IITIAN'S SPECTRUM
IIT JEE/NEET FOUNDATION

IITIAN'S SPECTRUM

Prudent Minds, Promising Path

Founder-Director
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B.Tech (IIT)

PHYSICS

DPS-4

DAILY PRACTICE SHEET

Class XI

Work, Energy and Power

INSTRUCTIONS

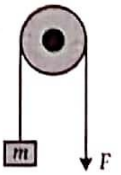
- DPS contains 45 topicwise questions and 5 exam section questions.
- Each question has four options out of which only one option is correct.
- Mark the correct answer in the OMR Sheet given at the end of the DPS.
- Each question carries 4 marks.
- For every incorrect answer deduct 1 mark.

Time : 50 minutes
Marks : 200

Date: .....

Work

1. A block of mass m (= 0.1 kg) is hanging over a frictionless light fixed pulley by an inextensible string of negligible mass. The other end of the string is pulled by a constant force F in the vertically downward direction. The linear momentum of the block increased by 2 kg m s^{-1} in 1s after the block starts from rest. Then,
(given g = 10 m s^{-2})



(a) the tension in the string is less than F.
(b) the tension in the string is 3 N.
(c) the work done by the tension on the block is 20 J during this 1 s.
(d) the work done against the force of gravity is 40 J.

2. A block of mass m is pulled along a horizontal surface by applying a force at an angle θ with the horizontal. If the block travels with a uniform velocity and has a displacement d and the coefficient of friction is μ, then the work done by the applied force is

(a) $\frac{\mu mgd}{\cos\theta+\mu\sin\theta}$ (b) $\frac{\mu mgd\cos\theta}{\cos\theta+\mu\sin\theta}$

(c) $\frac{\mu mgd\sin\theta}{\cos\theta+\mu\sin\theta}$ (d) $\frac{\mu mgd\cos\theta}{\cos\theta-\mu\sin\theta}$.

3. A force of 4 N is applied on a body of mass 20 kg. The work done in 3rd second is
(a) 3 J (b) 2 J (c) 4 J (d) 1 J

4. A block of mass 2 kg initially at rest moves under the action of an applied horizontal force of 6 N on a rough horizontal surface. The coefficient of friction between block and surface is 0.1. The work done by the applied force in 10 s is
(Take g = 10 m s^{-2})
(a) 200 J (b) −200 J (c) 600 J (d) −600 J.

5. A particle acted upon by constant forces $4\hat{i}+\hat{j}-3\hat{k}$ and $3\hat{i}+\hat{j}-\hat{k}$ is displaced from the point $\hat{i}+2\hat{j}+3\hat{k}$ to point $5\hat{i}+4\hat{j}+\hat{k}$. The total work done by the forces in SI unit is
(a) 20 (b) 40 (c) 50 (d) 30.

Kinetic Energy

6. A running man has half the kinetic energy than a boy half of his own mass has. The man speed up by 1.0 m s^{-1} and then he has the same energy as the boy. The original speeds of the man and boy respectively are
(a) 2.4 m s^{-1}, 1.2 m s^{-1} (b) 1.2 m s^{-1}, 4.4 m s^{-1}
(c) 2.4 m s^{-1}, 4.8 m s^{-1} (d) 4.8 m s^{-1}, 2.4 m s^{-1}

7. Two bodies A and B have masses 20 kg and 5 kg respectively. Each one is acted upon by a force of 4 kg wt. If they acquire the same kinetic energy in times t_A and t_B, then the ratio $\frac{t_A}{t_B}$ is

(a) $\frac{1}{2}$ (b) 2 (c) $\frac{2}{5}$ (d) $\frac{5}{6}$.

