Additional Problems For Self Practice (APSP)

PART-I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

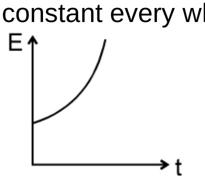
1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

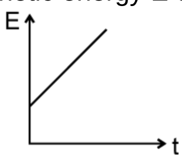
1. A rigid body moves a distance of 10 m along a straight line under the action of a force of 5 N. If the work done by this force on the body is 25 joules, the angle which the force makes with the direction of motion of the body is
(1) 0^o (2) 30^o (3) 60^o (4) 90^o

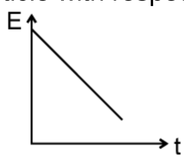
2. The work done in slowly pulling up a block of wood weighing 2 kN for a length of 10m on a smooth plane inclined at an angle of 15^o with the horizontal by a force parallel to the incline is
(1) 4.36 kJ (2) 5.17 kJ (3) 8.91 kJ (4) 9.82 kJ

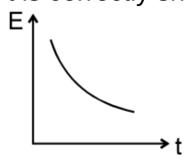
3. Two equal masses are attached to the two ends of a spring of spring constant k. The masses are pulled out symmetrically to stretch the spring by a length x over its natural length. The work done by the spring on each mass during the above pulling is
(1) $\frac{1}{2}kx^2$ (2) $-\frac{1}{2}kx^2$ (3) $\frac{1}{4}kx^2$ (4) $-\frac{1}{4}kx^2$

4. A particle is dropped from a height h. A constant horizontal velocity is given to the particle. Taking g to be constant every where, kinetic energy E of the particle with respect to time t is correctly shown in

(1) 

(2) 

(3) 

(4) 

5. A body moving at 2 m/s can be stopped over a distance x. If its kinetic energy is doubled, how long will it go before coming to rest, if the retarding force remains unchanged ?
(1) x (2) 2x (3) 4x (4) 8x

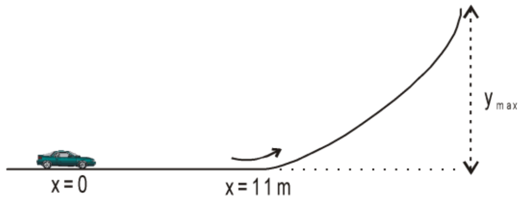
6. A rod of length 1m and mass 0.5 kg hinged at one end, is initially hanging vertical. The other end is now raised slowly until it makes an angle 60^o with the vertical. The required work is :(use g = 10 m/s^2)
(1) $\frac{5}{2}$ J (2) $\frac{5}{4}$ J (3) $\frac{17}{8}$ J (4) $\frac{5\sqrt{3}}{4}$ J

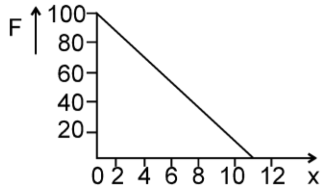
7. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to
(1) x^2 (2) e^x (3) x (4) $\log_e x$

8. A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0 is a constant. Then the distance covered by the mass before it stops is:

(1) $\frac{2}{\mu_0}\tan\theta$ (2) $\frac{4}{\mu_0}\tan\theta$ (3) $\frac{1}{2\mu_0}\tan\theta$ (4) $\frac{1}{\mu_0}\tan\theta$

9. A toy car of mass 5 kg starts from rest and moves up a ramp under the influence of force F (F is applied in the direction of velocity) plotted against displacement x. The maximum height attained is given by

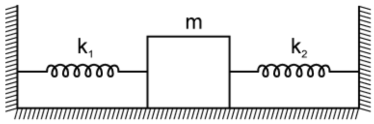




(1) y_{max} = 20 m (2) y_{max} = 15 m (3) y_{max} = 11 m (4) y_{max} = 5 m

10. __________________ of a two particle system depends only on the separation between the two particles. The most appropriate choice for the blank space in the above sentence is
(1) kinetic energy (2) total mechanical energy
(3) potential energy (4) total energy

11. A block of mass m is attached to two unstretched springs of spring constants k_1 and k_2 as shown in figure. The block is displaced towards right through a distance x and is released. Find the speed of the block as it passes through the mean position shown.

