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 36 Forces and equilibrium

Question	Answer	Extra information	Marks
36.1 (a)	Resolving horizontally: $15 - 8\cos 30° - 12\sin 45°$ $(= -0.41348\ldots)$ Resolving vertically: $8\sin 30° - 12\cos 45°$ $(= -4.48528\ldots)$ Using Pythagoras' theorem: $\sqrt{0.41348\ldots^2 + 4.48528\ldots^2} = 4.50$ (N)	Attempting to resolve in either direction Correct horizontal resolution Correct vertical resolution Use of Pythagoras' theorem Correct answer only	M1 A1 A1 M1 A1
36.1 (b)	$\tan^{-1}(4.48528\ldots \div 0.41348\ldots) = 84.7°$ Angle with positive horizontal $= 180° - 84.7° = 95.3°$	Use of tan to find an angle Correct answer only	M1 A1

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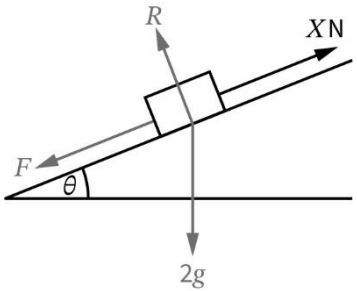
Question	Answer	Extra information	Marks
	Total		**7 marks**
36.2	$-3 + q + 5p = 0$ $4p - 8 - 2q = 0$ Solving simultaneously: $p = 1$ $q = -2$	Equation with **i** components Equation with **j** components Correct p value Correct q value	M1 M1 A1 A1
	Total		**4 marks**
36.3 (a)	Resolving perpendicular to the plane:  $R = 2g \cos \theta$ $R = 2g \times \frac{3}{5}$ $R = 11.8$ (N)	Attempting to resolve Correct answer	M1A1 A1

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Question	Answer	Extra information	Marks
36.3 (b)	Resolving parallel to the plane: $X = 2g \sin\theta + F$ $X = 2g \times \frac{4}{5} + 10$ $X = 25.7$ (N)	Attempting to resolve Correct answer	M1A1 A1
	Total		**6 marks**

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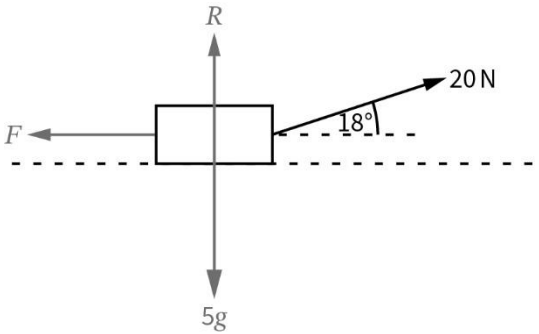
Question	Answer	Extra information	Marks
36.4			
	Resolving horizontally:	Attempting to resolve horizontally	M1
	$20 \cos 18° = F$	Correct equation	A1
	$F = 19.021...$		
	Resolving vertically:	Attempting to resolve vertically	M1
	$R + 20 \sin 18° = 5g$	Correct equation	A1
	$R = 42.819….$		
	Using $F = \mu R$:	Use of $F = \mu R$. Must substitute both F and R	M1
	$\mu = \frac{F}{R}$ $= \frac{19.021}{42.819}$		
	$= 0.44$	Correct answer only	A1
	Total		**6 marks**
36.5 (a)	The strings are at different angles	Valid explanation	B1

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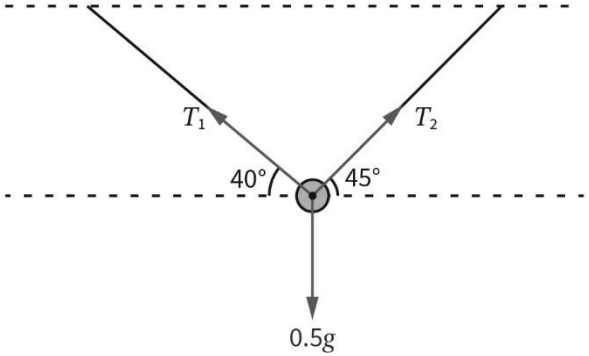
Question	Answer	Extra information	Marks
36.5 (b)			
	$T_1 \cos 40° = T_2 \cos 45°$	Resolving horizontally	M1A1
	$T_1 \sin 40° + T_2 \sin 45° = 0.5g$	Resolving vertically	M1A1
	Solving simultaneously:		
	$T_1 = 3.48$ (N)	T_1 correct	A1
	$T_2 = 3.77$ (N)	T_2 correct	A1
	Total		**7 marks**

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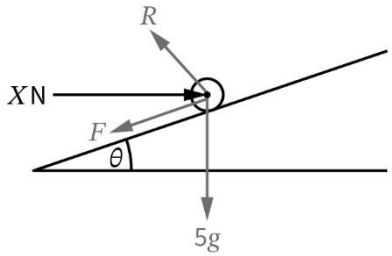
Question	Answer	Extra information	Marks
36.6 (a)			
	$X\cos\theta = F + 5g\sin\theta$ (1)	Resolving horizontally	M1A1
	$R = X\sin\theta + 5g\cos\theta$ (2)	Resolving vertically	M1A1
	$F = 0.25R$ (3)	Using $F = \mu R$	M1
	Substituting equation (2) and (3) in (1):		
	$X\cos\theta = 0.25(X\sin\theta + 5g\cos\theta) + 5g\sin\theta$		
	$\cos\theta = \frac{12}{13}$ $\sin\theta = \frac{5}{13}$		
	$\frac{12}{13}X = \frac{1}{4}\left(\frac{5}{13}X + 5g\frac{12}{13}\right) + \frac{25g}{13}$	Eliminating F, R and θ to obtain an equation in X only	M1
	$\frac{12}{13}X - \frac{5}{52}X = \frac{60}{52}g + \frac{25g}{13}$		
	$\frac{43}{52}X = \frac{40}{13}g$		
	$X = \frac{160}{43}g$	Correct simplification	A1