8. Two projectiles of same mass have their maximum kinetic energies in ratio 4 : 1 and ratio of their maximum heights is also 4 : 1 then what is the ratio of their ranges?
(a) 2 : 1 (b) 4 : 1
(c) 8 : 1 (d) 16 : 1

9. A body is projected with a speed u m s^{-1} at an angle β with the horizontal. The kinetic energy at the highest point is $\left(\frac{3}{4}\right)^{th}$ of the initial kinetic energy. The value of β is

(a) 30° (b) 45° (c) 60° (d) 120°

10. A particle is projected at 60° to the horizontal with a kinetic energy K. The kinetic energy at the highest point is
(a) K (b) zero (c) $K/4$ (d) $K/2$.

11. If the kinetic energy of a body is increased by 300%, the momentum of the body is increased by
(a) 300% (b) 200%
(c) 100% (d) 50%

12. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV, and the second with 100 keV. The ratio of their speeds is
(Here m_e and m_p are masses of electron and proton respectively)
(a) $\sqrt{\frac{1}{10}\frac{m_e}{m_p}}$ (b) $\sqrt{\frac{1}{10}\frac{m_p}{m_e}}$
(c) $\frac{1}{10}\frac{m_e}{m_p}$ (d) $\frac{1}{10}\frac{m_p}{m_e}$.

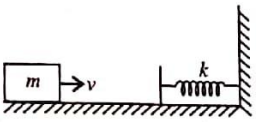
13. In a ballistics demonstration a police officer fires a bullet of mass 50 g with speed 200 m s^{-1} on soft plywood of thickness 2 cm. The bullet emerges with only 10% of its initial kinetic energy. The emergent speed of the bullet is
(a) $2\sqrt{10}$ m s^{-1} (b) $20\sqrt{10}$ m s^{-1}
(c) $10\sqrt{2}$ m s^{-1} (d) $10\sqrt{20}$ m s^{-1}.

Work - Energy Theorem

14. A variable force, given by the 2-dimensional vector $\vec{F}=(3x^2\hat{i}+4\hat{j})$, acts on a particle. The force is in newton and x is in metre. What is the change in the kinetic energy of the particle as it moves from the point with coordinates (2, 3) to (3, 0)? (The coordinates are in metres)
(a) −7 J (b) Zero (c) + 7 J (d) + 19 J

15. A raindrop of mass 1 g falling from a height of 1 km hits the ground with a speed of 50 m s^{-1}. If the resistive force is proportional to the speed of the drop, then the work done by the resistive force is
(Take g = 10 m s^{-2})
(a) 10 J (b) −10 J (c) 8.75 J (d) −8.75 J

16. A block of mass m is moving with a speed v on a horizontal rough surface and collides with a horizontally mounted spring of spring constant k as shown in the figure. The coefficient of friction between the block and the floor is μ. The maximum compression of the spring is
(a) $-\frac{\mu mg}{k}+\frac{1}{k}\sqrt{(\mu mg)^2+mkv^2}$
(b) $\frac{\mu mg}{k}+\frac{1}{k}\sqrt{(\mu mg)^2-mkv^2}$
(c) $-\frac{\mu mg}{k}-\frac{1}{k}\sqrt{(\mu mg)^2-mkv^2}$
(d) $\frac{\mu mg}{k}+\frac{1}{k}\sqrt{(\mu mg)^2+mkv^2}$.

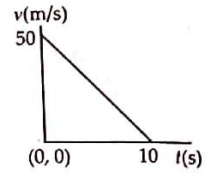


17. A block of mass 10 kg is moving in x-direction with a constant speed of 10 m s^{-1}. It is subjected to a retarding force F_r = − 0.1x J m^{-1} during its travel from x = 20 m to x = 30 m. Its final kinetic energy will be
(a) 250 J (b) 275 J (c) 450 J (d) 475 J

18. A particle of mass 0.5 kg travels in a straight line with velocity $v = ax^{3/2}$, where a = 5 $m^{-1/2}$ s^{-1}. The work done by the net force during its displacement from x = 0 to x = 2 m is
(a) 50 J (b) 45 J (c) 25 J (d) 30 J.

