ch. 7 # 2, 5, 35, 46, 50

#2 (a) $\Delta KE = KE_f - KE_i$

$= \frac{1}{2} m \cancel{V_f^2}^{0} - \frac{1}{2} m V_i^2$

$= -\frac{1}{2} (4\times10^6 kg)(15000\ m/sec)^2 = \underline{-4.5\times10^{14} J}$

(b) $4.5\times10^{14} J \times \frac{1 \text{ Megaton}}{4.2\times10^{15} J} = \underline{0.107 \text{ megaton bomb}}$

(c) $4.5\times10^{14} J \times \frac{1 \text{ Hiroshima}}{13 \text{ Kiloton}} \times \frac{1000 \text{ Kilo ton}}{1 \text{ Mega ton}} \times \frac{1 \text{ Megaton}}{4.2\times10^{15} J} = \underline{8.24 \text{ Hiroshima bomb.}}$

#5 let m_f = mass of farher
m_s = " son $(= \frac{1}{2} m_f)$
V_f = vel of farher
V_s = " son

$KE_f = \frac{1}{2} KE_s$

$\frac{1}{2} m_f V_f^2 = \frac{1}{2} \left(\frac{1}{2} m_s V_s^2 \right)$

$\frac{1}{2} m_f V_f^2 = \frac{1}{2} \left(\frac{1}{2} \left(\frac{1}{2} m_f\right) V_f^2 \right)$

$V_f^2 = \frac{1}{4} V_s^2$ ———— ①

Now the farher's speed is $(V_f + 1\ m/sec)$

$KE_f = KE_s$

$\frac{1}{2} m_f (V_f+1)^2 = \frac{1}{2} m_s V_s^2$

$\frac{1}{2} m_f (V_f+1)^2 = \frac{1}{2} \left(\frac{1}{2} m_f \right) V_s^2$

$2(V_f^2 + 2V_f + 1) = V_s^2$ ———— ②

① ← ②

$V_f^2 = \frac{1}{4} \left(2 \left(V_f^2 + 2V_f + 1\right)\right)$

$V_f^2 - 2V_f - 1 = 0 \longrightarrow V_f = \pm 2.41\ m/sec$ — ①′

① ← ①′

$\underline{V_s = \pm 4.82\ m/sec}$ (± indicate their directions)

