

Work, Energy and Power — NEET Physics PYQ (2006-2021)

Class 11 Physics · 29 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. A particle is released from height S from the surface of the Earth. At a certain height its kinetic energy is three times its potential energy. The height from the surface of earth and the speed of the particle at that instant are respectively :

- (A) $S/4$, $3gS/2$
- (B) $S/4$, $\sqrt{(3gS)/2}$
- (C) $S/2$, $\sqrt{(3gS)/2}$
- (D) $S/4$, $\sqrt{(3gS/2)}$

NEET 2021

2. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine ? ($g = 10 \text{ m/s}^2$)

- (A) 10.2 kW
- (B) 8.1 kW
- (C) 12.3 kW
- (D) 7.0 kW

NEET 2019 · Q4

3. Body A of mass $4m$ moving with speed u collides with another body B of mass $2m$, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is:

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

NEET 2019 · Q22

4. A force $F = 20 + 10y$ acts on a particle in y -direction where F is in newton and y in meter. Work done by this force to move the particle from $y = 0$ to $y = 1 \text{ m}$ is:

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

NEET 2018 · Q32

5. A moving block having mass m , collides with another stationary block having mass $4m$. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v , then the value of coefficient of restitution (e) will be

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

NEET 2016 Phase 2 · Q5

6. A bullet of mass 10 g moving horizontally with a velocity of 400 m s^{-1} strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be

- (A) 100 m s^{-1}
- (B) 80 m s^{-1}
- (C) 120 m s^{-1}
- (D) 160 m s^{-1}

NEET 2016 Phase 2 · Q6

7. Two identical balls A and B having velocities of 0.5 m/s and -0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

- (A) -0.5 m/s and 0.3 m/s
- (B) 0.5 m/s and -0.3 m/s
- (C) -0.3 m/s and 0.5 m/s
- (D) 0.3 m/s and 0.5 m/s

NEET 2016 Phase 2 · Q7

8. A particle moves from a point $(-2\hat{i} + 5\hat{j})$ to $(4\hat{j} + 3\hat{k})$ when a force of $(4\hat{i} + 3\hat{j}) \text{ N}$ is applied. How much work has been done by the force?

- (A) 8 J
- (B) 11 J
- (C) 5 J
- (D) 2 J

NEET 2016 Phase 1 · Q28

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

NEET 2016 Phase 1 · Q39

10. A body of mass 1 kg begins to move under the action of a time dependent force $\mathbf{F} = (2t\hat{i} + 3t^2\hat{j}) \text{ N}$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t ?

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

AIPMT 2015

11. Two particles of masses m_1 , m_2 move with initial velocities u_1 and u_2 . On collision, one of the particles get excited to higher level, after absorbing energy ϵ . If final velocities of particles be v_1 and v_2 then we must have:

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

AIPMT 2015

12. Two similar springs P and Q have spring constants K_P and K_Q , such that $K_P > K_Q$. They are stretched, first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as, in case (a) and case (b), respectively:

- (A) $W_P < W_Q$; $W_Q < W_P$
- (B) $W_P = W_Q$; $W_P > W_Q$
- (C) $W_P = W_Q$; $W_P = W_Q$
- (D) $W_P > W_Q$; $W_Q > W_P$

AIPMT 2015

13. 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) $(1/2)\sqrt{mk} t^{-1/2}$
- (B) $\sqrt{mk/2} t^{-1/2}$
- (C) $\sqrt{mk} t^{-1/2}$
- (D) $\sqrt{2mk} t^{-1/2}$

AIPMT 2015

14. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms^{-1} , is subjected to a retarding force $F = 0.1x \text{ J/m}$ during its travel from $x = 20 \text{ m}$ to 30 m . Its final KE will be:

- (A) 250 J
- (B) 475 J
- (C) 450 J
- (D) 275 J

AIPMT 2014

15. A body of mass $(4m)$ is lying in x-y plane at rest. It suddenly explodes into three pieces. Two pieces, each of mass (m) move perpendicular to each other with equal speeds (v) . The total kinetic energy generated due to explosion is:

- (A) $(3/2)mv^2$
- (B) $2mv^2$
- (C) $4mv^2$
- (D) mv^2

NEET 2013

16. A uniform force of $(3\hat{i} + \hat{j})$ newton acts on a particle of mass 2 kg. Hence the particle is displaced from position $(2\hat{i} + \hat{k})$ metre to position $(4\hat{i} + 3\hat{j} - \hat{k})$ metre. The work done by the force on the particle is

