

01. A ball of mass m and a ball B of mass $2m$ are projected with equal kinetic energies. Then at the highest point of their respective trajectories.

- (a) P.E. of A will be more than that of B
- (b) P.E. of B will be more than that of A
- (c) P.E. of A will be equal to that of B
- (d) can't be predicted.

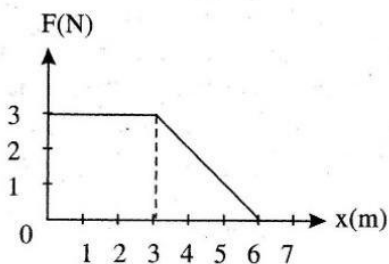
02. A force acts on a 30 gm particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in metres and t is in seconds. The work done during the first 4 seconds is

- (a) 576 mJ
- (b) 450 mJ
- (c) 490 mJ
- (d) 530 mJ

03. In a simple pendulum of length l the bob is pulled aside from its equilibrium position through an angle θ and then released. The bob passes through the equilibrium position with speed

- (a) $\sqrt{2g\ell(1 + \cos \theta)}$
- (b) $\sqrt{2g\ell \sin \theta}$
- (c) $\sqrt{2g\ell}$
- (d) $\sqrt{2g\ell(1 - \cos \theta)}$

04. A force F acting on an object varies with distance x as shown here. The force is in N and x in m. The work done by the force in moving the object from $x = 0$ to $x = 6$ m is:



- (a) 18.0 J
- (b) 13.5 J
- (c) 9.0 J
- (d) 4.5 J

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

- (a) 6 J
- (b) 13 J
- (c) 15 J
- (d) 9 J

06. A 2 kg block slides on a horizontal floor with a speed of 4 m/s. It strikes a uncompressed spring, and compresses it till the block is motionless. The kinetic friction force is 15 N and spring constant is 10,000 N/m. The spring compresses by

- (a) 8.5 cm
- (b) 5.5 cm
- (c) 2.5 cm
- (d) 11.0 cm

07. A particle of mass 100g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is

- (a) -0.5 J
- (b) -1.25 J
- (c) 1.25 J
- (d) 0.5 J

08. A body of mass m is accelerated uniformly from rest to a speed v in a time T . The instantaneous power delivered to the body as a function of time is given by

- (a) $\frac{mv^2}{T^2} \cdot t^2$
- (b) $\frac{mv^2}{T^2} \cdot t$
- (c) $\frac{1}{2} \frac{mv^2}{T^2} \cdot t^2$
- (d) $\frac{1}{2} \frac{mv^2}{T^2} \cdot t$

09. If the linear momentum is increased by 5%, the kinetic energy will increase by

- (a) 50%
- (b) 100%
- (c) 125%
- (d) 10%

10. A cord is used to lower vertically a block of mass M , through a distance d at a constant downward acceleration of $g/8$. Then the work done by the cord on the block is

- (a) $Mg d/8$
- (b) $3 Mg d/8$
- (c) $Mg d$
- (d) $-7 mg d/8$

11. Consider the following two statement:

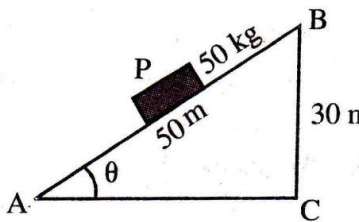
- I. Linear momentum of a system of particles is zero.
- II. Kinetic energy of a system of particles is zero.

Then

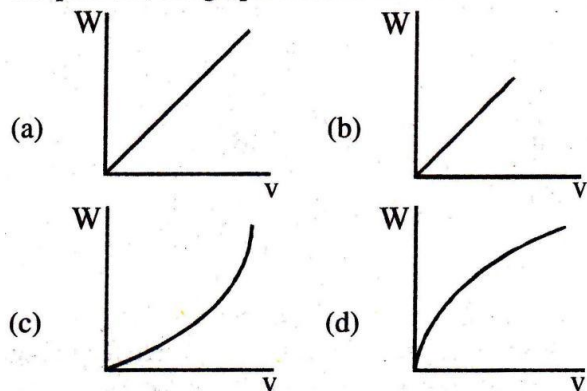
- (a) I implies II but II does not imply I.
- (b) I does not imply II but II implies I.
- (c) I implies II and II implies I.
- (d) I does not imply II and II does not imply I.