19. A 500 kg car, moving with a velocity of 36 km h^{-1} on a straight road undirectionally, doubles its velocity in one minute. The net work done by the engine is
(a) 75 kJ (b) 105 kJ (c) 115 kJ (d) 125 kJ

20. Velocity-time graph for a body of mass 10 kg is shown in figure. Work-done on the body in first two seconds of the motion is
(a) − 9300 J (b) 12000 J
(c) − 4500 J (d) − 12000 J



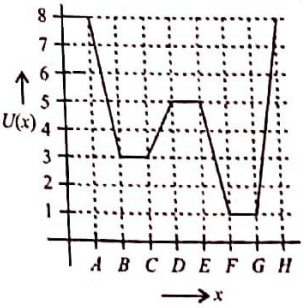
21. A block of mass 5 kg is resting on a smooth surface. At what angle a force of 20 N be acted on the body so that it will acquired a kinetic energy of 40 J after moving 4 m?
(a) 30° (b) 45° (c) 60° (d) 120°

Potential Energy

22. A particle in a certain conservative force field has a potential energy given by $U=\frac{20xy}{z}$. The force exerted on it is
(a) $\left(\frac{20y}{z}\right)\hat{i}+\left(\frac{20x}{z}\right)\hat{j}+\left(\frac{20xy}{z^2}\right)\hat{k}$
(b) $-\left(\frac{20y}{z}\right)\hat{i}-\left(\frac{20x}{z}\right)\hat{j}+\left(\frac{20xy}{z^2}\right)\hat{k}$.
(c) $-\left(\frac{20y}{z}\right)\hat{i}-\left(\frac{20x}{z}\right)\hat{j}-\left(\frac{20xy}{z^2}\right)\hat{k}$
(d) $\left(\frac{20y}{z}\right)\hat{i}+\left(\frac{20x}{z}\right)\hat{j}-\left(\frac{20xy}{z^2}\right)\hat{k}$.

23. A ball is projected vertically upwards with a certain initial speed. Another ball of the same mass is projected at an angle of 60° with the vertical with the same initial speed. At highest points of their journey, the ratio of their potential energies will be
(a) 1 : 1 (b) 2 : 1 (c) 3 : 2 (d) 4 : 1.

24. Solid line in the figure shows the potential energy $U(x)$ as a function of x of a particle confined to move along x-axis. Regions AB, BC, CD, EF, FG and GH are of equal distance. Rank the regions AB, BC, CD and EF according to the magnitude of the force on the particle, greatest first.



(a) $AB > EF > CD > BC$ (b) $CD > AB > EF > BC$
(c) $AB > EF > BC > CD$ (d) $BC > EF > AB > CD$

25. If 4 J of work is required to stretch a spring through 10 cm beyond its unstretched length. The extra work required to stretch it through additional 10 cm shall be
(a) 4 J (b) 8 J (c) 12 J (d) 16 J.

26. A stone is projected vertically up to reach maximum height h. The ratio of its kinetic energy to its potential energy at a height $\frac{4}{5}h$, will be

(a) 5 : 4 (b) 4 : 5 (c) 1 : 4 (d) 4 : 1.

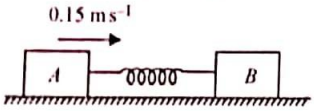
Law of Conservation of Energy

27. A uniform chain of length L and mass m is kept on a smooth table. It is released from rest when the overhanging part was n^{th} fraction of total length. Find the kinetic energy of the chain as it completely slips off the table.

