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 35 Projectiles

Question	Answer	Extra information	Marks
35.1 (a)	$s = ut + \frac{1}{2}at^2$ $-15 = -4.9t^2$ $t = 1.75$ (s)	Use of $s = ut + \frac{1}{2}at^2$ vertically Correct answer	M1 A1
35.1 (b)	$s = ut + \frac{1}{2}at^2$ $s = 18 \times 1.75$ $s = 31.5$ (m)	Use of $s = ut + \frac{1}{2}at^2$ horizontally Correct answer	M1 A1
	Total		**4 marks**

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Question	Answer	Extra information	Marks
35.2 (a)	$v^2 = u^2 + 2as$ $0 = (20 \sin 60°)^2 - 19.6s$ $s = \frac{300}{19.6}$ $= 15.3$ (m)	Complete method for height, e.g. use of $v^2 = u^2 + 2as$ vertically Correct equation Correct answer only	M1 A1 A1
35.2 (b)	$s = ut + \frac{1}{2}at^2$ $0 = \left(10\sqrt{3}\right)t - 4.9t^2$ $0 = t\left(10\sqrt{3} - 4.9t\right)$ $(t = 0$ or$)\ t = \frac{10\sqrt{3}}{4.9} = 3.53$ (s)	Correct method e.g. use of $s = ut + \frac{1}{2}at^2$ vertically Correct equation Correct answer only	M1 A1 A1
35.2 (c)	Air resistance will reduce the maximum height reached.	Any valid statement	B1
	Total		**7 marks**
35.3	$s = ut + \frac{1}{2}at^2$ $60 = (50 \sin 45°)t - 4.9t^2$ $4.9t^2 - 25\sqrt{2}\,t + 60 = 0$ $t = 4.4854, 2.7298$ Time above 60 m = 4.4854 – 2.7298 = 1.76 s	Use of $s = ut + \frac{1}{2}at^2$ vertically to form quadratic in t Two values of t Correct answer only	M1 A1 A1
	Total		**3 marks**

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Question	Answer	Extra information	Marks
35.4 (a)	$s = ut + \frac{1}{2}at^2$		
	$x = (21 \cos \alpha)\, t$	Use of $s = ut + \frac{1}{2}at^2$ horizontally	M1A1
	$t = \frac{x}{21 \cos \alpha}$		
	$s = ut + \frac{1}{2}at^2$		
	$y = (21 \sin \alpha)t - \frac{g}{2}t^2$	Use of $s = ut + \frac{1}{2}at^2$ vertically	M1A1
	$y = 21\sin\alpha\left(\frac{x}{21\cos\alpha}\right) - \frac{9.8}{2}\left(\frac{x}{21\cos\alpha}\right)^2$	Eliminating t	M1
	$y = x \tan\alpha - \frac{x^2}{90\cos^2\alpha}$	Reaching correct equation	A1
35.4 (b)	$x = 20, y = \frac{40}{9}$		
	$\frac{40}{9} = 20\tan\alpha - \frac{400}{90}\left(1 + \tan^2\alpha\right)$	Substituting $x = 20$, $y = \frac{40}{9}$ into equation from (a)	M1
	$\frac{40}{9} = 20\tan\alpha - \frac{40}{9} - \frac{40}{9}\tan^2\alpha$		
	$2\tan^2\alpha - 9\tan\alpha + 4 = 0$	Forming a quadratic in $\tan\alpha$	M1
	$\tan\alpha = 4$ or $\tan\alpha = \frac{1}{2}$	Both solutions correct	A1

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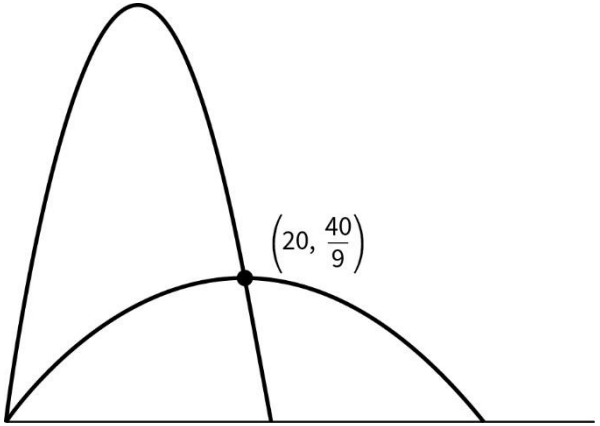
Question	Answer	Extra information	Marks
35.4 (c)	 There are two parabolic paths that will pass through the point $\left(20, \frac{40}{9}\right)$. Each requires a different angle of projection.	Graph and valid reasoning	B1
	Total		**10 marks**
35.5 (a)	$v^2 = u^2 + 2as$ $0 = U^2 \sin^2 \alpha + 2(-9.8)(4)$ $U^2 = 122.5$ $U = 11.1$ (m s^{-1})	Attempting to use $v^2 = u^2 + 2as$ in vertical direction Correct equation; $\sin \alpha = \frac{4}{5}$ does not need to be substituted Correct U	M1 A1 A1