12. A spring of spring constant 5×10^3 N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is

- (a) 18.75 J
- (b) 25.00 J
- (c) 6.25 J
- (d) 12.50 J

13. A crane is used to lift 1000 kg of coal from a mine 100 m deep. The time taken by the crane is 1 hour. The efficiency of the crane is 80%. If $g = 10 \text{ ms}^{-2}$, then the power of the crane is
- (a) 10^4 W (b) 10^5 W
 (c) $\frac{10^4}{36 \times 8} \text{ W}$ (d) $\frac{10^5}{36 \times 8} \text{ W}$
14. A machine, which is 75% efficient, uses 12 J of energy in lifting up a 1 kg mass through a certain distance. The mass is then allowed to fall through that distance. The velocity at the end of its fall is (in m/s)
- (a) $\sqrt{24}$ (b) $\sqrt{12}$
 (c) $\sqrt{18}$ (d) $\sqrt{9}$
15. In figure, a carriage P is pulled up from A to B. The relevant coefficient of friction is 0.40. The work done will be
- (a) 10 kJ
 (b) 23 kJ
 (c) 25 kJ
 (d) 28 kJ
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16. Johnny and his sister Jane race up a hill. Johnny weighs twice as much as Jane and takes twice as long as Jane to reach the top. Compared to Jane
- (a) Johnny did more work and delivered more power.
 (b) Johnny did more work and delivered the same amount of power.
 (c) Johnny did more work and delivered less power
 (d) Johnny did less work and Johnny delivered less power.
17. Ten litre of water per second is lifted from a well through 10 m and delivered with a velocity of 10 ms^{-1} . If $g = 10 \text{ ms}^{-2}$, then the power of the motor is
- (a) 1 kW (b) 1.5 kW
 (c) 2 kW (d) 2.5 kW
18. If the force acting on a body is inversely proportional to its velocity, then the kinetic energy acquired by the body in time t is proportional to
- (a) t^0 (b) t^1
 (c) t^2 (d) t^4
19. The engine of a truck moving along a straight road delivers constant power. The distance travelled by the truck in time t is proportional to
- (a) t (b) t^2
 (c) \sqrt{t} (d) $t^{3/2}$
20. A one-ton car moves with a constant velocity of 15 ms^{-1} on a rough horizontal road. The total resistance to the motion of the car is 12% of the weight of the car. The power required to keep the car moving with the same constant velocity of 15 ms^{-1} is
 [Take $g = 10 \text{ ms}^{-2}$]
- (a) 9 kW (b) 18 kW
 (c) 24 kW (d) 36 kW
21. A ball is allowed to fall from a height of 10 m. If there is 40% loss of energy due to impact, then after one impact ball will go up to
- (a) 10 m (b) 8 m
 (c) 4 m (d) 6 m
22. The potential energy of a conservative system is given by $U = ay^2 - by$, where y represents the position of the particle and a as well as b are constants. What is the force acting on the system?
- (a) $-ay$ (b) $-by$
 (c) $2ay - b$ (d) $b - 2ay$
23. An automobile engine of mass M accelerates and a constant power p is applied by the engine. The instantaneous speed of the engine will be
- (a) $[Pt/M]^{1/2}$ (b) $[2Pt/M]^{1/2}$
 (c) $[Pt/2M]^{1/2}$ (d) $[Pt/4M]^{1/2}$
24. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?
- (a) 2.0 cm (b) 3.0 cm
 (c) 1.0 cm (d) 1.5 cm
25. A body is attached to the lower end of a vertical helical spring and it is gradually lowered to its equilibrium position. This stretches the spring by a length x . If the same body attached to the same spring is allowed to fall suddenly, what would be the maximum stretching in this case?
- (a) x (b) $2x$
 (c) $3x$ (d) $x/2$

26. A particle, initially at rest on a frictionless horizontal surface, is acted upon by a horizontal force which is constant in magnitude and direction. A graph is plotted of the work done on the particle W , against the speed of the particle v . If there are no other horizontal forces acting on the particle, the graph would look like



27. A small block of mass m is kept on a rough inclined surface of inclination θ fixed in an elevator. The elevator goes up with a uniform velocity v and the block does not slide on the wedge. The work done by the force of friction on the block in time t as seen by the observer on the inclined plane will be

- (a) zero
- (b) $mgvt \cos^2 \theta$
- (c) $mgvt \sin^2 \theta$
- (d) $mgvt \sin 2\theta$

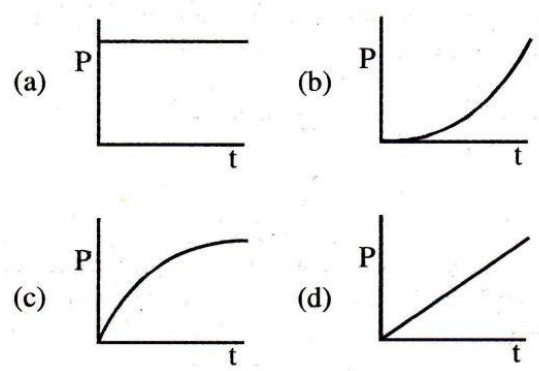
28. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to

