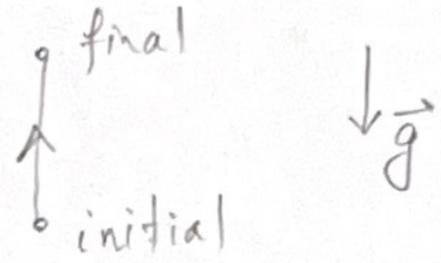
Solutions

PHYS-205A-002 (Midterm Exam 03) Fall 2022

Problem 1

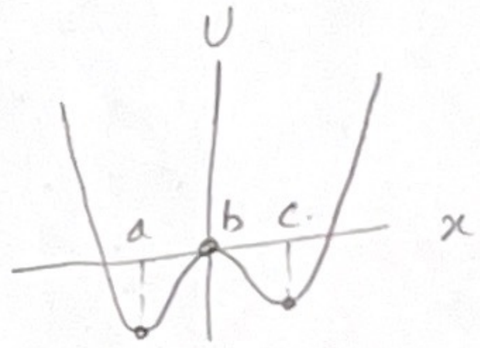
Yes. When a mass is lifted from ground to a height h.



Problem 2

Force is slope in U-versus-x plot.

At the three points marked a, b, and c, the force is zero.



Problem 3

$\frac{1}{2}mv^2 \rightarrow$ Joule.

$$p = mv = kg\left(\frac{meter}{sec}\right)$$

$$= \frac{Joule}{\left(\frac{meter}{sec}\right)^2}\left(\frac{meter}{sec}\right)$$

$$= \frac{(Joule)(sec)}{(meter)} = \frac{J \cdot s}{m}$$

$$\Rightarrow kg = \frac{Joule}{\left(\frac{meter}{sec}\right)^2}$$

Problem 4

Above R. There is more mass above the center.

Problem 5

$$m\vec{a} = m\vec{g} + \vec{N}$$

→ Normal force does not do work in this problem.

$$K_A + U_A = K_D + U_D$$

$$\frac{1}{2}mv_A^2 + mgh_A = \frac{1}{2}mv_D^2 + mgh_D$$

($\frac{1}{2}mv_A^2 = 0$)

$$v_D = \sqrt{2g(h_A - h_D)}$$

$$= \sqrt{2(9.8)(40.0 - 10.0)} = 24\ \frac{m}{s}$$

Problem 6

$$K_A + U_A^g + U_A^s = K_c + U_c^g + U_c^s$$

$$\frac{1}{2}mv_A^2 + mgh_A + \frac{1}{2}kx_A^2 = \frac{1}{2}mv_c^2 + mgh_c + \frac{1}{2}kx_c^2$$

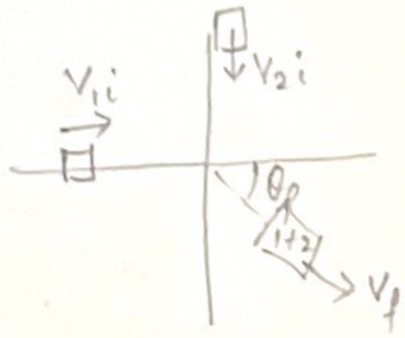
($\frac{1}{2}mv_A^2 = 0$, $\frac{1}{2}kx_A^2 = 0$, $\frac{1}{2}mv_c^2 = 0$, $mgh_c = 0$)

$$mgh_A = \frac{1}{2}kx_c^2$$

$$(20.0)(9.8)(1.0) = \frac{1}{2}(2.0\times10^4)\,x_c^2$$

$$x_c = 0.14\ m = 14\ cm.$$

Problem 7



$$m_1\vec{V}_{1i} + m_2\vec{V}_{2i} = (m_1 + m_2)\vec{V}_f$$

$$\vec{V}_f = \frac{m_1\vec{V}_{1i}}{m_1+m_2} + \frac{m_2\vec{V}_{2i}}{m_1+m_2}$$

$$= \frac{1}{4}\,25.0\,\hat{i} - \frac{3}{4}\,25.0\,\hat{j}$$

$$|\vec{V}_f| = \sqrt{\left(\frac{25.0}{4}\right)^2 + \left(\frac{3\times25.0}{4}\right)^2} = 20.8\ \frac{m}{s}$$

$$\frac{m_1}{m_1+m_2} = \frac{1}{4}$$

$$\frac{m_2}{m_1+m_2} = \frac{3}{4}$$

$$\theta_f = \tan^{-1}\left(\frac{3/4}{1/4}\right) = 72^\circ$$