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464000

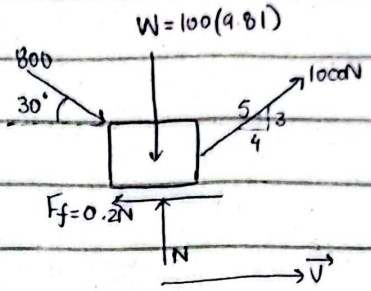
Assignment #04.

"I affirm that I will not give or receive any unauthorized help on this exam, and that all work will be my own."

14-3: $m = 100\ kg$ $v_i = 0\ m/s$

$v_f = 6\ m/s$

$\mu_k = 0.2$



As $F_f = \mu_k N \Rightarrow F_f = 0.2N$

$\Sigma F_y = ma_y$ (statics)

$\Sigma F_y = 0$

$$N + 1000\left(\frac{3}{5}\right) - 800 \sin 30^\circ - 100(9.81) = 0.$$

$$N + 600 - 400 - 981 = 0.$$

$$N = 781\ N \Rightarrow F_f = 156.2$$

Applying work energy principle.

$$T_1 + \Sigma U_{1-2} = T_2.$$

$$\frac{1}{2} m v_i^2 + \Sigma U_{1-2} = \frac{1}{2} m v_f^2$$

$$\frac{1}{2} m (0)^2 + 800 \cos 30^\circ (s) + 1000\left(\frac{4}{5}\right)s - 156.2s = \frac{1}{2}(100)(6)^2.$$

$$692.8s + 800s - 156.2s = 300(6)$$

$$1336.6s = 1800$$

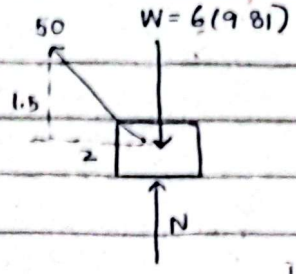
$$s = 1.35\ m$$

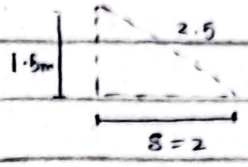
14-11: $F = 50\,N$ $s = 2$

$m = 6\,kg$

$v_1 = 0\,m/s$

$v_f = ?$





$s' = \sqrt{(1.5)^2 + (2)^2}$

$s' = 2.5\,m$

$s'' = 2.5 - 1.5 = 1$

$T_1 + \Sigma U_{1-2} = T_2$

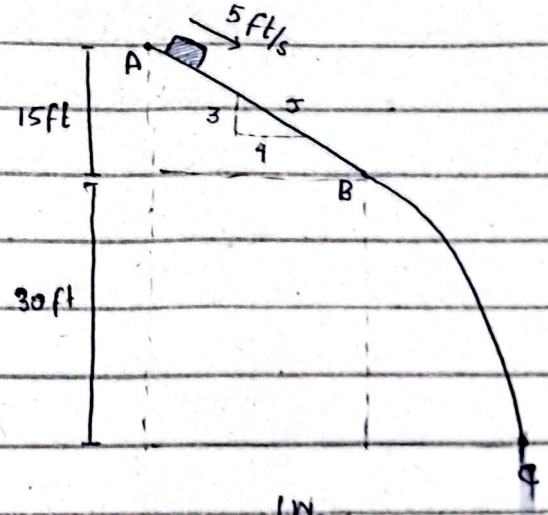
$\frac{1}{2} m v_1^{\,2} + \Sigma U_{1-2} = \frac{1}{2} m v_f^{\,2}$ ($v_1 = 0$)

$50\left(\frac{2}{2.5}\right)(1) = \frac{1}{2}(6)\,v_f^{\,2}$

$v_f^{\,2} = \frac{50 \times (4)}{2.5 \times 3}$

$v_f^{\,2} = \frac{200}{7.5} \Rightarrow v_f = 5.15\,m/s.$

4-13: ~~$m = 2$~~



For finding speed at B,

$T_A + \Sigma U_{A-B} = T_B$

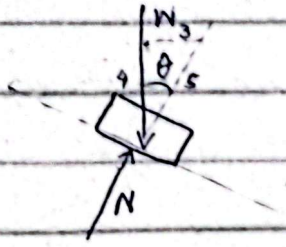
$\frac{1}{2} m v_A^{\,2} + \Sigma U_{A-B} = \frac{1}{2} m v_B^{\,2}$

