

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2016	9709	51

Qu	Answer	Part Marks	Marks	Notes
1	$v^2 = 12^2 - (16\cos 45)^2$ $v = 4$ $-4 = 4 - gt$ $t = 0.8 \text{ s}$	M1 A1 M1 A1	4	
2 (i)	$OG = 0.4\sin(\pi/2)/(\pi/2)$ $d = OG \cos 70 + 0.4\sin 70$ $d = 0.463$ AG	B1 M1 A1	3	= 0.25464...
(ii)	$0.463W = 15 \times 0.8\cos 35$ $W = 21.2 \text{ N}$	M1 A1	2	
3 (i)	$0.4v dv/dx = 0.4g \sin 30 - 0.8e^{-x}$ $v dv/dx = 5 - 2e^{-x}$ AG	M1 A1	2	
(ii)	$\int v dv = \int (5 - 2e^{-x}) dx$ $v^2/2 = 5x + 2e^{-x} (+ c)$ $v = 2.05$	M1 A1 M1 A1	4	Separates the variables and attempts to integrate Uses limits or finds c (c = -2)
4 (i)	$\mu = W \sin 20 / (W \cos 20)$ $\mu = 0.364$	M1 A1	2	$\mu = \tan 20$
(ii)	$Wx/2 + W(x+4.4/4) = 2WOG$ $OG = 0.4 \tan 70 (= 0.4/\tan 20)$ $x = 0.732$	M1 A1 B1 A1	4	Attempts to take moments OG = distance to C from M
5 (i)	$v \cos \theta = 8/2$ $-26 = -2v \sin \theta - g 2^2/2$ $v \sin \theta = 3$ $v^2 = (+/-3)^2 + 4^2$ or $\tan \theta = 3/4$ $v = 5 \text{ m s}^{-1}$	B1 M1 A1 M1 A1		Accept with sign errors

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(ii)	$\theta = 36.9$ $v_v = (+/-3) + 2g$ $\tan\alpha = v_v / (8/2)$ Angle = 80.1 with the horizontal or angle = 9.9 with the vertical	A1 M1 M1 A1	6 3	
6 (i) (a)	$2\cos 45 + 2 \times 3/5 = 0.4 \omega^2 \times 0.3$ $\omega = 4.67 \text{ rad s}^{-1}$	M1 A1 A1	 3	Uses N2L with 2 components of T and accn = $0.3 \omega^2$
(i) (b)	$R + 2\sin 45 + 2 \times 4/5 = 0.4g$ $R = 0.986 \text{ N}$	M1 A1	2	
(ii)	$T\sin 45 + T(4/5) = 0.4g$ $T = 2.65$ $T\cos 45 + T(3/5) = 0.4v^2 / 0.3$ $v = 1.61 \text{ m s}^{-1}$	M1 A1 M1 A1	 2.654 4	
7 (i)	$12(1.6 - 1.2) / 1.2 = mg\sin 30$ $m = 0.8 \text{ kg}$	M1 A1	2	Uses $T = \lambda xt/l$
(ii)	PE change = 1.6 $\text{IKE} + 12 \times 0.4^2 / 2.4 =$ $1.6 \times 0.2g\sin 30 + 12 \times 0.2^2 / 2.4$ $\text{IKE} = 1 \text{ J AG}$	B1 B1 M1 A1	 4	$2 \times \text{ans(i)}$ Both EE terms correct KE/PE/EE balance Both EE terms correct
(iii)	$12e / 1.2 = 1.6g\sin 30$ $e = 0.8$ $1.6v^2 / 2 + 12 \times 0.8^2 / 2.4 =$ $1.6g \times 0.6\sin 30 + 12 \times 0.2^2 / 2.4$ $v = 1.5 \text{ m s}^{-1}$	M1 A1 M1 A1 A1	 5	$\lambda e \times t/l = \text{new weight component}$ May be stated without explanation Must use new equilibrium position