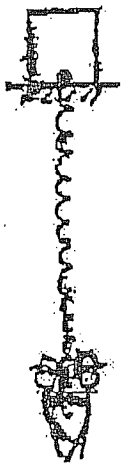
PHY132 - Day 1 Discussion Qu. 1.

1A. In an attempt to break out of jail, Diamond Jim (DJ) and Scarface (S) connect a lot of identical springs which they managed to lift from their beds. They tie one end of this chain of springs to their window frame and jump out together while holding on to the other end. This of course, results in their oscillating vertically like yo-yos with some period T_0. Suppose that DJ and S have the same mass m and that the mass of the spring chain is negligible compared to m. Suppose further that, in a moment of panic, DJ lets go while S continues to oscillate. If frictional energy losses are negligible, then Scarface's period of oscillation is

Then they're closest to the ground,

(A) $2T_0$ (B) $\sqrt{2}\,T_0$ (C) T_0 (D) $T_0/\sqrt{2}$ (E) $T_0/2$



When DJ and S jump, they will extend the chain beyond the point it would stretch if they were just hanging at rest at the bottom of the chain

Since the mass of the chain is negligible, as is friction, their period of oscillation is

$$T_0 = 2\pi\sqrt{\frac{m_{total}}{k}} = 2\pi\sqrt{\frac{2m}{k}}$$

Once DJ lets go, S will continue to oscillate but now with period

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{2m}{2k}} = \frac{1}{\sqrt{2}}\left(2\pi\sqrt{\frac{2m}{k}}\right) \quad \text{or} \quad T = \frac{T_0}{\sqrt{2}}$$

PH4132 - Day 1, Discussion Quest. 2

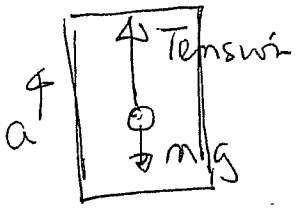
2A. A simple pendulum of length ℓ is tied to the ceiling of an elevator. When the elevator **moves up** with acceleration a = 0.5 g, the period of the pendulum is

(A) $2\pi\sqrt{\frac{\ell}{0.5g}}$ (B) $2\pi\sqrt{\frac{\ell}{g}}$ (C) $2\pi\sqrt{\frac{0.5\ell}{g}}$ (D) $2\pi\sqrt{\frac{1.5\ell}{g}}$

(E) $2\pi\sqrt{\frac{\ell}{1.5g}}$

An upward acceleration of an elevator with $a = 0.5g$ is effectively the same as being subject by a downward effective gravitational acceleration $g_{eff} = a + g = 0.5g + g = 1.5g$. The period of the pendulum is then $T = 2\pi\sqrt{\frac{\ell}{g_{eff}}} = 2\pi\sqrt{\frac{\ell}{1.5g}}$ (for small angles)

Remember that the tension acting on a vertically hanging mass m in such an elevator is given by



$ma = F_{net} = \text{Tension} - mg$

$\Rightarrow \text{Tension} = ma + mg = m(1.5g)$

It's equivalent to having a gravitational acceleration of 1.5 g.