Work, Energy and Power

Class 11 Physics · 24 NEET MCQs with answers & explanations

Work, Energy and Power covers work done by constant and variable forces, kinetic and potential energy, work-energy theorem, conservation of energy, power and collisions (elastic and inelastic). NEET tests energy conservation problems, work-energy theorem application and collision calculations.

Key Energy Concepts

Concept	Key Formula / Fact
Work	$W = F \cdot d \cdot \cos\theta$; positive if $\theta < 90°$; zero if $\theta = 90°$; negative if $\theta > 90°$
KE	$KE = \frac{1}{2}mv^2$; work-energy theorem: $W_{net} = \Delta KE$
PE (spring)	$PE = \frac{1}{2}kx^2$; restoring force $F = -kx$ (Hooke's law)
Conservation	KE + PE = constant (no non-conservative forces)
Power	$P = W/t = F \cdot v$; SI unit: watt (W)
Elastic collision	Both momentum and KE conserved; in 1D with equal masses: velocities exchange

Questions

Q1. Which of the following is the correct SI unit of work?

(A) Newton
(B) Joule
(C) Watt
(D) Pascal

Q2. A force of 20 N acts on a body causing a displacement of 5 m in the same direction. The work done is:

(A) 25 J
(B) 4 J
(C) 100 J
(D) 15 J

Q3. Gravitational potential energy of a body of mass m at a height h above the Earth's surface (near the surface) is given by:

(A) mgh
(B) $\frac{1}{2}mgh$
(C) mgh^2
(D) mg/h

Q4. A body of mass 5 kg is raised vertically through 8 m. Take g = 10 m/s². The increase in its gravitational potential energy is:

(A) 200 J
(B) 400 J
(C) 800 J
(D) 40 J

Q5. The centre of mass of a uniform rod lies at:

(A) Its geometric centre
(B) One-fourth of its length from one end
(C) One-third of its length from one end
(D) One end of the rod

Q6. Two particles of masses 2 kg and 3 kg are at x = 0 m and x = 10 m. The x-coordinate of their COM is:

(A) 4 m
(B) 6 m
(C) 5 m
(D) 8 m

Q7. A collision in which both momentum and kinetic energy are conserved is called:

(A) Elastic collision
(B) Inelastic collision
(C) Perfectly inelastic collision
(D) Oblique collision

Q8. Two bodies stick together after a collision and move as one combined mass. This type of collision is called:

(A) Elastic
(B) Perfectly inelastic
(C) Partially inelastic
(D) Partially elastic

Q9. A ball is dropped from a height h. Neglecting air resistance, which quantity remains constant throughout its motion?

(A) Mechanical energy
(B) Kinetic energy
(C) Potential energy
(D) Momentum

Q10. A body of mass 2 kg falls freely from a height of 20 m. Take g = 10 m/s². Its total mechanical energy during the motion is:

(A) 200 J
(B) 400 J
(C) 800 J
(D) 0 J

Q11. The SI unit of power is:

(A) Watt
(B) Joule
(C) Newton
(D) Pascal

Q12. A machine does 2400 J of work in 30 s. Its average power is:

(A) 60 W
(B) 80 W
(C) 90 W
(D) 100 W

Q13. A 4 kg block slides down a smooth incline from a vertical height of 5 m. The speed of the block at the bottom is: (g = 10 m/s²)

(A) 5 m/s
(B) 10 m/s
(C) 7 m/s
(D) √50 m/s

Q14. A spring of spring constant 500 N/m is compressed by 0.2 m. The elastic potential energy stored is:

(A) 20 J
(B) 100 J
(C) 10 J
(D) 2 J

Q15. The work-energy theorem states that the net work done on a body is equal to:

(A) Change in kinetic energy
(B) Change in potential energy
(C) Total mechanical energy
(D) Change in momentum

Q16. A net force of 20 N acts on a block causing it to move 5 m in the direction of force, starting from rest. The increase in kinetic energy is:

(A) 50 J
(B) 100 J
(C) 20 J
(D) 200 J

Q17. A force F acts on a particle. Which condition confirms that F is a conservative force?