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Question	Answer	Extra information	Marks
36.6 (b)	On the point of slipping down the plane means that F would be going up the plane. The magnitude of X would be smaller.	Correct statement about F Correct conclusion about magnitude	B1 B1
	Total		**9 marks**
36.7 (a)	$\tan\theta = \frac{3}{1}$ $\theta = 71.6°$	Use of trigonometry to find expression for tan θ Correct answer only	M1 A1
36.7 (b)	Let the resultant vector be $k\begin{pmatrix}1\\1\end{pmatrix}$ $2 + p = k$ $-5 + 3p = k$ $p = 3.5$	 Equation using **i** components Equation using **j** components Solving simultaneously. Correct answer only.	 M1 M1 A1
	Total		**5 marks**

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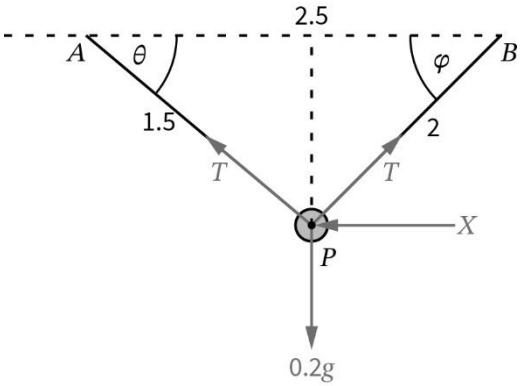
Question	Answer	Extra information	Marks
36.8 (a)	One continuous string with smooth bead so tension in each part of the string is the same Angle *APB* is a right angle as Pythagoras' theorem holds (triangle *ABP* is a 3:4:5 triangle)  		
	$\cos\theta = \frac{1.5}{2.5} = \frac{3}{5}$ $\sin\theta = \frac{4}{5}$ $\cos\varphi = \frac{2}{2.5} = \frac{4}{5}$ $\sin\varphi = = \frac{3}{5}$	For values cos and sin of each angle	B1
	Resolving vertically: $T\sin\theta + T\sin\varphi = 0.2g$ $\frac{4}{5}T + \frac{3}{5}T = 0.2g$	Attempting to resolve Correct equation	M1 A1
	$T = \frac{1}{7}g$	Correct T	A1

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Question	Answer	Extra information	Marks
36.8 (b)	Resolving horizontally: $-X + T\cos\varphi = T\cos\theta$ $X = \frac{1}{7}g\left(\frac{4}{5}\right) - \frac{1}{7}g\left(\frac{3}{5}\right)$ $X = \frac{g}{35}$ The magnitude of X is $\frac{g}{35}$ (N)	Attempting to resolve Correct equation Correct X	M1 A1 A1
	Total		**7 marks**
36.9	$s = ut + \frac{1}{2}at^2$ $s = 4\begin{pmatrix}3\\0\end{pmatrix} + \frac{1}{2}\times 16\begin{pmatrix}1\\3\end{pmatrix} = \begin{pmatrix}20\\24\end{pmatrix}$ Position is $\begin{pmatrix}2\\-1\end{pmatrix} + \begin{pmatrix}20\\24\end{pmatrix} = \begin{pmatrix}22\\23\end{pmatrix}$ 22**i** + 23**j**	Attempting to use $s = ut + \frac{1}{2}at^2$ Correct equation Adding original position Correct answer only. Accept vector form or **ij** form.	M1 A1 M1 A1
	Total		**4 marks**

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Question	Answer	Extra information	Marks
36.10	$0 = U \sin\theta - gt$ $t = \frac{U \sin\theta}{g}$ (1)	At maximum height, using $v = u + at$ vertically	M1A1
	Using $v^2 = u^2 + 2as$ vertically: $0 = U^2 \sin^2\theta - 2g(40)$ $80g = U^2 \sin^2\theta$ (2)	Using $v^2 = u^2 + 2as$ vertically	M1A1
	$80\sqrt{3} = Ut \cos\theta$ (3)	At maximum height, using $s = ut + \frac{1}{2}at^2$ horizontally	M1A1
	$80\sqrt{3} = \frac{U\cos\theta \times U\sin\theta}{g} = \frac{U^2 \sin\theta\cos\theta}{g}$	Substituting equation (1) into equation (3) to eliminate t	M1
	$80\sqrt{3} = \frac{80}{\sin^2\theta} \times \cos\theta \sin\theta$	Eliminating U and g	M1
	$\sqrt{3} = \frac{\cos\theta}{\sin\theta} = \cot\theta$	Correct equation for cot or tan	A1
	$\theta = 30°$ Using equation (2):		
	$U^2 = \frac{80g}{\sin^2 30°}$	Finding U^2	M1
	$U = 56$ (m s^{-1})	Correct answer	A1
	Total		**11 marks**

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