Name:_____ **Regents Physics**

Chapter 8- Work and Energy

Work and Power

Energy is the ability to do work. Energy is a **scalar** quantity. When work is done on or by a system, the total energy of the system is changed.

Work

Work is the **transfer of energy** to an object when the object moves due to the application of a force. Work is a **scalar** quantity. The amount of work done, **W**, is equal to the product of the force, **F**, along the direction of the displacement, **d**. The work done on the object produces a **change in the object's total energy, ΔE_t.**

$$W = Fd = \Delta E_t$$

Since force is in **Newtons** and displacement is in **meters**, all work and energy can be expressed in Newton-meters or **joules (J).** Realize that a **joule** is also equal to **$kg \cdot m^2/s^2$.**

The **joule (J)** is a derived unit equal to the work done on an object when a force of one Newton produces a displacement of one meter. When a force is applied to a mass, but the mass does not move, **no work is done**. The object **must move in order for there to be work!!!**

Note: You must find the component of the force that is in the same direction as the motion of the object!!! In Regents, this is usually the x-component (horizontal).

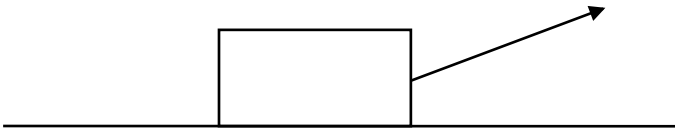
For Example:

1.) Zach pushes a 200-kg bull to the right with a force of 500 Newtons. If Zach manages to push the bull a displacement of 0.4 meters:

a.) Determine the work done by Zach on the bull.

b.) What is the change in energy of the bull?

2.) Kraig pulls a box to the right at an angle of 40 degrees to the horizontal with a force of 30 Newtons. If Kraig pulls the box a distance of 20 meters, determine the work done by Kraig. **(Remember: find the component of the force in the direction of motion).**



3.) If Brooke does 400 joules of work to push a bookcase 10 meters a cross a room, how much force did she apply to the bookcase?

4.) Liam uses 100 joules of work and a force of 20 Newtons to push a physics textbook across the lab table. How far will the textbook travel?

5.) Courtney accelerates her 2,000-kg car at a rate of 10 m/s^2. If Courtney accelerates for a displacement of 1,000 meters, how much work is done by the car?

6.) Nick raises a 4-kg mass vertically 0.05 meters above his head. Determine the work done on the mass.

Power

Power is simply the **rate at which work is done**. Power is a **scalar quantity**. Recall that the "rate" simply means dividing the variable by time. Therefore, power is found using:

$$P = \frac{W}{t}$$

However, we also know that **W=Fd** and that $v = \frac{d}{t}$. Therefore, the above equation may also be written as follows:

$$P = \frac{W}{t} = \frac{Fd}{t} = Fv$$

One joule of work done per second equals one **watt (W)** which is the **SI** derived unit for power.

1 W = 1 J/s = 1 kg·m^2/s^3

Since power is **inversely proportional to time**, the less time required to do a given amount of work, the greater the power developed.

For Example:

7.) It requires 1,000 J of work for Celeste to push a couch to the other side of her room. If Celeste completes this task in 600 seconds, determine the power used by Celeste.

8.) Serap uses 200 Newtons of force to lift a brick a distance of 4 meters. If it takes Serap 20 seconds to complete this task, determine the amount of power used.

9.) A car's engine provides a force of 2,000 Newtons which moves the car at an average velocity of 40 m/s. Determine the power developed by the engine.

10.) A truck uses 20,000 Watts of power to tow a trailer a distance of 2,000 meters in a time of 10 minutes. Determine the force used to pull the trailer.