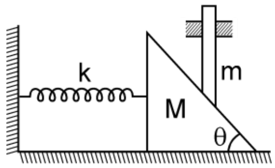


(1) $\sqrt{\frac{k_1+k_2}{m}}\,x$ (2) $\sqrt{\frac{k_1k_2}{m(k_1+k_2)}}\,x$ (3) $\sqrt{\frac{k_1^2k_2^2}{m(k_1^2+k_2^2)}}\,x$ (4) $\sqrt{\frac{k_1^3k_2^3}{m(k_1^3+k_2^3)}}$

12. A spring of spring constant k placed horizontally on a rough horizontal surface is compressed against a block of mass m placed on the surface so as to store maximum energy in the spring. If the coefficient of friction between the block and the surface is μ, the potential energy stored the spring is :

(1) $\frac{\mu^2m^2g^2}{k}$ (2) $\frac{2\mu m^2g^2}{k}$ (3) $\frac{\mu^2m^2g^2}{2k}$ (4) $\frac{3\mu^2mg^2}{k}$

13. A wedge of mass M fitted with a spring of stiffness 'k' is kept on a smooth horizontal surface. A rod of mass m is kept on the wedge as shown in the figure. System is in equilibrium. Assuming that all surfaces are smooth, the potential energy stored in the spring is :



(1) $\frac{mg^2\tan^2\theta}{2K}$ (2) $\frac{m^2g\tan^2\theta}{2K}$ (3) $\frac{m^2g^2\tan^2\theta}{2K}$ (4) $\frac{m^2g^2\tan^2\theta}{K}$

14. The spring extends by x on loading, then energy stored by the spring is (if T is the tension in spring and k is spring constant).

(1) $\frac{T^2}{2k}$ (2) $\frac{T^2}{2k^2}$ (3) $\frac{2k}{T^2}$ (4) $\frac{2T^2}{k}$

15. A body of mass m dropped from a certain height strikes a light vertical fixed spring of stiffness k. The height of its fall before touching the spring if the maximum compression of the spring is equal to $\frac{3mg}{k}$ is

(1) $\frac{3mg}{2k}$ (2) $\frac{2mg}{k}$ (3) $\frac{3mg}{4K}$ (4) $\frac{mg}{4K}$

16. A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by 1 m/s so as to have same kinetic energy as that of the boy. The original speed of the man will be

(1) $\sqrt{2}$ m/s (2) $(\sqrt{2} - 1)$m/s (3) $\frac{1}{(\sqrt{2}-1)}$ m/s (4) $\frac{1}{\sqrt{2}}$ m/s

17. A car of mass 'm' is driven with acceleration 'a' along a straight level road against a constant external resistive force 'R'. When the velocity of the car is 'V', the rate at which the engine of the car is doing work will be

(1) RV (2) maV (3) (R + ma)V (4) (ma – R)V

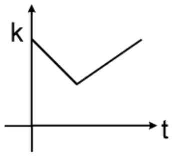
18. A car of mass m starts moving so that its velocity varies according to the law $v = \beta\sqrt{s}$, where β is a constant, and s is the distance covered. The total work performed by all the forces which are acting on the car during the first t seconds after the beginning of motion is

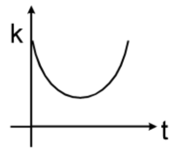
(1) $m\beta^4 t^2/8$ (2) $m\beta^2 t^4/8$ (3) $m\beta^4 t^2/4$ (4) $m\beta^2 t^4/4$

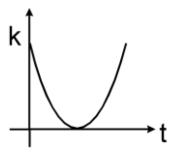
19. A block of mass 250 g is kept on a vertical spring of spring constant 100 N/m fixed from below. The srping is now compressed to have a length 10 cm shorter than its natural length and the system is released from this position. How high does the block rise? Take $g = 10\ m/s^2$.

