DO NOT TURN THIS PAGE!!!!

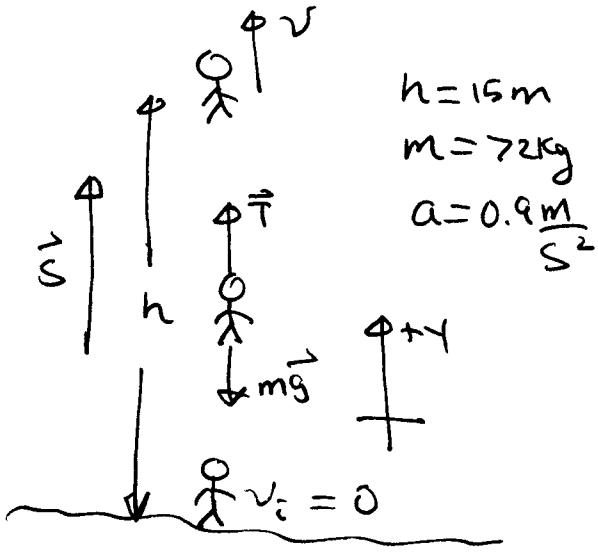
NAME: KEY

PHYSICS 50
SPRING 2010
EXAM 3

MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL. NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN!!!!!

1. A helicopter of lifts a 72 kg astronaut 15 m vertically from the ocean by means of a cable. The acceleration of the astronaut is 0.9 m/s^2. Calculate the work done by: (15 pts)

   a) The force from the helicopter.
   b) The gravitational force.
   c) Calculate the kinetic energy of the astronaut just before reaching the helicopter.
   d) Calculate the speed of the astronaut just before reaching the helicopter.



a) $\Sigma F_y = T - mg = ma$

$T = m(g+a)$

$T = 72(9.8+0.9)$

$\boxed{T = 770.4\,N}$

$W_T = T h \cos\theta$

$W_T = (770.4\,N)(15m)\cos 0^\circ$

$\boxed{W_T = 1.156 \times 10^4\,J}$

b) $W_g = mgh\cos 180^\circ$

$= (72)(9.8)(15)(-1)$

$\boxed{W_g = -1.058 \times 10^4\,J}$

c) $W_{net} = K_f - K_i$ ($K_i = 0$, $v = 0$)

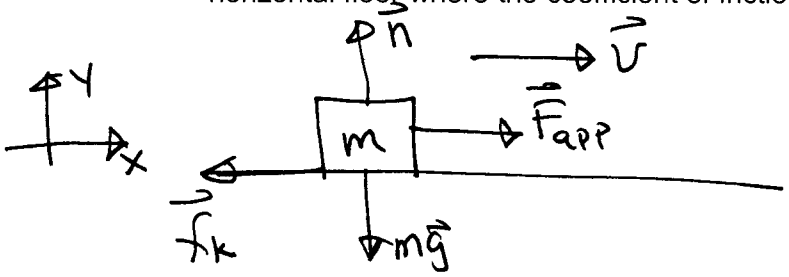
$W_g + W_T = K_f$

$\boxed{K_f = 980\,J}$

d) $K_f = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2K_f}{m}} = \sqrt{\frac{2(980\,J)}{72kg}} = \boxed{5.2\,m/s}$

2. a) Calculate how much power is needed to push a 95-kg chest at 0.62 m/s along a horizontal floor where the coefficient of friction is 0.78. (5 pts)



$P = F_{app} v \cos\theta$

$P = \mu_k mg v \cos 0^\circ$

$P = (0.78)(95)(9.8)(0.62)$

$\boxed{P = 450\,W}$

$\Sigma F_x = F_{app} - f_k = 0$

$F_{app} = f_k = \mu_k n = \mu_k mg$

$\Sigma F_y = n - mg = 0$

$n = mg$

b) Calculate how much work is done in pushing the chest 11.0 m. (5 pts)

