Energy WS#3a
Date: _____

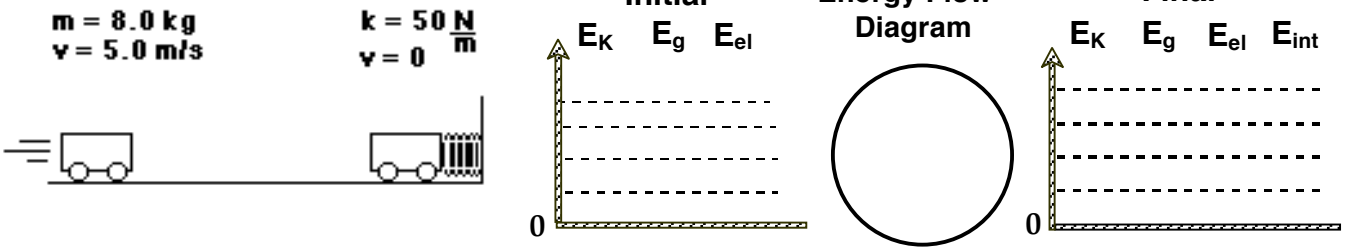
Payton Physics
Name: _____ Pd.____

Energy, Forces & Motion

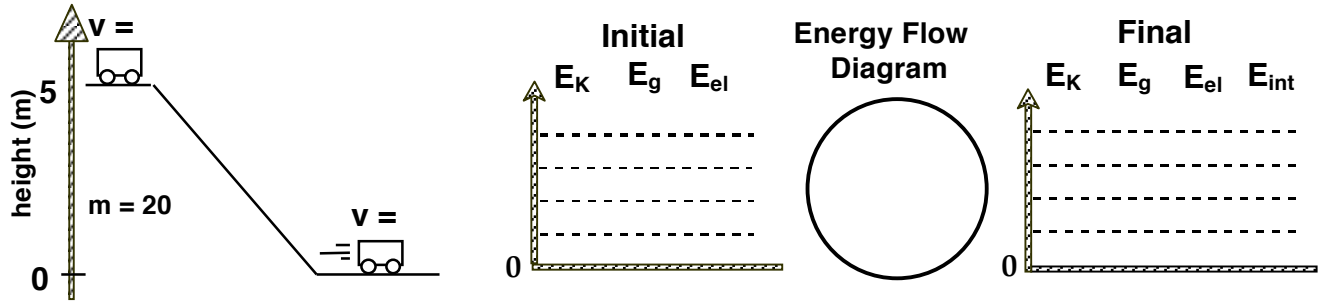
For each situation shown below:

1. In the energy flow diagram show the system you choose to analyze. *Assume the systems to be frictionless unless stated otherwise.*
2. Complete the energy bar graph QUANTITATIVELY (numerically accurate).
3. In the space below each diagram use conservation of energy equations to solve for the quantity called for in the question.

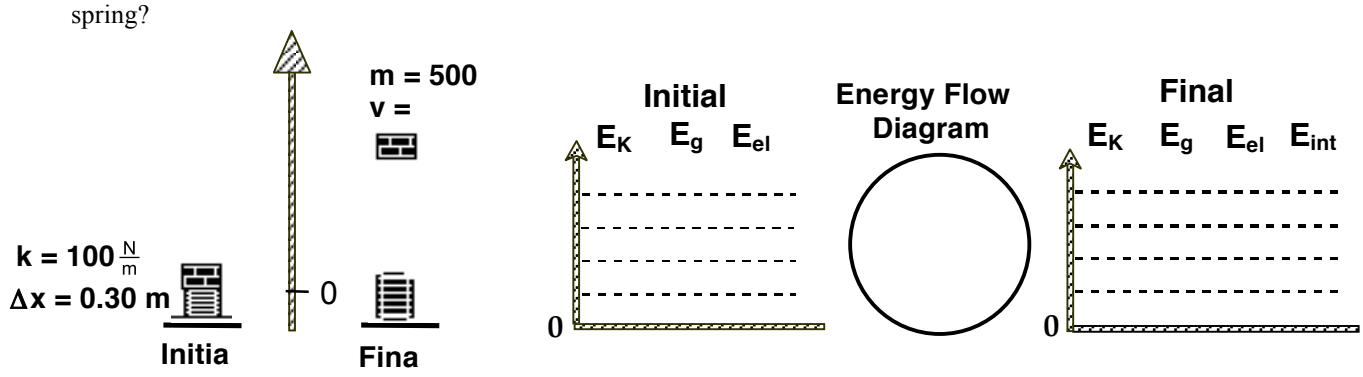
1. A moving cart hits a spring, traveling at 5.0 m/s at the time of contact. At the instant the cart is motionless, by how much is the spring compressed?



