



Chapter 5 : Work, Energy and Power (50 Important MCQs)

by - Tomar Sir

Notes

50 important MCQs from GSEB, CBSE, NEET and JEE exams · Answer key at the end

Section A — Multiple Choice Questions

Each question carries 1 mark. Choose the correct option.

Q.1 The bob of mass 50 g of a pendulum of length 1.5 m is released from rest with the string horizontal (point A). What is its kinetic energy at the lowermost point B? ($g = 10 \text{ m/s}^2$)

- (A) $2.5 \times 10^{-1} \text{ J}$ (B) $15 \times 10^{-1} \text{ J}$ (C) $5 \times 10^{-1} \text{ J}$ (D) $7.5 \times 10^{-1} \text{ J}$

Q.2 A particle of mass m moves on a circular path of radius r . Its centripetal acceleration is kt^2 , where k is a constant and t is time. The power delivered to the particle as a function of t is

- (A) kmt (B) $kmrt$ (C) km/t (D) kmr/t

Q.3 When a spring is stretched by 2.5 cm, the elastic potential energy stored in it is U . If it is stretched by 5 cm, its elastic potential energy becomes

- (A) $U/2$ (B) $4U$ (C) $2U$ (D) $U/4$

Q.4 The mass of a car is 1500 kg. How much work must be done on it to make it move with a speed of 72 km/h (starting from rest)?

- (A) $30 \times 10^5 \text{ J}$ (B) $3 \times 10^5 \text{ J}$ (C) $1.6 \times 10^6 \text{ J}$ (D) $3 \times 10^4 \text{ J}$

Q.5 A particle moves from $x = 0$ to $x = 2 \text{ m}$ along the X-axis under the force $\vec{F}(x) = (4x^3 - 3x^2 + 2x + 5) \hat{i}$ N. The work done on the particle is

- (A) 22 J (B) 36 J (C) 46 J (D) none of these

Q.6 A force $\vec{F} = (60\hat{i} + 15\hat{j} - 3\hat{k}) \text{ N}$ acts on a particle moving with velocity $\vec{v} = (2\hat{i} - 4\hat{j} + 5\hat{k}) \text{ m/s}$. The power is _____ W.

- (A) 30 (B) 450 (C) 45 (D) 90

Q.7 A body is displaced by 6 m in the Y-direction by a force $(5, 2, 3) \text{ N}$. The work done is

- (A) 12 N (B) 12 V (C) 12 m (D) 12 J

Q.8 With what speed should a student of mass 80 kg run so that his kinetic energy becomes 320 J?

- (A) 2 m/s (B) $\sqrt{2} \text{ m/s}$ (C) 3 m/s (D) $2\sqrt{2} \text{ m/s}$

Q.9 A bullet fired into a large wooden block loses half its velocity after penetrating 6 cm. Assuming a constant resistive force, how much further will it travel before its velocity becomes $1/4$ of the initial velocity?

- (A) 3.0 cm (B) 2.5 cm (C) 2.0 cm (D) 1.5 cm

Q.10 A particle is subjected to a force that varies with displacement as follows: $F = 0$ from 0 to 3 m; $F = 2$ N from 3 m to 7 m; then F decreases linearly from 2 N at 7 m to zero at 12 m. The work done on the particle over the displacement of 12 m is

- (A) 18 J (B) 21 J (C) 26 J (D) 13 J

Q.11 A uniform force $(3\hat{i} + \hat{j})$ N acts on a particle of mass 2 kg, which is displaced from position $(2\hat{i} + \hat{k})$ m to $(4\hat{i} + 3\hat{j} - \hat{k})$ m. The work done by the force is

- (A) 15 J (B) 9 J (C) 6 J (D) 13 J

Q.12 A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest, the force on the particle at time t is

- (A) $\sqrt{mk} t^{-1/2}$ (B) $\sqrt{2mk} t^{-1/2}$ (C) $\frac{1}{2}\sqrt{mk} t^{-1/2}$ (D) $\sqrt{\frac{mk}{2}} t^{-1/2}$

