QB365 Question Bank Software Study Materials

Work, Energy and Power Important 2 Marks Questions With Answers (Book Back and Creative)

11th Standard

Physics

Total Marks : 60

2 Marks

30 x 2 = 60

1) Explain how the definition of work in physics is different from general perception.

Answer : In Physics, work is said to be done by the force when applied on a body displaces it. To do work, energy is required. But, generally work refers to both physical and mental work. In fact, any activity can be called as work.

2) Explain the characteristics of elastic and inelastic collision.

Answer : **Characteristics of elastic collision are**

1. Total momentum remains conserved
2. Total kinetic energy remains conserved.
3. In elastic collision conservative forces are involved. Hence total kinetic energy is conserved.
4. In elastic collision, mechanical energy is not dissipated.

Characteristics of inelastic collision are

1. Total momentum is conserved.
2. Total kinetic energy is not conserved.
3. Forces involved are non-conservative forces
4. Mechanical energy is dissipated into heat, light, sound etc.

3) Two different unknown masses A and B collide. A is initially at rest when B has a speed v. After collision B has a speed v/2 and moves at right angles to its original direction of motion. Find the direction in which A moves after collision?

Answer : After collision, along x-ax is

$m_1u_1 = m_1v_1\cos\theta_1 + m_2v_2\cos\theta_2$

Along Y-ax is

$0 = m_1v_1\sin\theta_1 - m_2v_2\sin\theta_2$

$m_1v_1\sin\theta_1 = m_2v_2\sin\theta_2$

$m_1 = m_2$

$\therefore v\sin\theta = \frac{v}{2}\sin 90^\circ$

$\sin\theta = \frac{1}{2}\times 1 = \frac{1}{2}$

$\therefore \theta = \sin^{-1}(0.5) = 30^\circ$

4) A bullet of mass 20 g strikes a pendulum of mass 5 kg. The centre of mass of pendulum rises a vertical distance of 10 cm. If the bullet gets embedded into the pendulum, calculate its initial speed?

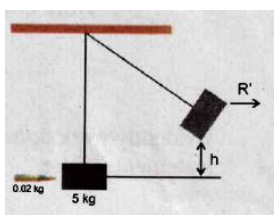
Answer : Mass of a bullet $m = 20g = 20\times10^{-3}$ kg $= 0.02$ kg

Mass of a pendulum $M = 5$ kg

Height h $= 10$ cm

$= 10\times10^{-2}$

$= 0.1$ m



K.E. of the block = P.E. of the block

$\frac{1}{2}Mv^2 = Mgh$

$\therefore v^2 = \sqrt{2gh}$

$= \sqrt{2\times9.8\times0.1} = \sqrt{1.96} = 1.4$ m/s

$\therefore$ Final speed $v = 1.4$ m/s

Final speed $v = \frac{m_1u_1+m_2u_2}{(m_1+m_2)}$

$v_1 = \frac{0.02u_1+5\times0}{(0.02+5)} = \frac{0.02}{5.02}u_1$

But $v = 1.4$

$\therefore 1.4 = \frac{0.02}{5.02}u_1$

$u_1 = \frac{1.4\times5.02}{0.02} = \frac{7.028}{0.02} = 351.4\ \text{m/s}$

$\therefore$ Initial speed $= 351.4\ \text{m/s}$

5) A box is pulled with a force of 25 N to produce a displacement of 15 m. If the angle between the force and displacement is 30°, find the work done by the force.

Answer : Force, F = 25 N

Displacement, dr = 15 m

Angle between F and dr, θ = 30°

Work done, W = F dr cos θ

W = 25 x 15 x cos 30° = $25\times15\times\frac{\sqrt{3}}{2}$

W = 324.76 J

6) A weight lifter lifts a mass of 250 kg with a force 5000 N to the height of 5m

(a) What is the work done by the weight lifter?

(b) What is the work done by the gravity?

(c) What is the net work done on the object?

Answer : a) When the weight lifter lifts the mass, force and displacement are in the same direction, which means that the angle between them θ = 0°. Therefore, the work done by the weight lifter,

$W_{\text{weight lifter}} = F_w h \cos\theta = F_w h\ (\cos 0°)$

$= 5000\times5\times(1) = 25{,}000$ joule$= 25$ kJ

(b) When the weight lifter lifts the mass, the gravity acts downwards which means that the force and displacement are in opposite direction. Therefore, the angle between them θ = 180°.

