SATISH CHANDRA MEMORIAL SCHOOL

Assessment tool of Creative and Critical Thinking

Subject: Physics

Class 9

1. MOTION

In physics, motion is the change in the position of an object over time. Motion is described in terms of displacement, distance, velocity, acceleration, speed, and time. The motion of a body is observed by attaching a frame of reference to an observer and measuring the change in position of the body relative to that frame. If the position of an object is not changing relatively to a given frame of reference, the object is said to be at rest, motionless, immobile, stationary, or to have a constant or time-invariant position with reference to its surroundings. As there is no absolute frame of reference, absolute motion cannot be determined. Thus, everything in the universe can be considered to be in motion. Motion applies to various physical systems: to objects, bodies, matter particles, matter fields, radiation, radiation fields, radiation particles, curvature and space-time. One can also speak of motion of images, shapes and boundaries. So, the term motion, in general, signifies a continuous change in the positions or configuration of a physical system in space. For example, one can talk about motion of a wave or about motion of a quantum particle, where the configuration consists of probabilities of occupying specific positions. The types of motions are: - Simple harmonic motion (pendulum), Linear motion, Circular motion (orbits of planets), Rotatory motion (wheel), Rotational motion (wheel of a bicycle), Oscillatory motion, Vibratory motion, and Projectile motion.

Questions on Motion

1. All oscillatory motions are periodic, but all periodic motions are not oscillatory motions. Explain.
2. Why displacement is a vector quantity?
3. Why distance is a scalar quantity?
4. A uniformly moving cricket ball is turned back by hitting it with a bat for a very short time interval. Show the variation of its acceleration with time. (Take acceleration in the backward direction as positive).
5. Give examples of a one-dimensional motion where

a) the particle moving along positive x-direction comes to rest periodically and moves forward

b) the particle moving along x-direction comes to rest periodically and moves backward.

2. WORK

In physics, **work** is the product of force and displacement. A force is said to do work if, when acting, there is a displacement of the point of application in the direction of the force. For example, when a ball is held above the ground and then dropped, the work done on the ball as it falls is equal to the weight of the ball (a force) multiplied by the distance to the ground (a displacement). When the force" F" is constant and the angle between the force and the displacement "s" is ϴ, then the work done is given by W= Fs cos ϴ. Work transfers energy from one place to another or one form to another. The SI unit of work is the joule (J). The work W done by a constant force of magnitude F on a point that moves a displacement s in a straight line in the direction of the force is the product of W=Fs. For example, if a force of 10 newtons (F= 10 N) acts along a point that travels 2 metres (s= 2m), then W= Fs= (10N) (2m) = 20J. This is approximately the work done lifting 1 kg object from ground level to over a person's head against the force of gravity. The work is doubled either by lifting twice the weight the same distance or by lifting the same weight twice the distance.

Questions on Work

1. A coolie carrying a load on his head and moving on a frictionless horizontal platform does not work. Explain.
2. A satellite revolves around the Earth in a circular orbit. What is the work done by the force of gravity?
3. The work done by a fielder when he takes a catch in a cricket match is negative. Explain.
4. Is work a scalar or vector quantity? Why?
5. A man lifts a box of 50 kg mass to a height of 2m in 2minutes, while another man lifts the same box to the same height in 5 minutes. Compare the work done by both.

3. ENERGY

In physics, **energy** is the quantitative property that must be transferred to an object in order to perform work on, or to heat the object. Energy is a conserved quantity; the law of conservation_of_energy states that energy can be converted in form, but not created or destroyed. The SI_unit of energy is the joule, which is the energy transferred to an object by the work of moving it a distance of 1 metre against a force of 1 newton. Common forms of energy include the kinetic_energy of a moving object, the potential__energy stored by an object's position in force field (gravitational, electric or magnetic), the elastic___energy stored by stretching solid objects, the chemical_energy released when a fuel burns, the radiant energy carried by light, and the thermal_energy due to an object's temperature. Mass and energy are closely related. Due to mass–energy_equivalence, any object that has mass when stationary (called rest_mass) also has an equivalent amount of energy whose form is called rest_energy, and any additional energy (of any form) acquired by the object above that rest energy will increase the object's total mass just as it increases its total energy. For example, after heating an object, its increase in energy could be measured as a small increase in mass, with a sensitive enough scale. The total energy of a system can be subdivided and classified into potential energy, kinetic energy, or combinations of the two in various ways. Kinetic_energy is determined by the movement of an object – or the composite_motion of the components of an object – and potential_energy reflects the potential of an object to have motion, and generally is a function of the position of an object within a field or may be stored in the field itself.

Questions on Energy

1. When an arrow is shot from a bow, it has kinetic energy in it. Explain briefly from where does it get its kinetic energy?
2. State the energy changes in the following cases-
    a) an electromagnet, b) burning coal, c) steam engine, d) photosynthesis in green leaves
3. Name the mechanical energy which is put to use.
4. Is it possible that no transfer of energy may take place even when a force is applied to a body?
5. In what does the temperature of water at the bottom of a waterfall differ from the temperature at the top? Explain.

3. NEWTON’S LAW OF MOTION

Newton's laws of motion are three physical laws that, together, laid the foundation for classical mechanics. They describe the relationship between a body and the forces acting upon it, and its motion in response to those forces. More precisely, the first law defines the force qualitatively, the second law offers a quantitative measure of the force, and the third asserts that a single isolated force doesn't exist. These three laws have been expressed in several ways, over nearly three centuries, and can be summarized as follows: The **first law** is- in an inertial frame of reference, an object either remains at rest or continues to move at a constant velocity, unless acted upon by a force. The **second law** is- in an inertial frame of reference, the vector sum of the forces F on an object is equal to the mass *m* of that object multiplied by the acceleration a of the object: F = *m*a. (It is assumed here that the mass *m* is constant. The **third law** is-when one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body. The three laws of motion were first compiled by Isaac Newton . He used them to explain and investigate the motion of many physical objects and systems.

Questions on Newton's Law of Motion

1. Two bodies A and B, of same masses are moving with velocities v and 2v respectively. Compare their a) inertia and b) momentum.
2. How does Newton's Second law of motion differ from First law of motion?
3. Why does a glass vessel break when it falls on a hard floor, but it does not break when it falls on a carpet?
4. You pull your hands while catching a fast moving cricket ball. Use Newton's Second law of motion to explain this statement.
5. You prefer to land on sand instead of hard floor while taking a high jump. Use Newton's Second law of motion to explain this statement.