PHY 110 Spring 2018 Quiz 6 Solution

1. A marble (mass = 15 g) is released from rest in a jar of liquid. After it has fallen 10 cm through the shampoo, its velocity is 75 cm/s. What is the work done on the marble by the drag force of the liquid?

a) –10.5 mJ b) –28.4 mJ c) –37.1 mJ d) –49.3 mJ

Both gravity and the drag force do work, but we still know that $W_{net} = W_g + W_{drag} = \Delta K = \frac{1}{2}mv_f^2$*, since the object starts from rest. We then have*

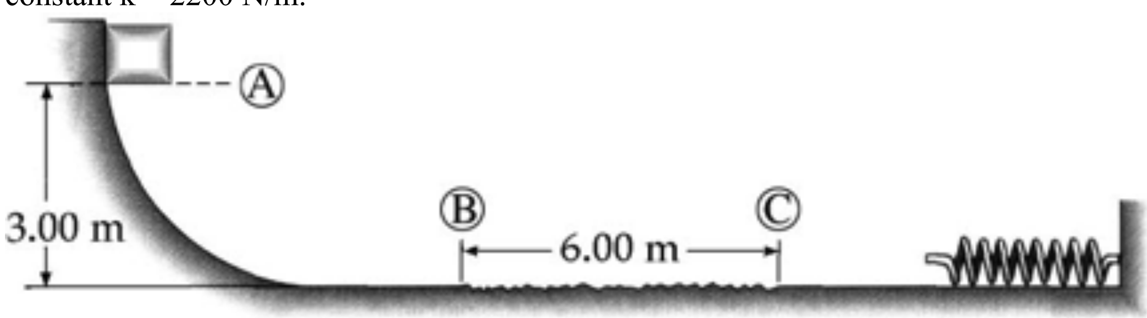
$$W_{drag} = \frac{1}{2}mv_f^2 - W_g = \frac{1}{2}(0.015)(0.75)^2 - (0.015)(9.81)(0.1) = -0.01049\,J = -10.5\,mJ$$

2. A block is given an initial velocity up a rough incline, then it slides back down. When it reaches its starting point, its velocity will be

a) the same as its starting velocity, since kinetic energy is conserved.
b) larger than its starting velocity, since gravity acts.
c) smaller than its starting velocity, since friction removes energy from the system.
d) larger or smaller than its starting velocity, depending on the value of μ_k.
e) …sorry, there is not enough information to answer this question.

Since gravity does a certain amount of negative work on the way up and an equal amount of positive work on the way down, it causes no change in the block's speed at the starting location. However, since friction does negative work over the whole trip, the total change in kinetic energy must be negative, so the block must be slower when it returns to its starting position.

A 10 kg block is released from rest at A in the figure below. The path of the block is smooth except between B and C, where $\mu_k = 0.1$ is the coefficient of kinetic friction. The spring is initially unstretched and its spring constant k = 2200 N/m.



3. The work done by gravity is

a) 168 J **b) 294 J** c) 313 J d) 477 J

$$W_g = mg\left(y_i - y_f\right) = (10)(9.81)(3-0) = 294.3\,J$$

4. The work done by friction is

a) –59 J b) –63 J c) –79 J d) –92 J

$$W_f = \vec{F}_f \bullet \Delta\vec{r} = \mu mg\left(-\hat{i}\right) \bullet \Delta x\,\hat{i} = -\mu mg\,\Delta x = -\left(0.1\right)\left(10\right)\left(9.81\right)\left(6\right) = -58.86\,J$$

5. How far is the spring compressed before the block comes momentarily to rest?

a) 13 cm b) 28 cm c) 35 cm **d) 46 cm**

$$W_{net} = \Delta K$$
$$W_g + W_f + W_s = K_f - K_i = 0$$
$$294.3 - 58.86 + \frac{1}{2}\left(2200\right)\left(0^2 - x_f^2\right) = 0$$
$$x_f = 0.463m \ \ or \ \ 46.3cm$$

For a constant force, $W = \vec{F}\cdot\Delta\vec{r}$. In general, $W = \int \vec{F}\cdot d\vec{r}$. $\vec{A}\cdot\vec{B} = AB\cos\theta$ $W_{net} = \Delta K$ $K = \frac{1}{2}mv^2$

With y positive upward, $W_g = mg\left(y_i - y_f\right)$. $W_s = \frac{1}{2}k\left(x_i^2 - x_f^2\right)$ $f_k = \mu_k N$