Q.13 Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2 . On collision, one of the particles gets excited to a higher level after absorbing energy ε . If the final velocities are v_1 and v_2 , then we must have

- (A) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$
 (B) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$
 (C) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$
 (D) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

Q.14 A ball is thrown vertically downwards from a height of 20 m with an initial velocity v_0 . It collides with the ground, loses 50% of its energy in the collision and rebounds to the same height. The initial velocity v_0 is ($g = 10 \text{ m s}^{-2}$)

- (A) 10 m s^{-1} (B) 14 m s^{-1} (C) 20 m s^{-1} (D) 28 m s^{-1}

Q.15 On a frictionless surface, a block of mass M moving at speed v collides elastically with another block of the same mass M at rest. After the collision, the first block moves at an angle θ to its initial direction with speed $v/3$. The second block's speed after the collision is

- (A) $\frac{\sqrt{3}}{2}v$ (B) $\frac{2\sqrt{2}}{3}v$ (C) $\frac{3}{4}v$ (D) $\frac{3}{\sqrt{2}}v$

Q.16 A body of mass 1 kg begins to move under the action of a time-dependent force $\vec{F} = (2t\hat{i} + 3t^2\hat{j})$ N. The power developed by the force at time t is

- (A) $(2t^2 + 4t^4) \text{ W}$ (B) $(2t^3 + 3t^4) \text{ W}$ (C) $(2t^3 + 3t^5) \text{ W}$ (D) $(2t^2 + 3t^3) \text{ W}$

Q.17 What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

- (A) $\sqrt{2gR}$ (B) $\sqrt{3gR}$ (C) $\sqrt{5gR}$ (D) $\sqrt{gR}$

Q.18 A body starts from rest under a source of constant power. Which graph correctly shows displacement (s) against time (t)?

- (A) s decreases with t , curving down to zero
 (B) a straight line through the origin
 (C) a horizontal line (s constant)
 (D) a curve through the origin bending upward (slope increasing)

Q.19 A body initially at rest slides along a frictionless track from a height h and just completes a vertical circle of diameter $AB = D$ at the bottom of the track. The height h is

- (A) $\frac{5}{4}D$ (B) $\frac{3}{2}D$ (C) $\frac{7}{5}D$ (D) D

Q.20 A block of mass m moving with velocity v collides with a stationary block of mass $4m$. The lighter block comes to rest after the collision. The coefficient of restitution e is

- (A) 0.4 (B) 0.5 (C) 0.8 (D) 0.25

Q.21 A force $F = 20 + 10y$ acts on a particle in the y -direction, where F is in newton and y in metre. The work done by this force to move the particle from $y = 0$ to $y = 1$ m is

- (A) 20 J (B) 30 J (C) 5 J (D) 25 J

Q.22 Body A of mass $4m$ moving with speed u collides head-on and elastically with body B of mass $2m$ at rest. The fraction of its energy lost by A is

- (A) $5/9$ (B) $1/9$ (C) $8/9$ (D) $4/9$

Q.23 A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when

- (A) it is inclined at 60° from the vertical (B) the mass is at the highest point
(C) the wire is horizontal (D) the mass is at the lowest point

Q.24 An electric lift with a maximum load of 2000 kg (lift + passengers) moves up with a constant speed of 1.5 m s^{-1} . The frictional force opposing the motion is 3000 N. The minimum power delivered by the motor to the lift is ($g = 10 \text{ m s}^{-2}$)

- (A) 34500 W (B) 23500 W (C) 23000 W (D) 20000 W

Q.25 Two bodies A and B of the same mass undergo a completely inelastic one-dimensional collision. A moves with velocity v_1 while B is at rest. The velocity of the system after the collision is v_2 . The ratio $v_1 : v_2$ is

- (A) 4 : 1 (B) 1 : 4 (C) 1 : 2 (D) 2 : 1

Q.26 Two heaters A and B have power ratings of 1 kW and 2 kW respectively. They are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for the two cases is

- (A) 1 : 2 (B) 2 : 3 (C) 1 : 1 (D) 2 : 9

Q.27 A body of mass 5 kg is raised through a height of 10 m by a force of 170 N. Its velocity at this height will be ($g = 10 \text{ m/s}^2$)