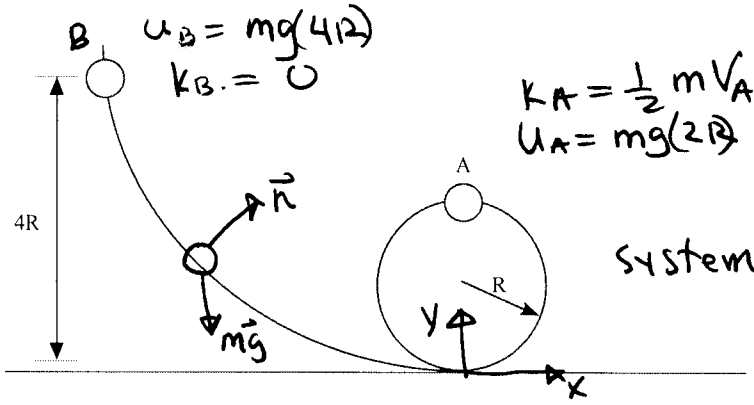
$W = F_{app} s \cos\theta$

$= \mu_k mg s \cos 0^\circ$

$= (0.78)(95)(9.8)(11)$

$\boxed{W = 8000\,J}$

3. A bead slides without friction around a loop-the-loop as shown below. The bead is released from rest from a height of 4R. (10 pts)



a. What is the speed at point A?
b. Calculate the normal force on the bead at point A if its mass is 10.0g.

a) $m\vec{g}$ is the only force that does work.
Since $m\vec{g}$ is conservative, then:

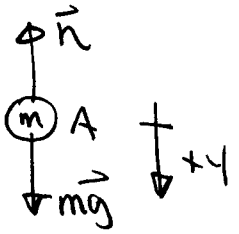
$U_B = K_A + U_A$

$mg(4R) = \frac{1}{2}mV_A^2 + mg(2R)$

$mg(2R) = \frac{1}{2}mV_A^2$

$$V_A = \sqrt{4gR}$$

b)



$\Sigma F_y = mg - n = \frac{mV_A^2}{R}$

$n = mg - \frac{mV_A^2}{R}$

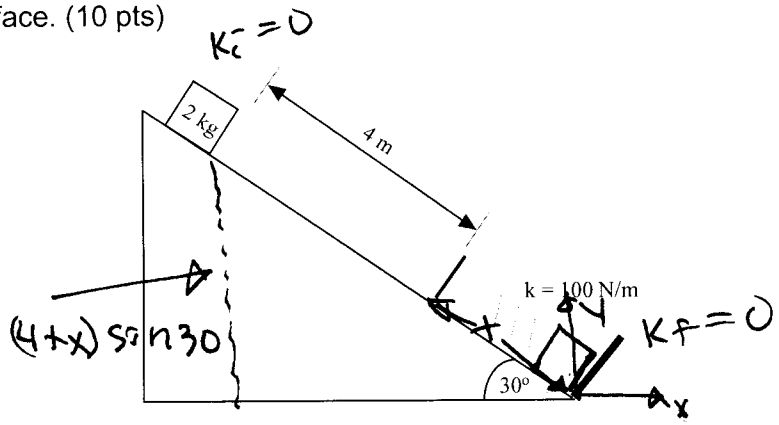
$n = m(g - \frac{4gR}{R})$

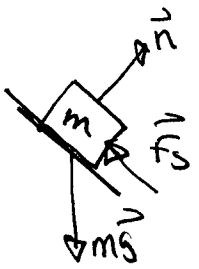
$n = -3mg$

$$n = -0.294\,N$$

points down!

4. A 2.0 kg block is released 4.0 m from a massless spring with spring constant k = 100 N/m that is along a plane inclined at 30° as shown below. Use energy considerations to find the maximum compression of the spring. Assume frictionless surface. (10 pts)





system = block + spring + earth

$F_s = -kx$ and $m\vec{g}$ only forces that do work. Since they are conservative, then:

$$E_i = E_f$$

$$\cancel{K_i}^{0} + U_{i(g)} + \cancel{U_{i(s)}}^{0} = \cancel{K_f}^{0} + \cancel{U_{f(g)}}^{0} + U_{f(s)}$$

$$mg(4+x)\sin 30 = \frac{1}{2}kx^2$$

$$(2)(9.8)(4+x)\left(\tfrac{1}{2}\right) = \tfrac{1}{2}(100)x^2$$

$$39.2 + 9.8x = 50x^2$$

$$\boxed{50x^2 - 9.8x - 39.2 = 0}$$

quadratic Eq.

$$\boxed{x = 0.99\ m}$$
$$\boxed{x = 99\ cm}$$