PRISM WORLD

Std.: 9 (English)

Science 1

Chapter: 2

Q.1 Multiple Choice Questions 10

1 If we increase the velocity of a car moving on a flat surface to four times its original speed, its potential energy ....

a. will be twice its original energy. b. remains unchanged.
c. will be 4 times its original energy. d. will be 16 times its original energy.

Ans Option b.

2 The total energy of an object falling freely towards the ground ....

a. decreases b. remains unchanged.
c. increases. d. increases in the beginning and then decreases.

Ans Option b.

3 Power is a measure of the ....

a. The rapidity with which work is done
b. Amount of energy required to perform the work
c. The slowness with which work is performed
d. length of time

Ans Option a.

4 Which of the forces involved in dragging a heavy object on a smooth, horizontal surface, have the same magnitude?

a. The horizontal applied force b. Gravitational force
c. Reaction force in vertical direction d. Force of friction

Ans Option d.

5 The work done on an object does not depend on ....

a. displacement
b. applied force
c. initial velocity of the object
d. the angle between force and displacement.

Ans Option c.

6 .... are the forces involved in dragging a heavy object on a smooth, horizontal surface, having the same magnitude.

a. Horizontal applied force and gravitational force.
b. Gravitational force and reaction force in the vertical direction
c. Horizontal applied force and reaction force in the vertical direction.
d. Gravitational force and force of friction.

Ans Option b.

7 The potential energy of your body is least when you are ....

a. sitting on a chair. b. sitting on the ground.
c. sleeping on the ground. d. standing on the ground.

Ans Option c.

8 Joule is the unit of ....

a. force b. work c. power d. both (b) and (c)

Ans Option d.

9 For work to be performed, energy must be ....

a. Transferred from one place to another b. Concentrated
c. Transformed from one type to another d. Destroyed

Ans Option c.

10 While dragging or lifting an object, negative work is done by ....

a. the applied force. b. frictional force.
c. gravitational force. d. both (b) and (c).

Ans Option d.

Q.2 Solve Numerical problems **12**

1 Determine the amount of work done when an object is displaced at an angle of 30° with respect to the direction of the applied force.

Ans Given : Angle (θ) = 30°.

To find : Work done, W= ?

Solution : Work done on a body,

W= Force(F) x Displacement(s) x Cos θ.

$W = F\ s \cos\theta$

$W = F\ s \cos 30°$

$W = F\ s\ \frac{\sqrt{3}}{2}$

$W = \frac{\sqrt{3}}{2}$ **F s** joule.

Therefore, the work done by the force is $\frac{\sqrt{3}}{2}$ **F s** joule.

2 If a 1200 W electric iron is used daily for 30 minutes, how much total electricity is consumed in the month of April?

Ans Given : Power (P) = 1200 W = 1200×10^{-3} kW.

Time (t) = 30 min = 0.5 hr.

Number of days = 30 days(April).

To find : Electricity consumed(E) = ?

Solution : E = P x t x Number of days

$E = 1200 \times 10^{-3} \times 0.5 \times 30$

E = 18 unit.

Therefore, the total electricity consumed by electric iron is 18 unit.

3 An electric pump has 2 kW power. How much water will the pump lift every minute to a height of 10 m?

Ans Given : Power (P) = 2 kW = 2×10^3 W.

Time (t) = 1 min = 60 seconds.

Height(h) = 10 m.

To find : Mass (m) of water = ?

Solution : Power (P) $= \frac{\text{Work (W)}}{\text{Time (t)}} = \frac{mgh}{t}$

$2 \times 10^3 = \frac{m \times 9.8 \times 10}{60}$

$m = \frac{2 \times 10^3 \times 60}{9.8 \times 10}$

m = 1224.5 kg

Therefore, the amount of water lifted by the pump is 1224.5 kg.

4 Ravi applied a force of 10 N and moved a book 30 cm in the direction of the force. How much was the work done by Ravi?

Ans Given : Force, F = 10 N.

Displacement, s = 30 cm = 30×10^{-2} cm.