$W_{\text{gravity}} = F_g h \cos\theta = mgh(\cos 180°)$

$= 250\times10\times5\times(-1) = -12{,}500$ joule $= -12.5$ kJ

(c) The net work done (or total work done) on the object

$W_{\text{net}} = W_{\text{weight lifter}} + W_{\text{gravity}}$

= 25 kJ -12.5 kJ = +12.5 kJ

7) A variable force $F = kx^2$ acts on a particle which is initially at rest. Calculate the work done by the force during the displacement of the particle from x = 0 m to x = 4 m. (Assume the constant k = 1 N m^{-2})

Answer : Work done, $W - \int_{x_i}^{x_f} F(x)dx = k\int_0^4 x^2dx = \frac{64}{3}Nm$

8) Consider an object of mass 2 kg moved by an external force 20 N in a surface having coefficient of kinetic friction 0.9 to a distance 10 m. What is the work done by the external force and kinetic friction? Comment on the result. (Assume g = 10 ms^{-2})

Answer : m = 2 kg, d = 10 m, F_{ext} = 20 N, μ_k = 0.9.

when an object is in motion on he horizontal surface, it experiences two forces.

(a) External force, F_{ext} = 20 N

(b) Kinetic friction,

$f_k = \mu_k\ mg = 0.9 \times (2) \times 10 = 18N$

The work done by the external force $W_{ext} = Fd = 20 \text{ x } 10 = 200J$

The work done by the force of kinetic friction $W_k = f_k d = (-18) \times 10 = -180$ J. Here the negative sign implies that the force of kinetic friction is opposite to the direction of displacement.

The total work done on the object $W_{total} = W_{ext} + W_k = 200$ J - 180 J = 20 J.

Since the friction is a non-conservative force, out of 200 J given by the external force, the 180 J is lost and it can not be recovered.

9) Calculate the energy consumed in electrical units when a 75 W fan is used for 8 hours daily for one month (30 days).

Answer : Power, P = 100 W

Time of usage, t = 8 hour × 30 days = 240 hours

Electrical energy consumed is the product of power and time of usage.

Electrical energy = power × time of usage = P × t

= 75 watt × 240 hour = 18000 watt hour = 18 kilowatt hour = 18 kWh

1 electrical unit = 1 kWh

Electrical energy = 18 unit

10) A vehicle of mass 1250 kg is driven with an acceleration 0.2 along a straight level road against an external resistive force 500 N. Calculate the power delivered by the vehicle's engine if the velocity of the vehicle is 30 ms^{-1}.

Answer : The vehicle's engine has to do work against resistive force and make vehicle to move with an acceleration. Therefore, power delivered by the vehicle engine is

P (resistive force + mass x acceleration) (velocity)

$$P = \overrightarrow{F_{-tot}}\vec{v} = (F_{resistance} + F)\,\vec{v}$$

$$P = \overrightarrow{F_{tot}}.\,\vec{v} = (F_{resistance} + ma)\,\vec{v}$$

= (500 N + (1250 kg) × (0.2 ms^{-2})) (30 ms^{-1}) = 22.5 kW

11) Calculate the work done by a force of 30N in lifting a load of 2Kg to a highest of 10m (g = 10 m s^{-2})

Answer : Force f = 30N

Mass m = 2 kg

Height h = 10 m

g = 10 ms^{-2}

Work done, W = f x h

W = 30 x 10

= 300 J

12) What is the work done by the centripetal force in circular motion?

Answer : In circular motion the centripetal force does not do work on the object moving on a circle as it is always perpendicular to the displacement.

F dr cos 90° [cos 90°=0]

∴ W=0

13) Define power.

Answer : Power is defined as the rate of work done or energy delivered.

Power(P)=$\frac{work\ done(W)}{time\ taken(t)}$

14) A charged particle moves towards another charged particle. Under what conditions the total momentum and the total energy of the system conserved?

Answer : (i) Both charged particles shall be dissimilar charge. (i.e. positive and negative)

(ii) After collision the charged particles should stick together permanent.

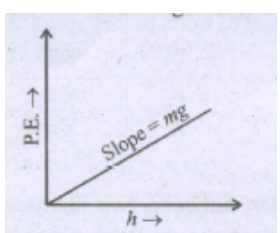
(iii) They should move with common velocity.

15) Is whole of the kinetic energy lost in any perfectly inelastic collision?

