Chapter 6
Selected Energy Solutions

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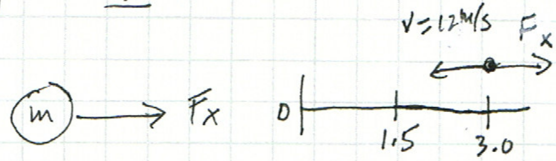
Ans:
b) 9.5 J
c) 13 m/s

Chap 6 # 30



$F_x = cx^3$; $c = 0.50$

x in m
F in N

$PE = c(19) = 9.5\,J$
$= \frac{c}{4}(75.9) =$
$-\frac{c}{4}(5.06 - 81)$

(a) unit of c $= \boxed{\frac{N}{m^3}}$

(b.) $W = \int_{3.0}^{1.5} \vec{F}_x \cdot d\vec{x} = -c\int_{x=3.0}^{x=1.5} x^3\,dx = -\frac{c}{4}x^4\Big|_{x=3}^{x=1.5} = -\frac{c}{4}\left((1.5)^4 - (3)^4\right)$

$\vec{F}$ AND $d\vec{x}$ opposite

(c.) At $x = 3.0$ m $\vec{F}$ pts opposite to $\vec{v}$ ($|\vec{v}| = 12.0$ m/s)
What is speed at $X = 1.5$ m

d.) Can you tell the direction of motion at $x = +1.5$ using only the work-kinetic energy theorem.?

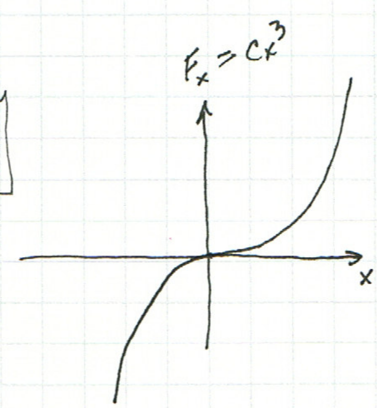
$\Delta KE = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$9.5\,J = \frac{1}{2}(1.5)v_f^2 - \frac{1.5}{2}(12)^2 = \frac{1.5}{2}(v_f^2 - 12^2)$

$\frac{2}{1.5}\left[9.5 + \frac{1.5}{2}(144)\right] = v_f^2$

$\frac{2}{1.5}[117.5] = 156.7 = v_f^2$

$\boxed{v_f = \sqrt{156.7} = 12.5\ \text{m/s}}$



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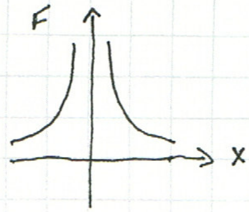
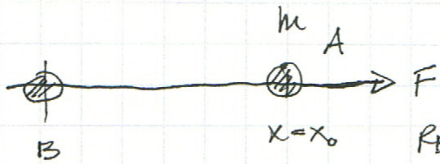


m RELEASED UNDER FORCE F_x.

WORK DONE ON PARTICLE AS A FUNCTION OF X

FIND KE AND SPEED AS PARTICLE APPROACHES ∞



REPULSIVE FORCE DUE TO B

$$F_x = \frac{A}{x^2} \qquad A > 0$$

$$W = \int_{x=x_0}^{x} F_x \cdot dx = \int_{x=x_0}^{x} \frac{A}{x^2}\,dx = A\int_{x=x_0}^{x} \frac{dx}{x^2} = A\int_{x=x_0}^{x} x^{-2}dx = -A\,x^{-1}\Big|_{x=x_0}^{x}$$

$$W = -A\,\frac{1}{x}\Big|_{x=x_0}^{x} = -A\left(\frac{1}{x} - \frac{1}{x_0}\right) = \boxed{A\left(\frac{1}{x_0} - \frac{1}{x}\right)}$$

$$\Delta KE = W$$

$$\lim_{x \to \infty} \Delta KE = \lim_{x \to \infty} A\left(\frac{1}{x_0} - \frac{1}{x}\right) = \boxed{\frac{A}{x_0}}$$

$$KE_f = \frac{A}{x_0} = \frac{1}{2} m v_f^2$$

$$\boxed{v_f = \sqrt{\frac{2A}{m x_0}}}$$

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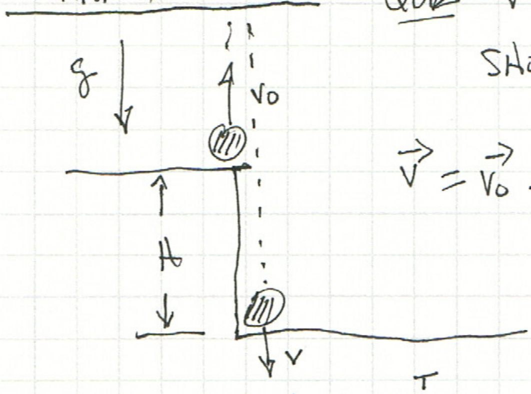

QUES $\vec{v} = \vec{v}(t)$

SHOW $\int_0^T \vec{F}_{net} \cdot \vec{v}\, dt = KE_f - KE_i$

$\vec{v} = \vec{v}_0 - \vec{g}t \qquad \vec{F}_{net} = -m\vec{g}$

$$I = \int \vec{F}_{net} \cdot \vec{v}(t)\, dt = \int_0^T (-mg\,\hat{j}) \cdot (v_0\hat{j} - gt\,\hat{j})\, dt$$

$$= -mg v_0 \int_0^T dt + mg^2 \int^T t\, dt$$

$$I = -mg v_0 T + \frac{mg^2}{2} T^{2}$$

(1) $\quad I = -mg\left(v_0 T - \frac{1}{2} g T^2\right) = \qquad -mg(-H) = mgH$

$\Delta KE = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$

NEED TO FIND VALUE OF T

$$v = v_0 - gT \longrightarrow T = \frac{v_0 - v}{g}$$

SUB INTO (1)

$$I = -mg\left[v_0\left(\frac{v_0 - v}{g}\right) - \frac{g}{2}\left(\frac{v_0 - v}{g}\right)^2\right]$$

$$= -mv_0(v_0 - v) + \frac{m}{2}(v_0 - v)^2$$

$$= -mv_0^2 + mv_0 v + \frac{m}{2}(v_0^2 - 2v_0 v + v^2)$$

$$= -mv_0^2 + mv_0 v + \frac{m}{2}v_0^2 - mv_0 v + \frac{m}{2}v^2$$

$$I = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$$

$$I = KE_f - KE_i$$