2005 Exam II March 01

MC 1. (E)

MC 2 ~~(B)~~ (D)

MC 3 $\Delta E = (m_{10_B} + m_n - m_{11_B})c^2 = (1.66214 \cdot 10^{-26} + 1.67493 \cdot 10^{-27} - 1.82754 \cdot 10^{-26})\,kg \times (2.998 \cdot 10^8\, m/s)^2$

$= 1.88119 \cdot 10^{-12}\ J = 11.743\ MeV$ (A)

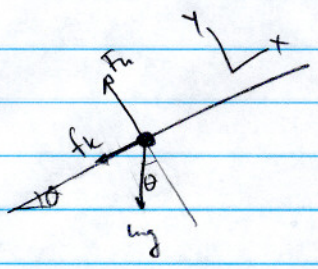
MC 4 $\frac{1}{2}k\Delta x^2 = \frac{1}{2}mv^2$

$\Delta x = \sqrt{\frac{m}{k}}\, v$

$\Delta x' = \sqrt{\frac{4m}{k}}\, 3v = 6\sqrt{\frac{m}{k}}\, v = 6\,\Delta x$ (E)

MC 5 (D)

II a)



$$-f_k - mg\sin\theta = ma_x$$

$$F_n - mg\cos\theta = 0$$

$$F_n = mg\cos\theta.$$

$$f_k = \mu_k mg\cos\theta$$

$$-\mu_k mg(\mu_k\cos\theta + \sin\theta) = ma_x$$

$$a_x = -(\mu_k\cos\theta + \sin\theta)g$$

$$v^2 - v_0^2 = 2a(x - x_0)$$

$$x - x_0 = \frac{-v_0^2}{2a} = \frac{v_0^2}{2(\mu_k\cos\theta + \sin\theta)g} = 0.348\ m = 34.8\ cm$$

b) $\Delta E_{th} = f_k \Delta s = \mu_k mg\cos\theta \cdot 2 \cdot 0.348\ m = 1.48\ J$

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

$$v_f = \sqrt{v_i^2 - 2\mu_k g\cos\theta \cdot 2 \cdot (x - x_0)} = 4.68\ m/s$$

c) $\Delta E_{th} = 1.48\ J$

d)

$$f_{s,max} = mg\sin\theta \Rightarrow \mu_s \cdot mg\cos\theta = mg\sin\theta$$

$$\mu_s = \tan\theta = 0.58$$

III a)

$$\frac{1}{2}mv_T^2 = \frac{1}{2}mv_B^2 - 2mgR$$

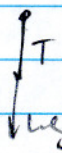
$$v_T = \sqrt{v_B^2 - 4gR} = 2.32\ m/s$$

b)

$$T_B - mg = m\frac{v_B^2}{R}$$

$$T_B = m\left(g + \frac{v_B^2}{R}\right) = 23.92\ N$$

c)



$$T_T + mg = m\frac{v_T^2}{R}$$

$$T_T = m\left(-g + \frac{v_T^2}{R}\right) = 0.38\ N$$

IV a) $\frac{1}{2}k\Delta x^2 = \frac{1}{2}mv^2 + mgh$

$$v_i = \sqrt{\frac{k}{m}\Delta x^2 - 2gh} = 1.64\ m/s$$

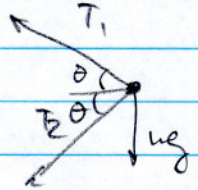
b) $\frac{1}{2}mv_i^2 = mgh$

$$h = \frac{v_i^2}{2g} = 13.7\ cm$$

c) $\frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 - 10N \cdot h$

$$v_f = \sqrt{v_i^2 - \frac{2 \cdot 10N \cdot h}{m}} = 1.15\ m/s$$

V a)



$\theta = 30°$

b) $x: T_1 \cos\theta + T_2 \cos\theta = m\frac{v^2}{R}$

$y: T_1 \sin\theta - T_2 \sin\theta - mg = 0$

$T_2 = T_1 - \frac{mg}{\sin\theta} = \underline{\underline{7.48\ N}}$

c) $|F_{net}| = F_x = (T_1 + T_2)\cos\theta = \underline{\underline{34.2\ N}}$

d) $F_x = m\frac{v^2}{R}$

$v = \sqrt{\frac{R F_x}{m}}$ $\qquad R = 1.7m \cos\theta$

$= \underline{\underline{6.35\ m/s}}$