

Unit 4: Momentum and Energy

4A: Momentum and Impulse

impulse (I) - the product of the force acting on an object over the time during which the force acts.

impulse-momentum theorem - this theorem states that the impulse applied to an object is equal to the change in momentum of an object.

momentum (p) - the quantity of motion of an object or, mass in motion; is calculated by multiplying the mass of an object by the velocity of an object.

4B: Conservation of Momentum

closed system - matter does not enter or leave a system, and no net outside forces act on the system.

law of conservation of momentum - in a closed and isolated system, the total momentum of objects in the system before a collision is equal to the total momentum in the system after the collision.

momentum (p) - the quantity of motion of an object or, mass in motion; is calculated by multiplying the mass of an object by the velocity of an object.

4C: Collisions

collision - when momentum or kinetic energy is transferred from one object to another.

elastic collision - a collision where objects bounce off of one another; momentum and kinetic energy are conserved.

inelastic collision - when two objects collide and do not bounce away from each other; momentum is conserved, kinetic energy is not conserved.

kinetic energy (KE) - the energy of motion; equal to one half times mass times the square of the velocity of an object.

momentum (p) - the quantity of motion of an object or, mass in motion; is calculated by multiplying the mass of an object by the velocity of an object.

perfectly inelastic collision - when objects stick together, so that their final velocities are the same; momentum is conserved, kinetic energy is not conserved.

4D: Work

closed system - matter does not enter or leave a system, and no net outside forces act on the system.

energy - the ability to do work.

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4D: Work (continued)

joule (J) - a unit of work or energy equal to the work done by a force of one newton acting through a displacement of one meter.

law of conservation of energy - energy is never created or destroyed, it is transferred or transformed from one form to another.

work (W) - when a force causes displacement of an object.

4E: Kinetic Energy and Gravitational Potential Energy

energy - the ability to do work.

gravitational potential energy (PE_g) - the stored energy of an object due to its position relative to a reference point on Earth; is equal to the mass of an object multiplied by the acceleration due to gravity multiplied by the height of the object relative to the reference point.

kinetic energy (KE) - the energy of motion; equal to one half times mass times the square of the velocity of an object.

law of conservation of energy - energy is never created or destroyed, it is transferred or transformed from one form to another.

potential energy - stored energy that can come in a variety of forms such as spring, gravity, and chemical.

4F: Work-Energy Theorem

energy - the ability to do work.

kinetic energy (KE) - the energy of motion; equal to one half times mass times the square of the velocity of an object.

work (W) - when a force causes displacement of an object.

work-energy theorem - this theorem states that the work done on an object will either add kinetic energy to an object or take kinetic energy away; work is equal to an object's change in kinetic energy.

4G: Spring Potential Energy

equilibrium position - an object at its natural position, where it has no tendency to move and the net force acting on it is zero.

Hookean Springs - when the force needed to compress or stretch a spring by a given displacement is linear and abides by Hooke's Law.

non-Hookean Springs - when the force needed to compress or stretch a spring by a given displacement is not linear and does not abide by Hooke's Law.

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4G: Spring Potential Energy (continued)

spring constant (k) - a characteristic of a spring that is equal to the force exerted on it divided by the displacement the spring stretches; the unit is a Newton per meter (N/m).

spring force (F_s) - this force is equal to the spring constant for a given spring multiplied by the displacement the spring is stretched from the equilibrium position.

spring potential energy (PE_s) - the amount of stored energy in a spring; is equal to one half times the spring constant times the displacement the spring is stretched from the equilibrium position, squared.

4H: Conservation of Energy

conservative force - forces that cause energy to be converted into forms that can be easily regained; examples are gravity, the electrostatic force, and the spring force.

gravitational potential energy (PE_g) - the stored energy of an object due to its position relative to a reference point on Earth; is equal to the mass of an object multiplied by the acceleration due to gravity multiplied by the height of the object relative to the reference point.

kinetic energy (KE) - the energy of motion; equal to one half times mass times the square of the velocity of an object.

law of conservation of energy - energy is never created or destroyed, it is transferred or transformed from one form to another.

non-conservative force - forces that cause energy to be converted into forms that cannot be easily regained; examples are friction and air resistance.

4I: Power

power (P) - The amount of work done in a given amount of time; the amount of force exerted at a given velocity; SI unit is the watt.

work (W) - when a force causes displacement of an object.