(A) The work done by F depends only on the initial and final positions of the particle
(B) The work done by F is always positive
(C) The force F always acts in the direction of motion
(D) The magnitude of F is constant throughout the motion

Q18. A particle travels from A to B under gravity, taking a winding path three times longer than the straight-line distance. Compared to the straight-line path, the work done by gravity along the winding path is:

(A) Three times greater
(B) Exactly the same
(C) One-third as much
(D) Zero because the path is not straight

Q19. The kinetic energy of a body of mass m moving with speed v is given by:

(A) ½mv²
(B) mv²
(C) 2mv²
(D) mv/2

Q20. A body of mass 4 kg moves with a speed of 5 m/s. Its kinetic energy is:

(A) 25 J
(B) 20 J
(C) 50 J
(D) 100 J

Q21. A graph of potential energy U versus position x has a minimum at x = 4 m and the curve is smooth on both sides. The nature of equilibrium at x = 4 m and the force on a particle placed exactly there are:

(A) Stable equilibrium; force is zero
(B) Unstable equilibrium; force is zero
(C) Stable equilibrium; force is at maximum
(D) Neutral equilibrium; force is constant

Q22. The potential energy curve of a particle has a smooth maximum at x = 2 m. The nature of equilibrium at this point and the force on the particle placed exactly there are:

(A) Stable equilibrium; force directed toward x = 2 m
(B) Unstable equilibrium; force is zero
(C) Neutral equilibrium; force is zero everywhere
(D) No equilibrium; force is maximum here

Q23. A particle moves horizontally while a constant vertical force acts downward on it. The work done by the vertical force on the particle is:

(A) Zero
(B) Positive and equal to Fd
(C) Negative and equal to −Fd
(D) Depends on the magnitude of the force

Q24. A particle moves 4 m east under a force of 8 N directed eastward. The work done is:

(A) 16 J
(B) 4 J
(C) 24 J
(D) 32 J

Answer key

1-B	**2-C**	**3-A**	**4-B**	**5-A**	**6-B**	**7-A**	**8-B**
9-A	**10-B**	**11-A**	**12-B**	**13-B**	**14-C**	**15-A**	**16-B**
17-A	**18-B**	**19-A**	**20-C**	**21-A**	**22-B**	**23-A**	**24-D**

Answers with explanations

Q1 — Answer: (B) Joule
Work = Force × displacement (along force direction), so its SI unit is N·m = joule (J). Watt is the unit of power; Newton is the unit of force; Pascal is the unit of pressure.

Q2 — Answer: (C) 100 J
Work = Fd cosθ = 20 × 5 × cos0° = 100 J. Since force and displacement are parallel, θ = 0° and cos0° = 1. Dividing instead of multiplying gives the trap value 4 J.

Q3 — Answer: (A) mgh
Near Earth's surface, gravitational PE is U = mgh with reference at ground level. Option B incorrectly introduces a factor of ½. Options C and D are dimensionally incorrect.

Q4 — Answer: (B) 400 J
ΔU = mgh = 5 × 10 × 8 = 400 J. Option A halves the height (uses 4 m). Option C doubles the height. Option D omits mass entirely from the calculation.

Q5 — Answer: (A) Its geometric centre
For a uniform rod, mass is evenly distributed, so the COM lies at the midpoint — its geometric centre. Non-uniform rods have COM shifted toward the heavier side. This result follows directly from $x_{CM} = \Sigma mx/\Sigma m$ applied to a continuous uniform body.

Q6 — Answer: (B) 6 m
$x_{CM} = (2\times0 + 3\times10)/5 = 30/5 = 6$ m. Option C (5 m) is the unweighted average — valid only when masses are equal. The heavier 3 kg mass pulls the COM closer to x = 10 m.

Q7 — Answer: (A) Elastic collision
In an elastic collision both linear momentum and kinetic energy are conserved. In inelastic collisions, momentum is conserved but KE is not. Oblique refers to geometry of impact, not energy classification.

Q8 — Answer: (B) Perfectly inelastic
Bodies sticking together and moving with a common velocity is the defining characteristic of a perfectly inelastic collision. KE loss is maximum in this case. In elastic collisions bodies separate; in partially inelastic they separate but with some KE loss.

Q9 — Answer: (A) Mechanical energy
Only gravity (conservative force) acts, so total mechanical energy KE + PE remains constant. During the fall, PE decreases while KE increases by an equal amount. Momentum is not conserved — gravity provides an external impulse.

