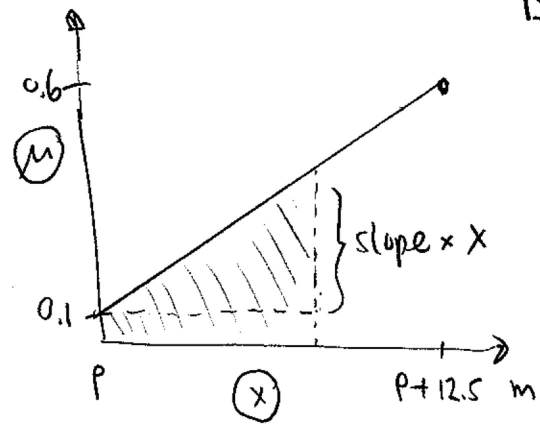
Homework #6 Solutions Physics 160 - Thomas - Fall '09

6.67



a

$W_f = \int F_f \cdot ds = -\int n\mu \, dx = -n \int \mu \, dx$

$= -\text{area} \cdot n$

$= -\left[0.1 \cdot x + \frac{1}{2} \cdot x^2 \cdot \text{slope}\right] \cdot n$

$\text{Slope} = \frac{0.5}{12.5} = 0.04 \; ; \; n = mg$

Then $W_f = \Delta K = -\frac{1}{2} m v_i^2$

so $(0.1x + 0.02x^2)\, g = \frac{1}{2} v_i^2 = \frac{1}{2} \cdot 4.5^2$

$0.196x^2 + 0.98x - 10.125 = 0$

$x = 5.10 \text{ m}$ + spurious soln

b $\mu_{stop} = 0.1 + 0.04 \cdot 5.10$

$= \mu_0 + \text{slope} \times x$

$= 0.304$

c If $\mu = \text{const} = 0.1$

$W_f = -0.1 \cdot x \cdot mg = -\frac{1}{2} m v_i^2$

$x = 10.33 \text{ m}$

6.69 **a** $T_i = F_{rad} = \frac{mv_i^2}{r} = \frac{0.12 \times 0.7^2}{0.4} = 0.147 \text{ N}.$

b $T_f = \frac{0.12 \times 2.8^2}{0.1} = 9.41 \text{ N}.$

c $W = \Delta K = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$= \frac{1}{2} r_f T_f - \frac{1}{2} r_i T_i = 0.47 - 0.03 \text{ J}$

$= 0.44 \text{ J}$

Extra credit. Use infinitesimals first.

$dW = -T\,dr = -\frac{mv^2}{r} dr = dK = \frac{1}{2} m \, d(v^2) = \frac{1}{2} m \cdot 2v \, dv$

so $-\frac{dr}{r} = \frac{dv}{v}$ Integrate: $-\ln r = \ln v + c_1$

Exponentiate both sides $r^{-1} = C_2 v$ or $\frac{1}{r} \propto v$ QED.