35

$$W = \int F \cdot dx$$

$$= \int m \cdot a \cdot dx$$

$$= \int m \frac{dv}{dt} \cdot dx$$

$$= \int m \; dv \cdot \frac{dx}{dt}$$

$$= \int m \cdot dv \cdot \cancel{v}$$

$$= m \int v \cdot dv$$

$$= m \int v \cdot \frac{dv}{dt} \cdot dt$$

$$= m \int v \cdot a \cdot dt \quad \text{———} \quad ①$$

$$X = 3t - 4t^2 + 1t^3 \quad \text{———} \quad ②$$

$$\frac{dx}{dt} = V = 3 - 8t + 3t^2$$

$$\frac{dV}{dt} = a = -8 + 6t \quad \text{———} \quad ③$$

① ← ② & ③

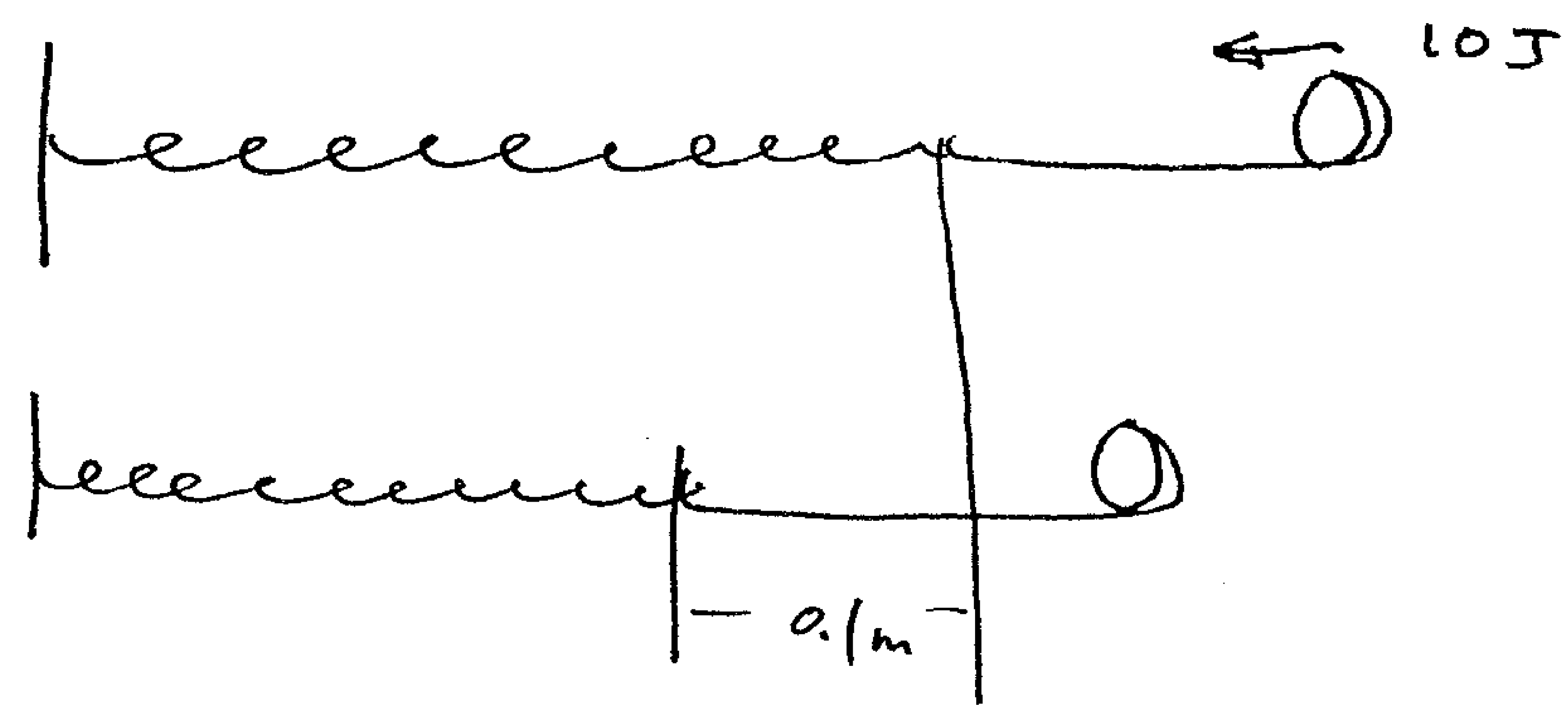
$$W = 3 \int_0^4 (3 - 8t + 3t^2)(-8 + 6t) \cdot dt$$

$$= \int_0^4 (-72 + 246t - 216t^2 + 54t^3) \cdot dt$$

$$= -72t + 123t^2 - 72t^3 + \frac{54}{4} t^4 \Big|_0^4$$

$$= \underline{\underline{528 \text{ J}}}$$

\# 46



$M_{ladle} = 0.3\,kg$

$k = 500\,N/m$

$$P = \frac{dw}{dt} = \frac{d(\int F.dx)}{dt}$$

if F is const,

$$= F\,\frac{d(\int dx)}{dt}$$

$$= F \cdot \frac{dx}{dt} = \underline{\underline{F \cdot V}}$$

if not

$P = F \cdot V$ is not true.

(a) at Equilibrium, $F = 0$

Hence $P = \dfrac{d\int 0.dx}{dt} = \underline{\underline{0\ w}}$

(b)

