1 $OG = 0.25 \sin(\pi/2)/(\pi/2)$	B1		0.159 (15..)
$v = 0.159 \times 2.4$	M1		
$v = 0.382 \text{ ms}^{-1}$	A1√	[3]	√ 2.4 × cv (OG)
2 (i)	M1		Takes moments about B
$6 \times 0.4\cos60 = 0.8 P\cos45$	A1		P is the force at A
$P = 2.12\text{N}$	A1	[3]	
(ii) $F = P\sin75$ (F is friction force at B)	B1		Must use correct angle (cos15)
$R = 6 + P\cos75$ (R is normal reaction at B)	B1		Must use correct angle (sin15)
$\mu = (2.12\sin75)/(6 + 2.12\cos75)$	M1		
$\mu = 0.313$	A1	[4]	
3 (i) $0.2\, dv/dt = 0.2g - 0.8v$	M1		Use Newton's Second Law, – sign essential
$a = (dv/dt =)10 - 4v$ AG	A1	[2]	
(ii) $\int 1/(10-4v)\, dv = \int dt$	M1		Separates variables and attempts to integrate
$\frac{-1}{4} \ln(10-4v) = t\ (+c)$	A1		
$[c = \frac{-1}{4} \ln 10]$	M1		Attempts to find the constant or uses the correct limits
$\frac{-1}{4} \ln(10-4v) = 0.6 - \frac{1}{4} \ln 4$	A1		
$v = 2.27$	A1	[5]	
4 $R\cos45 - T\cos45 = mg$	M1		Resolves vertically for P
$R\cos45 = mg + mg\cos45$	A1		May be implied for later work
$R\sin45 + T\sin45 = m\omega^2 \times 0.67$	M1		Uses Newton's Second Law horizontally for P
	M1		Obtaining an equation in m (and g)
$mg + mg\cos45 + mg\sin45 = m\omega^2 \times 0.67$	A1		
$\omega = 6(.00) \text{ rads}^{-1}$	A1	[6]	

OR			
4	M1		Resolves radial acceleration parallel to the slope for P
Acceleration = $\omega^2 \times 0.67\cos45$	A1		May be implied by later work
$m\omega^2 \times 0.67\cos45 = T + mg\cos45$	M1		Uses Newton's Second Law parallel to the slope for P
	M1		Obtaining an equation in m (and g)
$m\omega^2 \times 0.67\cos45 = mg + mg\cos45$	A1		
$\omega = 6(.00)\ \text{rads}^{-1}$	A1		
5 **(i)** $v^2 = 17^2 - (30\cos60)^2$	M1		Finds vertical speed
$v = -8$	A1	[2]	– may be implied by later work
(ii) $-8 = 30\sin60 - gt$	M1		Finds relevant time
$t = 3.4$	A1		3.398
$y = [(30\sin60)^2 - 8^2]/(2g)\ (= 30.55)$	B1		Or $y = (30\sin60) \times 3.4 - g\,3.4^2/2\ (= 30.53)$
$OP^2 = (30\cos60 \times 3.4)^2 + 30.55^2$	M1		Use of Pythagoras
$OP = 59.4$ m	A1	[5]	Accept 59.5
6 **(i)** Height of triangle = $0.36/0.3 (= 1.2\text{ m})$	B1		
Semi-circle C of M = $2 \times 0.6/(3\pi/2)$	B1		Centre of mass lamina from BOD
$0.36 \times (1.2/3) = \pi \times 0.6^2/2 \times 2 \times 0.6/(3\pi/2)$	M1		Equating moments idea
$0.144 = 0.144$	A1	[4]	Evidence of checking equality
OR			
$0.36 \times (1.2/3) - \pi \times 0.6^2/2 \times 2 \times 0.6/(3\pi/2)$			
= distance × total area	M1		Table of moments idea
Distance = 0	A1		
(ii) 0.36×0.3	A1		Correct sum of parts
$= (0.36 + \pi\,0.6^2/2) \times OG$	A1		Correct moment of whole
$OG = 0.117$ m	A1	[4]	

7 (i)		M1	Energy conservation, no KE, 2 EE terms
	$45 \times 1^2/(2 \times 1.5) + 0.6\,gh = 45\,h^2/(2 \times 1.5)$	A1	
	$5h^2 - 2h - 5 = 0$	M1	Simplifies, tries to solve a 3 term quadratic equation
	$h = 1.22$ m	A1 [4]	
(ii)	$45e/1.5 = 45(1 - e)/1.5 + 6$	M1	Finds equilibrium position ($e = 0.6$)
	$AP = (1.5 + 0.6) = 2.1$ AG	A1	
	$0.6\,v^2/2 = 0.6\,g \times 0.6 + 45\,(1)^2/(2 \times 1.5)$ $- 4.5(0.6)^2/(2 \times 1.5) - 45(0.4)^2/(2 \times 1.5)$	M1 A1	Energy conservation with KE/PE/EE terms
	$v = 6$ ms^{-1}	A1 [5]	
(iii)	$0.6\,a = \pm\,(0.6g + 45 \times 1/1.5)$	M1*	Top $a = \pm\,60$ ms^{-2}
	$0.6\,a = \pm\,(0.6g - 45 \times 1.22/1.5)$	M1*	Bottom $a = \pm\,51$ ms^{-2}
	$\lvert a \rvert = 60$ ms^{-2}	A**1 [3]	Needs acceleration at both extreme positions considered.