- (a) x
- (b) e^x
- (c) x^2
- (d) $\log_e x$

29. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle, the motion of the particles takes place in a plane. It follows that

- (a) its kinetic energy is constant
- (b) its acceleration is constant
- (c) its velocity is constant
- (d) it moves in a straight line

30. A motor drives a body along a straight line with a constant force. The power P developed by the motor must vary with time t according to



31. A 10 m long iron chain of linear mass density 0.8 kg m^{-1} is hanging freely from a rigid support. If $g = 10 \text{ ms}^{-2}$, then the power required to lift the chain upto the point of support in 10 second

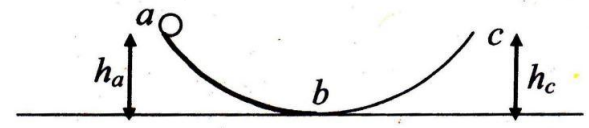
- (a) 10 W
- (b) 20 W
- (c) 30 W
- (d) 40 W

32. The kinetic energy of particle moving along a circle of radius R depends upon the distance covered S and is given by $K = aS$ where a is a constant. Then the force acting on the particle is

- (a) $\frac{aS}{R}$
- (b) $\frac{2(aS)^2}{R}$
- (c) $\frac{aS^2}{R^2}$
- (d) $\frac{2aS}{R}$

33. The ball rolls down without slipping (which is at rest at a) along ab having friction. It rolls to a maximum height h_c where bc has no friction. K_a , K_b and K_c are kinetic energies at a, b and c.

Which of the following is correct ?



- (a) $K_a = K_c, h_a = h_c$
- (b) $K_b > K_c, h_a = h_c$
- (c) $K_b > K_c, h_a < h_c$
- (d) $K_b > K_c, h_a > h_c$

34. If v be the instantaneous velocity of the body dropped from the top of a tower, when it is located at height h , then which of the following remains constant ?

- (a) $gh + v^2$ (b) $gh + \frac{v^2}{2}$
 (c) $gh - \frac{v^2}{2}$ (d) $gh - v^2$

35. The potential energy of a 1 kg particle free to move along

the x -axis is given by $V(x) = \left(\frac{x^4}{4} - \frac{x^2}{2} \right) \text{J}$.

The total mechanical energy of the particle is 2 J. Then, the maximum speed (in m/s) is

- (a) $\frac{3}{\sqrt{2}}$ (b) $\sqrt{2}$
 (c) $\frac{1}{\sqrt{2}}$ (d) 2

36. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force.

(Consider $g = 10 \text{ m/s}^2$).

- (a) 4 N (b) 16 N
 (c) 20 N (d) 22 N

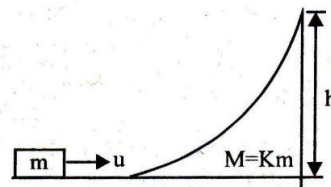
37. Two particles having the position $\vec{r}_1 = (3\hat{i} + 5\hat{j}) \text{ m}$ and

$\vec{r}_2 = (-5\hat{i} - 3\hat{j}) \text{ m}$ move with velocities $\vec{V}_1 = (4\hat{i} + 3\hat{j}) \text{ m/s}$

and $\vec{V}_2 = (a\hat{i} + 7\hat{j}) \text{ m/s}$. If the particles collide, then value of a must be

- (a) 8 (b) 6
 (c) 4 (d) 2

38. A block of mass m is moved towards a movable wedge of mass $M = km$ and height h with velocity u (All the surface are smooth). If the block just reaches the top of the wedge, the value of u is



- (a) $\sqrt{2gh}$ (b) $\sqrt{\frac{2ghK}{1+K}}$
 (c) $\sqrt{\frac{2gh(1+K)}{K}}$ (d) $\sqrt{2gh \left(1 - \frac{1}{K} \right)}$

39. The work done on a particle of mass m by a force,

$$K \left[\frac{x}{(x^2 + y^2)^{3/2}} \hat{i} + \frac{y}{(x^2 + y^2)^{3/2}} \hat{j} \right]$$

(K being a constant of appropriate dimensions), when the particle is taken from the point $(a, 0)$ to the point $(0, a)$ along a circular path of radius a about the origin in the x - y plane is

- (a) $\frac{2K\pi}{a}$
 (b) $\frac{K\pi}{a}$
 (c) $\frac{K\pi}{2a}$
 (d) 0