 160.3°$	All solutions correct	A1
	Total		**4 marks**
15.8	$3(\text{cosec}^2 x - 1) + \text{cosec}\, x - 2 = 0$	Use of identity	M1
	$3\,\text{cosec}^2 x + \text{cosec}\, x - 5 = 0$	Forming a three-term quadratic	M1
	Hence $\text{cosec}\, x = \frac{-1 \pm \sqrt{61}}{6}$	$\text{cosec}\, x$ values. Accept as decimals to a suitable degree of accuracy.	A1
	Hence $\sin x = \frac{6}{-1 \pm \sqrt{61}}$	Use of identity	M1
	$x = 1.08, 2.06, 3.89, 5.53$	All solutions correct	A1
	Total		**5 marks**
15.9 (a)	$\frac{2\sin\theta\cos\theta}{1+2\cos^2\theta-1} = \frac{2\sin\theta\cos\theta}{2\cos^2\theta}$	Use of double angle formulae	M1
	$= \frac{\sin\theta}{\cos\theta}$	Simplifying and cancelling	M1
	$= \tan\theta$	Correct result	A1
15.9 (b)	$\tan\theta = 3$	Use of (a) to form equation in tan	M1
	$\theta = 1.25, 4.39$	Both solutions correct	A1

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Question	Answer	Extra information	Marks
	Total		**5 marks**
15.10 (a)	$\sec^2 A \cot^2 A - \cos^2 A \sec^2 A = \operatorname{cosec}^2 A - 1 = \cot^2 A$	Use of identity	M1A1
15.10 (b)	$\cot^2(3x - 10) = 2 \Rightarrow \cot(3x - 10) = \pm\sqrt{2}$ Hence $\tan(3x - 10) = \pm\frac{1}{\sqrt{2}}$ $3x - 10 = 35.3, -35.3$ Also, $3x - 10 = 215.3, 395.3, 144.7, 324.7, 504.7$ Hence $x = 15.1, 51.6, 75.1, 111.6, 135.1, 171.6$	Use of result in (a) Use of identity Principal solutions Appropriate method to find at least one more solution All solutions correct	M1 M1 A1 M1 A1
	Total		**7 marks**
15.11 (a)	$R = \sqrt{1^2 + 2^2} = \sqrt{5}$ $\tan\alpha = 2$ so $\alpha = 63.4° \Rightarrow f(x) = \sqrt{5}\cos(x - 63.4°)$	Correct R Use of identity Correct α	B1 M1 A1
15.11 (b)	$-\frac{1}{\sqrt{5}}$	Correct answer	B1
	Total		**4 marks**
15.12 (a)	$R = \sqrt{7^2 + 2^2} = \sqrt{53}$ $\tan\alpha = \frac{7}{2}$ so $\alpha = 1.29 \Rightarrow f(x) = \sqrt{53}\cos(x - 1.29)$	Correct R Use of identity Correct α	B1 M1 A1

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Question	Answer	Extra information	Marks
15.12 (b)	$\sqrt{53}\cos(x+1.29)=5 \Rightarrow \cos(x+1.29)=\frac{5}{\sqrt{53}}$	Use of result from (a)	M1
	$x + 1.29 = 0.8137, 5.4695, 7.0969$	Correct principal value for $x + 1.29$	A1
		All three values for $x + 1.29$	A1
	Hence $x = 4.2, 5.8$	Both solutions correct	A1
	Total		**7 marks**
15.13 (a)	$R = \sqrt{4^2+5^2} = \sqrt{41}$	Correct R	B1
	$\tan\alpha = \frac{5}{4}$	Use of identity	M1
	so $\alpha = 51.34° \Rightarrow f(x) = \sqrt{41}\sin(x - 51.34°)$	Correct α	A1
15.13 (b)	$-\sqrt{41} \le f(x) \le \sqrt{41}$ (o.e)	$\sqrt{41}$	B1
		Fully correct	B1
	Total		**5 marks**
15.14 (a)	$R = \sqrt{0.5^2+0.6^2} = \frac{\sqrt{61}}{10}$	Correct R	B1
	$\tan\alpha = \frac{0.6}{0.5}$	Use of identity	M1
	so $\alpha = 50.19° \Rightarrow f(x) = \frac{\sqrt{61}}{10}\sin(x - 50.19°)$	Correct α	A1

