WORK POWER & ENERGY

EXERCISE - I

1. A particle moves along the x-axis from x = 0 to x = 5m under the influence of a force given by $F = 7 - 2x + 3x^2$ N. The work done in the process is
(a) 107 J (b) 270 J (c) 100 J (d) 135 J

2. The total work done on a particle is equal to the change in its kinetic energy
(a) always
(b) only if the forces acting on the body are conservative
(c) only if the forces acting on the body are gravitational
(d) only if the forces acting on the body are elastic

3. A body of mass *m* is moving in a circle of radius *r* with a constant speed *v*. The force on the body is mv^2/r and is directed towards the centre. What is the work done by the force in moving the body half the circumference of the circle :
(a) $\frac{mv^2}{r} \times \pi r$ (b) zero (c) $\frac{mv^2}{r^2}$ (d) $\frac{\pi r^2}{mv^2}$

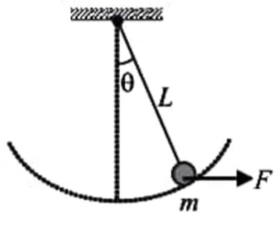
4. A particle moves with a velocity $\vec{v} = (5\hat{i} - 3\hat{j} + 6\hat{k})$ m/s under the influence of a constant force $\vec{F} = (10\hat{i} - 10\hat{j} + 20\hat{k})N$. The instantaneous power applied to the particle is
(a) 200 W (b) 140 W (c) 40 W (d) 170 W

5. A chain is held on a frictionless table with one third of its length hanging over the edge. If the chain has a length *L* and mass *M*, how much work is required to pull the hanging part back on the table
(a) MgL (b) $\frac{MgL}{3}$ (c) $\frac{MgL}{9}$ (d) $\frac{MgL}{18}$

6. There is a hemispherical bowl of radius *R*. A block of mass *m* slides from the rim of the bowl to the bottom. The velocity of the block at the bottom will be
(a) $\sqrt{Rg}$ (b) $\sqrt{2Rg}$ (c) $\sqrt{2\pi Rg}$ (d) $\sqrt{\pi Rg}$

7. A spring of force-constant *k* is cut into two pieces such that one piece is double the length of the other. Then the longer piece will have a force-constant of
(a) (2/3)k (b) (3/2)k (c) 3k (d) 6k

8. An object of mass *m* is tied to a string of length L and a variable horizontal force is applied on it which starts at zero and gradually increases until the string makes an angle θ with the vertical. This process is done slowly. Work done by the force *F* is
(a) $mgL(1 - \sin\theta)$ (b) mgL
(c) $mgL(1 - \cos\theta)$ (d) $mgL(1 + \cos\theta)$



9. A body of mass *m* is projected at an angle with an initial velocity *u*. The mean power of gravity over the whole time of journey is
(a) $mg\cos\theta$ (b) $\frac{1}{2}mg\sqrt{u\cos\theta}$ (c) $\frac{1}{2}mgu\sin\theta$ (d) zero

10. 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) x^2 (c) $\ln x$ (d) e^x

11. Under the action of a force, a 2kg body moves such that its position x as a function of time is given by $x = \frac{t^3}{3}$, where x is in meter and t is in second. The work done by the force in the first two second is

(a) 1600 J (b) 160 J (c) 16 J (d) 1.6 J

12. If a simple pendulum of length l has maximum angular displacement θ then the maximum kinetic energy of its bob of mass m is

(a) $\frac{1}{2}m\left(\frac{l}{g}\right)$ (b) $\frac{1}{2}m\left(\frac{g}{l}\right)$ (c) $mgl(1 - \cos\theta)$ (d) $\left(\frac{1}{2}\right)m\left(\frac{g}{l}\right)$

13. A person pulls a bucket of water from a well of depth h. If the mass of uniform rope is m and that of the bucket full of water M, the work done by the person is

(a) $\left(M + \frac{m}{2}\right)gh$ (b) $\frac{1}{2}(M + m)gh$ (c) $\left(M + \frac{m}{2}\right)gh$ (d) $\left(\frac{M}{2} + m\right)gh$

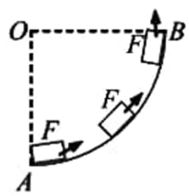
14. A car starts from rest and moves on a surface in which the coefficient of friction between the road and the tyres increases linearly with distance (x). The car moves with the maximum possible acceleration. The kinetic energy (E) of the car will depends on x as

(a) $E \propto \frac{1}{x^2}$ (b) $E \propto \frac{1}{x}$ (c) $E \propto x$ (d) $E \propto x^2$

15. A cord is used to lower vertically a block of mass M a distance d at a constant downward acceleration of $g/4$. Then the work done by the cord on the block is