- (A) 15 m/s (B) 37 m/s (C) 9.8 m/s (D) 22 m/s

Q.28 A spring of spring constant k extends by x on loading. If T is the tension in the spring, the energy stored in the spring is

- (A) $\frac{T^2}{2x}$ (B) $\frac{T^2}{2k}$ (C) $\frac{2k}{T^2}$ (D) $\frac{2T^2}{k}$

Q.29 A body of mass 5 kg has a momentum of 10 kg m s^{-1} . A force of 0.2 N is applied on it in the direction of motion for 10 s. What is the change in its kinetic energy?

- (A) 1.1 J (B) 2.2 J (C) 3.3 J (D) 4.4 J

Q.30 A particle of mass m moving in the x -direction with speed $2v$ is hit by another particle of mass $2m$ moving in the y -direction with speed v . If the collision is perfectly inelastic, the percentage loss of energy is close to

- (A) 44% (B) 50% (C) 56% (D) 62%

Q.31 A time-dependent force $F = 6t$ acts on a particle of mass 1 kg. If the particle starts from rest, the work done by the force during the first 1 s is

- (A) 9 J (B) 18 J (C) 4.5 J (D) 22 J

Q.32 In a collinear collision, a particle with initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles after the collision is

- (A) $\frac{v_0}{4}$ (B) $\sqrt{2} v_0$ (C) $\frac{v_0}{2}$ (D) $\frac{v_0}{\sqrt{2}}$

Q.33 A neutron suffers an elastic head-on collision with a deuterium nucleus at rest; its fractional loss of energy is P_d . For a similar collision with a carbon nucleus at rest, the fractional loss is P_c . The values of P_d and P_c are respectively

- (A) (0.89, 0.28) (B) (0.28, 0.89) (C) (0, 0) (D) (0, 1)

Q.34 A particle experiencing a force $\vec{F} = 3\hat{i} - 12\hat{j}$ undergoes a displacement $\vec{d} = 4\hat{i}$. If it had a kinetic energy of 3 J at the beginning, what is its kinetic energy at the end of the displacement?

- (A) 9 J (B) 12 J (C) 10 J (D) 15 J

Q.35 A 60 HP electric motor lifts an elevator with a maximum total load of 2000 kg. If the frictional force on the elevator is 4000 N, the speed of the elevator at full load is close to (1 HP = 746 W, $g = 10 \text{ m/s}^2$)

- (A) 1.9 m/s (B) 1.7 m/s (C) 2 m/s (D) 1.5 m/s

Q.36 A particle of mass 1 kg slides from rest down a frictionless track from point A at height 2 m. It leaves the track and moves freely as a projectile. At the highest point P of its flight (height 1 m), its kinetic energy is ($g = 10 \text{ m/s}^2$)

- (A) 5 J (B) 10 J (C) 20 J (D) 30 J

Q.37 An elevator can carry a maximum of 10 persons of average mass 68 kg. The elevator itself has mass 920 kg and moves up with a constant speed of 3 m/s against a frictional force of 6000 N. The minimum power delivered by the motor at full capacity is ($g = 10 \text{ m/s}^2$)

- (A) 66000 W (B) 63248 W (C) 48000 W (D) 56320 W

Q.38 Blocks of masses $m, 2m, 4m$ and $8m$ are placed in a line on a frictionless floor. Another block of mass m moving with speed v along the line collides with the first block (mass m) in a perfectly inelastic manner, and all subsequent collisions are also perfectly inelastic. By the time the last block ($8m$) starts moving, the total energy loss is $p\%$ of the original energy. p is close to

- (A) 87 (B) 37 (C) 94 (D) 77

Q.39 A particle tied to a light string of length l (m) revolves in a vertical circle. The ratio of maximum to minimum tension is 5 : 1. The minimum speed in the motion is

- (A) $\sqrt{\frac{5gl}{4}}$ (B) $\sqrt{\frac{5gl}{8}}$ (C) $\sqrt{\frac{5gl}{2}}$ (D) $\sqrt{\frac{5gl}{16}}$

