Chapter 5 — Work, Energy and Power

Exercise — Short Answer Questions (with Answers)

Class 9 Physics (New Syllabus) — Board Level

Q 5.1. What is the work done on an object that remains at rest when a force is applied on it?

Ans: Work done depends on displacement: $W = F \times S$. If the object stays at rest, its displacement S = 0, so W = F × 0 = 0. Hence no work is done, no matter how large the force. For example, a man pushing hard against a fixed wall does no work because the wall does not move.

Q 5.2. A slow-moving car may have more kinetic energy than a fast-moving motorcycle. How is this possible?

Ans: Kinetic energy $E_k = \frac{1}{2} m v^2$ depends on both mass and velocity. A car has a much greater mass than a motorcycle. Even though the car moves slowly, its large mass can make ½mv² greater than that of the light but fast motorcycle. So, a heavy slow car can possess more kinetic energy than a light fast motorcycle.

Q 5.3. A force F_1 does 5 J of work in 10 s. Another force F_2 does 3 J of work in 5 s. Which force delivers greater power?

Ans: Power P = W / t. For F_1: P_1 = 5 J ÷ 10 s = 0.5 W. For F_2: P_2 = 3 J ÷ 5 s = 0.6 W. Since $P_2 > P_1$, the second force F_2 delivers greater power — even though it does less total work, it does the work in a shorter time.

Q 5.4. A woman runs up a flight of stairs. The gain in her gravitational potential energy is 4500 J. If she runs up the same stairs with twice the speed, what will be her gain in potential energy?

Ans: Gravitational P.E. = *mgh*, which depends only on mass, g and height — not on speed. The height of the stairs and her mass are unchanged, so the gain in P.E. is still 4500 J. Running faster only increases her power (work done per unit time), not the potential energy gained.

Q 5.5. Define work and its SI unit.

Ans: Work is defined as the product of the magnitude of force and the distance covered in the direction of the force: $W = F \times S$. Its SI unit is the joule (J). One joule of work is done when a force of one newton moves a body through one metre in its own direction, i.e. 1 J = 1 N × 1 m.

Q 5.6. What is the potential energy of a body of mass m when raised through a height h?

Ans: When a body is raised to height h, work is done against gravity and is stored as gravitational potential energy. The force needed equals the weight, w = mg. Therefore P.E. = work done = force × height = *mgh*. Thus $\boldsymbol{E_p = mgh}$, where h is measured from the reference level.

Q 5.7. Find an expression for the kinetic energy of a moving body.

Ans: The kinetic energy equals the work done to stop the body: $E_k = F \times S$. Using F = ma, S = (v/2)t and a = v/t:

$E_k = ma \times S = m(v/t) \times (v/2)\, t = \frac{1}{2} m v^2$

Hence kinetic energy $\boldsymbol{E_k = \frac{1}{2} m v^2}$, where m is mass and v is velocity of the body.

Q 5.8. Define efficiency of a working system. Why can a system not have 100% efficiency?

Ans: Efficiency is the ratio of useful output energy to the total input energy: Efficiency = useful output energy / total input energy (× 100 for %). A system cannot have 100% efficiency because during every energy conversion some energy is always wasted, mostly as heat due to friction and air resistance. Since the output energy is always less than the input, efficiency is always less than 100%.

Q 5.9. What is power? Define the unit used for it.

Ans: Power is defined as the time rate of doing work: $P = W / t$. Its SI unit is the watt (W). One watt is the power of a system that does one joule of work in one second, i.e. 1 W = 1 J/s.

Q 5.10. Differentiate between renewable and non-renewable energy sources.

Ans: Renewable sources are those that are replaced by nature after use and never run out — e.g. hydroelectric, solar, wind, tidal, wave and geothermal energy. Non-renewable sources are those that deplete with continuous use and are not easily replaced — e.g. fossil fuels (coal, oil, natural gas) and nuclear fuels. Renewable sources are generally pollution-free, while non-renewable sources usually cause pollution.