$\frac{1}{2}\left(\frac{2}{32.2}\right)(5)^2 +$

$\cos\theta = 4/5$

$\theta = \cos^{-1}(4/5)$

$\theta = 36.9°$



$\frac{1}{2}(2)(5^2) + W \sin\theta\,(15) = \frac{1}{2}(2)\,v^2$

$$25 + W\sin(36.9)(15) = \tfrac{1}{2}V_B^2$$

$$25 + 966 = V_B^2$$

$$V_B = 31.48\ m/s$$

From B to C:

B (0, 30) C (d, 0)

$V_B = 31.48\ m/s$.

$x = x_0 + v_{0x}t$.

$d = 0 + 31.48\left(\frac{4}{5}\right)t$.

$d = 25.184t$.

$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

$$30 = 0 + 31.48\left(\frac{3}{5}\right)t + \frac{1}{2}(32.2)t^2$$

$$30 = 18.88t + 16.1t^2$$

$$16.1t^2 + 18.88t - 30 = 0.$$

$t = 0.899\ s$

$d = 25.184(0.899)$

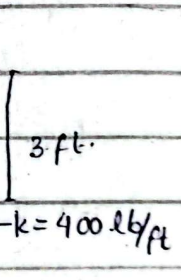
$d = 22.6\ ft$.

14.25: $V_A = 10\ ft/s$ $m = 5\ lb$ $V_B = 0$.

$T_1 + \Sigma U_{1-2} = T_2$

$\frac{1}{2}mv_A^2 + \Sigma U_{1-2} = \frac{1}{2}mv_B^2$ ($v_B^2 \to 0$)

$\frac{1}{2}(5)(10)^2 + \Sigma U_{1-2} = 0.$



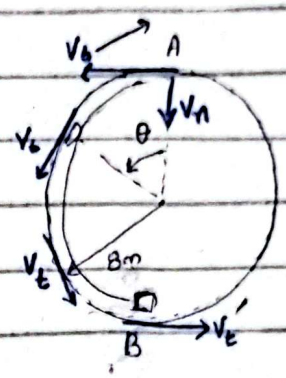
250 + Work done by weight − Work done by spring = 0.

$250 + 5(3+5) - \frac{1}{2}\left[400\left((0.75+s)^2 - (0.75)^2\right)\right] = 0$

$$250 + 15 + 5s - 200\left((0.75+s)^2 - (0.75)^2\right) = 0.$$

$$s = 0.0735 < 1\text{ ft}.$$

14-27: To find speed of car at B.



$$T_A + \Sigma U_{A-B} = T_B$$

$$\frac{1}{2}mV_A^2 + \Sigma U_{A-B} = \frac{1}{2}mV_B^2$$

$$\frac{1}{2}(250)(3)^2 + F(S_{AB}) = \frac{1}{2}(250)V_B^2$$

S_{AB} = dia = 16m

$$(125 \times 9) + 250(9.81)(16) = 125V_B^2$$

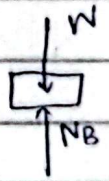
$$1125 + 39240 = 125V_B^2$$

$$V_B^2 = \frac{40365}{125}$$

$$V_B^2 = 322.92$$

$$V_B = 17.97 \text{ m/s}$$

To find the normal reaction



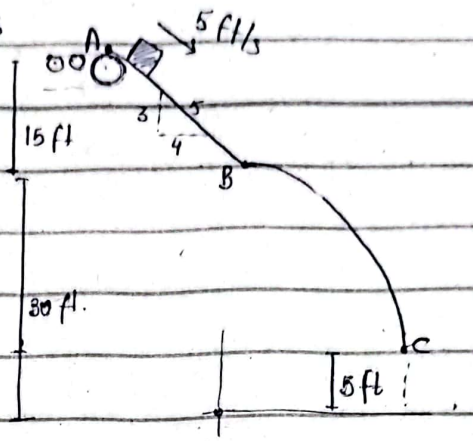
$$\Sigma F_n = ma_n$$

$$N_B - 250(9.81) = 250\frac{(17.97)^2}{8} \quad \because a_n = \frac{v_n^2}{\rho}$$