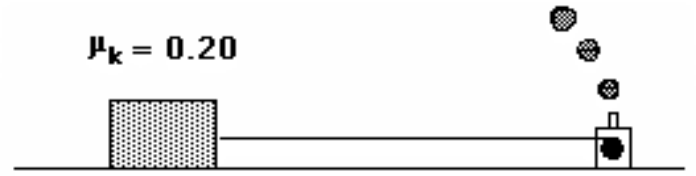
2. Determine final velocity of the cart, assuming that 10% of the energy is dissipated by friction.



3. A block is placed on a spring, compressing it 0.30m. What height does the block reach when launched by the spring?



4. A 200. kg box is pulled at constant speed by the little engine pictured below. The box moves a distance of 2.5 m across a horizontal surface.



a) Draw a force diagram of all relevant forces acting on the box.

b) Construct a qualitative energy bar graph/flow diagram for this situation. Be sure to specify your system.
c) How much energy is transferred by the engine?
d) What type of motion would occur if the engine pulled with a force of 500 N?
Modify your force diagram and apply Newton's 2nd Law.
e) How far could the box be pulled *at constant velocity* with the expenditure of 8,000 J of energy?

5. A baseball (m = 140 g) traveling at 30. m/s moves a fielder's glove backward 35 cm when the ball is caught.

a. Construct an energy bar graph of the situation, with the ball as the system.
b. What was the average force exerted by the ball on the glove?

6. A 60. kg student jumps from the 10 meter platform at Arizona State Univerity's swimming complex into the pool below.

a. Determine her E_g at the top of the platform.
b. How much E_k does she possess at impact? What is her velocity at impact?
c. Repeat steps a and b for a 75 kg diver.

7. A spring whose spring constant is 850 N/m is compressed 0.40 m. What is the maximum speed it can give to a 500 g ball?

8. If the spring in #7 were compressed twice as much, how many times greater would the velocity of the ball be?

9. A bullet with a mass of 10. g is fired from a rifle with a barrel that is 85 cm long. There is a chemical reaction in the gun that creates gas that pushes the bullet out of the gun.

a. Assuming that the force exerted by the expanding gas to be a constant 5500 N, what speed would the bullet reach?
b. Do an energy pie chart analysis of the situation, with the entire gun and bullet as the system.

10. A 24 kg child descends a 5.0 m high slide and reaches the ground with a speed of 2.8 m/s.

    a. How much energy was dissipated due to friction in the process?
    b. Do a pie chart analysis of this situation, using an accurate % of the pie to represent the amount of E_{INT} in the process.

11. Suppose Wile E. Coyote (20 kg) was shot from a cannon straight up with an initial velocity of 50 m/s.
    Assuming that *all* his initial E_k was transferred into E_g, what is the maximum height he could reach?

12. A 60 kg box is lifted by a rope a distance of 10 meters straight up at constant speed. How much power is required to complete this task in 5 seconds?

13. Hulky and Bulky are two workers being considered for a job at the UPS loading dock. Hulky boasts that he can lift a 100 kg box 2.0 meters vertically, in 3.0 seconds. Bulky counters with his claim of lifting a 200 kg box 5.0 meters vertically, in 20 seconds.
    Which worker has a greater power rating?

14. How long would it take a 7.5 KW motor to raise a 500 kg piano to an apartment window 10 meters above the ground?

15. Your electric utility company sends you a monthly bill informing you of the number of kilowatt-hours you have used that month.
    a. Is the utility charging you for energy or power? Explain.
    b. How many joules does your 1600W blow dryer transfer if you dry your hair in 5 min?