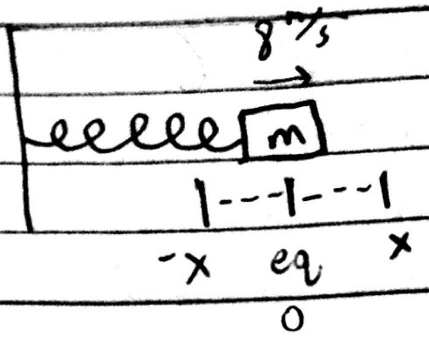
elastic $U_E = \frac{1}{2} k x_m^2$

7.



$K = 4 \, N/m$

$m = 2 \, kg$

$V = 8 \, m/s$

At the equilibrium point, there is no potential energy.
Thus all energy is kinetic

$K = \frac{1}{2} m v^2$

$= \frac{1}{2}(2 kg)(8 m/s)^2 = \boxed{64 j}$

At maximum displacement, the block is at rest and all energy is potential Energy.

$U = K x_{max}^2$

$E_f = E_o$

$J = N \cdot m$

$\frac{1}{2} k x_m^2 = \frac{1}{2} m v^2 = 64 j$

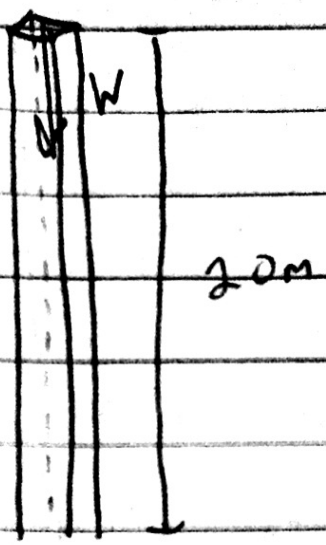
$\frac{1}{2} k x_m^2 = 64 j$

$k x_m^2 = 128 j$

$x_m^2 = \frac{128 j}{k}$

$x_m = \sqrt{\frac{128 j}{4 N/m}}$

$\boxed{x_m = 5.66 m}$



$Y = 2.0 \times 10^{11}$

$\Delta L = -0.5\,mm$

$A = 1\,m$

$L = 20\,m$

$F = Y\left(\Delta L / L_0\right)A$

$Pa = N/m^2$

$F = 2.0 \times 10^{11}\,Pa \left(-\frac{0.0005\,m}{20\,m}\right) 1\,m^2$

$F = 2.0 \times 10^{11}\,Pa \left(-0.000025\right) 1\,m^2$

$F = -5{,}000{,}000\,N$

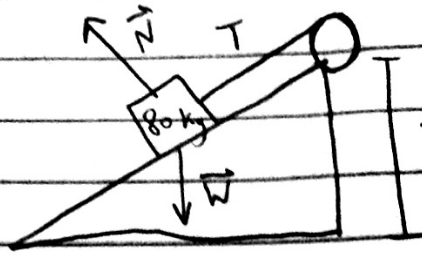
$F = mg$

$m(+9.8\,m/s^2) = +5{,}000{,}000\,N$

$m = \frac{5{,}000{,}000\,N}{9.8\,m/s^2}$

$\boxed{510204.1\,kg} = m$

9.



a.

No. Tension is an outside force doing work on the object. If Tension was not involved, the block wouldn't have moved. Tension is external and non conservative

b.

$ME_I + W_{ext} = ME_F$

$W_{Ext} = ME_f - ME_0$

$ME = KE + UE$

$W = KE_F + UE_F - KE_I - UE_I$

$W = \frac{1}{2}mV_f^2 + mgh_f - \frac{1}{2}mV_0^2 - mgh_0$

$V_f = V_0$ → speed is constant

$W = mgh_f - \cancel{mgh_0}$ → height is initially 0

$W = mgh_f$

$W = (80kg)(9.8m/s^2)(3m)$

$\boxed{W = 2352 J}$

10.

Mass doesn't matter.
Is energy conserved? Yes. All forces are conservative.

$$ME_i = ME_f$$

$$\frac{1}{2}\cancel{m}V_0^2 + mgh_0 = \frac{1}{2}mV_f^2 + mgh_f$$

$$\cancel{m}gh_0 = \frac{1}{2}\cancel{m}V_f^2 + \cancel{m}gh_f$$

$$gh_0 = \frac{1}{2}V_f^2 + gh_f$$

$$V_f^2 = 2g(h_0 - h_f)$$

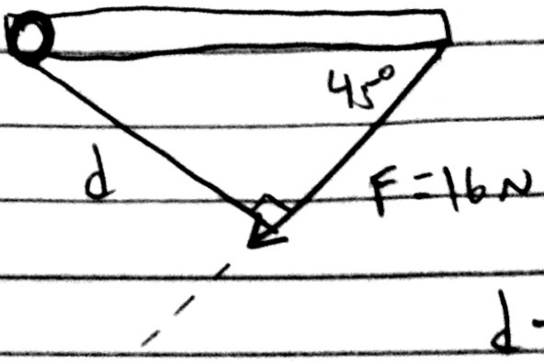
$$V_f = \sqrt{2g(h_0 - h_f)}$$

$$V_f = \sqrt{2(9.8\,m/s^2)(100m - 80m)}$$

$$V_f = \sqrt{19.6\,m/s^2\,(20m)}$$

$$V_f = \sqrt{392\,m^2/s^2}$$

$$\boxed{V_f = 19.8\,m/s}$$

11. 

$F = 16N$

$\theta = 45°$

$\tau = 2.3\ Nm$

$d \rightarrow$ lever arm

$\sin(\theta) = \frac{d}{L}$

$\tau = F \cdot d$

$2.3\ Nm = 16N \cdot d$

$d = \frac{2.3}{16} m$

$\boxed{d = 0.14\ m}$

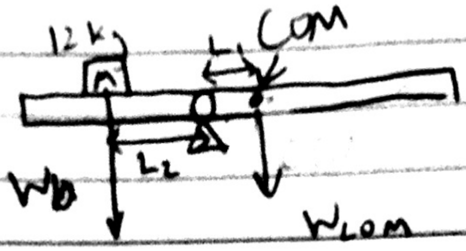
$\sin(\theta) = \left(\frac{0.14}{L}\right)$

$L = \frac{0.14}{\sin(\theta)}$

$L = \frac{0.14}{0.71}$

$\boxed{L = 0.2\ m}$

12.



$L_1 = 20$ cm
$L_2 = 40$ cm
$m_b = 12$ kg

$\tau_{cc} = \tau_c$

$\tau = F \cdot d$

the lever arm for both of these points are L_1 & L_2 because the force is perpidicular to the plank.

$\tau_{com} = W_{com} \cdot L_1$

$\tau_b = W_b \cdot L_2$

$W_b \cdot L_2 = W_{com} \cdot L_1$

$m_b \cdot \cancel{g} \cdot L_2 = m_{com} \cdot \cancel{g} \cdot L_1$

$m_b \cdot L_2 = m_{com} \cdot L_1$

$12\,kg \cdot 0.4\,m = m_{com} \cdot 0.2\,m$

$m_{com} = \frac{4.8}{0.2}\,m$

$\boxed{m_{plank} = 24\,kg.}$