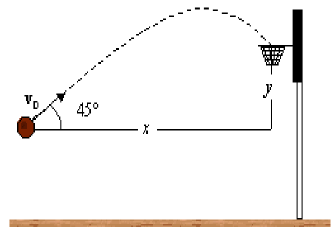
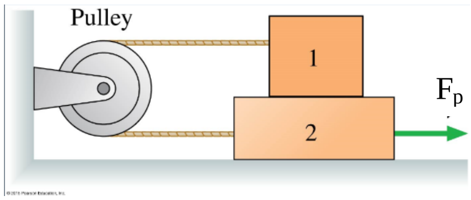
Here are the final questions of this term. I hope you enjoyed the term as much I did and have fun solving these last problems. Remember that problem solving includes pictures, physics tools like free body diagrams, or before-and-after pictures and explanations of equations in case you use any equations. You have to show your work to receive credit.

1) *(10 points)* A basketball is launched with an initial speed of 8.0 m/s and follows the trajectory shown. The ball enters the basket 0.96 s after it is launched. What are the distances *x* and *y*? **Note**: *The drawing is not to scale and should be redone.*



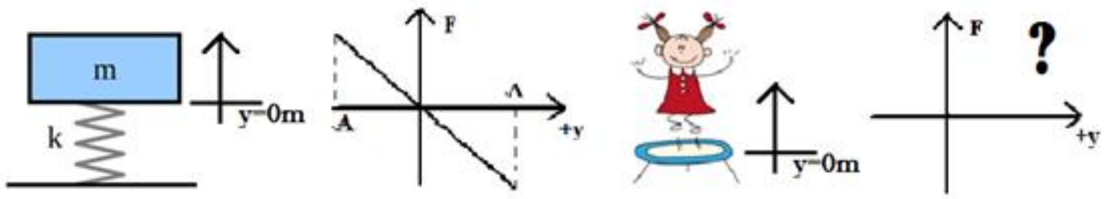
2) (15 points) The pull force F is strong enough to accelerate the two blocks 1 and 2. The pulley is massless and frictionless. The friction coefficient between block 1 and 2 and between block 2 and ground is $\mu_s = 0.2$ and $\mu_k = 0.1$



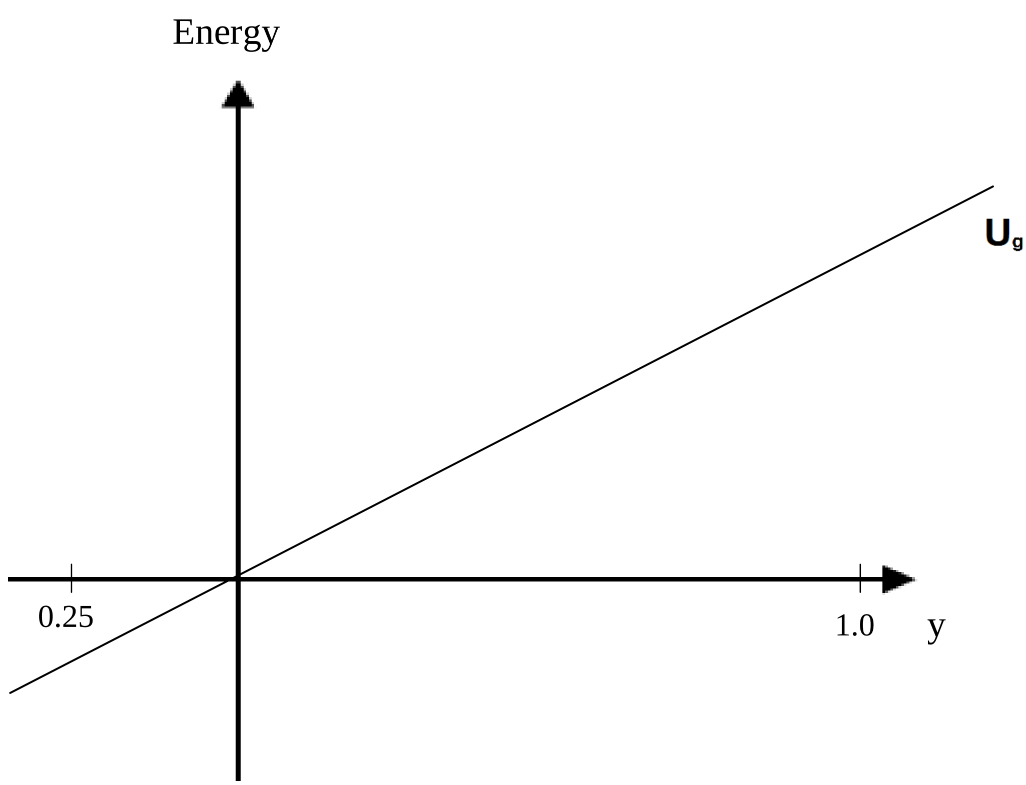
a) Draw a free body diagram for each of the blocks.
b) What is the minimum force necessary to pull on block 2 to start the blocks moving when both blocks are initially at rest?
c) What is the acceleration of block 2 when the pull force is $F_p = 20N$?
d) What is the tension in the string when block 2 is pulled with 20N

