KEY - Physics 1 Exam 2 Concepts

Work and Energy

Kinetic Energy

- ★ Energy in motion
- ★ K=$\frac{1}{2}mv^2$
  - Scalar not a vector
  - Units: J
  - Never negative always positive

Potential Energy

- ★ Stored energy
- ★ PE_g=mgh
- ★ PE_{Spring}= $\frac{1}{2}kx^2$
- ★ Units: Joules (J)

Conservation of Energy

- ★ $\Delta Kenetic\ Energy\ +\ \Delta Potential = 0\ =\ Constant$
  - $KE_i+PE_i= KE_f+PE_f$
    - $\frac{1}{2}mv_i + mgh_i = \frac{1}{2}mv_f + mgh_f$
- ★ If going down a hill and starting from rest and hitting the bottom then
  - $PE_{top}=KE_{bottom}$
    - This is because the initial speed is 0 and the final height is also 0, canceling out kinetic energy at the top and potential energy at the bottom

Work

- ★ The product of the component of the forces in the direction of motion
- ★ w=Fdcosθ
  - Units: J
  - Can be negative
  - Centripetal force does not do work

Work Energy Theorem

- ★ Net Work = change in kinetic

Questions

1. Describe a situation in which a force is exerted for a long time but does no work.

   Holding a heavy briefcase stationary, which is a force exerted for a long time but does no work.

2. Work done on a system puts energy into it. Work done by a system removes energy from it. Give an example for each statement.

   Work done on a system: Lifting a briefcase up a flight of stairs. The person's upward force is in the same direction as the briefcase's upward motion, so the person does work on the briefcase. This transfers energy to the briefcase, increasing its gravitational potential energy.

   Work done by a system: When the car's engine uses fuel, it does work by moving the car. The chemical energy in the fuel is converted into the kinetic energy of the moving car.

3. Describe the energy transfers and transformations for a javelin, starting from the point at which an athlete picks up the javelin and ending when the javelin is stuck into the ground after being thrown.

4. Do devices with efficiencies of less than one violate the law of conservation of energy? Explain.

   No, the law of conservation of energy states that energy can not be created nor destroyed. the efficaency being less then one just means the at the energy was only transformed int to a less useful form like heat or sound

Momentum

Momentum

- ★ p=mv
- ★ Conservation of momentum
  - ○ P_{tot}=constant
  - ○ $P_{tot}=P'_{tot}$
  - ○ $p_1 + p_2 = p'_1 + p'_2$ (F_{net}=0)

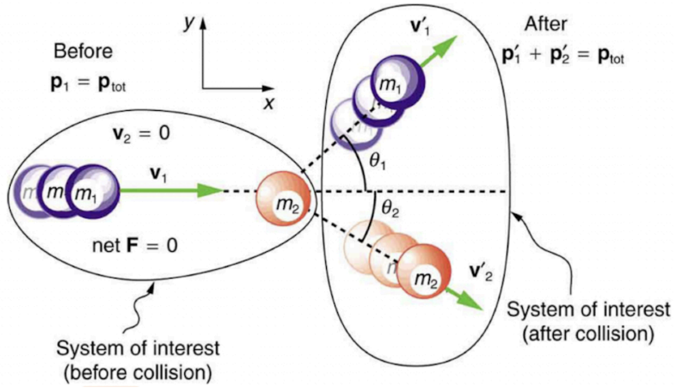
Impulse

- ★ Change in momentum
- ★ $\Delta p = F_{net} \bullet \Delta t$
- ★ Force acts on an object
- ★ If you are looking at the impulse between 2 objects, they are experiencing the same impulse

Types of collision

- ★ Totally Elastic
  - ○ Conserves kinetic energy and momentum
- ★ Partially inelastic
  - ○ Particles don't stick together
  - ○ Momentum is conserved
  - ○ Kinetic energy is not conserved
  - ○ Example
    - ■ Air hockey
- ★ Totally Inelastic
  - ○ Particles stick together
  - ○ Momentum is conserved
  - ○ Kinetic energy is not conserved
  - ○ Example:
    - ■ A ball caught in a glove

Collisions of 2 point masses



Questions

1. An object that has a small mass and an object that has a large mass have the same momentum. Which object has the largest kinetic energy?

   The small object

2. An object that has a small mass and an object that has a large mass have the same kinetic energy. Which mass has the largest momentum?

   Larger object

3. How can a small force impart the same momentum to an object as a large force?

   This can be done by acting over a longer period of time. This is because momentum is the product of mass and velocity, and velocity is the change in position over time.

4. Under what circumstances is momentum conserved?

   When there is no net external force

Torque and statics

Statics

- ★ The study of forces in equilibrium
- ★ Conditions
  - ○ Net F=0N
    - ■ The first condition is that the net external force on the system is equal to 0
  - ○ Net τ=0
    - ■ A rotating body or system can be in equilibrium if its rate of rotation is constant and remains unchanged by the forces acting on it.

Torque

- ★ The rotational equivalent of a force
- ★ Counter-clockwise is positive
- ★ Clockwise is negative

$$\tau = rF\sin\theta = r_{\perp}F$$

➢ $r_{\perp} = r\sin\theta$

- ★ Units: newtons times meter (m•N)
- ★ If Net τ = 0
  - ○ Then $\tau_1 - \tau_2 = 0$
    - ■ So $\tau_1 = \tau_2$

Questions

1. Under what conditions can a rotating body be in equilibrium? Give an example.

   When net torque and net force equal zero

   - Example:
     i. A planet rotating at a constant angular velocity
     ii. The wheels of a car are at a constant speed.

2. What three factors affect the torque created by a force relative to a specific pivot point?
   - Magnitude of the force
   - Distance from pivot point
   - Angle of the force

3. Mechanics sometimes put a length of pipe over the handle of a wrench when trying to remove a very tight bolt. How does this help? (It is also hazardous since it can break the bolt.)

   The wrench extends the length of the lever arm → multiplies the torque
   This allows someone to use the same amount of force from a greater distance, making it easier to break the bolt.

4. How does a pulley enable a person to lift a load as heavy as a piano with little effort?
   A pulley system is a simple machine that uses wheels to redirect the force, applying a mechanical advantage.