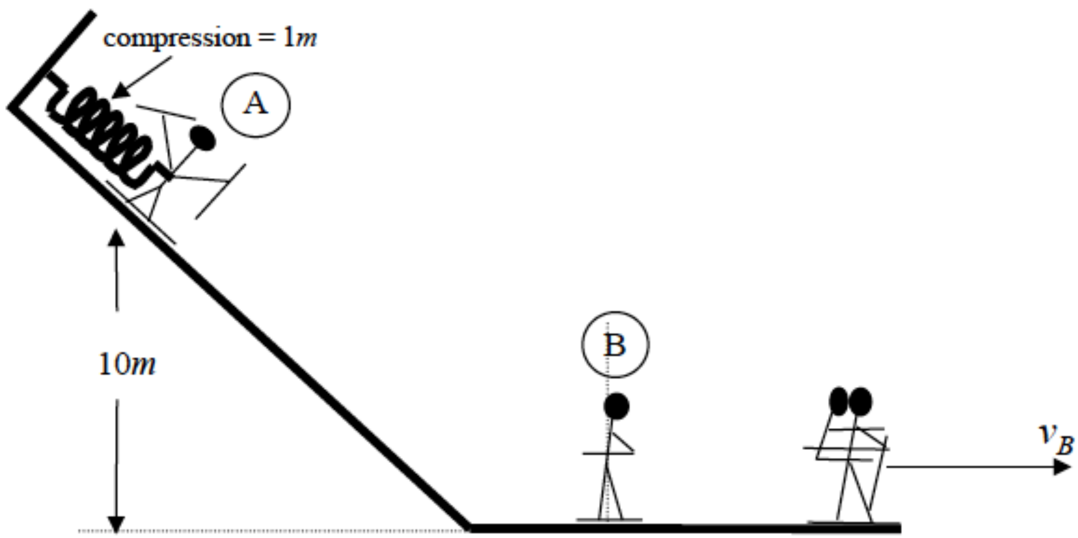
QUIZ 7, PHY 191 B, Red, Friday, Oct 21, 2016 (20 pts)
[see both sides of sheet!]
SHOW WORK CLEARLY OTHERWISE ZERO CREDIT!!

Question 1: Dr. Evil has tied a skier of mass 40 kg to a spring of force constant k = 8440 N/m at the top of a frictionless incline as shown below. The spring is compressed initially by 1 m and her height above the ground while tied (position A in figure) is 10 m. The skier manages to untie herself and simultaneously release the spring so that she hurtles down the incline. At point B she jumps on to the back of her stationary friend (mass = 60 kg). Together they glide off to safety over the frictionless flat surface with a velocity v_B.

a) 5 m/s b) 6 m/s c) 7 m/s d) 8 m/s



a) What is her speed just before her "collision" with her friend? (7pts)

USE C.O.M.E. to find her speed V just before collision, then use C.O.L.M. to find v_B.

C.O.M.E. for "HER" between (A) & (B): $\Delta K + \Delta U_g + \Delta U_{el} = 0$

$(\frac{1}{2}mv^2 - 0) + (-mgh) + (-\frac{1}{2}kx^2) = 0 \Rightarrow \frac{1}{2}(40)v^2 = 40(9.8)(10) + \frac{1}{2}(8440)1^2$

$\Rightarrow V = 20.2\,m/s$

Other answers: Blue 17.5 m/s Green: 21.3 m/s

b) What is the value of v_B? (3 pts)

Now use C.O.L.M. for her collision:

$p_i = p_f \Rightarrow 40(20.2) = (40+60)v_B \Rightarrow v_B = 8\,m/s$

Other answers: Blue 7 m/s Green 8.5 m/s

Turn sheet over

Question 2: Two masses, of mass 2*m* and *m*, are hung on strings of the same length. Mass 2*m* is released from a height H = 1.5 m above its free-hanging position and has an *elastic* collision with the mass *m*.

a) 1.8 m b) 2.7 m c) 3.6 m d) 4.5 m e) 5.5 m

a) What is the speed of the mass 2*m* just before collision with the stationary mass? **(4pts)**

Use C. O. M. E. to find velocity of 2*m* just before collision. Let's call this velocity v_{before} . The ball 2*m* descends by *H,* so its loss in PE $(2m)gH$ must equal its gain in KE ½ $(2m)v_{before}^2$ (we get this by a straightforward consideration of $\Delta K + \Delta U = W_{nc}$ where W_{nc} is zero).

$$(2m)gH = \tfrac{1}{2}(2m)v_{before}^2, \text{ which means } gH = \tfrac{1}{2} v_{before}^2, \text{ or } v_{before} = \sqrt{2gH} =$$

5.4 m/s

Other answers: Blue 4.4 m/s Green 6.3 m/s

b) What is the height *h* to which the mass *m* rises after the collision? **(6 pts)**

Use C. O. L. M. to find velocity of *m* just after elastic collision. Let's call this v_{after} .

$$v_{after} = \left(\frac{2(2m)}{2m+m}\right)(5.4) = 7.2 \text{ m/s}$$

Now use C. O. M. E. again, just as in part (a) above, to find the height to which *m* rises after the collision. A straightforward consideration of $\Delta K + \Delta U = W_{nc}$ where W_{nc} is zero yields $mgh = \tfrac{1}{2} m v_{after}^2$, which means $gh = \tfrac{1}{2} v_{after}^2$, or $h = \frac{v_{after}^2}{2g} \approx$ 2.7 m

Other answers: Blue 1.8 m Green 3.6 m