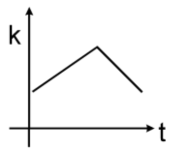
(1) 20 cm (2) 30 cm (3) 40 cm (4) 50 cm

20. In a projectile motion, KE varies with time as in graph :

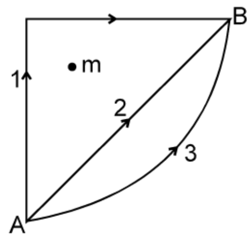
(1) 

(2) 

(3) 

(4) 

21. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2, 3 respectively (as shown) in the gravitational field of a point mass m, find the correct relation between W_1, W_2 and W_3



(1) $W_1 > W_2 > W_3$
(2) $W_1 = W_2 = W_3$
(3) $W_1 < W_2 < W_3$
(4) $W_2 > W_1 > W_3$

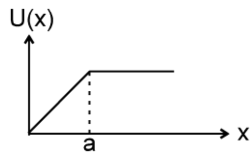
22. An open knife edge of mass 'm' is dropped from a height 'h' on a wooden floor. If the blade penetrates upto depth 'd' into the wood, the average resistance offered by the wood to the knife edge is

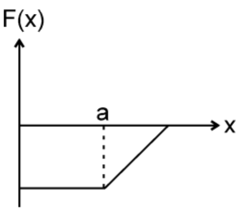
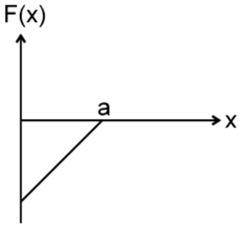
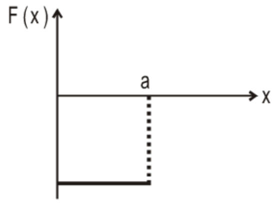
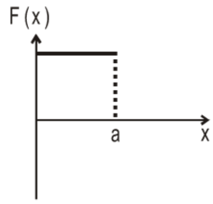
(1) mg (2) $mg\left(1-\frac{h}{d}\right)$ (3) $mg\left(1+\frac{h}{d}\right)$ (4) $mg\left(1+\frac{h}{d}\right)^2$

23. A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to (u = 0) -

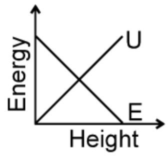
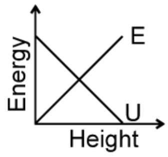
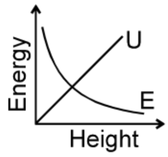
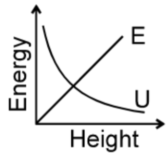
(1) $t^{1/2}$ (2) $t^{3/4}$ (3) $t^{3/2}$ (4) t^2

24. The potential energy of a system is represented in the first figure, the force acting on the system will be represented by

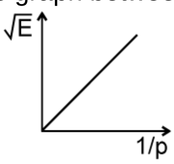
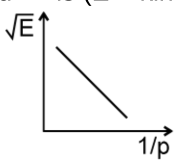
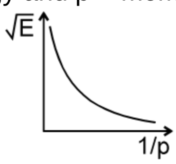
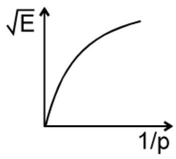


(1)  (2)  (3)  (4) 

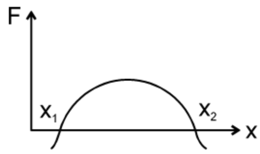
25. Which of the following graphs is correct between kinetic energy (E), potential energy (U) and height (h) from the ground of the particle ($h << R_E$ and U = 0 at h = 0)

(1)  (2)  (3)  (4) 

26. The graph between $\sqrt{E}$ and $\frac{1}{p}$ is (E = kinetic energy and p = momentum)

(1)  (2)  (3)  (4) 

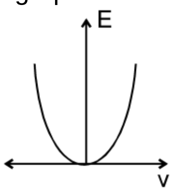
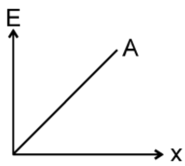
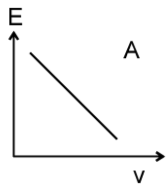
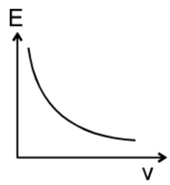
27. The force acting on a body moving along x-axis varies with the position of the particle as shown in the figure.