Continue on the next page.

3) (*15 points total)* A 27 kg girl is jumping on a trampoline. This motion is very similar to a mass on a spring. From the surface of the trampoline, she jumps 1.0 m high, and when landing on the trampoline she sinks in by 25cm. Let your zero point of your coordinate system be level with the trampoline frame.



a. (6pts) The gravitational potential energy is already drawn. Clearly indicate the highest and lowest potential energy on the horizontal axis of the graph. Calculate the values. Clearly indicate the change of potential gravitational energy between the highest and lowest point. Calculate the value.
Make sure your graph shows what you know about conservation of energy. The potential energy is zero at y=0m (the equilibrium position of the empty trampoline). Carefully and in scale to U_g add the two graphs for the kinetic energy of the girl and the trampoline potential spring energy as a function of the position to the graph.

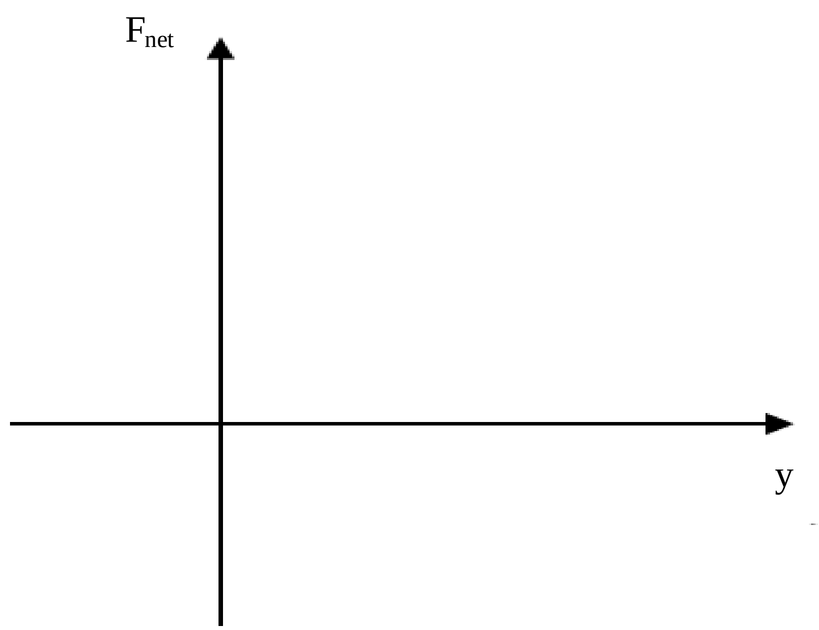


Continued on the next page.

b. (2 pts) Assuming energy is conserved in this situation, what is the total energy of the system. First define your system.

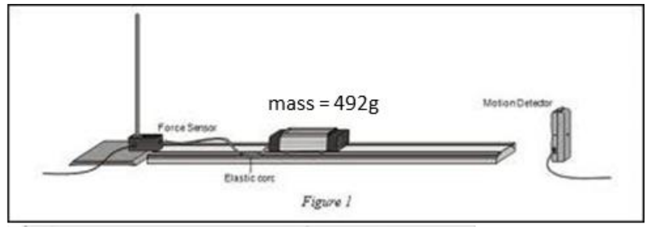
c. (3 pts) Describe the motion of the girl with respect to time – draw a *y* vs *t* graph. Do not forget to label the axis and show the scale.

