Question Number	Scheme	Marks
7(a)	$(T=)\dfrac{20(1)}{2}=\dfrac{\lambda\times 0.8}{1.2}$	M1A1
	$\lambda=15$ *	A1* (3)
(b)	Either $1.25\ddot{x}=\dfrac{15(0.8-x)}{1.2}-\dfrac{20(1+x)}{2}$	M1A1A1
	Or $1.25\ddot{x}=\dfrac{20(1-x)}{2}-\dfrac{15(0.8+x)}{1.2}$	
	$\ddot{x}=-18x$	A1* (4)
(c)	$10=a\sqrt{18}\Rightarrow a=\dfrac{10}{\sqrt{18}}$ oe	B1
	When string PB becomes slack $v^2=18\left(\left(\dfrac{10}{\sqrt{18}}\right)^2-0.8^2\right)$	M1
	$v=9.4063...$ $v=9.4$ or $9.41\,\text{m s}^{-1}$	A1 (3)
(d)	$0.8=\dfrac{10}{\sqrt{18}}\sin\sqrt{18}t_1$	M1A1
	$t_1=\dfrac{1}{\sqrt{18}}\sin^{-1}\left(0.8\dfrac{\sqrt{18}}{10}\right)$ $(=0.0816...)$	A1
	PA becomes slack when $x=-1$	
	$(\pm 1)=\dfrac{10}{\sqrt{18}}\sin\sqrt{18}t_2$	M1
	$t_2=\dfrac{1}{\sqrt{18}}\sin^{-1}\left(\dfrac{\sqrt{18}}{10}\right)$ $(=0.1032...)$	A1
	$T=2(t_1+t_2)=2\left(\dfrac{1}{\sqrt{18}}\sin^{-1}\left(0.8\dfrac{\sqrt{18}}{10}\right)+\dfrac{1}{\sqrt{18}}\sin^{-1}\left(\dfrac{\sqrt{18}}{10}\right)\right)$	A1 (6)
	$=0.3697...=0.37$ or 0.370	
	Notes	**[16]**

(a)

M1 Form an equation by equating the 2 tensions (found using HL)

A1 Equation correct

A1* Correct answer correctly obtained

(b)

M1 Equation of motion for *P*. Acceleration can be *a*

A1 Correct equation of motion with at most one error, acceleration may be *a*

A1 Fully correct equation of motion, acceleration may be *a*

A1* Correct **given** equation, correctly obtained

(c)	
B1	Correct amplitude, $a = \frac{10}{\sqrt{18}}, \frac{5\sqrt{2}}{3}, \frac{\sqrt{50}}{3}$, 2.4 oe
M1	Use $v^2 = \omega^2\left(a^2 - x^2\right)$ with x = 0.8 and their a and ω
A1	Correct speed when x = 0.8
(d)	
M1	Use x = 0.8 to find the time until PB becomes slack using their a and ω
A1	Correct equation
A1	Correct time (seen or implied) Allow consistent use of degrees. **NB** There are alternative method for finding this time but a complete method for the time until PB becomes slack must be used for the M mark to be awarded.
M1	Use $x = \pm 1$ to find the time until PA becomes slack (as before, alternative methods must be complete) using their a and ω
A1	Correct time obtained. Ignore consistent use of degrees.
A1	Complete to obtain the **correct** value of T
ALT (c)	**Conservation of Energy, O to slack**
M1 B1 (treat as A1)	Dimensionally correct energy equation with **3 EPE** terms and **2 KE** terms $\frac{20\times1^2}{2\times2}+\frac{1.25\times10^2}{2}+\frac{15\times0.8^2}{2\times1.2}=\frac{20\times1.8^2}{2\times2}+\frac{1.25\times v^2}{2}$
A1	Correct answer. $v = 9.4063...$ $v = 9.4$ or $9.41\ \text{m s}^{-1}$
ALT 7 (d)	**Using cos**
M1 A1	$0.8 = \frac{10}{\sqrt{18}}\cos\sqrt{18}t_1$
A1	$t_1 = \frac{1}{\sqrt{18}}\cos^{-1}\left(0.8\frac{\sqrt{18}}{10}\right)$ $\left(=0.2886...\right)$
M1	$-1 = \frac{10}{\sqrt{18}}\cos\sqrt{18}t_2$
A1	$t_2 = \frac{1}{\sqrt{18}}\cos^{-1}\left(-\frac{\sqrt{18}}{10}\right)$ $\left(=0.4735...\right)$
A1	$T = 2\left(t_2 - t_1\right) = 2\left(\frac{1}{\sqrt{18}}\cos^{-1}\left(-\frac{\sqrt{18}}{10}\right)-\frac{1}{\sqrt{18}}\cos^{-1}\left(0.8\frac{\sqrt{18}}{10}\right)\right)$ $= 0.3697... = 0.37$ or 0.370

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