Topic 4: Energy and Momentum

Subtopic 4.1: Energy

Knowledge	Application
The work done on an object is equivalent to the change in energy of that object. When a force is applied to an object causing a displacement over a distance, work is done. Energy exists in a number of different forms. Energy can be transferred from one object to another or transformed into different forms of energy. Energy is conserved when transferred from one object to another in an isolated system. Power is defined as the rate at which work is done and is equivalent to the rate at which energy is used.	Explain work in terms of an applied force. Solve problems using $W = \Delta E$ and $W = Fs$ where the displacement is parallel to the force. Describe different forms of energy including kinetic, elastic, gravitational potential, rotational kinetic, heat, and electrical. Describe examples of energy being transferred from one object to another. Describe examples of energy being transformed. Explain qualitatively the meaning and some applications of various forms of energy, including kinetic energy and potential energy. Solve problems using $E_K = \frac{1}{2}mv^2$ and $E_P = mgh$. Describe energy transfers between objects and within different mechanical systems. Solve problems using the conservation of energy. Describe and explain the energy losses that occur in systems involving energy transfers. Solve problems using $P = \frac{W}{t}$ and $P = Fv$. Interpret solutions in context.

Subtopic 4.2: Momentum

Knowledge	Application
Momentum is a property of moving objects, which depends on their mass and velocity. Momentum can be expressed mathematically as $\vec{p} = m\vec{v}$. Momentum may be transferred from one object to another when a force acts over a time interval. The rate of change of momentum of an object with respect to time is equal to the net force acting upon the object. This can be expressed mathematically as: $\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$. The impulse of an object is equal to $F\Delta t$, and consequently equals the change in momentum.	Use Newton's Second Law in the form $\vec{F} = m\vec{a}$ to derive the formula: $\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$. Solve problems involving changes in momentum and impulse (for one dimension). Draw and interpret graphs of force vs time.
In an isolated system, the total momentum is conserved. An elastic collision is one in which the total initial kinetic energy equals the total final kinetic energy. In an inelastic collision, some kinetic energy is transformed.	Use the conservation of momentum to solve problems in a variety of contexts. Describe the difference between an elastic collision and an inelastic collision using examples. Solve problems involving one-dimensional collisions, using $E_K = \frac{1}{2}mv^2$ and $\vec{p} = m\vec{v}$. Describe the energy transformations during inelastic collisions. Undertake experiments to investigate the conservation of energy or conservation of momentum.