The body is in stable equilibrium at

(1) $x = x_1$ (2) $x = x_2$
(3) both x_1 and x_2 (4) neither x_1 nor x_2

28. The graph between kinetic energy E and velocity v is :

(1)  (2)  (3)  (4) 

29. A ball is released from the top of a tower. The ratio of work done by force of gravity in first, second and third second of the motion of the ball is

(1) 1 : 2 : 3 (2) 1 : 4 : 9 (3) 1 : 3 : 5 (4) 1 : 5 : 3

30. A 50 g bullet moving with velocity 10 m/s strikes a block of mass 950 g at rest and gets embedded into it. The loss in kinetic energy will be

(1) 100 % (2) 95 % (3) 5 % (4) 50 %

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

1. A block of mass M is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F. The kinetic energy of the block increases by 20 J in 1s.
(1) the tension in the string is Mg
(2) the tension in the string is F
(3) the work done by the tension on the block is 20 J in the above 1 s.
(4) the work done by the force of gravity is – 20 J in the above 1s.

2. Which of the following statement is not true?
(1) Work done by conservative force on an object depends only on the initial and final states and not on the path taken.
(2) The change in the potential energy of a system corresponding to conservative internal forces is equal to negative of the work done by these forces.
(3) If some of the internal forces within a system are non-conservative, then the mechanical energy of the system is not constant [given work done by non conservative force is non zero]
(4) If the internal forces are conservative, the work done by the internal forces is equal to the change in mechanical energy.

3. The potential energy function associated with the force $\vec{F} = 4xy\,\hat{i} + 2x^2\hat{j}$ is :
(1) $U = -2x^2 y$ (2) $U = -2x^2 y$ + constant
(3) $U = 2x^2 y$ + constant (4) not defined

4. A particle moving along x axis is acted upon by a force of variable magnitude but having direction along positive x axis. If the work done by the force as function of position is $W = \frac{-x^3}{3} + 2x^2$, the maximum force acting on the particle during its motion is :
(1) 2 N (2) 3 N (3) 4 N (4) 6 N

5. When a conservative force does positive work, the potential energy of the system associated with that force:
(1) decreases (2) increases (3) remains constant
(4) depends on whether other non conservative force is working or not.

6. A particle is projected vertically upwards with a speed of 16 m/s, after some time, when it again passes through the point of projection, its speed is found to be 8 m/s. It is known that the work done by air resistance is same during upward and downward motion. Then the maximum height attained by the particle is (Take $g = 10\ m/s^2$) :

(1) 8 m (2) 4.8 m (3) 17.6 m (4) 12.8 m

7. A particle is projected along a horizontal field whose coefficient of friction varies as $\mu = \frac{A}{r^2}$ where r is the distance from the origin in meters and A is a positive constant. The initial distance of the particle is 1 m from the origin and its velocity is radially outwards. The minimum initial velocity at this point so that particle never stops is :

(1) ∞ (2) $2\sqrt{gA}$ (3) $\sqrt{2gA}$ (4) $4\sqrt{gA}$

8. A body is projected with kinetic energy k at angle φ with the vertical. Neglecting friction, its potential energy at the highest point will be

(1) $k\cos^2\varphi$ (2) $k\sin^2\varphi$ (3) k (4) zero

9. The potential energy of a 0.64 kg particle moving along the x-axis is given by $U(x) = 8x^2$, where, U is in joules and 'x' is in meters. When the particle is at x = 1.0 m, it is traveling in the positive x-direction with a speed 5.0 m/s. It next stops momentarily to turn around at 'x', where 'x'.

(1) is equal to 2 (2) is equal to $\sqrt{2}$ (3) is equal to $\frac{1}{\sqrt{2}}$ (4) None of these

10. A body of mass 6 kg is acted upon by a force which causes a displacement in it given by $x = \frac{t^2}{4}$ metre where t is the time in second. The work done by the force is 2 seconds is:

(1) 12 J (2) 9 J (3) 6 J (4) 3 J

11. A particles with constant total energy E moves in one direction in a region where the potential energy is U(x). The speed of the particle is zero when.