(a) $\frac{1}{2}mgL(1-n^2)$ (b) $2mgL(1-n^2)$

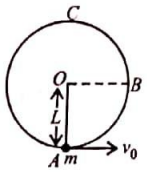
(c) $\frac{1}{2}mgL(n^2-1)$ (d) $2mgL(n^2-1)$

28. Two rectangular blocks A and B of masses 2 kg and 3 kg respectively are connected by a spring of spring constant 10.8 N m^{-1} and are placed on a frictionless horizontal surface. The block A was given an initial velocity of 0.15 m s^{-1} in the direction shown in the figure. The maximum compression of the spring during the motion is



(a) 0.01 m (b) 0.02 m
(c) 0.05 m (d) 0.03 m

29. A bob of mass m is suspended by a light string of length L. It is imparted a horizontal velocity v_0 at the lowest point A such that it completes a semicircular trajectory in the vertical plane with the string becoming slack only on reaching the topmost point, C.



Match the Column I with Column II.

	Column I		Column II
(A)	Velocity v_0 is	(p)	3
(B)	Velocity at point B is	(q)	$\sqrt{gL}$
(C)	Velocity at point C is	(r)	$\sqrt{5gL}$
(D)	Ratio of kinetic energy at B and C is	(s)	$\sqrt{3gL}$

(a) A – p, B – q, C – s, D – r
(b) A – q, B – r, C – p, D – s
(c) A – r, B – s, C – q, D – p
(d) A – s, B – p, C – r, D – q

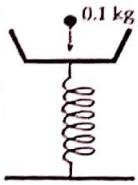
30. A ball of mass m is dropped from a cliff of height H. The ratio of its kinetic energy to the potential energy when it is fallen through a height $\frac{3}{4}H$ is

(a) 3 : 4 (b) 4 : 3
(c) 1 : 3 (d) 3 : 1.

31. A ball dropped from a height of 2 m rebounds to a height of 1.5 m after hitting the ground. Then the percentage of energy lost is

(a) 25 (b) 30 (c) 50 (d) 100

32. A massless platform is kept on a light elastic spring, as shown in the figure. When particle of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the particle strikes the pan, and the spring is compressed by 0.01 m. From what height should the particle be dropped to cause a compression of 0.04 m?



(a) 0.96 m (b) 2.96 m (c) 3.96 m (d) 0.48 m

33. At her maximum height, a girl in a swing is 3 m above the ground and at the lowest point, she is 2 m above the ground. What is her maximum velocity?

(a) $\sqrt{19.6}$ m s^{-1} (b) $\sqrt{39.2}$ m s^{-1}
(c) $\sqrt{9.8}$ m s^{-1} (d) 9.8 m s^{-1}

34. A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of the change in its velocity as it reaches a position where the string horizontal is

(a) $\sqrt{u^2-2gL}$ (b) $\sqrt{2gL}$
(c) $\sqrt{u^2-gL}$ (d) $\sqrt{2(u^2-gL)}$.

Power

35. A force F acting on a body depends on the distance x as $F \propto x^{-1/3}$. The power delivered by F will depend on distance x as

(a) x^0 (b) $x^{-1/2}$ (c) $x^{-5/3}$ (d) $x^{2/3}$.

36. A box is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to

(a) $t^{1/2}$ (b) $t^{3/4}$ (c) $t^{3/2}$ (d) t^2.

37. A horizontal cable accelerates a package across a frictionless horizontal floor. The amount of work that has been done by the cable's force on the package is given by $W(t) = (0.20\ \text{J/s}^2)t^2$. The average power $<P>$ due to cable's force in the time interval $t_1 = 5$ s to $t_2 = 10$ s and instantaneous power at $t = 3$ s are

(a) 2.0 W, 1.80 W (b) 2.0 W, 1.20 W
(c) 3.0 W, 1.80 W (d) 3.0 W, 1.20 W.

38. A 30 m deep well is having water upto 15 m. An engine evacuates it in one hour. The power of the engine, if the diameter of the well is 4 m is

(a) 11.55 kW (b) 1155 kW
(c) 23.10 kW (d) 2310 kW

39. A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m^3 in 15 min. If the tank is 40 m above the ground, and the efficiency of the pump is 30%, how much electric power is consumed by the pump?
(Take $g = 10$ m s^{-2})

(a) 36.5 kW (b) 44.4 kW
(c) 52.5 kW (d) 60.5 kW.