Q10 — Answer: (B) 400 J
Initial ME = PE = mgh = 2 × 10 × 20 = 400 J. Only gravity acts so ME is conserved — it remains 400 J at every point during the fall. Option A halves mgh by forgetting to multiply correctly. Option C doubles the correct answer.

Q11 — Answer: (A) Watt
Power is rate of doing work; its SI unit is Watt (W), defined as 1 joule per second. Joule is unit of energy, Newton of force, Pascal of pressure.

Q12 — Answer: (B) 80 W
Average power P = W/t = 2400/30 = 80 W. Common error is multiplying W × t instead of dividing, or using wrong time units.

Q13 — Answer: (B) 10 m/s
By conservation of energy: $mgh = \frac{1}{2}mv^2$, so $v = \sqrt{(2gh)} = \sqrt{(2\times10\times5)} = 10$ m/s. Mass cancels — result is mass-independent. Option A uses $v = \sqrt{(gh)}$, missing the factor of 2 from $\frac{1}{2}mv^2$.

Q14 — Answer: (C) 10 J
Elastic PE = $\frac{1}{2}kx^2 = \frac{1}{2}\times500\times(0.04) = 10$ J. Option A (20 J) arises from forgetting the ½ factor, giving $kx^2 = 20$ J. Option B (100 J) is the force kx = 100 N, not energy.

Q15 — Answer: (A) Change in kinetic energy
$W_{net} = \Delta KE$ — net work by all forces equals change in KE. Option B describes energy conservation ($\Delta KE = -\Delta PE$), not the theorem. Option D (momentum change) equals impulse (F×t), not work (F×s).

Q16 — Answer: (B) 100 J
$W_{net} = F \times s = 20 \times 5 = 100$ J. By WET, $\Delta KE = W_{net} = 100$ J. Option A (50 J) computes ½ × F × s, incorrectly applying a ½ factor to work. Option D (200 J) doubles F × s without physical basis.

Q17 — Answer: (A) The work done by F depends only on the initial and final positions of the particle
A conservative force is defined by path-independence: its work depends only on the endpoints, not the route. A force being positive, constant, or aligned with motion are not defining criteria. Friction can be constant in magnitude yet remains non-conservative.

Q18 — Answer: (B) Exactly the same
Gravity is conservative — work depends only on the vertical displacement between A and B, not path length. Since endpoints are identical, work done by gravity is the same on both paths. Option A is the classic proportionality error. Option D confuses non-straight paths with zero work.

Q19 — Answer: (A) ½mv²
KE = ½mv² by definition, derived from work done accelerating a body from rest. Option B omits the factor ½. Option C uses incorrect factor 2. Option D has units of kg·m/s (momentum), not joules — dimensionally wrong.

Q20 — Answer: (C) 50 J
KE = ½mv² = ½ × 4 × 25 = 50 J. Option D (100 J) omits the factor ½, computing 4 × 25 directly. Option A (25 J) computes ½ × 5² without multiplying by mass. Option B (20 J) uses KE = ½mv (speed not squared), giving ½ × 4 × 5 = 10... corrected trap: ½ × 4 × 5 = 10 is not 20 — see note.

Q21 — Answer: (A) Stable equilibrium; force is zero
At a PE minimum, dU/dx = 0 so F = 0 and d²U/dx² > 0 confirms stable equilibrium. Any displacement increases PE and the restoring force returns the particle. Options C and D incorrectly describe force at an equilibrium point.

Q22 — Answer: (B) Unstable equilibrium; force is zero
At a PE maximum, dU/dx = 0 so force is zero and equilibrium exists. Since d²U/dx² < 0, any displacement lowers PE and pushes the particle further away — unstable equilibrium. Option D incorrectly denies equilibrium at a PE maximum.

Q23 — Answer: (A) Zero
When force is perpendicular to displacement, θ = 90° and cos90° = 0, so W = Fd cos90° = 0. The vertical force has no component along horizontal displacement. Multiplying magnitudes directly without cosθ is the common error.

Q24 — Answer: (D) 32 J
Work = Fd cosθ = 8 × 4 × cos0° = 32 J. Force and displacement are in the same direction so θ = 0°. Dividing F by d gives the trap value 2, and adding gives 12 — both common errors.

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