Quiz: Work/Energy

Full Name, Period:

1 I'm not sure how I feel about energy,

1. (4 pt) The moment of inertia of objects I, can be written as $\epsilon m r^2$. A ball with $\epsilon = \frac{2}{5}$ and a cylinder with $\epsilon = \frac{1}{2}$, are placed at the top of an incline with friction. Both roll to the bottom. What is the ratio of the speed that the ball has when it reaches the bottom v_b to the speed that the cylinder has when it reaches the bottom v_c.

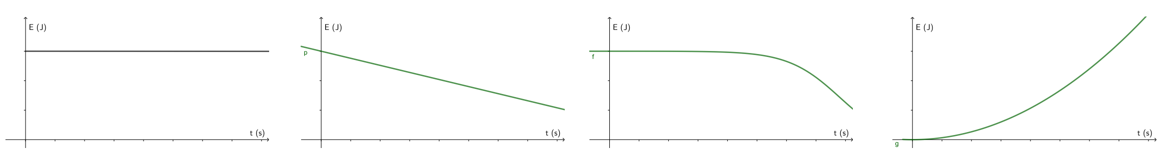
   A. $\frac{v_b}{v_c} = \sqrt{\frac{7}{10}}$

   B. $\frac{v_b}{v_c} = \sqrt{\frac{4}{5}}$

   $\boxed{\text{C.}}$ $\frac{v_b}{v_c} = \sqrt{\frac{15}{14}}$

   D. $\frac{v_b}{v_c} = \sqrt{\frac{10}{9}}$

2. Two objects have the same mass, but one has a relatively low density and the other has an extremely high density. The objects are dropped off of a building in the presence of air. Assume that the Earth is taken as part of the system and the potential energy is defined. For the low density object assume that it takes a while to reach a velocity high enough for air resistance to be important. For the high density object, assume that air resistance never becomes important.



(a) (b) (c) (d)

   (a) (3 pt)Which of the graphs might represent the total energy as a function of time for the system with the low density object?

   A. (a)

   B. (b)

   $\boxed{\text{C.}}$ (c)

   D. (d)

   Explanation: We are told that air resistance eventually becomes important, this means energy will be very nearly conserved initially, but the system will begin to loose energy to air resistance after the object stops speeding up.

   (b) (3 pt) Which of the graphs might represent the total energy as a function of time for the system with the high density object?

   $\boxed{\text{A.}}$ (a)

   B. (b)

   C. (c)

   D. (d)

   Explanation: Air resistance never becomes important, so energy is conserved.

3. (**All**) An object travels down a helical ramp submerged in a non-Newtonian fluid while in an elevator on Jupiter during a storm. Write your name on your paper.

   A. No!

   C. [Profanity redacted]

2 but I love doing work!

1. (5 point) You slide a mass across a surface with an initial speed v. You notice that the mass stops in a distance of D. Find the coefficient of kinetic friction between the mass and the surface.

   We use $W = \Delta E$ and $W = FD$. Combining gives

$$FD = \frac{1}{2}mv^2$$

now use that

$$F = F_f = F_N\mu_k = mg\mu_k$$

so

$$mg\mu_k D = \frac{1}{2}mv^2$$

$$\mu_k = \frac{v^2}{2gD}$$

2. (5 pt) Pendulums conserve mechanical energy. You create a pendulum using a string (massless) and a mass M. The pendulum has a length L and is released from rest at an angle θ **from the vertical**. You are on Earth, where the gravity is g downwards. In terms of the variables given, what will be its speed when it reaches its lowest point?

   The length of the string is l. If we take the pivot to be 0, the final height of the pendulum is $-mgl$ the initial height is $-mgl\cos\theta$. We only care about the difference, which is

$$\Delta h = l(1 - \cos\theta)$$

so conservation of energy becomes

$$mg\Delta h = \frac{1}{2}mv^2$$

plugging in our Δh and solving gives

$$v = \sqrt{2gl(1 - \cos\theta)}$$