Phys 211 – Physics 1 Seminar
Module 5 – v1

Name:_____ Peer Leader:_____

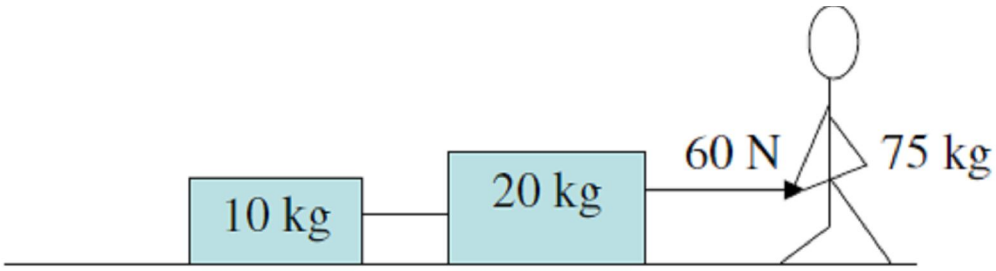
Date: _____ _____

Work and Energy

This workshop focuses on the understanding of work, kinetic energy, potential energy and the relationship among these quantities.

I. Work, Kinetic Energy and the Work-Energy Principle

(a) A 75 kg maintenance worker is pulling wheeled crates of mass 20 kg and 10 kg each on a smooth floor with a force of 60 N as shown. Draw all the forces present. (Assume that the friction between the crates and the floor is negligible)



(b) Determine the work done by the worker on the two crates over a distance of 5m. Is the work done on the crates by the man positive or negative? **Justify your answer.**

(c) Determine the work done by the crates on the worker over the same distance. Is the work done on the man by the crates postive or negative? **Justify your answer.**

(d) Acoording to (b) should the kinetic energy of the crates increase, decrease or remain the same? **Justify your answer.**

(e) Analize your answer to (c) and determine whether the kinetic energy of the man increases, decreases or remains the same. **Does your answer make sense? What else should you consider so your answer does make sense?**

(f) The worker starts pulling the two crates trhough a rough stretch of flooring where the coefficient of kinetic friction between the individualcrates and the floor is 0.25. Assuming that the crates start from rest and are pulled a distance og 10 m, find the final kinetic energy of the crates if the pulling force applied is now 120 N.

(g) The worker in the previous problem is dragging now a single 30kg crate over the same rough surface ($\mu_K = 0.25$). But, instead of pulling horizontally he decides to pull it with a 120N force at a 19.1^o angle. What is the final kinetic energy of the system if the box is pulled a distance of 10m? Did his strategy pay off? **Explain**

II. Potential Energy

The Center for Student Engagement in Science is getting a supercomputer cluster for a computer room on the second floor of the science building. A group of Physics I students (of whom you happen to be one) volunteer to pull the rack up the ramp of the science building. The computers and the wheeled rack they are housed in have a combined mass of 500 kg. Assume that the coefficient of kinetic friction between the wheels of the rack and the flooring of the ramp is 0.2, and that the incline of the ramp in the science building is about15 degrees, and that the second floor that is about 5m higher than the first.

(a) Determine the minimum energy required to bring the rack to the second floor if you could pull it straight up?

(b) Determine the energy required to pull the rack up the ramp.

(c) Is the energy in (b) larger, smaller, or the same as in (a)? What method would you prefer to use to bring the cluster to the second floor? **Justify your answer.**

III. Conservation of energy

You are hired to design a spring cannon to send packages up a virtually friction free ramp (on rollers) to a plateau that is 20 m higher than the lower level. The largest package the cannon will handle has a mass of 100 kg.

(a) Suppose the spring can be compressed by 2.0 m. What is the smallest spring constant spring one can use to succesfully send the package to the higher level?

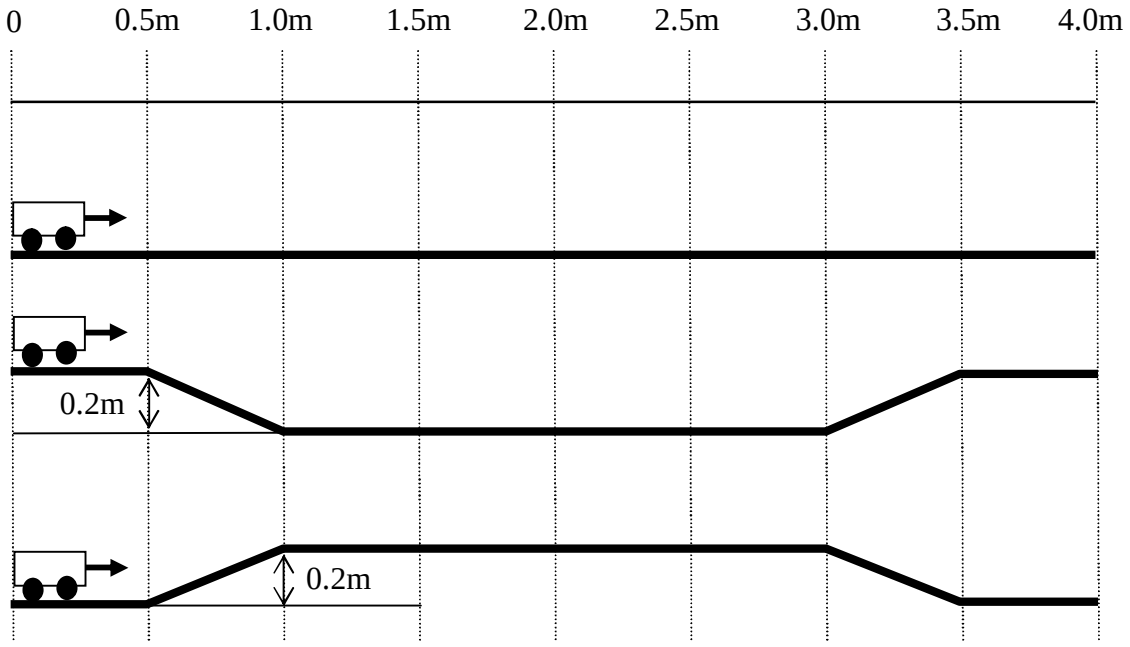
(b) Suppose a package has to reach an intermediate level that is only 10 m higher then the lower level. How much you need to compress the spring to succesfully send the package?

(c) Suppose you are to send a 25 kg package to the highest level and compress the spring to its maximum compression (2.0m). How fast will the package be when it reaches the highest level?

(d) Suppose the rollers start to rust and are no longer frictionless. What adjustmests you will need to make so your packages continue to reach the top level?

IV. Conservation of Energy

In a classroom demonstration an instructor designs three frictionless tracks (see figure below) and race three cars that have the same initial velocity of 3.0 m/s.



(a) Which of the three cars will have a larger speed as they reach the 4.0m mark? **Justify your answer**

(b) Which car will get to the finish line first (4.0m)? **Justify your answer**

(c) Calculate the time it takes for each of the car to reach the 4.0 m mark?