$$P = \frac{d(\int F.dx)}{dt} = \frac{d(\int kx.dx)}{dt}$$

$$= \frac{d\left(\frac{1}{2}kx^2\right)}{dt}$$

$$= \frac{1}{2}k\left(2x \cdot \frac{dx}{dt}\right)$$

$$= \frac{1}{2}k\,2x \cdot V = kxV$$

$$10\,J = \frac{1}{2}mV^2 + \frac{1}{2}kx^2$$

$$= \frac{1}{2}(0.3)V^2 + \frac{1}{2}\,500\,N/m \cdot (0.1m)^2$$

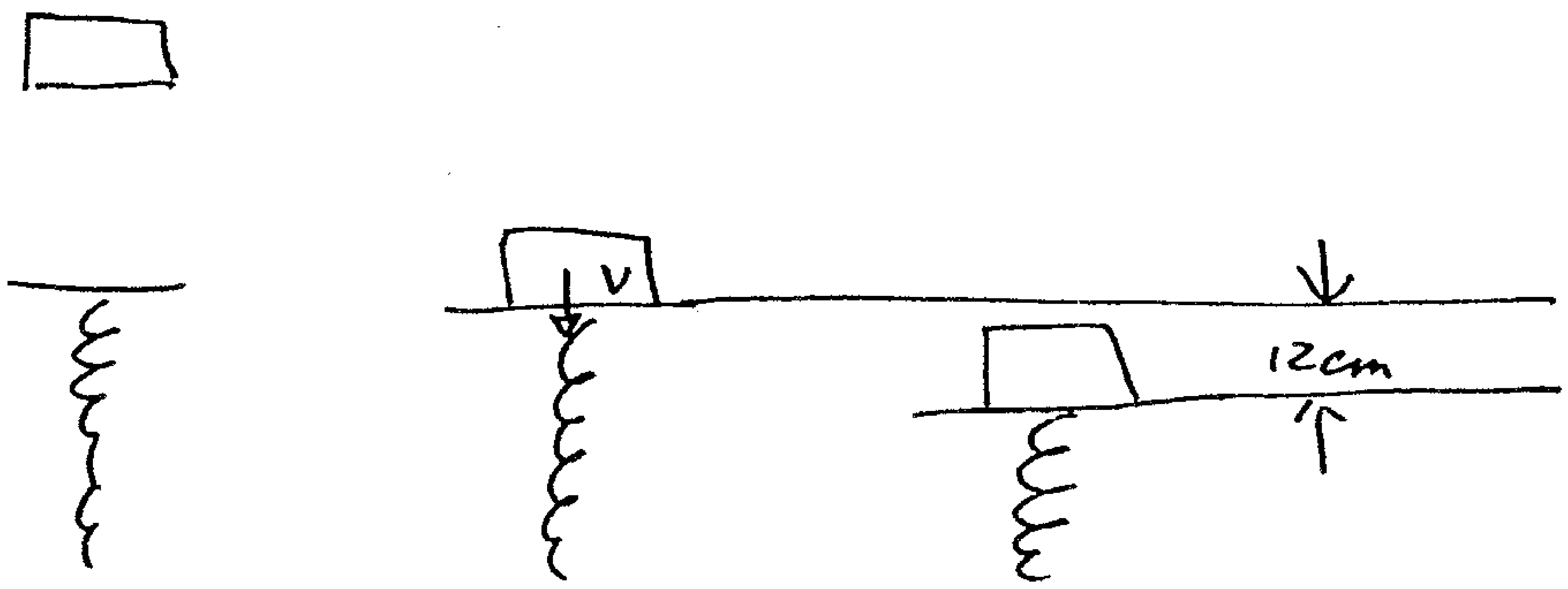
$$V = 7.071067812\ m/sec\ (at\ x = 0.1m)$$

So $P = kxV$

$$= 500\,N/sec \cdot 0.1m \cdot 7.071067812\,m/sec$$

$$= 353.5533906\ w$$

$= 353.55\,w$ spring taking away from the ladle.



$m = 0.25\,kg$

$K = 2.5\,N/cm = 250\,N/m$

$X = 12\,cm = 0.12\,m$

(a) ΔPE

$mgx = 0.25 \cdot 9.81 \cdot 0.12 = \underline{\underline{0.2943\,J}}$

(b) ΔSE

$\frac{1}{2}kx^2 = \frac{1}{2}\ 250\,N/m \cdot (0.12)^2 = \underline{\underline{1.8\,J}}$

the energy was stored into the spring. the spring did a negative work. $\Rightarrow$ $\underline{\underline{-1.8\,J}}$

(c) the spring stored 1.8 J of energy which came from KE & PE.

$\Delta KE + \Delta PE = \Delta SE$

$\frac{1}{2}mV^2 + mgx = \frac{1}{2}kx^2$

$V = \sqrt{\frac{2(\frac{1}{2}kx^2 - mgx)}{m}} = 3.470677167\,m/sec$

$= \underline{\underline{3.47\,m/sec}}$

(d) Once again.

$\Delta KE + \Delta PE = \Delta SE$ $\qquad V = 2 \times 3.470677167\,m/sec$

$\frac{1}{2}mV^2 + mgx = \frac{1}{2}kx^2$

$\frac{1}{2}kx^2 + mgx - \frac{1}{2}mV^2 = 0$

$X = \frac{mg \pm \sqrt{(mg)^2 - 4(\frac{1}{2}k)(\frac{1}{2}mV^2)}}{2(+\frac{1}{2}k)}$

$= 0.229533998\,m$.

$= \underline{\underline{22.95\,cm}}$