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

AIPMT 2012 Mains

17. A stone is dropped from a height h . It hits the ground with a certain momentum P . If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by

- (A) 68%
- (B) 41%
- (C) 200%
- (D) 100%

AIPMT 2012 Mains

18. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P_0 . The instantaneous velocity of this car is proportional to

- (A) $t^2 P_0$
- (B) $t^{1/2}$
- (C) $t^{-1/2}$
- (D) $t/\sqrt{m}$

AIPMT 2012 Prelims

19. The potential energy of a particle in a force field is $U = A/r^2 - B/r$, where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium the distance of the particle is

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

AIPMT 2011 Mains

20. A mass m moving horizontally (along the x -axis) with velocity v collides and sticks to a mass of $3m$ moving vertically upward (along the y -axis) with velocity $2v$. The final velocity of the combination is

- (A) $(2/3)v \hat{i} + (1/3)v \hat{j}$
- (B) $(3/2)v \hat{i} + (1/4)v \hat{j}$
- (C) $(1/4)v \hat{i} + (3/2)v \hat{j}$
- (D) $(1/3)v \hat{i} + (2/3)v \hat{j}$

AIPMT 2011 Prelims

21. The potential energy of a system increases if work is done

- (A) Upon the system by a conservative force
- (B) Upon the system by a non-conservative force
- (C) By the system against a conservative force
- (D) By the system against a non-conservative force

AIPMT 2010 Prelims · Q8

22. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5 then their velocities (in m/s) after collision will be

- (A) $0, 2$
- (B) $0, 1$
- (C) $1, 1$
- (D) $1, 0.5$

AIPMT 2009 Prelims · Q27

23. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water?

- (A) mv^2
- (B) $(1/2)mv^2$
- (C) $(1/2)m^2v^2$
- (D) $(1/2)mv^3$

24. A body of mass 1 kg is thrown upwards with a velocity 20 m/s. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? ($g = 10 \text{ m/s}^2$)

- (A) 30 J
- (B) 40 J
- (C) 10 J
- (D) 20 J

25. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k . The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be:

- (A) 2 Mg/k
- (B) 4 Mg/k
- (C) $\text{Mg}/2k$
- (D) Mg/k

26. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional forces are 10% of energy. How much power is generated by the turbine? ($g = 10 \text{ m/s}^2$)

- (A) 7.0 kW
- (B) 8.1 kW
- (C) 10.2 kW
- (D) 12.3 kW

27. The potential energy of a long spring when stretched by 2 cm is U . If the spring is stretched by 8 cm the potential energy stored in it is :

- (A) $4U$
- (B) $U/8$
- (C) $16U$
- (D) $U/4$

28. A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = (1/3)t^2$, where t is in s. Work done by the force in 2 s is :

- (A) $17/3 \text{ J}$
- (B) $3/8 \text{ J}$
- (C) $8/3 \text{ J}$
- (D) $3/17 \text{ J}$

29. 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking $g = 10 \text{ m/s}^2$, work done against friction is :

- (A) 50 J
- (B) 100 J
- (C) zero
- (D) 150 J

Answer key and explanations

1. Answer: (D) $S/4$, $\sqrt{(3gS/2)}$

At height h , $\text{PE} = mgh$ and $\text{KE} = mg(S - h)$. $\text{KE} = 3\text{PE}$ gives $S - h = 3h$, so $h = S/4$. Then $v^2 = 2g(S - h) = 2g(3S/4) = 3gS/2$, so $v = \sqrt{(3gS/2)}$; the forms $\sqrt{(3gS)/2}$ or $3gS/2$ are dimensionally or numerically wrong.

2. Answer: (B) 8.1 kW

Input power = (mass per second) $\times$ g $\times$ h = $15 \times 10 \times 60 = 9000$ W. With 10% loss, output = $0.9 \times 9000 = 8100$ W = 8.1 kW.

3. Answer: (B) 8/9

For a 1-D elastic collision $v_A = (m_1 - m_2)u/(m_1 + m_2) = (4m - 2m)u/6m = u/3$. A keeps $(1/3)^2 = 1/9$ of its kinetic energy, so it loses 8/9. 1/9 is the fraction retained, not lost.

4. Answer: (C) 25 J

$W = \int_0^1 (20 + 10y) dy = 20 + 5 = 25$ J. Using the final force value 30 N times 1 m gives 30 J, ignoring that the force varies.

