MCQ – chapter 6

Question 1

$\Delta x = 0.5$ cm

$\Delta F = 4800 - 3200 = 1600$ N

(C) $\Delta F = -k\Delta x \rightarrow k = -\frac{1600}{-0.5} = 3200$ N/cm

(Note: Usually "k" is given in N/m and not N/cm).

Question 2

$\Delta x = 7.2$ cm

$F = mg = 1.4 \times 9.8 = 13.72$ N

a) $k = \frac{|F|}{|\Delta x|} = \frac{13.72\ N}{7.2\ cm} = 1.9$ N/cm

(D) b) $\Delta x = 12.2$ cm $\quad F = ?$

$F = k\Delta x = (1.9\ N/cm)(12.2\ cm) = 23.2$ N

but $m = \frac{F}{g} = \frac{23.2\ N}{9.8\ N/kg} = 2.4$ kg

Question 3

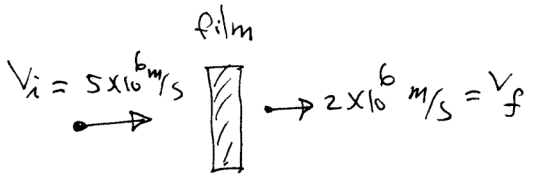
a) $W = F\Delta r \cos\theta = (mg)(\Delta r)(\cos 0^\circ)$, $\cos 0^\circ = 1$

$W = (4 \times 9.8)(1.5) = 59$ J

(A) b) The same calculations except $\theta = 180^\circ$ and

$\cos\theta = -1 \Rightarrow W = -59$ J

Question 4



We use work-energy theorem:

$$W = \Delta K \rightarrow W = K_f - K_i$$

$$W = \frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 = \frac{1}{2} m (V_f^2 - V_i^2)$$

(A) $$W = \frac{1}{2} \times 1.67 \times 10^{-27} \times \left[(2 \times 10^6)^2 - (5 \times 10^6)^2 \right]$$

$$W = -1.8 \times 10^{-14} \text{ J}$$

But $$W = \overline{F} \Delta x \rightarrow \overline{F} = \frac{W}{\Delta x} = \frac{-1.8 \times 10^{-14}}{0.01 \times 10^{-3}}$$

$$\boxed{\overline{F} = 1.8 \times 10^{-9} \text{ N}}$$

Question 5

$m = 200$ kg $\quad \Delta y = 1.5$ m

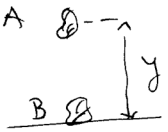
$W = ?$

We use work-energy theorem, except now it is the change in PE:

$$W = \Delta U = mgy_f - mgy_i = (200 \times 9.8)(1.5)$$

(B) $$\boxed{W = 2940 \text{ J}}$$

Question 6 $m = 2\,kg$ $K = 400\,J$



$E_A = E_B$

(B) $\cancel{K_A}^{0} + U_A = \cancel{K_B} + \cancel{U_B}^{0}$

$mgy = 400 \Rightarrow y = \frac{400}{2 \times 9.8} \simeq 20\,m$

Question 7 $K = 6.2 \times 10^{-21}\,J$ $m = 4.7 \times 10^{-26}\,kg$

a) The same concepts Question 6:

(A) $U_A = K_B \rightarrow mgy = K_B \Rightarrow (4.7 \times 10^{-26})(9.8)y = 6.2 \times 10^{-21}\,J$

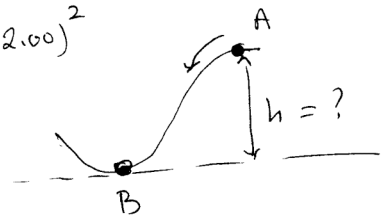
$\Rightarrow y = 13.5 \times 10^{3}\,m = 13.5\,km$

b) $K = \frac{1}{2} m v_i^2 \rightarrow v_i = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2 \times 6.2 \times 10^{-21}}{4.7 \times 10^{-26}}} \simeq 510\,m/s$

Question 8

$\cancel{K_A}^{0} + U_A = K_B + U_B$

$mgh = \frac{1}{2} m (2.00)^2 + 0$

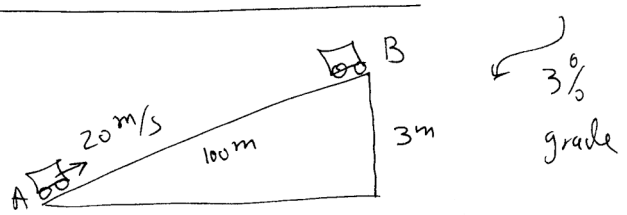


(A) $h = \frac{(2)^2}{2 \times 9.8} = \ldots = 20.4\,cm/s$

Question 9

(A) $P = \frac{W}{t} = \frac{mgy}{t} = \frac{(500 \times 9.8) \times 20}{60} = 1633 \text{ watts}$

Question 10



By the time the car goes from A to B, $W = \Delta U =$

$W = mgy = (1000 \times 9.8) \times 3 = 29400 \text{ J}$

Since it is going at a constant speed, $a = 0$, thus

$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ (the $\frac{1}{2} a \Delta t^2$ term $\to 0$)

$100 = (20) \Delta t \rightarrow \boxed{\Delta t = 5 \text{ s}}$

(C)

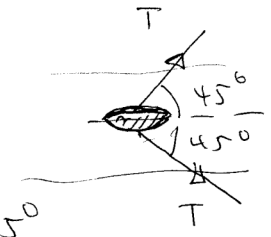
$\Rightarrow P = \frac{W}{t} = \frac{29400 \text{ J}}{5 \text{ s}} = 5880 \text{ watts}$

$= 5.9 \text{ kW}$

In hp: $P = \frac{5880 \text{ watts}}{746 \text{ watts/hp}} = \boxed{7.9 \text{ hp}}$

Question 11

$m = 5 \times 10^4$ kg



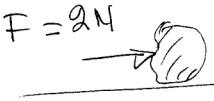
$W_{\text{each}} = F \Delta r \cos\theta$

$= (1000\ N)(150)\cos 45^\circ$

(B) $= 106 \times 10^3$ J

$W_{\text{total}} = 106 \times 10^3 \times 2 = 212 \times 10^3$ J $= 212$ kJ

Question 12



a) $W = \Delta K$

$F \Delta r \cos\theta = \Delta K \Rightarrow (2)(0.35) = K_f - K_i$ ($K_i = 0$)

(A) $\boxed{K_f = 0.7\ J}$

b) $K_f = \frac{1}{2} m v_f^2 \rightarrow v_f = \sqrt{\frac{2K}{m}}$

$= \sqrt{\frac{2(0.7)}{10}} = 0.37$ m/s