Q.40 A block of mass 5.99 kg hangs from a string. A small mass of 10 g strikes it with velocity v and sticks to it (perfectly inelastic collision). If the system rises to a height of 9.8 cm, find v . ($g = 10 \text{ m/s}^2$)

- (A) 800 m/s (B) 840 m/s (C) 900 m/s (D) 1000 m/s

Q.41 A body of mass 10 kg is at point A at a height of 10 m on a smooth track. It slides down and then up to point B at a height of 5 m. Its speed at B is ($g = 10 \text{ m/s}^2$)

- (A) 5 m/s (B) $\sqrt{20}$ m/s (C) 10 m/s (D) 20 m/s

Q.42 Two billiard balls, each of mass 0.05 kg, moving in opposite directions with 10 m s^{-1} , collide and rebound with the same speed. If the contact time is 0.005 s, the force exerted on each ball is

- (A) 100 N (B) 200 N (C) 300 N (D) 400 N

Q.43 A bag of sand of mass 9.8 kg is suspended by a rope. A bullet of mass 200 g travelling at 10 m s^{-1} gets embedded in it. The loss of kinetic energy is

- (A) 4.9 J (B) 9.8 J (C) 14.7 J (D) 19.6 J

Q.44 A body of mass 1000 kg is moving horizontally with velocity 6 m/s. Another body of mass 200 kg is gently placed on it. The new velocity is

- (A) 5 m/s (B) 4 m/s (C) 2 m/s (D) 3 m/s

Q.45 A simple pendulum of length 10 m is released with its string horizontal. 10% of its energy is lost by the time the bob reaches the lowermost position. The speed of the bob there is ($g = 10 \text{ m/s}^2$)

- (A) 6 m/s (B) $6\sqrt{5}$ m/s (C) $7\sqrt{5}$ m/s (D) $4\sqrt{2}$ m/s

Q.46 A particle tied to a light thread performs vertical circular motion. Its speed at the lowermost point B is just sufficient to complete the circle. Ignoring air friction, the ratio of kinetic energy at the topmost point A to that at B is

- (A) 1 : 5 (B) 5 : 1 (C) $1 : 7\sqrt{2}$ (D) $1 : 5\sqrt{2}$

Q.47 An artillery gun of mass M_1 fires a shell of mass M_2 . At the time of firing, the ratio of kinetic energy of the gun to that of the shell is

- (A) $\frac{M_2}{M_1}$ (B) $\frac{M_1 + M_2}{M_1}$ (C) $\frac{M_1 + M_2}{M_2}$ (D) $\frac{M_1}{M_1 + M_2}$

Q.48 A bob of mass m hangs from point O by a light string of length l . It is given a horizontal velocity v_0 at the lowest point A, and the string just becomes slack at the highest point D. B is the point where the string makes 60° with the downward vertical, and C is the point where it makes 60° with the upward vertical. The ratio of kinetic energies at B and C is

- (A) 1 (B) 3 (C) 4 (D) 2

Q.49 A force $F = \alpha + \beta x^2$ acts on an object in the x-direction. The work done by the force is 5 J when the object is displaced by 1 m (from $x = 0$). If $\alpha = 1 \text{ N}$, then β is

- (A) 8 N/m^2 (B) 15 N/m^2 (C) 12 N/m^2 (D) 10 N/m^2

Q.50 A spring is compressed by 1 cm by a force of 3.92 N. Find the potential energy of the spring when it is compressed by 10 cm.

- (A) 1.96 J (B) 2.45 J (C) 19.6 J (D) 196 J

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	D	11	B	21	D	31	C	41	C
2	B	12	D	22	C	32	B	42	B
3	B	13	B	23	D	33	A	43	B
4	B	14	C	24	A	34	D	44	A
5	A	15	B	25	D	35	A	45	B
6	C	16	C	26	D	36	B	46	A
7	D	17	C	27	D	37	A	47	A
8	D	18	D	28	B	38	C	48	D
9	D	19	A	29	D	39	C	49	C
10	D	20	D	30	C	40	B	50	A