5. Answer: (B) 0.25

Momentum: $mv = 4mv'$, so $v' = v/4$. $e = (\text{relative speed of separation})/(\text{relative speed of approach}) = (v/4 - 0)/v = 0.25$. A value of 0.8 would not conserve momentum with the lighter block stopping.

6. Answer: (C) 120 m s⁻¹

The block's speed just after impact is $\sqrt{2gh} = \sqrt{2 \times 10 \times 0.1} \approx 1.41$ m/s. Momentum conservation: $0.01 \times 400 = 0.01v + 2 \times 1.41$, so $0.01v = 4 - 2.83 = 1.17$ and $v \approx 117 \approx 120$ m/s. Energy is not conserved in the bullet-block collision, so equating kinetic energies is the trap.

7. Answer: (B) 0.5 m/s and -0.3 m/s

In a one-dimensional elastic collision between equal masses the velocities are exchanged, so B moves with 0.5 m/s and A with -0.3 m/s. The question asks for B first, so the order is 0.5 m/s and -0.3 m/s; reversing the order is the common slip.

8. Answer: (C) 5 J

Displacement $d = (4\hat{j} + 3\hat{k}) - (-2\hat{i} + 5\hat{j}) = 2\hat{i} - \hat{j} + 3\hat{k}$. Work $W = F \cdot d = 4 \times 2 + 3 \times (-1) + 0 \times 3 = 8 - 3 = 5$ J. Forgetting the negative y-component gives 11 J.

9. Answer: (D) $\sqrt{5gR}$

At the top, the minimum speed is $\sqrt{gR}$ (tension or normal force zero). Energy conservation from bottom to top: $v^2 = gR + 2g(2R) = 5gR$, so $v = \sqrt{5gR}$. $\sqrt{gR}$ is the minimum speed at the top, not at entry.

10. Answer: (D) $(2t^3 + 3t^5)$ W

With $m = 1$ kg, $\vec{a} = F$, and starting from rest $\vec{v} = \int \vec{a} dt = t^2 \hat{i} + t^3 \hat{j}$. Power $P = F \cdot \vec{v} = 2t \cdot t^2 + 3t^2 \cdot t^3 = 2t^3 + 3t^5$ W. Multiplying force by time instead of integrating gives the wrong powers of t .

11. Answer: (D) $(1/2)m_1u_1^2 + (1/2)m_2u_2^2 = (1/2)m_1v_1^2 + (1/2)m_2v_2^2 + \epsilon$

Total energy is conserved: the initial kinetic energy equals the final kinetic energy plus the energy ϵ absorbed in exciting the particle, so $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \epsilon$. Writing $-\epsilon$ on the final side would mean the system gained energy, which is wrong.

12. Answer: (D) $W_P > W_Q$; $W_Q > W_P$

Same extension: $W = \frac{1}{2}kx^2$, so the stiffer spring P does more work ($W_P > W_Q$). Same force: $x = F/k$ and $W = F^2/2k$, so the softer spring Q does more work ($W_Q > W_P$).

13. Answer: (B) $\sqrt{(mk/2)} t^{(-1/2)}$

Constant power: $\frac{1}{2}mv^2 = kt$, so $v = \sqrt{(2kt/m)}$. Then $F = m dv/dt = m \times \sqrt{(2k/m)} \times \frac{1}{2}t^{(-1/2)} = \sqrt{(mk/2)} t^{(-1/2)}$. Forgetting the $\frac{1}{2}$ from differentiation gives $\sqrt{(2mk)} t^{(-1/2)}$.

14. Answer: (B) 475 J

Initial KE = $\frac{1}{2} \times 10 \times 10^2 = 500$ J. Work by the retarding force = $-\int_{20}^{30} 0.1x dx = -0.05(900 - 400) = -25$ J. Final KE = $500 - 25 = 475$ J.

15. Answer: (A) $(3/2)mv^2$

The two m pieces have perpendicular momenta mv each, so the $2m$ piece carries $\sqrt{2}mv$ and moves at $v/\sqrt{2}$. Total KE = $2 \times (1/2)mv^2 + (1/2)(2m)(v^2/2) = (3/2)mv^2$.

16. Answer: (A) 9 J

Displacement $d = (4\hat{i} + 3\hat{j} - \hat{k}) - (2\hat{i} + \hat{k}) = 2\hat{i} + 3\hat{j} - 2\hat{k}$. $W = F \cdot d = 3 \times 2 + 1 \times 3 + 0 \times (-2) = 9$ J. The mass of the particle is not needed for the work done by a given force.

