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Initial Max. deformation

The maximum force $F = kx$ occurs when x is a maximum with $\dot{x} = 0$.

$$U_1 + \Delta T = mgs - \frac{1}{2}kx^2 = 0, \quad x = \frac{2mg}{k}$$

$$\text{So } F = kx = 2mg$$

$$3/129 \quad T_A + V_{A-0} = T_C : 0 + 2mgR = \frac{1}{2}mv_C^2, \quad v_C^2 = 4gR$$

$$(a) \quad \Sigma F_n = ma_n : N_B = m \frac{4gR}{R} = 4mg$$

$$(b) \quad T_A + V_{A-C} = T_C : 0 + 3mgR = \frac{1}{2}mv_C^2, \quad v_C^2 = 6gR$$

$$\Sigma F_n = ma_n : N_C - mg = m \frac{6gR}{R}$$

$$N_C = 7mg$$

(c) Coll. stopping point E:

$$T_A + V_{A-E} = T_E$$

$$0 + 2mgR - mg\left(\frac{1}{2}\right) - \mu_k \frac{15}{2}mg = 0$$

$$s = \frac{4R}{1 + \mu_k 15}$$

(Note: Normal force on incline is)

$$N = mg \cos 30^\circ = \frac{\sqrt{3}}{2}mg$$

3/130 Let s = distance down incline before reversal of direction.

$$U_1 + \Delta T = 100(2)(10 + s - s) - 200(10 + s - s)\frac{5}{13} = 1046 \text{ ft}\cdot\text{lb}$$

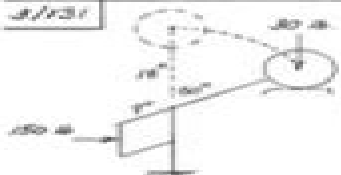
$$\Delta T = \frac{1}{2} \frac{350}{32.2} [v^2 - (17)^2] = 4.66v^2 - 377 \text{ ft}\cdot\text{lb}$$

$$U_1 + \Delta T : 1046 = 4.66v^2 - 377$$

$$v = 17.45 \text{ ft/sec}$$

The initial kinetic energy is positive regardless of the velocity direction.

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$$U_1 + \Delta T$$

$$150\left(\frac{1}{2} \sin 60^\circ\right) - 30 \frac{2}{13} (10 + s - s)$$

$$= \frac{1}{2} \frac{350}{32.2} (v^2 - 0)$$

$$v^2 = 160.8, \quad v = 12.68 \text{ m/sec}$$

$$3/132 \quad U_1 + \Delta T : mg(0.8 - 1.8 \cos 60^\circ)$$

$$= \frac{1}{2}m(12^2 - 9^2)$$

$$R(1)(0.20) = \frac{1}{2}(12^2 - 9^2), \quad 12^2 = 12.92, \quad 12 = 3.59 \text{ m/s}$$

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$$+\uparrow \Sigma F = 0 : 9810 - 4T = 0, \quad T = 2450 \text{ N}$$

Length of cable $L = 4s_0 + \text{constants}$

$$L = 4v_0 = 4(3) = 12 \text{ m/s}$$

$$P_{\text{out}} = -T\dot{L} = -2450(12) = 29400 \text{ watts}$$

$$\text{or } P_{\text{out}} = 29.4 \text{ kW}$$

$$C = \frac{P_{\text{out}}}{P_{\text{in}}}, \quad P_{\text{in}} = \frac{P_{\text{out}}}{C} = \frac{29.4}{0.8}$$

$$P_{\text{in}} = 36.8 \text{ kW}$$

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$$U_1 + \Delta T (\text{system})$$

$$\text{First interval: } 30(9.81)(1.2) - [30(9.81)(0.5 + 1.224)] \frac{1}{2} = \frac{1}{2} 30 v^2 + \frac{1}{2} 30 (10)^2$$

$$v^2 = 6.076 \text{ m/s}^2, \quad v = 2.447 \text{ m/s}$$

$$\text{Second interval: } 15(9.81)(2) - [30(9.81)(0.5 + 1.224)] \frac{1}{2} = 0 - \frac{1}{2} 15 (2.447)^2$$

$$- \frac{1}{2} 30 \left(\frac{5.076}{2} \right)$$

$$y = 2.18 \text{ m}, \quad s = \frac{1}{2} (1.2 + 2.18) = 1.69 \text{ m}$$

$$3/135 \quad U_1 + \Delta T : - \int_0^0 (3x^2 + 60x) dx = \frac{1}{2} \frac{450}{32.2} (0 - v^2) 12$$

$$x^3 + 30x^2 \Big|_0^0 = \frac{555}{32.2} v^2, \quad v \text{ in ft/sec.}$$

$$v^2 = \frac{32.2}{555} (60 + 480) = 60.82 \text{ (ft/sec)}^2, \quad v = 7.80 \text{ ft/sec}$$

$$3/136 \quad \Theta = \tan^{-1} \frac{6}{100} = 3.43^\circ$$

$$U_1 + \Delta T : U_1 + mgh = \frac{1}{2} m (v_1^2 + v_2^2)$$

$$U_1 = -1400(9.81)(200 \sin 3.43^\circ)$$

$$+ \frac{1}{2} 1400 \left[\left(\frac{20}{5.2} \right)^2 - \left(\frac{100}{5.2} \right)^2 \right]$$

$$= -683,000 \text{ J} \quad \text{or} \quad -683 \text{ kJ}$$

$$\text{Energy lost } Q = 683 \text{ kJ}$$

3/137 The power output of the drivetrain is

$$P_{\text{out}} = Fv = 540 \left(\frac{30}{3.6} \right) = 14,400 \text{ W}$$

The power input to the drivetrain:

$$P_{\text{in}} = \frac{P_{\text{out}}}{\epsilon} = \frac{14,400}{0.70} = 20,571 \text{ W}$$

$$\text{So the motor output } P = 20.6 \text{ kW}$$

Engineering Dynamics 7th Edition Solutions

Yi-Tong Ma



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