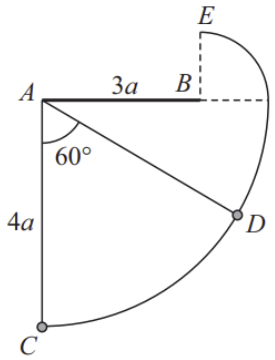
Question Number	Answer	Mark
		
6(a)	Equation for circular motion	M1
	$T - mg\cos 60° = \frac{mv^2}{4a}$	A1
	Conservation of energy from C to D	M1
	$\frac{1}{2}mu^2 = \frac{1}{2}mv^2 + mg \times (4a - 4a\cos 60°)$	A1
	$T = \frac{mu^2}{4a} - \frac{mg}{2}$	A1
		(5)
6(b)	Conservation of energy from C to E $\frac{1}{2}mu^2 = \frac{1}{2}mw^2 + mg \times 5a$ **and** N2L for circular motion $T = \frac{mw^2}{a} - mg$	M1
	Use of condition for circular motion to form an inequality in a, g and u or w only $(T \geq 0 \ \ldots) \quad w^2 \geq ag$	M1
	Complete solution must include sight of $T \geq 0$, correct inequality signs and correct working that leads to $u \geq \sqrt{11ga}$ *	A1*
		(3)
6(c)	Use $u^2 = 12ga$ to obtain $w^2 = 2ag$ **or** $w = \sqrt{2ga}$	B1ft
	Vertical motion to find the time taken $a = \frac{1}{2}gt^2, \quad t = \cdots \left(\sqrt{\frac{2a}{g}}\right)$	M1
	Horizontal motion to find the distance $s = \sqrt{2ga} \times t$	M1
	$= 2a$	A1
		(4)
		(13)
	Notes for Question 6	
6(a)		
M1	N2L with circular form of acceleration and $r = 4a$. Accept $4a$ replaced later in working. Dimensionally correct. All required	

	terms present and no extra. Condone sign errors and sin/cos confusion.	
A1	Correct unsimplified equation	
M1	Conservation of energy from *B* to *C*. Dimensionally correct. All required terms present and no extra. Condone sign errors and sin/cos confusion. All energy terms with the correct structure. Accept vertical height as $2a$ without seeing $(4a - 4a\cos 60°)$.	
A1	Correct unsimplified equation	
A1	Accept equivalent but must have *mg* terms collected.	
6(b)		
M1	Equations for conservation of energy and circular motion at *E*. Dimensionally correct. All required terms present and no extra. Condone sign errors. Accept two energy equations where the journey from *C* to *E* is broken down into *C to level with B* then *level with B to E*. *C* to *B*: $\frac{1}{2}mu^2 = \frac{1}{2}mv^2 + mg(4a) \Rightarrow v^2 = u^2 - 8ag$ and *B* to *E*: $\frac{1}{2}m(u^2 - 8ag) = \frac{1}{2}mw^2 + mg(a)$	
M1	Use correct condition for circular motion to form an inequality in *a*, *g* and *w* or *u*. For the method mark only, condone $T \geq 0$ not stated and condone strict inequality sign.	
A1*	Obtain given answer from complete and correct working. This must include sight of $T \geq 0$ and the correct inequality signs throughout.	
6(c)		
B1ft	Use $u^2 = 12ga$ to obtain $w^2 = 2ga$ **or** $w = \sqrt{2ga}$ Follow through is for their *w* following substitution of $u^2 = 12ga$ into their expression for v^2 in their energy equation in (b).	
M1	Vertical motion: correct use of *suvat* to find an expression for *t* in terms of *a* and *g*	
M1	Horizontal motion to find the distance *BF*	
A1	Correct only	

7.

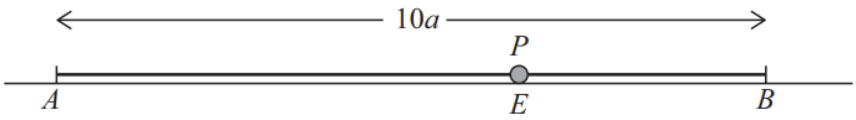


Figure 6

The fixed points A and B lie on a smooth horizontal surface with $AB = 10a$.

A particle P has mass m.

One end of a light elastic string, of natural length $5a$ and modulus of elasticity $\frac{1}{3}mg$, is attached to P and the other end is attached to A.

One end of another light elastic string, of natural length $3a$ and modulus of elasticity $\frac{2}{5}mg$, is attached to P and the other end is attached to B.

The particle P is resting in equilibrium at the point E on the surface, as shown in Figure 6.

(a) Show that $EB = \frac{11a}{3}$

(3)

Particle P is now held on the surface at the point C, between A and B, where $CB = 3a$, and released from rest.

(b) Show that P moves with simple harmonic motion about E.

(4)

(c) Show that the simple harmonic motion has period $2\pi\sqrt{\frac{5a}{g}}$

(2)

In any one complete oscillation of the simple harmonic motion, the particle is less than a distance $\frac{1}{3}a$ from E for a time S.

(d) Find S in terms of π, a and g.

(3)