****Physics 100 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rubber Band Cars

Work and Energy

**Work** = (force) x (distance)

**W = fd**

When force varies (as with a stretched rubber band): **W = (average force) x (distance)**

**Kinetic Energy = energy of motion = ½ mv2**

**Work ≈ energy**

**Energy Efficiency = (Energy Input / Energy Output) x 100%**

**Units for work and energy = joules = j** 1j = 1Nm

1. A child pushes a sled with a force of 10N over a distance of 5 meters.

1. How much work does the child do?
2. How much energy does the child use?\*\*

2. When a rubber band car is wound up, the band is stretched a distance of 0.1m. When the car is released, the rubber band applies an average force of 4N as it resiles (unstretches over the 0.1m distance).

1. How much work is done by the rubber band?
2. How much energy input does the rubber band give the car?\*\*

3. Suppose a car has a mass of 0.1kg and a maximum velocity of 2m/s.

1. What is the car’s maximum kinetic energy?
2. How much kinetic energy would this same car have if it went twice as fast ( 0.1kg and 4m/s)?
3. How much kinetic energy would this same car have if it went the same speed but had twice the mass (0.2kg and 2m/s)?

4. The rubber band powering a car does 0.5j of work, and the car’s maximum kinetic energy is 0.2j. What is the car’s efficiency?

5. The rubber band powering a car does 1j of work, and the car’s maximum kinetic energy is 0.3j. What is the car’s efficiency?

6. A student’s car is powered by a stretched rubber band. When the car is fully wound, the rubber band has a tension of 10N. After the car is released, at the moment that the rubber band “pops” loose, the tension in the rubber band is 2N. What is the average force that is exerted by the rubber band?

7. A student’s car is powered by a stretched rubber band. When the car is fully wound, the rubber band has a tension of 16N. After the car is released, at the moment that the rubber band “pops” loose, the tension in the rubber band is 0N. What is the average force that is exerted by the rubber band?

8. A student’s car is powered by a stretched rubber band.

* When the car is fully wound, the rubber band has a tension of 12N. After the car is released, at the moment that the rubber band “pops” loose, the tension in the rubber band is 4N.
* During the winding process, the rubber band is stretched a distance of 0.012m
* The car’s mass is 0.05kg
* The car’s maximum velocity is 2.5m/s
1. What is the average force of the car’s rubber band “motor?”
2. What is the distance over which the rubber band does its work?
3. What is the car’s energy input?
4. What is the car’s maximum kinetic energy?
5. What is the car’s efficiency?

9. Collect/calculate the following for your car...

1. Maximum rubber band force, in Newtons (when fully wound) =
2. Minimum rubber band force, in Newtons (just before releasing axle) =
3. Rubber band stretch distance, in meters =
4. Energy input, in joules =
5. Car mass, in kilograms (mass in grams / 1000) =
6. Maximum velocity, in m/s (0.305m x 240fps / number of frames to travel 1 tile) =
7. Maximum kinetic energy =
8. Efficiency =