Collisions

40. A bullet of mass m travelling with a speed v hits a block of mass M initially at rest and gets embedded in it. The combined system is free to move and there is no other force acting on the system. The heat generated in the process will be

(a) zero (b) $\frac{mv^2}{2}$ (c) $\frac{Mmv^2}{2(M-m)}$ (d) $\frac{mMv^2}{2(M+m)}$.

41. A ball of mass m moving with a constant velocity u strikes against a ball of same mass at rest. If e is the coefficient of restitution, then what will be the ratio of velocity of two balls after collision?

(a) $\frac{1-e}{1+e}$ (b) $\frac{e-1}{e+1}$ (c) $\frac{1+e}{1-e}$ (d) $\frac{e+1}{e-1}$

42. A body is dropped from a height of 4 m on a surface. If in collision 25% of energy is lost, then the height upto which it will rise after collision is

(a) 3 m (b) 6 m (c) 9 m (d) 12 m.

43. A body of mass m_1 collides elastically with another body of mass m_2 at rest. If the velocity of m_1 after collision becomes 2/3 times its initial velocity, the ratio of their masses is

(a) 1 : 5 (b) 5 : 1 (c) 5 : 2 (d) 2 : 5.

44. Consider the following statements A and B. Identify the correct choice in the given answers.

A. In a one dimensional perfectly elastic collision between two moving bodies of equal masses, the bodies merely exchange their velocities after collision.

B. If a lighter body at rest suffers perfectly elastic collision with a very heavy body moving with a certain velocity, then after collision both travel with same velocity.

(a) A and B are correct
(b) Both A and B are wrong
(c) A is correct, B is wrong
(d) A is wrong, B is correct

45. A trolley of mass 200 kg moves with a uniform speed of 36 km h^{-1} on a frictionless track. A child of mass 20 kg runs on the trolley from one end to the other (10 m away) with a speed 4 m s^{-1} relative to the trolley in a direction opposite to its motion, and jumps out of the trolley. The final speed of the trolley is

(a) 8.4 m s^{-1} (b) 10.4 m s^{-1}
(c) 12.2 m s^{-1} (d) 14.6 m s^{-1}.

EXAM SECTION

46. A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{j}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})$ 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 Phase II 2016)

47. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8×10^{-4} J by the end of the second revolution after the beginning of the motion?

(a) 0.18 m/s^2 (b) 0.2 m/s^2
(c) 0.1 m/s^2 (d) 0.15 m/s^2

(NEET Phase I 2016)

48. 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) $\sqrt{3gR}$ (b) $\sqrt{5gR}$ (c) $\sqrt{gR}$ (d) $\sqrt{2gR}$

(NEET Phase I 2016)

49. 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, 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) $(2t^3 + 3t^4)$ W (b) $(2t^3 + 3t^5)$ W
(c) $(2t^2 + 3t^3)$ W (d) $(2t^2 + 4t^4)$ W.

(NEET Phase I 2016)

50. Two particles A and B, move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vectors are $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for particles A and B for their collision is

(a) $\vec{r}_1\times\vec{v}_1=\vec{r}_2\times\vec{v}_2$ (b) $\vec{r}_1\times\vec{r}_2=\vec{v}_1\times\vec{v}_2$
(c) $\frac{\vec{r}_1-\vec{r}_2}{|\vec{r}_1-\vec{r}_2|}=\frac{\vec{v}_2-\vec{v}_1}{|\vec{v}_2-\vec{v}_1|}$ (d) $\vec{r}_1\cdot\vec{v}_1=\vec{r}_2\cdot\vec{v}_2$. *(AIPMT 2015)*

OMR SHEET

Use HB pencil only and darken each circle completely.
Mark only one choice for each question as indicated.

Correct marking ● ⓑ ⓒ ⓓ
Wrong marking ⊗ ⓐ ◑ ⊙

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

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.