= 30×10^{-2} cm.

To find : Work done, W = ?

Solution : Work done on a body, W = Force(F) x Displacement(s)

$W = F \times s$
$W = 10 \times 30 \times 10^{-2}$ m
$W = 3$ J.

Therefore, the work done by Ravi is 3 J.

5 If the energy of a ball falling from a height of 10 m is reduced by 40%, how high will it rebound?

Ans Given : Height (h_1) = 10 m.
$(P.E.)_2 = (P.E.)_1 - 40\%$ of $(P.E.)_1 = 60\% \times (P.E.)_1$

To find : Height, (h_2) = ?

Solution : Potential energy, $(P.E.)_1 = m\,g\,h_1$. ………………(1)
$(P.E.)_2 = m\,g\,h_2$.
$60\% \times (P.E.)_1 = m\,g\,h_2$. ………………(2)

Dividing equation (1) and (2), we get,

$$\frac{60\% \times (P.E.)_1}{(P.E.)_1} = \frac{m\,g\,h_2}{m\,g\,h_1}$$ ……………..(2)

$$\frac{60}{100} = \frac{h_2}{10}$$

$$h_2 = \frac{60 \times 10}{100} = 6 \text{ m}$$

Therefore, the ball will rebound 6 m high.

6 The velocity of a car increases from 54 km/h to 72 km/h. How much is the work done if the mass of the car is 1500 kg?

Ans Given : Initially velocity, u = 54 km/hr = $54 \times \frac{5}{18}$ = 15 m/s.
Final velocity, v = 72 km/hr = $72 \times \frac{5}{18}$ = 20 m/s.
Mass, m = 1500 kg.

To find : Work, W = ?

Solution : Work, W = Final K.E. – Initial K.E.

$W = \frac{1}{2} \times m \times v^2 - \frac{1}{2} \times m \times u^2$
$W = \frac{1}{2} \times m\,(v^2 - u^2)$.
$W = \frac{1}{2} \times 1500\,(400 - 225)$
$W = \frac{1}{2} \times 1500\,(175)$
$W = 131250$.

Therefore, the amount of work done is 131250 J.

Q.3 Answer the following. **2**

1 If an object has zero momentum, does it have kinetic energy? Explain your answer.

Ans i. Momentum(p) of an object is the product of its mass(m) and velocity(v) i.e. $p = m \times v$
ii. If momentum of an object is zero, then its velocity (v) is also equal to zero. i.e. $v = 0$
iii. Kinetic energy of an object is given by, K.E. $= \frac{1}{2} mv^2 = \frac{1}{2} m (0)^2 = 0$
iv. Therefore, if an object has zero momentum, it does not have any kinetic energy

Q.4 Distinguish between **2**

1 Potential Energy and Kinetic Energy

Ans

	POTENTIAL ENERGY	KINETIC ENERGY
i.	Energy possessed by a body on account of its position or shape is called **P.E.**	Energy possessed by a body on account of motion is called **kinetic energy.**
ii.	It occurs in various forms	It occurs in only one form.
iii.	Work is not done till it is transformed into kinetic energy.	For doing work it does not have to be transformed into another form.
iv.	Mathematically, P.E = m x g x h	Mathematically, **K.E = ½ mv²**
v.	5. Potential energy depends upon the height of an object i.e. at ground level.	Kinetic energy is independent of the height of an object but depends on the velocity of the object. (If v

	(If h = 0, then P.E. = 0).	= 0, then K.E. = 0).
vi.	**Eg :** stretched spring, explosive material	**Eg :** wind, running train.

Q.5 **Extra data (Not to be Use)** 5

1 The work done on an object moving with uniform circular motion is zero.

Ans 1. When an object is moving in uniform circular motion, the force acting on it is along the radius of the circle and its displacement is along the tangent of the circle.
2. Thus they are perpendicular to each other.
3. So when the force and the displacement are perpendicular to each other, the work done by the force is zero.
Hence, The work done on an object moving with uniform circular motion is zero.

