PHYS 1311 Chapter 7 Eoc

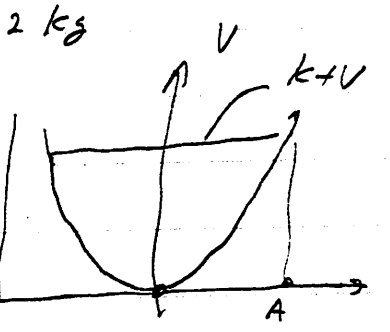
Probs. P17, P21, P25, P26, P33 4-6-2016

Problem P17

$k_s = 0.5\ N/m$, $l_0 = 0.15\ m$, $m = 0.02\ kg$

$l = 0.25\ m$, $V_i = 0$, $V_f = ?$

$A = l - l_0 = 0.10\ m = X_i$; $X_f = 0$



use energy principle

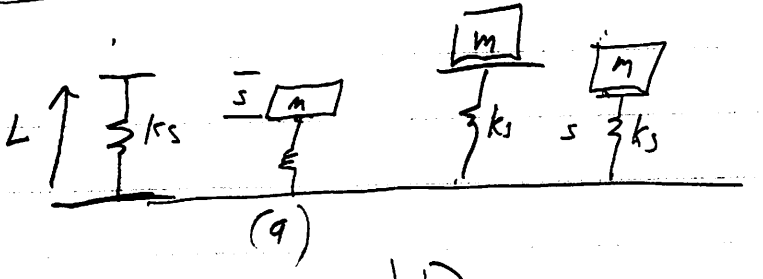
$E_f = E_i + W_{surr}$ ($W_{surr} = 0$)

$\frac{1}{2}mV_f^2 + \frac{1}{2}kX_f^2 = \frac{1}{2}mV_i^2 + \frac{1}{2}kX_i^2$ ($X_f = 0$, $V_i = 0$)

$\frac{1}{2}mV_f^2 = \frac{1}{2}kX_i^2$

or $V_f = \sqrt{\frac{k}{m}}X_i = \sqrt{\frac{0.5}{0.02}}(0.1\ m) = \boxed{0.5\ m/s}$

extra Problem P19



(a)

a) 

$\Sigma F_y = Ma_y$

$k_s s - Mg = 0$

$\boxed{s = \frac{M}{k_s}g}$

b)

$W = -\Delta U = \frac{1}{2}k_s X_i^2 - \frac{1}{2}k_s y_f^2$

$= -\frac{1}{2}k_s s^2 = -\frac{1}{2}k_s\left(\frac{M}{k_s}g\right)^2$

$\boxed{W = -\frac{M^2 g^2}{2k_s}}$

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Problem P21

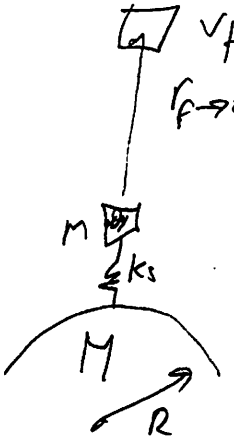
$m = 9\,kg$

$M = 8.0 \times 10^{20}\,kg$

$R = 8.7 \times 10^5\,m = r_i$

$v_f = 226\,m/s$, $v_i = 0$

$k_s = 2.8 \times 10^5\,N/m$



$$K + U = \frac{1}{2}mv^2 - \frac{GMm}{r} + \frac{1}{2}k_s x^2$$

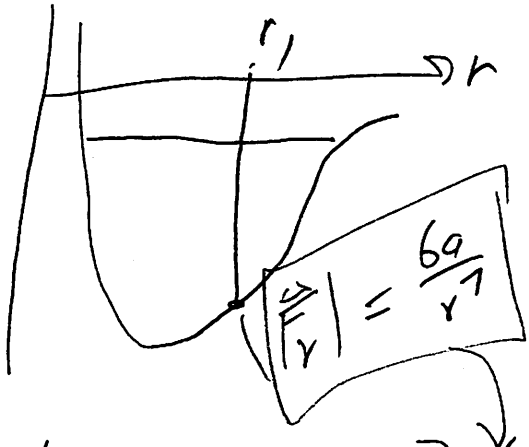
$$K_i + U_i = -\frac{GMm}{R} + \frac{1}{2}k_s x^2 = \frac{1}{2}m v_f^2$$

$$\frac{1}{2}k_s y^2 = \frac{1}{2}m v_f^2 + \frac{GMm}{R}$$

$$y = \sqrt{\frac{m}{k_s}\left[v_f^2 + \frac{2GM}{R}\right]} = \sqrt{\frac{9}{2.8\times10^5}\left[220^2 + \frac{2(6.67\times10^{-11})(8\times10^{20})}{8.7\times10^5}\right]}$$

$$\boxed{y = 2.36\,m}$$

Problem P25



a) at $r = r_1$, $K = 1.1\,eV$

$U = -1.3\,eV$

$K + U = -0.2\,eV$

b) $E_{diss} = 0.2\,eV$

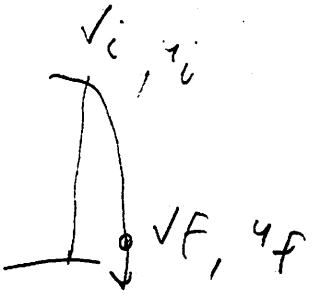
c) $U = -\frac{q}{r^6}$, $F_r = -\frac{dU}{dr} = -\frac{d}{dr}\left(-\frac{q}{r^6}\right) = q\left[\frac{-6}{r^7}\right] = \boxed{\frac{-6q}{r^7}}$

$=$

Prchs. P26 4-6-2013

$y_i = 50m$, $y_f = 0$, $v_i = 0$

$v_f = ?$



- For the water drop

$E_f = E_i + W_{surr}$ (0)

$\frac{1}{2}mv_f^2 + mgy_f = \frac{1}{2}mv_i^2 + mgy_i$ (0, 0)

$v_f = \sqrt{2gy_i}$

- When water strikes rock

$E_f = E_i + W_{surr}$

or $\Delta E_{sys} = W + Q$

$\frac{1}{2}mv_f^2 = Cm\Delta T$

$\Delta T = \frac{v_f^2}{2C} = \frac{(2gy_i)}{2C} = \frac{2(9.8)(50)}{2(4200)}$

$= \boxed{0.12\ K}$

Water

$C = 4.2 \frac{J}{g\,K}$

$= 4200 \frac{J}{kg\,K}$

Problem P33 $P = \frac{W}{\Delta t}$

As in problem P26, $K_f = mgy_i$ = Work done by water in pond on block $= (1kg)(9.8\frac{m}{s^2})(50m)$

$= \boxed{490\ J}$ for 1kg

$P = 10^6 W = 10^6 \frac{J}{s}$, then $10^6 \frac{J}{s} \times \frac{1kg}{490\ J} = \boxed{2041 \frac{kg}{s}}$