17. Answer: (B) 41%

Momentum on hitting the ground is $P = mv\sqrt{2gh}$. Doubling the height multiplies P by $\sqrt{2} \approx 1.414$, an increase of about 41%. Doubling the momentum (100%) would need four times the height.

18. Answer: (B) $t^{(1/2)}$

With constant power, the work done equals the kinetic energy gained: $P_{\text{ot}} = \frac{1}{2}mv^2$, so $v = \sqrt{(2P_{\text{ot}}/m)}$ and $v \propto t^{(1/2)}$. The velocity grows ever more slowly, not linearly or as t^2 .

19. Answer: (C) 2A/B

Equilibrium needs $dU/dr = -2A/r^3 + B/r^2 = 0$, giving $r = 2A/B$. At this r , $d^2U/dr^2 = 6A/r^4 - 2B/r^3 = B^4/(8A^3) > 0$, so U is a minimum and the equilibrium is stable. A/B is where U itself is zero, not where the force is zero.

20. Answer: (C) $(1/4)v \hat{i} + (3/2)v \hat{j}$

Momentum is conserved in this perfectly inelastic collision: $m v \hat{i} + 3m(2v) \hat{j} = 4m \mathbf{V}$. So $\mathbf{V} = (v/4) \hat{i} + (6v/4) \hat{j} = (1/4)v \hat{i} + (3/2)v \hat{j}$. Swapping the components, $(3/2)v \hat{i} + (1/4)v \hat{j}$, is the common trap.

21. Answer: (C) By the system against a conservative force

Potential energy is defined only for conservative forces: $\Delta U = -W(\text{conservative})$. When the system does work against a conservative force (the conservative force does negative work), its potential energy increases. Work by non-conservative forces does not change potential energy.

22. Answer: (B) 0, 1

Momentum: $m \times 2 = m v_1 + 2m v_2$, so $v_1 + 2v_2 = 2$. Restitution: $v_2 - v_1 = 0.5 \times 2 = 1$. Solving gives $v_2 = 1$ m/s and $v_1 = 0$, i.e. velocities 0 and 1 m/s. The pair 1 and 1 would need perfectly inelastic sticking, which conserves momentum only if $v = 2/3$.

23. Answer: (D) $(1/2)mv^3$

Mass leaving per second = (mass per length) $\times$ speed = mv . KE delivered per second = $\frac{1}{2}(mv)v^2 = \frac{1}{2}mv^3$. Taking $\frac{1}{2}mv^2$ treats m as the mass per second instead of per unit length.

24. Answer: (D) 20 J

Initial KE = $\frac{1}{2} \times 1 \times 20^2 = 200$ J. PE at 18 m = $1 \times 10 \times 18 = 180$ J. Energy lost to air friction = $200 - 180 = 20$ J.

25. Answer: (A) 2 Mg/k

Released from rest with the spring unstretched, the block moves until it is momentarily at rest again. Energy conservation: $Mgx = \frac{1}{2}kx^2$, so the maximum extension is $x = 2Mg/k$. Mg/k is only the equilibrium extension (where the block moves fastest), not the maximum.

26. Answer: (B) 8.1 kW

Input power = $(dm/dt)gh = 15 \times 10 \times 60 = 9000$ W. With 10% lost, the output is $0.9 \times 9000 = 8100$ W = 8.1 kW. 9 kW without the loss is not offered; adding the loss instead of subtracting it would give about 9.9 kW.

27. Answer: (C) 16U

Spring energy is $U = \frac{1}{2}kx^2$, so $U \propto x^2$. Increasing the stretch from 2 cm to 8 cm (4 times) multiplies the energy by $4^2 = 16$, giving 16U. Assuming $U \propto x$ would give only 4U.

28. Answer: (C) 8/3 J

From $s = t^2/3$, $v = ds/dt = 2t/3$ and $a = 2/3$ m s⁻², so the force is $F = 3 \times 2/3 = 2$ N. At $t = 2$ s, $s = 4/3$ m, so $W = 2 \times 4/3 = 8/3$ J; this equals the gain in kinetic energy $\frac{1}{2} \times 3 \times (4/3)^2 = 8/3$ J. The reciprocal $3/8$ J is a slip in the algebra.

29. Answer: (B) 100 J

Work against gravity is $mgh = 2 \times 10 \times 10 = 200$ J. The remaining $300 - 200 = 100$ J of the work done is spent against friction (assuming no gain in kinetic energy). Zero would be true only on a frictionless incline.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.