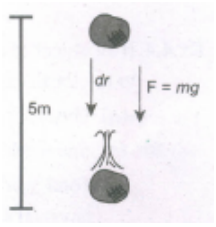
Answer : No, only that much amount of kinetic energy is lost as is necessary for the conservation of momentum.

16) Draw a graph showing the variation of potential energy of an object thrown vertically upward by a boy with respect to its height.

Answer : As P.E. = mgh ⇒ P.E., ∞ h. So the graph of P.E. verses height is a straight line as shown.



17) An object of mass 2 kg falls from a height of 5 m to the ground. What is the work done by the gravitational force on the object? (Neglect air resistance; Take g = 10m s^{-2}).



Answer : $W = \int_{r_i}^{r_f} \vec{F}.d\vec{r}$

$W = (F\,cos\theta)\int_{r_i}^{r_f} dr = (mg\,cos\theta)(r_f - r_i)$

The object also moves downward which is in the direction of gravitational force ($\vec{F} = m\vec{g}$) as shown in figure. Hence, the angle between them is 9 = 0° cos 0° = 1 and the displacement, (r_f-r_ji) = 5 m

W = mg (r_f - r_i)

W = $2\times10\times5$ = 100J

The work done by the gravitational force on the object is positive

18) A force $\vec{F} = \vec{i} + 2\vec{j} + 3\vec{k}$ k acts on a particle and displaces it through a distance $\vec{S} = 4\vec{i} + 6\vec{j}$. Calculate the work done if force and work done are in the same direction?

Answer : Force $\vec{F} = \vec{i} + 2\vec{j} + 3\vec{k}$

Distance $\vec{S} = 4\vec{i} + 6\vec{j}$

Work done $\vec{F}.\vec{S} = (\vec{i}2\vec{j} + 3\vec{k}).(4\vec{i} + 6\vec{j}) = 4 + 12 + 0 = 16J$

19) Define the conservative and non-conservative forces. Give examples of each.

Answer : **Conservative force:** e.g., Gravitational force, electrostatic force.

Non-Conservative force: e.g., forces of friction, viscosity.

20) Does the P.E. of a spring decreases or increases when it is compressed or stretched?

Answer : Increases because WD on it when it increases is compressed or stretched.

21) Name a process in which momentum changes but KE. does not.

Answer : Uniform circular motion.

22) A body is moving along the z-axis of a coordinate system under the effect of a constant force F = Find the work done by the force in moving the body a distance of 2 m along the z-axis.

Answer : $\vec{F} = \left(2\hat{i} + 3\hat{j} + \hat{k}\right)N,\ \vec{s} = 2\hat{k}$

$W = \vec{F}.\vec{S} = 2J$

23) Two bodies of unequal masses have same linear momentum, which one has greater kinetic energy?

Answer : Kinetic energy K.E. = $\frac{1}{2}mv^2 = \frac{(mv)^2}{2m} = \frac{p^2}{2m}$

For same momentum $K.E\alpha\frac{1}{m}$

Hence the lighter body has more kinetic energy than the heavier body.

24) During the motion of a body in a vertical circle does the tension of the string do work. Give reason.

Answer : The tension will not do any work on the mass as the tension and the direction of motion is always perpendicular.

25) State the unit and dimension work.

Answer : The unit of work s joule and its dimension is ML^2T^2.

26) Mention the relation between

(i) One kilowatt hour and joule

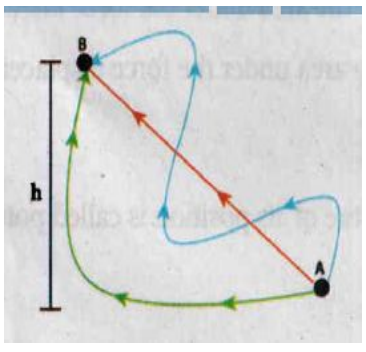
(ii) One erg and joule

Answer : (i) One kilowatt hour (1Kwh) = 3.6×10^6 J

(ii) One erg = 10^{-7} J

27) Represent conservative force with the help of a diagram.

Answer :



28) What is meant by mechanical energy?

Answer : The energy possessed by a body due to its position or motion is called mechanical energy.

29) State the value of one electrical unit.

Answer : 1 electrical unit = 1 kwh

$= 1 \times (10^3 \text{ w}) \times (3600 \text{ s})$

1 electrical unit $= 3600 \times 10^3$ Ws

1 electrical unit $= 3.6 \times 10^6$ J

30) Which physical quantity is conserved during elastic and inelastic collisions?

Answer : The total linear momentum of the system.