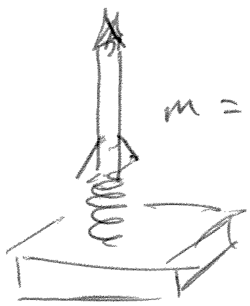
1D



$m = 0.12\ kg$

$F = -kx$ x = spring compression

$PE_s = \frac{1}{2}kx^2$

$E_i = E_f$ $KE = \frac{1}{2}mv^2$ $PE_s = \frac{1}{2}kx^2$ $PE_g = mgh$

a) Find k of spring

$x_1 = .15\ m$ $h_1 = 25\ m$

$PE_s = PE_g$

$\frac{1}{2}kx_1^2 = mgh_1$ $k = \frac{2mgh_1}{x_1^2} = 2613\ \frac{N}{m}$

$x_2 = ?$ $h_2 = 50\ m$

$\frac{1}{2}kx_2^2 = mgh_2$ $x_2^2 = \frac{2mgh_2}{k} = \frac{2mgh_2}{2mgh_1}x_1^2$

$x_2 = \left(\frac{h_2}{h_1}\right)^{1/2} x_1 = 0.212\ m$

Force needed to compress spring is

$$F_2 = kx_2 = \frac{2mgh_1}{x_1^2} \cdot \left[\frac{h_2}{h_1}x_1^2\right]^{1/2} = \frac{2mg}{x_1}(h_1h_2)^{1/2}$$

$$F_2 = \frac{2(0.12\ kg)(9.8\ m/s^2)(25\ m \cdot 25\ m)^{1/2}}{(0.15\ m)}$$

$F_2 = 554\ N$

✓ units $\frac{kg\ \frac{m}{s^2}(m^2)^{1/2}}{m} = N$

$h_1 \uparrow$ $F \uparrow$ Not obvious...

$m \uparrow$ $F \uparrow$

$x_1 \uparrow$ $F \downarrow$ weaker spring

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In General: $mC\Delta T = Q_{TOT}$ ↑ Heat = Energy

$$mC\Delta T = (P_{in} + P_{out})\Delta t$$

A

$P_{in} = 2\,kW = 2000\ J/sec$

$P_{out} = ?$

$\Delta t = 400\ sec$

$\Delta T = 50°C - 20°C = 30°C$

$m = \rho V = \frac{1\,g}{ml} \cdot 1000\,ml = 1000\ g$

$C = 4.2 \frac{J}{gK}$

$$P_{out} = \frac{mC\Delta T}{\Delta t} - P_{in} = \frac{(1000)(4.2)(30)}{400} - 2000 = -1685\ J/sec$$

☑ units

$\Delta T \uparrow$ $P_{out} \downarrow$

$\Delta t \uparrow$ $P_{out} \uparrow$

B $P'_{out} = \frac{P_{out}}{2} = -842.5\ J/sec$

$$\frac{mC\Delta T}{(P_{in} + P_{out})} = \Delta t = \frac{(1000)(4.2)(30)}{(2000 - 842.5)} = 109\ sec$$

☑ units

$\Delta T \uparrow$ $\Delta t \uparrow$

$P_{in} \uparrow$ $\Delta t \downarrow$

$P_{out} \uparrow$ $\Delta t \downarrow$