CBSE Test Paper 02

Chapter 11 Work and Energy

1. When an object starts to fall freely, which statement is incorrect about it? **(1)**

   A Its potential energy is increased and kinetic energy is decreased

   B Its kinetic energy is increased and potential energy is decreased

   C Potential energy remains unchanged

   D Kinetic energy remains unchanged

   a. (a), (b), (c) and (d) are correct
   b. (b) and (c) are correct
   c. (a) and (b) are correct
   d. (a), (c) and (d) are incorrect

2. A microphone converts sound energy to **(1)**
   a. A pulse
   b. Sound energy
   c. Electrical signal/energy
   d. A wave

3. A boy of mass 50 kg runs up a staircase of 45 steps in 9 s. If the height of each step is 15 cm, find his power. Take g = 10 m s^{-2}. **(1)**
   a. 400 W
   b. 560 W
   c. 270 W
   d. 375 W

4. Match the following with correct response. **(1)**

Column A	**Column B**
(1) Kinetic energy	(A) Energy due to position
(2) Potential energy	(B) The rate of doing work
(3) Work	(C) Force displaces an object in the direction of force
(4) Power	(D) Energy due to motion

   a. 1-A, 2-C, 3-B, 4-D

b. 1-B, 2-D, 3-A, 4-C
c. 1-D, 2-A, 3-C, 4-B
d. 1-C, 2-B, 3-D, 4-A

5. A body is thrown vertically upwards, during its rise the P. E _____ and K. E _____. **(1)**
   a. decreases, increases
   b. remains same, remains same
   c. increases, increases
   d. increases, decreases
6. What is the work done when the force acting in the body and the displacement produced in the body are at right angles to each other? **(1)**
7. When do we say that work is done? **(1)**
8. A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy? **(1)**
9. What is power? **(1)**
10. What is the amount of work done by a force when a body moves in a circular path? **(1)**
11. Which would have greater effect on kinetic energy of an object - doubling the mass, or doubling the velocity? **(3)**
12. What is the work done by a coolie walking on a horizontal platform with a load on his head? **(3)**
13. A boy of mass 40 kg runs up flight of 50 steps each 10 cm high in 5 second. Find i) the work done by the boy ii) the power developed. ($g = 9.8\ ms^{-2}$) **(3)**
14. Derive an expression for the kinetic energy of the body? Calculate the kinetic energy for a body of mass 5 Kg moving a velocity 2.5 m/s^2. **(5)**
15. The area of cross-section of the stem of a hydrometer is 0.32 cm^2 and its length is 20 cm. Its mass is 22.8 g and volume of the bulb is 10 cm^3. Find. **(5)**
    i) The density of the liquid in which it floats upto its midpoint.
    ii) The density of the liquid in which it is completely immersed.

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Answers

1. d. (a), (c) and (d) are incorrect

   Explanation: When an object starts to fall freely, the K.E. increase with decrease in potential energy and total mechanical energy remains constant. So, statement A, C, and D are incorrect and B is correct.

2. c. Electrical signal/energy

   Explanation: Microphones are loudspeakers in reverse, it converts sound (mechanical) energy to electrical energy.

3. d. 375 W

   Explanation: Weight of the boy, mg = 50 kg × 10 m s^{-2} = 500 N
   Height of the staircase, h = 45 × $\frac{15}{100}$ m = 6.75 m
   Time taken to climb, t = 9 s
   Power = $\frac{Work\ done}{time\ taken}$
   P = $\frac{mgh}{t}$ = $\frac{500\ N\ \times\ 6.75\ m}{9s}$ = 375 W.
   Power is 375 W.

4. c. 1-D, 2-A, 3-C, 4-B

   Explanation: (1) Kinetic energy is the energy of motion. KE = $\frac{1}{2}$ mv^2
   (2) Energy possessed by an object because of its position is called potential energy.
   (3) Work is defined as a force acting upon an object to cause a displacement .
   (4) Rate of doing work is called power.

5. d. increases, decreases

   Explanation: When a body is thrown vertically upwards, during its upward movement the potential energy is increase due to increase in height and kinetic energy decreases due to decrease in velocity.

6. Zero

7. Work is said to be done when a force causes displacement of an object in the direction

of applied force.

8. A free falling object has maximum kinetic energy before hitting. Eventually on hitting ground it rolls and stops after some distance, since on striking the ground its kinetic energy is used to work against friction and kinetic energy is converted to heat energy.

9. Power is defined as the rate of doing work. It is measured in watt and also in horse power.

10. Work done is given by the expression W = FS cos θ. When a body moves in a circular path, then the displacement (S) is Zero. Therefore, the work done is W = F $\times$ 0 = 0

11. We know that KE $\propto$ m and KE $\propto$ v^2
    Therefore, by doubling the mass, the kinetic energy doubles, while by doubling the velocity, the kinetic energy increases four times. Therefore, doubling the velocity will have a greater effect on the kinetic energy of an object.

12. In order to balance the load on his head, the coolie applies a force on it in the upward direction, equal to its weight. His displacement is along the horizontal direction. Thus the angle between force F and displacement is 90^o.
    Therefore, work done W = Fs cosθ = Fs cos90° = 0

13. The boy has to overcome the force of gravity. Hence force of gravity on the boy
    F = mg = 40 × 9.8 = 392 N
    Total distance covered s = 50 × 10 = 500 cm = 5 m
    i) Work done by the body in climbing = force × distance = W = 392 × 5 = 1960 J
    ii) Power developed = $\frac{W}{t} = \frac{1960}{5}$ = 392 W

14. Kinetic energy of the body is defined as the energy possessed by the virtue of motion of the body. Let a body of mass 'm' is at rest.
    A force F N acts on it and produces an acceleration of a m/s^2 and it acquires a velocity of v m/s and moves a distance of s meter.
    Now, from third equation of motion
    $v^2 = u^2 + 2as$
    $v^2 = o + 2as$
    $a = \frac{v^2}{2s}$ (u = 0 because, body starts from rest)

From Newton's second law,

F = ma

put value of 'a' from above equation

$F = \frac{m \times v^2}{2s} = \frac{mv^2}{2s}$

Work Done on the moving Body = Kinetic energy

$= \text{Force} \times \text{Distance}$

$= \frac{mv^2}{2s} \times s = \frac{1}{2}mv^2$

Mass = 5 Kg

Velocity = 2.5 m/s

K.E. = $\frac{1}{2}mv^2$

$= \frac{1}{2} \times 5 \times (2.5)^2$

$= \frac{3125}{2 \times 100}$

$= \frac{1562.5}{100}$

K. E = 15.625 J

15. i. Let V_1 = Total volume immersed (upto mid-point)

= Volume of the bulb + Volume of the immersed part of stem

= 12 + 0.32 × 10(Volume = Area of cross section × immersed length)

= 15.2 cm^3

For a floating body,

Weight of solid (mg) = Upthrust (Vdg)

22.8 × g = 15.2 × d_1 × g

or $d_1 = \frac{22.8}{15.2}$ = 1.5 g cm^{-3}

ii. V_2 = Total volume immersed = Volume of the bulb + total volume of stem

= 12 + 0.32 × 20 = 18.4 cm^{-3}

Since weight = upthrust, therefore

22.8 = 18.4 × d_2

or $d_2 = \frac{22.8}{18.4}$ = 1.24 gcm^{-3}