(1) U(x) = E (2) U(x) = 0 (3) $\frac{dU(x)}{d(x)} = 0$ (4) $\frac{d^2U(x)}{d(x)^2} = 0$

Comprehension # 1

A rigid body of mass 2 kg initially at rest moves under the action of an applied horizontal force of 7 N on a table with coefficient of kinetic friction = 0.1 then

12. Work done by the applied force on the body in 10 s.

(1) 875 J (2) 870 J (3) – 250 J (4) 625 J

13. Work done by friction on the body in 10 s.

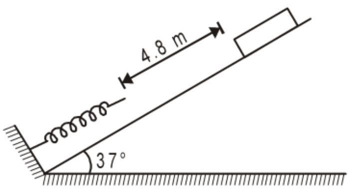
(1) 875 J (2) 870 J (3) – 250 J (4) 625 J

14. Work done by the net force on the body in 10 s.

(1) 875 J (2) 870 J (3) – 250 J (4) 625 J

Comprehension # 2

Figure shows a spring fixed at the bottom end of an incline of inclination 37°. A small block of mass 2 kg starts slipping down the incline from a point 4.8 m away from the spring. The block compresses the spring by 20 cm, stops momentarily and then rebounds through a distance of 1 m up the incline and come to rest again. Take $g = 10\ m/s^2$.



15. Work done by gravity up to block come to rest second time :

(1) 48J (2) 50J (3) 49J (4) None of these

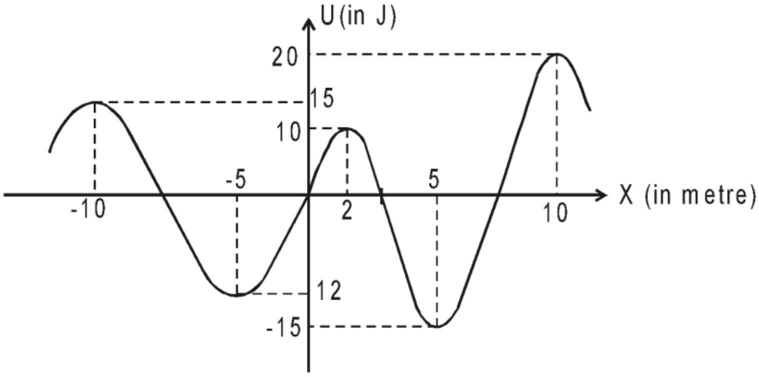
16. The friction coefficient between the plane and the block

(1) 1 (2) 0.5 (3) 0.25 (4) 0.75

17. The spring constant of the spring.
(1) 1000N/m (2) 1500N/m (3) 500N/m (4) 750N/m

Comprehension # 3

In the figure the variation of potential energy of a particle of mass m = 2kg is represented w.r.t. its x-coordinate. The particle moves under the effect of this conservative force along the x-axis.



18. If the particle is released at the origin then :
(1) it will move towards positive x-axis.
(2) it will move towards negative x-axis.
(3) it will remain stationary at the origin.
(4) its subsequent motion cannot be decided due to lack of information.

19. If the particle is released at $x = 2 + \Delta$ where $\Delta \to 0$ (it is positive) then its maximum speed in subsequent motion will be :
(1) $\sqrt{10}$ m/s (2) 5 m/s (3) $5\sqrt{2}$ (4) 7.5 m/s

20. x = – 5 m and x = 10 m positions of the particle are respectively of
(1) neutral and stable equilibrium. (2) neutral and unstable equilibrium.
(3) unstable and stable equilibrium. (4) stable and unstable equilibrium.

APSP Answers

PART - I

1.	(3)	**2.**	(2)	**3.**	(4)	**4.**	(1)	**5.**	(2)	**6.**	(2)	**7.**	(1)
8.	(1)	**9.**	(3)	**10.**	(3)	**11.**	(1)	**12.**	(3)	**13.**	(3)	**14.**	(1)
15.	(1)	**16.**	(3)	**17.**	(3)	**18.**	(1)	**19.**	(1)	**20.**	(2)	**21.**	(2)
22.	(3)	**23.**	(3)	**24.**	(3)	**25.**	(1)	**26.**	(3)	**27.**	(2)	**28.**	(1)
29.	(3)	**30.**	(2)										

PART - II

1.	(2)	**2.**	(4)	**3.**	(2)	**4.**	(3)	**5.**	(1)	**6.**	(1)	**7.**	(3)
8.	(1)	**9.**	(2)	**10.**	(4)	**11.**	(1)	**12.**	(1)	**13.**	(3)	**14.**	(4)
15.	(1)	**16.**	(2)	**17.**	(1)	**18.**	(2)	**19.**	(2)	**20.**	(4)		