(9) It reaches the post at a time: $t_h = \frac{d}{u}$

The vertical initial velocity obeys: $y(t_h) = h = -\frac{g}{2}t_h^2 + V_0 t_h$

$$\Rightarrow V_0 = \frac{hu}{d} + \frac{gd}{2u}$$

The time for it to reach $y(t_0) = 0$ again is

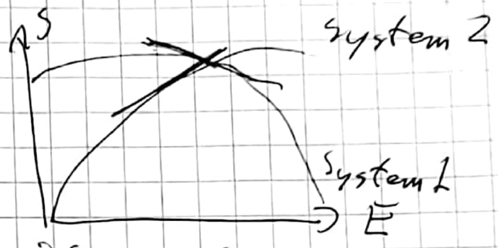
$$y(t_0) = 0 = -\frac{g}{2}t_0^2 + V_0 t_0 \Rightarrow t_0 = \frac{2V_0}{g} = \frac{2hu}{gd} + t_h$$

So in a time $t_0 - t_h$, it travelled a distance: $r = u(t_0 - t_h) = \frac{2hu^2}{gd}$ from the post which is independent of the starting point on l since it is only expressed in terms of the constants h, u, g, d. Thus it lands on a circ of radius $\frac{2hu^2}{gd}$ around the pole.

10a $E = \frac{1}{8\pi T}$, $C_T = \frac{-1}{8\pi T^2}$

Thermal equilibrium:

Negative C_T makes it unstable.



$$\frac{\partial S_1}{\partial E_1} = -\frac{\partial S_2}{\partial E_1}$$

(b) $\frac{\partial S_{total}}{\partial M} = 0$; $\frac{\partial S_{total}}{\partial T} = \frac{\partial S_{BH}}{\partial M}\frac{\partial M}{\partial T} - \frac{\partial S_R}{\partial M}\frac{\partial M}{\partial T}$

$$\frac{\partial M}{\partial T} = -\frac{\partial E_R}{\partial T} \Rightarrow -C_{BH} = C_R = \frac{1}{8\pi T^2}$$