Q.6 **Answer the following in detail** 15

1 Prove that the kinetic energy of a freely falling object on reaching the ground is nothing but the transformation of its initial potential energy.

Ans i. Consider an object initially at point ‘A’, with potential energy = mgh.
ii. When the object is displaced from ‘A’ to ‘C’, under the influence of gravity, it is said to be in free fall.
iii. Let the velocity of the object at ground i.e., at point ‘C’ be v_C.
iv. The initial velocity of the object is zero, distance covered by the object is the height of free fall (h) and acceleration of the object is due to gravity (g).
v. According to Newton’s third equation of motion, $v^2 = u^2 + 2as$.
$v_C^2 = 0 + 2gh$.
$v_C^2 = 2gh$. ... (1)
vi. Kinetic energy of the object is given by, K.E. $= \frac{1}{2} mv^2$.
K.E. $= \frac{1}{2} m v_C^2$.
K.E. $\frac{1}{2} m (2gh)$. [From (1)]
K.E. $= mgh$

Thus, the kinetic energy of a freely falling object on reaching the ground is nothing but the transformation of its initial potential energy.

2 Study the following activity and answer the questions.
i. Take two alluminium channels of different lengths.
ii. Place the lower ends of the channels on the floor and hold their upper ends at the same height.
iii. Now take two balls of the same size and weight and release them from the top end of the channels. They will roll down and cover the same distance.

Questions
1. At the moment of releasing the balls, which energy do the balls have?
2. As the balls roll down which energy is converted into which other form of energy?
3. Why do the balls cover the same distance on rolling down?
4. What is the form of the eventual total energy of the balls?
5. Which law related to energy does the above activity demonstrate ? Explain.

Ans 1. **At the moment of releasing the balls, which energy do the balls have?**
At the moment of release, the balls will possess potential energy.
2. **As the balls roll down which energy is converted into which other form of energy?**
When balls roll down, potential energy gets converted into kinetic energy.
3. **Why do the balls cover the same distance on rolling down?**
Balls cover the same distance on rolling down because two balls are of same size and weight and are released from the same height. Therefore potential stored in them will be the same because potential energy depends only on the mass and height and is independent of the path followed.
4. **What is the form of the eventual total energy of the balls?**
The total energy fo the balls will be sum of their kinetic energy and potential energy. The total energy will always remain constant.
i.e., Total energy = Kinetic energy + Potential energy
5. **Which law related to energy does the above activity demonstrate? Explain.**
i. The above activity demonstrates law of conservation of energy correctly.
ii. Initially when ball was at rest it had potential energy stored in ti. When the ball is released, its potential

energy gets converted into kinetic energy and the net energy is conserved.

3 Derive the formula for the kinetic energy of an object of mass ‘m’, moving with velocity ‘v’?

Ans i. Consider a stationary object ($u = 0$) of mass ‘m’ which is set into motion due to the applied force ‘F’.

ii. Due to the applied force, the object undergoes an acceleration ‘a’ and after time ‘t’, the velocity of the object becomes ‘v’.

iii. During this time‘t’, the object displaces through distance ‘s’.

vi. Hence, the work done on the object is given by $W = F \times s$. ………….(1)

v. According to Newton’s second law of motion, $F = m \times a$. ………….(2)

vi. Similarly, according to Newton’s second equation of motion,

$s = ut + \frac{1}{2} a t^2$.

$s = 0 + \frac{1}{2} a t^2$.

$s = \frac{1}{2} a t^2$. ………….(3)

vii. Substituting values in eq. (2) and (3) in eq. (1), we get,

$W = ma \times \frac{1}{2} a t^2$

$W = \frac{1}{2} m (a t)^2$. ………….(4)

viii. Using Newton’s first equation of motion, $v = u + at$.

$v = 0 + at = at$.

Squaring on both sides, we get,

$v^2 = (at)^2$. ………….(5)

From eq. (4) and (5), we get, $W = \frac{1}{2} mv^2$.

ix. The kinetic energy gained by an object is equal to the amount of work done on the object.

i.e. K.E. = W

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