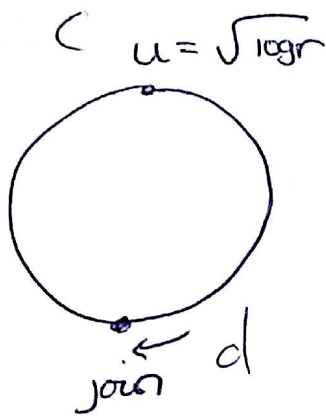


2007
6.b



✓

C hits + joins d

Show combined mass won't reach C.

C to d :

Energy

$$mg(2r) + \frac{1}{2} m 10gr = mg(0) + \frac{1}{2} m v^2$$

$$2mgr + 5mgr = \frac{1}{2} m v^2$$

$$14mgr = m v^2$$

$$14gr = v^2$$

speed of C, when reached D.

Collision :

PCM :

$$m\sqrt{14gr} + m(0) = 2mV$$

speed 2 of them set off at

$$\frac{\sqrt{14gr}}{2} = V$$

rel at top

Combined mass journey

$$2mg(0) + \frac{1}{2}(2m) \frac{14gr}{4} = 2mg(2r) + \frac{1}{2} 2m V^2$$

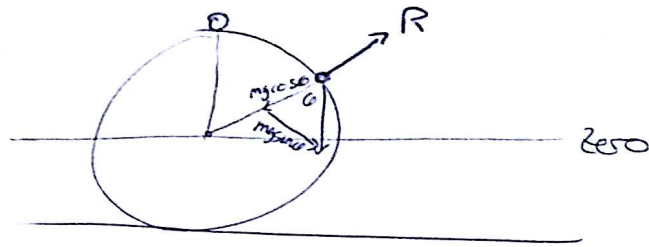
$$\frac{7mgr}{2} = 4mgr + \frac{1}{2} m v^2$$

$$-\frac{1}{2} mgr = \frac{1}{2} m v^2 \quad \left. \vphantom{-\frac{1}{2} mgr = \frac{1}{2} m v^2} \right\} \frac{-1}{2} gr = v^2$$

not possible \Rightarrow don't reach top.

2010
6.9

$$r = 2$$
$$m = m$$



Forces : $mg \cos \theta - R = \frac{mv^2}{r}$ ①

Energy : $mgr + \frac{1}{2}m0^2 = mgr \cos \theta + \frac{1}{2}mv^2$

$$2mgr - 2mgr \cos \theta = mv^2$$

$$2mgr - 2mgr \cos \theta = mv^2$$
 ②

② into ① : $mg \cos \theta - R = 2mg - 2mg \cos \theta$

$$3mg \cos \theta - R = 2mg$$

leave sphere : $R = 0$

$$3mg \cos \theta = 2mg$$

$$\cos \theta = \frac{2}{3}$$

into ① : $mg \frac{2}{3} - 0 = \frac{mv^2}{r}$

$$g \frac{2}{3} = \frac{v^2}{2}$$

$$\sqrt{\frac{4g}{3}} = v$$

vt

ii) Energy A = Energy B

$$\frac{1}{2} m v^2 = \frac{1}{2} m \left(\frac{4g}{3} \right) + mg (2 + 2\cos \theta)$$

$$\frac{1}{2} v^2 = \frac{2g}{3} + g \left(2 + \frac{2}{3} \right)$$

$$v = \sqrt{8g}$$