Chapter 5-1

Work

- Work = force x displacement
- Work is not done unless the object moves.
- The application of force alone does not make work.

- Work is done only when components of a force are parallel to the movement.
- If you are pushing down on a box and the box is moving sideways (not down), then you are not doing work.

- If more than one force is acting on the object, you must find the net force.
- If friction is involved;
- Force – $F_f = F_{net}$
- $F_f = \mu F_n$

Units

- Work is force x length
- Force – newtons
- Length – meters
- Work = Nm

- Work is scalar and can be positive or negative
- Work is positive when the component of force is in the same direction of the movement.
- Work is negative when the force is in the opposite direction of movement.

- If the net work is positive, then the object speeds up and the net force does work on the object.
- If the net work is negative, then the object slows down and work is done by the object. (Friction is greater then force done)

Practice 5A

- #1. A boat pulls with a force of 5000 N. How much work is done if it moves 3000 m?
- Knowns?
- Unknown?
- Equation?

Power

- The rate at which work is done is called power.
- P = Work/time
- Work = force x distance
- P = (Fd)/t

Power and Speed

- If speed is known, use alternative power formula.
- Power = Force x velocity
- P = Fv

Units

- Units of power = watt (W)
- Watt = 1 Joule / second
- Horsepower is another unit of power.
- 1 Horsepower = 746 Watts

Power Ratings

- Machines with different power ratings do the same work in different times.
- The higher the rating, the more work done in a set amount of time.

Practice 5F

- #1. A 1000 kg elevator carries a load of 800kg. A frictional force of 4000 N keeps the upward movement constant. What power is needed to lift the load at a speed of 3m/s?
- Known?
- Unknown?
- P = ?

5-2 Notes

Energy

Kinetic Energy

- Kinetic energy is the energy due to motion.
- $KE = \frac{1}{2} mv^2$
- Units for energy = joule (J).

Potential Energy

- Potential energy is stored energy.
- Gravitational Potential energy is the energy due to the position of the object.
- PE = mgh
- Units are joules (J)

Elastic Potential Energy

- Elastic potential energy in a stretched or compressed elastic object.
- $PE_{elastic} = \frac{1}{2} kx^2$
- PE = Joules (J)

Spring Constant

- k = spring constant
- Spring constant expresses how resistant a spring is to being compressed or stretched.
- Flexible spring = small k
- Stiff Spring = large k
- Spring constant = N/m

Practice 5B

- #1. Calculate the speed of an 8000 kg airliner with KE of 1.1×10^9 J.
- Knowns?
- Unknown?
- Equation?

Sample Problem 5C

- A person kicks a 10kg sled, giving an initial speed of 2.2m/s. How far does it move if the $\mu k = .1$?
- Known?
- Unknown?
- Equation?

- A 70 kg man is on a bungee cord with an unstretched length of 15m. He jumps off a bridge that is 50 m high. When jumping, his cord stretches to 44m. The spring constant of the cord is 71.8 N/m. What is the total potential energy relative to the water?
- Knowns?
- Unkown?
- Equations?

5-3 Notes

Conservation of Energy

- When we say something is conserved, we mean it remains constant.
- If we have a certain amount of a conserved quantity, we will have the same amount at a later time.
- This does not mean the quantity can't change forms though.

Conservation of Energy

- $\frac{1}{2}\, mv^2_i + mgh_i = \frac{1}{2}\, mv^2_f + mgh_f$
- Where friction is involved, the principal of conservation of mechanical energy is not true because kinetic energy is not all converted potential energy but some is lost to heat and sound.

Practice 5E

- #1. A bird is flying with a speed of 18 m/s over water and drops a 2 kg fish. If the bird is 5.4 m high, what is the speed of the fish when it hits the water?
- Known?
- Unknown?
- Equation?

Energy Classification