$$N_B = 10091.2 + 2452.5$$

$$N_B = 12543.7 \text{ N}.$$

14-28: $\mu_k = 0.2$ $v_A = 5$ ft/s



$\Sigma F_y = 0$

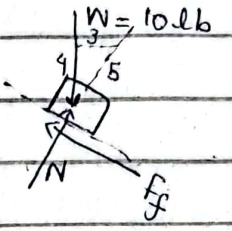
$N - W\left(\frac{4}{5}\right) = 0$

$N - 10(4/5) = 0$

$N = 8$ lb.

$F_f = \mu_k N = (0.2)(8$

$F_f = 1.60$ lb.



From A to B; $T_A + \Sigma U_{A-B} = T_B$.

$$\frac{1}{2} m v_A^2 + \Sigma U_{A-B} = \frac{1}{2} m v_B^2.$$

$$\frac{1}{2}\left(\frac{10}{32.2}\right)(5)^2 + 10(15) - 1.60(25) = \frac{1}{2}\left(\frac{10}{32.2}\right) v_B^2$$

$$v_B = 27.08 \text{ ft/s}$$

From B to C; B(0, 30) , C(x, 5).

$x = x_0 + v_{0x} t$

$x = 0 + v_B t.$

$x = 27.08 t$

$y = y_0 + v_{0y} t + \frac{1}{2} g t^2$

$5 = 30 + 27.08\left(\frac{3}{5}\right) t - 16.1 t^2$

$16.1 t^2 + 16.25 t - 25 = 0.$

$t = 0.84$ s

$x = 27.08(0.84)$

$x = 18.2$ ft.

14-45: $W = 13000\ lb$ $\quad T = 5200\ lb$ $\quad v_i = 600\ mi/h$

$= 600\ \frac{mi}{h} \times \frac{5280\ ft}{1\ mi} \times \frac{1\ hr}{3600\ s}$

$v_i = 880\ ft/s.$

Power output $= P = FV = (5200\ lb)(880\ ft/s)$

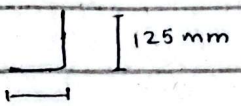
$= 4576000\ lb\ ft/s.$

In hp:-

$P = 4576000\ lb\ ft/s = 8320\ hp$

14-47: $v = 0.6\ m/s$ $\quad P = ?$

$m = 150\ kg/step$ $\quad n = 32$



Total $m = 150\ kg/step \times 32 = 4800\ kg.$

Total $W = (150\ kg/step)(32)(9.81) = 47088\ N.$

Total $L = 32(0.25) = 8\ m.$

Total $H = (32)(0.125) = 4\ m.$ $\quad \Rightarrow v = 0.6\ m/s$

$v_y = 0.27\ m/s$ $\quad r = \sqrt{8^2+4^2} = 4\sqrt{5}\ m$

$P = Fv = (47088)(0.27)$

$= 12.7\ kW$

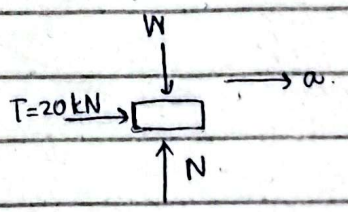
14-61: $T = 20\ kN$ $\quad m = 1\ Mg = 1000\ kg.$ $\quad v_i = 0\ m/s$

$\Sigma F_x = ma_x$

$T = ma_x.$

$20 \times 10^3 = 10^3\, a.$

$\boxed{a = 20\ m/s^2}$



$v = v_0 + at.$

$v = 0 + 20t = 20t.$

$P = \vec{F} \cdot \vec{v} = 20(10^3)\, 20t$

$P = [4 \times 10^5\, t]\ W$