Work: $dU = \underset{\sim}{F} \cdot d\underset{\sim}{r}$

Power: $P = \underset{\sim}{F} \cdot \underset{\sim}{v}$

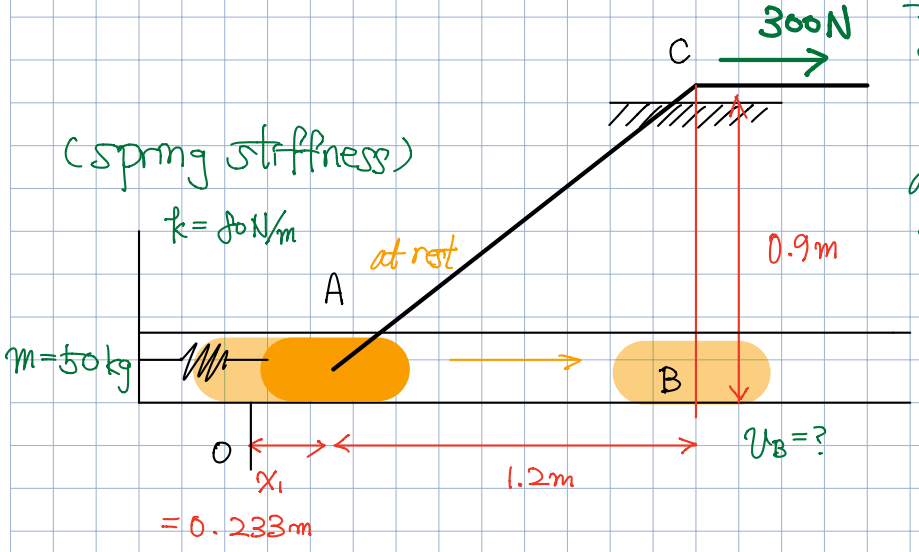
$1\ W = 1\ J/s$

$1\ hp = 550\ ft \cdot lb/s$

$= 746\ W$

Efficiency: $e_m = P_{output} / P_{input}$

Example 3.13



The 50-kg block moves along the fixed horizontal rail with negligible friction under the action of the constant 300-N force in the cable.

The block is released from rest at A, with the spring to which it is attached extended an initial amount $x_1 = 0.233\ m$.

Calculate the velocity v of the block as it reaches position B.

$U_{A-B} = U_{A-B,\,spring} + U_{A-B,\,tension}$ — Spring Force + External Force

$= \frac{1}{2}k(x_A^2 - x_B^2) + (300N) \cdot s$ ← $x_A = x_1 = 0.233m$, $x_B = x_1 + 1.2 = 1.433m$

$= -80\ J + 180\ J$ $s = \sqrt{1.2^2 + 0.9^2} - 0.9 = 0.6m$

$= 100\ J$

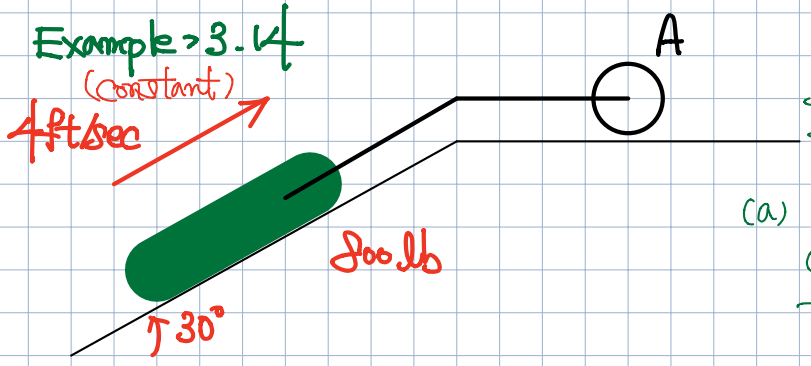
$T_{A-B} = T_B - T_A$ (at rest)

$= \frac{1}{2}m v_B^2$

$= \frac{1}{2}(50\ kg) \cdot v_B^2$

$\therefore v_B = 2\ m/s$ Ans

Example 3.14

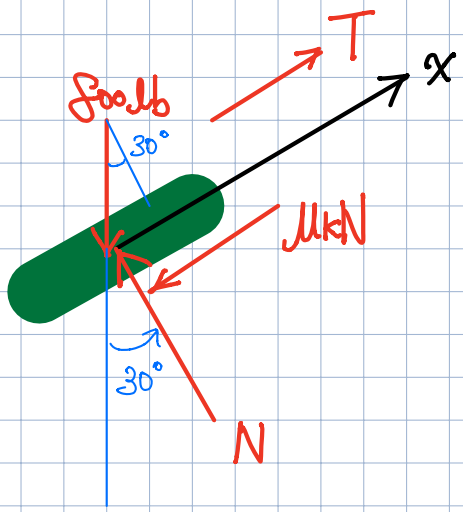


A hoists the 400-lb log up the 30° incline at a constant speed of 4 ft/sec.

(a) If the power output is 6 hp, compute the coefficient of kinetic friction (μ_k).

(b) $P = 8$ hp $\rightarrow$ $a = ?$

(a)



$\Sigma F_x = 0$ $\leftarrow$ when $P = 6$ hp, constant $v = 4$ ft/sec

$\Sigma F_x = 0$; $T - 400\sin 80^\circ - \mu_k N = 0$

$T = 400\sin 80^\circ + \mu_k N$

$= 400 + \mu_k(693)$

$400\cos 80^\circ = N$

$\therefore N = 693$

$P = \underset{\sim}{F} \cdot \underset{\sim}{v} = Tv = \{400 + \mu_k(693)\} \cdot (4\ \text{ft/sec}) = 6$ hp

$= 6$ hp $\cdot \dfrac{550\ \text{ft}\cdot\text{lb/s}}{1\ \text{hp}}$

1 hp = 550 ft·lb/s

$\therefore 400 + \mu_k(693) = \dfrac{6 \cdot 550}{4} = 825$

$\therefore \mu_k = 0.613$

(b)

$P = \underset{\sim}{F} \cdot \underset{\sim}{v} = T \cdot v$

$8\,hp = T \cdot (4\,ft/s)$

$8\,hp \dfrac{550\,ft\cdot lb/s}{1\,hp} = T \cdot 4\,ft/s$

$\therefore T = \dfrac{8 \cdot 550}{4} = 1100\,lb$

$\Sigma F_x = T - 800\cos 30^\circ - \mu_k N \quad \longleftarrow \quad \mu_k = 0.613$

$N = 693\,lb$

$= (1100\,lb) - (400\,lb) - (0.613)\cdot(693\,lb)$

$= 700 - 424.8 = 275.2\,lb = ma$

$F = mg$

$800\,lb = m \cdot (32.2\,ft/s^2)$

$\therefore m = 800\,lb/32.2\,ft/s^2 = 800/32.2\ lb/ft/s^2$

$= 24.84\ lb/ft/s^2$

$\therefore a = \dfrac{275.2}{24.84}\ \dfrac{lb}{lb/ft/s^2}$

$= 11.07\ ft/s^2$ Ans.