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Question	Answer	Extra information	Marks
35.5 (b)	At ship's mast vertical displacement = –4 $v^2 = (11.068\ldots \sin \alpha)^2 + 2(-9.8)(-4)$ $v^2 = 156.8$ $v = 12.5218\ldots$ (m s^{-1}) The horizontal component of velocity remains constant at $11.068 \cos \alpha = 6.6407\ldots$ Speed = $\sqrt{6.6407\ldots^2 + 12.5219\ldots^2}$ = 14.2 (m s^{-1})	Correct use of $v^2 = u^2 + 2as$ vertically Correct vertical component Correct horizontal component Correct use of Pythagoras' theorem with both components Correct answer only	M1A1 A1 B1 M1 A1
35.5 (c)	For example: The sea is not flat or horizontal The cliff is unlikely to be vertical There could be waves	Any valid limitation	B1
	Total		**10 marks**
35.6 (a)	$2p = t$ $-p = 2(2p) - 4.9\,(2p)^2$ $-p = 4p - 19.6p^2$ $19.6p^2 - 5p = 0$ $p = \frac{5}{19.6} = \frac{25}{98}$ $p = 0.255$ (or -0.255)	Use of $s = ut + \frac{1}{2}at^2$ horizontally Use of $s = ut + \frac{1}{2}at^2$ vertically Correct quadratic in p Correct p	M1 M1 A1 A1

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Question	Answer	Extra information	Marks
35.6 (b)	$v = 2 - 9.8 \times 2 \times \frac{25}{98}$ $v = -3$ Velocity at A is $\mathbf{i} - 3\mathbf{j}$	Use of $v = u + at$ vertically Correct v Must write as column vector or in **ij** notation	M1 A1 A1
	Total		**7 marks**
35.7 (a)	Using $s = ut + \frac{1}{2}at^2$ horizontally $x = wt$ $t = \frac{x}{w}$ $s = 3wt - \frac{gt^2}{2}$ $y = 4 - \lvert s \rvert$ $y = 4 - \left(-3wt + \frac{gt^2}{2}\right)$ $y = 4 + 3w\left(\frac{x}{w}\right) - \frac{gx^2}{2w^2}$ $y = 3x - \frac{gx^2}{2w^2} + 4$	Forming equation for t in terms of w and x Use of $s = ut + \frac{1}{2}at^2$ vertically Reaching equation in w and x only Correct simplification	M1A1 M1A1 A1 A1

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Question	Answer	Extra information	Marks
35.7 (b)	Vertical displacement is zero when $y = 4$		
	$4 = 3x - \frac{gx^2}{2w^2} + 4$	Attempting to find equation in x and k	M1A1
	$3x = \frac{gx^2}{2w^2}$		
	$6xw^2 = gx^2$		
	$x = \frac{6w^2}{g}$	Correct x-coordinate	A1
	Position vector is		
	$\frac{6w^2}{g}\mathbf{i} + 4\mathbf{j}$	Correct answer only	A1
35.7 (c)	At B: $s = ut + \frac{1}{2}at^2$ vertically	Use of $s = ut + \frac{1}{2}at^2$ vertically	M1
	$-4 = (3w)5 - 4.9(25)$	Correct equation	A1
	$-4 = 15w - 122.5$		
	$118.5 = 15w$		
	$w = 7.9$	Correct w	A1
	$s = ut + \frac{1}{2}at^2$ horizontally	Use of $s = ut + \frac{1}{2}at^2$ horizontally	M1
	$p = 5w$		
	$p = 39.5$	Correct p	A1

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Question	Answer	Extra information	Marks
	Total		**15 marks**
35.8 (a)	$\frac{2t^4-18}{5t^2}=\frac{1}{-1}$ $-2t^4+18=5t^2$ $2t^4+5t^2-18=0$ $t^2=\frac{-9}{2}$ or 2 $t = 1.41$ (s)	Forming an equation with the ratio of the components Correct t	M1A1 A1
35.8 (b)	$\mathbf{r}=\int \mathbf{v}\ \mathrm{d}t=\left(\frac{2}{5}t^5-18t+c\right)\mathbf{i}+\left(\frac{5}{3}t^3+d\right)\mathbf{j}$ $t = 0,\ \frac{19}{5}\mathbf{i}=c\mathbf{i}+d\mathbf{j}$ $c=\frac{19}{5}, d=0$ $\mathbf{r}=\left(\frac{2}{5}t^5-18t+\frac{19}{5}\right)\mathbf{i}+\left(\frac{5}{3}t^3\right)\mathbf{j}$ When $t = 3$ $\mathbf{r} = 47\mathbf{i} + 45\mathbf{j}$	Attempting to integrate v. Condone omission of c and d for mark. Finding constants of integration Correct answer	M1A1 M1 A1
	Total		**7 marks**

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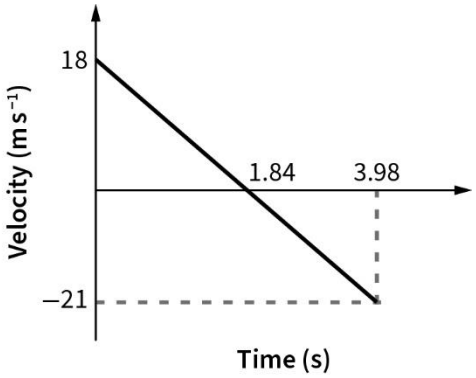
Question	Answer	Extra information	Marks
35.9 (a)	$v^2 = u^2 + 2as$ $v^2 = 18^2 + 2(-9.8)(-6)$ $v^2 = 441.6$ $v = 21.0$ (m s^{-1})	Use of $v^2 = u^2 + 2as$ Correct equation Correct v	M1 A1 A1
35.9 (b)	$v = u + at$ $0 = 18 - 9.8t$ $t = 1.84$ (s) $s = ut + \frac{1}{2}at^2$ $-6 = 18t - 4.9t^2$ $t = 3.98$ (s)  	Attempting to find time to the top Attempting to find time to ground Straight line with negative slope For end point at (3.98,−21) For their 1.84 at intersection with x-axis	M1 M1 B1 B1 B1
	Total		**8 marks**

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