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Question	Answer	Extra information	Marks
15.14 (b)(i)	$22 + \frac{\sqrt{61}}{10} = 22.78$	Correct maximum	B1
15.14 (b)(ii)	$\frac{90 + 50.19}{12}$ $= 11.68$	Use of their angle from (a) + 90 Correct value of y	M1 A1
15.14 (c)	$\frac{\sqrt{61}}{10}\sin(12y - 50.19) = -0.5 \Rightarrow \sin(12y - 50.19) = -\frac{5\sqrt{61}}{61}$ Hence $12y - 50.19 = -39.8, 219.8, 320.2, 579.8$ $y = 0.865, 22.499, 30.865, 52.500$ $22.499 - 0.865 + (52.500 - 30.865) = 43.269 = 43$ minutes	Use of their (a) Use of inverse sine Correct values for y Correct time	M1 M1 A1 A1
	Total		**10 marks**
15.15 (a)	$R = \sqrt{24^2 + 5^2} = \sqrt{601}$ $\tan\alpha = \frac{5}{24}$ so $\alpha = 0.21 \Rightarrow f(x) = \sqrt{601}\cos(\theta - 0.21)$	Correct R Use of identity Correct α	B1 M1 A1
15.15 (b)	$H = 25 - 24 + 0$ $= 1$ metre	Use of $t = 0$ Correct height	M1 A1
15.15 (c)(i)	Max height $= 25 + \sqrt{601}$ $= 49.5$ m	Correct max height	B1

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Question	Answer	Extra information	Marks
15.15 (c)(ii)	Occurs when $\cos(0.2t - 0.21) = -1$ Hence $0.2t - 0.21 = \pi$ $t = 16.757\ldots = 16.8$ minutes	Forming and solving equation Correct time	M1 A1
15.15 (d)	Next reaches max height at $\frac{3\pi + 0.21}{0.2} = 48.2$ minutes So, one revolution = 48.2 – 16.8 = 31.4 minutes Two complete revolutions = 62.8 minutes	Attempting to find next time Time for first revolution. Can be implied by correct answer. Time for second revolution	M1 A1 A1
	Total		**11 marks**
15.16 (a)	Three full cycles in 60 minutes means that the period is 20, so $C = 360 \div 20 = 18$	Finding period Correct C	M1 A1
15.16 (b)	$38 = A + B$ $24 = A - B$ $38 - 24 = 14$ $14 \div 2 = 7 \Rightarrow B = 7$ and $A = 31$	 Subtracting Correct A and B	 M1 A1A1
15.16 (c)	$\cos(18t) = -1$ $18t = 180°, 540°, 900°$ Hence $t = 10, 30, 50$ minutes	Forming and solving cos equation Correct values for $18t$ Correct t values	M1 A1 A1
15.16 (d)	Add an exponential term with negative index (e.g. $e^{-0.1t}$)	Correct answer	B1
	Total		**9 marks**

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Question	Answer	Extra information	Marks
15.17 (a)	$1 + 7(1)^6(-2x)^1 + \frac{7\times6}{2}(1)^5(-2x)^2$ $= 1 - 14x + 84x^2$	Use of formula First two terms All terms correct	M1 A1 A1
15.17 (b)	$x = 0.01$ $0.98^7 \approx 1 - 14 \times 0.01 + 84 \times 0.01^2 = 0.8684$	Correct x identified Correct value	M1 A1
15.17 (c)	$\frac{0.8684 - 0.98^7}{0.98^7} \times 100 = 0.032\%$	Use of formula Correct percentage error	M1 A1
	Total		**7 marks**
15.18 (a)	$(x-2)^2 + (y+3)^2 - 4 - 9 - 54 = 0$ Centre $(2, -3)$	Attempting to complete the square One mark per coordinate	M1 A1A1
15.18 (b)	$r = \sqrt{67}$	Allow follow through from their completed square equation in (a)	B1
15.18 (c)	$(x-2)^2 + (2x+2)^2 = 67$ $x^2 - 4x + 4 + 4x^2 + 8x + 4 - 67 = 0$ $5x^2 + 4x - 59 = 0$ Hence $x = \frac{-2 \pm \sqrt{299}}{5}$	Correct substitution Attempting to simplify Correct quadratic Both values of x	M1 M1 A1 A1
	Total		**8 marks**

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