Question Number	Scheme		Marks
3(a)	$\ddot{x} = -\omega^2 x \quad \Rightarrow \quad (\pm)0.5 = (\pm)0.02\omega^2$		M1
	$\omega = 5$		A1
	$T = \dfrac{2\pi}{\omega}$		M1
	$\dfrac{2\pi}{5}$ (s)		A1
			(4)
(b)	$v^2 = \omega^2\left(a^2 - x^2\right)$		M1
	$0.3^2 = "\omega^2"\left(a^2 - 0.02^2\right)$		A1ft
	$a = \dfrac{\sqrt{10}}{50}$ (m)		A1
			(3)
(c)	$x = a \sin \omega t$	$x = a \cos \omega t$	M1
	$t = \dfrac{1}{\omega}\sin^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{30}$	$t = \dfrac{1}{\omega}\cos^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{15}$	A1
	Time $= 4 \times \dfrac{\pi}{30}$	Time $= "\dfrac{2\pi}{5}" - 4 \times \dfrac{\pi}{15}$	DM1
	$\dfrac{2\pi}{15}$ (s)		A1
			(4)
			(11 marks)

Notes	
(a) M1	Uses $\ddot{x}$ or $a = -\omega^2 x$ with $\ddot{x} = 0.5$ and $x = 0.02$ to form an equation for ω^2. Condone sign errors.
A1	Obtains correct value for ω or ω^2 from correct working ie no sign errors (E.g. $\omega^2 = -25$ leading to $\omega = 5$ scores M1A0)
M1	Use of $T = \dfrac{2\pi}{\omega}$ with their value of ω
A1	Accept 1.3 or better (1.256637061…) N.B. it is possible to score M1A0M1A1 in part (a)
(b) M1	Use of $v^2 = \omega^2(a^2 - x^2)$ with $v = 0.3$, $x = 0.02$ and their ω Must be correct substitution (e.g. not ω or T or a instead of ω^2)
A1ft	Correct equation, follow through their ω
A1	Accept 0.063 or better (0.0632455532…)
(c) M1	Use of $x = a\sin\omega t$ or $x = a\cos\omega t$ with their ω and $x = \pm\dfrac{1}{2}a$. May see a or their value substituted.
A1	Correct time from centre or end (0.1047… or 0.2094…)
DM1	Correct method to find the required time. Depends on first M1.
A1	Accept 0.42 or better (0.4188790205…)

4. A light elastic string has natural length 5 m and modulus of elasticity 20 N.

The ends of the string are attached to two fixed points A and B, which are 6 m apart on a horizontal ceiling.

A particle P is attached to the midpoint of the string and hangs in equilibrium at a point which is 4 m below AB.

(a) Calculate the weight of P.

(6)

The particle is now raised to the midpoint of AB and released from rest.

(b) Calculate the speed of P when it has fallen 4 m.

(5)

(Total for Question 4 is 11 marks)