Physics 10310 Exam II 2006.

MC1. $T\cos\theta - f_k = 0$ const. velocity

$\Downarrow$

$f_k = T\cos\theta$ B

But:

$f_k = \mu_k F_N = \mu_k (mg - T\sin\theta)$ E Both solutions correct.

MC2. $F_x = -dU/dx$ C

MC3. Potential energy decreases : $\Delta U < 0$

Kinetic energy increases : $\Delta K > 0$ A

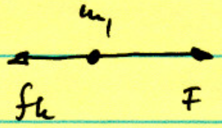
MC4. Cons. of energy => same speed at landing

Time different C

MC5. $\Delta E = (E_{0,p} + E_{0,e} - E_{0,n}) = 0.782$ MeV B

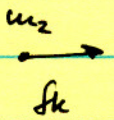
II:

a+b)



$$F - f_k = m_1 a_1$$

$$f_k = F - m_1 a_1 = 320\,N - 60\,kg \cdot 3\,m/s^2 = \underline{\underline{140\,N}}$$

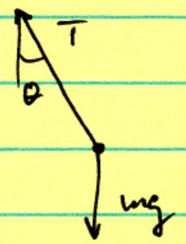


$$f_k = \mu_k m_1 g$$

$$\mu_k = \frac{f_k}{m_1 g} = \frac{140\,N}{60\,kg \cdot 9.81\,m/s^2} = \underline{\underline{0.238}}$$

c) $$a_2 = \frac{f_k}{m_2} = \frac{140\,N}{100\,kg} = \underline{1.40\,m/s^2}$$

III:



a) Towards center of circular orbit.

b) $$T\cos\theta = mg \Rightarrow T = \frac{mg}{\cos\theta}.$$

c) $$T\sin\theta = m\frac{v^2}{r} = m\frac{v^2}{L\sin\theta}$$

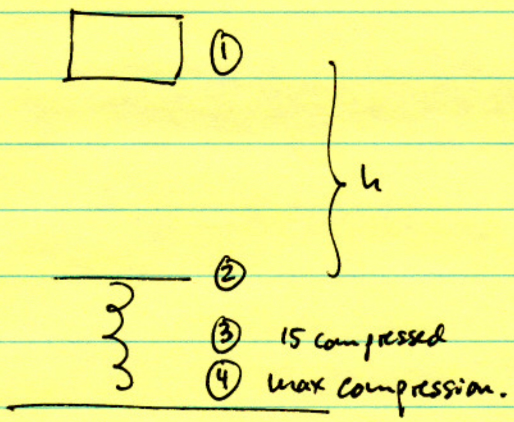
"

$$mg\tan\theta = m\frac{v^2}{r} \qquad v = \sqrt{g\,r\tan\theta}$$

or

$$mg\tan\theta = m\frac{v^2}{L\sin\theta} \qquad v = \sqrt{gL\frac{\sin^2\theta}{\cos\theta}}$$

IV:



a) $K_2 = U_1 - U_2 = mgh$

$= 2.4\,kg \cdot 9.81\,m/s^2 \cdot 5\,m = \underline{\underline{117.7\,J}}$

b) $K_3 = K_2 + (U_2 - U_3) - U_{s3}$

$\frac{1}{2} m v_3^2 = mgh + mg\,\Delta x - \frac{1}{2} k\,\Delta x^2 = mg(h+\Delta x) - \frac{1}{2} k\,\Delta x^2$

$v_3 = \sqrt{2g(h+\Delta x) - k/m\,\Delta x^2} = \sqrt{2 \cdot 9.81\,m/s^2 (5\,m + 15\,cm) - \frac{3955\,N/m}{2.4\,kg}(15\,cm)^2}$

$= \underline{\underline{8.0\,m/s}}$

c) $K_4 = K_2 + (U_2 - U_4) - U_{s4}$

$0 = mgh + mg\,\Delta x_{max} - \frac{1}{2} k\,\Delta x_{max}^2$

$\Delta x_{max} = \frac{mg \pm \sqrt{(mg)^2 + 4\frac{1}{2} k mgh}}{2\frac{1}{2} k} = \frac{mg \pm \sqrt{(mg)^2 + 2kmgh}}{k}$ (+)

$= \frac{2.4\,kg \cdot 9.81\,m/s^2 + \sqrt{(2.4\,kg \cdot 9.81\,m/s^2)^2 + 2 \cdot 3955\,N/m \cdot 2.4\,kg \cdot 9.81\,m/s^2 \cdot 5\,m}}{3955\,N/m} = \underline{\underline{0.25\,m}}$

V:

a) $\Delta E_{th} = f_k \Delta s = \mu_k m_1 g \Delta s = 0.35 \cdot 4kg \cdot 9.81 m/s^2 \cdot 2m = \underline{\underline{27.47 \text{ J}}}$

b) $\Delta E_{mech} = -\Delta E_{th} = \underline{\underline{-27.47 \text{ J}}}$

c) $\Delta K = \Delta U + \Delta E_{mech}$

$\frac{1}{2}(m_1 + m_2) v_f^2 = m_2 g h + \Delta E_{mech}$

~~$\frac{1}{2} m_2 v_f^2 = m_2 g h + \Delta E_{mech}$~~

$v_f = \sqrt{\frac{2(m_2 g h - 27.47 \text{ J})}{m_1 + m_2}} = \underline{\underline{1.98 m/s}}$

~~VI:~~