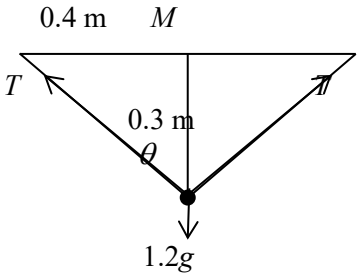
Question Number	Scheme	Marks
5(a)	$x = 4\cos\left(\frac{1}{5}\pi t\right) \quad \dot{x} = -4\times\frac{\pi}{5}\sin\left(\frac{1}{5}\pi t\right)$	
	$\ddot{x} = -4\times\left(\frac{\pi}{5}\right)^2\cos\left(\frac{1}{5}\pi t\right)$	M1A1
	$\ddot{x} = -\left(\frac{\pi}{5}\right)^2 x \quad \therefore \text{SHM}$	A1 (3)
(b)	$\text{period } = \frac{2\pi}{\frac{\pi}{5}} = 10 \text{ (s)}$	M1A1 (2)
(c)	$\text{amplitude} = 4 \text{ (m)}$	B1 (1)
(d)	$\dot{x} = -4\times\frac{\pi}{5}\sin\left(\frac{1}{5}\pi t\right)$ or $\lvert\dot{x}_{\max}\rvert = a\omega$	M1
	$\text{Max speed} = 4\times\frac{\pi}{5} = \frac{4\pi}{5}$ or 0.8π (ms^{-1})	A1 (2)
(e)	At A $x = 1.5$ $\quad 1.5 = 4\cos\left(\frac{1}{5}\pi t\right) \quad \Rightarrow t_A = \frac{5}{\pi}\cos^{-1}\left(\frac{1.5}{4}\right)$	M1A1
	At B $x = -2.5$ $\quad -2.5 = 4\cos\left(\frac{1}{5}\pi t\right) \quad \Rightarrow t_B = \frac{5}{\pi}\cos^{-1}\left(\frac{-2.5}{4}\right)$	A1
	Time A to B $= t_B - t_A = \frac{5}{\pi}\cos^{-1}\left(\frac{-2.5}{4}\right) - \frac{5}{\pi}\cos^{-1}\left(\frac{1.5}{4}\right) = 1.6862... = 1.7 \text{ or better (s)}$	A1 (4)
		[12]

(a)	
M1	Differentiate the given expression for x twice (**Both derivatives must be shown)** Need to see: cos to sin to cos (ignore signs)
A1	Both derivatives correct
A1	Rewrite in the standard form for SHM and give the conclusion.
(b)	
M1	Correct method
A1	Correct period
(c)	
B1	Correct amplitude
(d)	
M1	Use either method to obtain the max speed
A1	Correct max speed
(e)	
M1	Find the time from the start to either A or B
A1	One correct time
A1	Second relevant time
A1	Correct time from A to B. 1.7 (s) or better

Question Number	Scheme	Marks
ALT (e)	$1.5 = 4\sin\left(\frac{1}{5}\pi t\right) \quad \Rightarrow t_A = \frac{5}{\pi}\sin^{-1}\left(\frac{1.5}{4}\right)$ M1A1 $2.5 = 4\sin\left(\frac{1}{5}\pi t\right) \quad \Rightarrow t_B = \frac{5}{\pi}\sin^{-1}\left(\frac{2.5}{4}\right)$ A1 ${}_A t_B = t_B + t_A = \frac{5}{\pi}\sin^{-1}\left(\frac{2.5}{4}\right) + \frac{5}{\pi}\sin^{-1}\left(\frac{1.5}{4}\right) = 1.6862..$ 1.7 or better A1	
6(a)	$T = \frac{\lambda x}{l} \Rightarrow 30 = \frac{\lambda \times 0.3}{0.5}$	M1A1
	$\lambda = 50$ *	A1* (3)
(b)		
	Extension = 0.5 m (used in (b) or (c))	B1
	$T = \frac{50 \times 0.5}{0.5} = (50)$	M1A1ft
	$\text{R}(\uparrow) \quad 2T\cos\theta - 1.2g = 1.2a$	M1
	$100 \times \frac{3}{5} - 1.2 \times 9.8 = 1.2a$	A1ft
	$a = 40.2 \quad a = 40$ or 40.2 m s^{-2} (positive)	A1 (6)
(c)	E.P.E. $= \frac{1}{2} \times 50 \times \frac{0.5^2}{0.5}$	B1ft (any correct EPE)
	$1.2g \times 0.3 + \frac{1}{2} \times 1.2v^2 = \frac{1}{2} \times 50 \times \frac{0.5^2}{0.5} - \frac{1}{2} \times 50 \times \frac{0.3^2}{0.5}$	M1A1A1
	$v^2 = \frac{1}{0.6}\left(25 \times \frac{0.5^2}{0.5} - 25 \times \frac{0.3^2}{0.5} - 1.2g \times 0.3\right) \quad (= 7.452)$	DM1
	$v = 2.730... \quad = 2.7$ or $2.73\,\text{m s}^{-1}$	A1 (6)