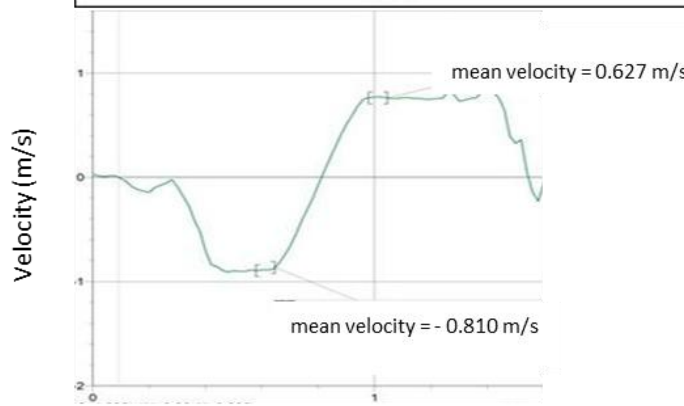
d. (4pts) In the graph below draw the *net* force versus position graph for the girl jumping on the trampoline. Clearly mark the highest point, the point of contact with the trampoline and at the lowest point of her motion. Don't forget to include an appropriate scale. *Hint: It may help to draw a couple of FBDs.*



4) *(6 points total)* During the term we have made significant observations each week in the lab. That way we could convince ourselves that equations that we use to calculate some physical quantities are actually valid. In one of these experiments we used a motion detector and a force sensor to prove the impulse momentum theorem.

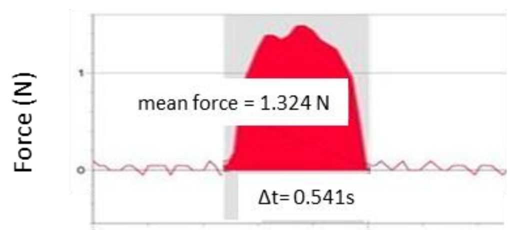
For this experiment, a dynamics cart (m=492g) rolled along a level track. Its momentum changed as it reaches the end of an initially slack elastic tether cord. The tether stretched and applied an increasing force until the cart stops. The cart then changed direction and the tether went slack. The force applied by the cord was measured by a Force Sensor. The cart velocity throughout the motion was measured with a Motion Detector.





A) Use the given data to show that impulse and momentum have the same numerical value.

B) What would you expect to happen to the Force vs time graph if you gave the cart a higher initial velocity? Draw the graph over the given graph and explain your reasoning.



5) (5 points) Below are scenarios that a physics 201 student might need to solve. Indicate which physics concept A), B, or C) you will use to solve the problem? Do not solve the problems!

A) Using Newton's Laws and free body diagrams.
B) Conservation of Momentum
C) Conservation of Energy

Scenarios:

1. A snowball with a velocity of 40 m/s hits a bicyclist cycling with 10 m/s from the back and sticks to the jacket? What is the velocity of the cyclist after she was hit?

2. You position a wooden ladder on a wooden floor. At what angle relative to the wall does the ladder start to slide?

3. You pencil is falling from the table. With what speed is it hitting the floor?

4. A truck drives along Hwy 99E with 40mph. At LBCC the driver slams the breaks and brings the truck to rest within 100feet. How much heat is produced in that process?

5. Two perfectly elastic billiard balls collide head on. One ball has the initial velocity of 10m/s the other ball has a velocity of -5m/s. What are the final velocities of the balls

6) *(4 points)* In chapter 6 you have learned about the universal constant of gravity and found that the period of satellite motion on a path with radius R around an object of Mass M is given by

$$T^2 = \left(\frac{4\pi^2}{GM}\right) R^3$$

In a parallel universe with a different gravitational constant an alien has measured out some satellite motions around a planet and created the following graph. What is the gravitational constant in that universe?