Question Number	Scheme	Marks
6(a)	$\dfrac{\frac{3}{4}mge}{a} = mg$	M1
	$e = \dfrac{4}{3}a \Rightarrow AP = \dfrac{7}{3}a$	A1
		(2)
(b)	$m\ddot{x} = mg - \dfrac{\frac{3}{4}mg\left(x + \frac{4}{3}a\right)}{a}$	M1A1
	$m\ddot{x} = mg - \dfrac{3mgx}{4a} - mg = -\dfrac{3mgx}{4a}$	
	$\ddot{x} = -\dfrac{3g}{4a}x = -\omega^2 x \therefore \text{SHM}$	DM1A1
	$\text{amp} = \dfrac{2}{3}a \qquad \text{KE} = -\dfrac{mg}{2}$	B1
	$\dfrac{2}{3}a < \dfrac{4}{3}a$ oe So string remains taut or String never goes slack, therefore always SHM	B1
		(6)
(c)	$v^2 = \dfrac{3g}{4a}\left(\left(\dfrac{2a}{3}\right)^2 - \left(\dfrac{a}{3}\right)^2\right)$	M1A1ft
	$v^2 = \dfrac{ag}{4} \qquad v = \dfrac{\sqrt{ag}}{2}$	A1
		(3)
Alt	$\text{Energy}\dfrac{\frac{3mg}{4}(2a)^2}{2a} = \dfrac{\frac{3mg}{4}(a)^2}{2a} + mga + \dfrac{1}{2}mv^2$	M1A1
	$v = \dfrac{\sqrt{ag}}{2}$	A1
(d)	$-\dfrac{a}{3} = \dfrac{2a}{3}\cos(\omega t) \qquad \left[\dfrac{a}{3} = \dfrac{2a}{3}\sin(\omega t) \qquad \dfrac{T}{4} = \pi\sqrt{\dfrac{a}{3g}}\right]$	M1A1ft
	$\cos(\omega t) = -\dfrac{1}{2}$	

Question Number	Scheme	Marks
	$t\sqrt{\frac{3g}{4a}}=\frac{2\pi}{3}$	
	$t=\frac{2\pi}{3}\sqrt{\frac{4a}{3g}}$	DM1A1
		(4)
		[14]

(a) **M1** Resolve vertically. Can be in either *e* or *AP*.

A1 $AP=\frac{7}{3}a$

(b) **M1** Form an equation of motion including weight and tension. Variable must be measured from equilibrium position. If *e* is used, this must have been defined already in working (part (a)). Acceleration can be $\ddot{x}$ or *a*.

A1 Correct unsimplified equation. Can use $\ddot{x}$ or *a*, but if *a* used, it must be in same direction as *x*.

DM1 Solve to obtain $\ddot{x}=$ Must be $\ddot{x}$ now.

A1 $\ddot{x}=-\frac{3g}{4a}x=-\omega^2 x\therefore \text{SHM}$ Correct equation **and** statement.

B1M1 Correct/sufficient values found to establish string remains taut.

B1A1 Appropriate argument

(c) **M1** Use of $v^2=\omega^2\left(a^2-x^2\right)$ with their ω (ignore the dimensions of their ω)

A1ft Correct equation in *v* and *a*. ft their ω and amplitude(really their AP. Condone failing to add *a* to their extension in (a))

A1 Correct *v*. c.s.o., but award if correct ω found with only sign error in (b)

Alt for first 2 Marks

M1 Energy equation. Must contain 2 EPE terms, GPE and KE.

A1 Correct equation.

(d) **M1** Use of $x="a"\cos\left(\omega t\right)$ or $x="a"\sin\left(\omega t\right)$. Amplitude must be consistent with their *AP*.

A1 Correct equation in ω

DM1 Solve equation to find expression for *t*. Must now have a full method to find complete time.

A1 Any correct equivalent. Must come from correct working throughout, but condone sign error on acceleration in (b).