(a) $\frac{Mgd}{4}$ (b) $-\frac{Mgd}{4}$ (c) $\frac{3Mgd}{4}$ (d) $\frac{-3Mgd}{4}$

16. If the block in the figure is pulled by a constant force F which is always tangential to the surface then, the work done by this force between A and B is



(a) $F\pi R$ (b) $\sqrt{2}FR$

(c) $\frac{\pi}{2}FR$ (d) FR

17. Power supplied to a particle of mass 2 kg varies with time as $p = 3\,t^2/2$ watt. Here t is in seconds. If velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at time $t = 2s$ will be

(a) 1 m/s (b) 4 m/s (c) 2 m/s (d) $2\sqrt{2}$ m/s

18. 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 ball is

(a) 1 : 2 : 3 (b) 1 : 4 : 16 (c) 1 : 3 : 5 (d) 1 : 9 : 25

19. The potential energy function for the force between two atoms of a diatomic molecule is given by $U(x) = a/x^{12} - b/x^6$, where a and b are positive constant and x is the distance between the atoms. The minimum energy needed to break up the molecule is

(a) $2a^2/b$ (b) $b/2a^2$ (c) $b^2/4a$ (d) $-b^2/4a$

20. A block of mass m, placed on a rough horizontal plane is pulled by a constant power P. The friction coefficient between the block and the surface is μ. Maximum velocity of the block will be

(a) $\mu P/mg$ (b) $\mu mg/P$ (c) μmgP (d) $P/\mu mg$

21. A body pulls a 5 kg block 20m along a horizontal surface at a constant speed with a force directed 45° above the horizontal. If the coefficient of kinetic friction is 0.2, how much work does the boy do on the block ? Take $g = 9.8 m/s^2$.

(a) 32.5 J (b) 113.5 J (c) 163.3 J (d) 25.00 J

22. A wind-powered generator converts wind energy into electrical energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to speed v as

(a) v (b) v^2 (c) v^3 (d) v^4

23. A simple pendulum has a string of length l and bob of mass m. When the bob is at its lowest position, it is given the minimum horizontal speed necessary for it to move in a circular path about the point of suspension. The tension in the string at the lowest position of the bob is

(a) 3 mg (b) 4 mg (c) 5 mg (d) 6 mg

24. A mass of 2 kg falls from a height of 40 cm on a spring of force constant 1960 N/m. The spring is compressed by Take $g = 9.8 m/s^2$.

(a) 10 cm (b) 0.4 cm (c) 0.01 cm (d) 0.04 cm

25. A force $\vec{F} = k(y\hat{i} + x\hat{j})$, where k is a positive constant, acts on a particle moving in the xy plane. Starting from the origin, the particle is taken along the positive x-axis to the point $(a, 0)$, and then parallel to the y-axis to the point (a, a). The total work done by the force on the particle is

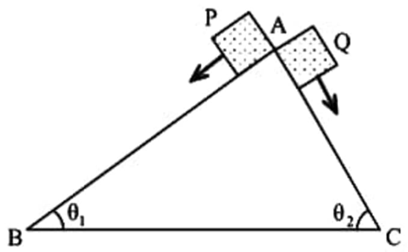
(a) $-2ka^2$ (b) $2ka^2$ (c) $-ka^2$ (d) ka^2

EXERCISE - II

Multiple Choice Questions with One or More Choices Correct

1. 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 particle take place in a plane. It follows that
(a) the velocity of the particle is constant
(b) the acceleration of the particle is constant
(c) the kinetic energy of the particle is constant
(d) the particle moves in a circular path.

2. Two inclined frictionless tracks of different inclinations meet at A from where two block P and Q of different masses are allowed to slide down from rest at the same time, one on each track, as shown in figure.



(a) Both blocks will reach the bottom at the same time
(b) Block Q will reach the bottom earlier than block P
(c) Both blocks reach the bottom with the same speed
(d) Block Q will reach the bottom with a higher speed than block P

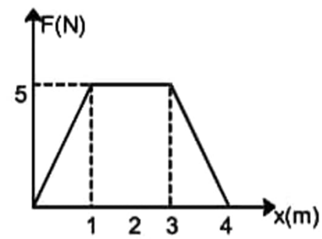
3. Choose the correct statements from the following:
(a) When a conservative force does positive work on a body, its potential energy increases.
(b) When a body does work against friction, its kinetic energy decreases.
(c) The rate of change of total momentum of a many-particle system is proportional to the net external force acting on the system.
(d) The rate of change of total momentum of many-particle system is proportional to the net internal force acting on the system.

4. A body is subjected to a constant force F in newton given by

$$F = -\hat{i} + 2\hat{j} + 3\hat{k}$$

where $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y and z axes respectively. The work done by this force in moving the body through a distance of
(a) 4m along the y-axis is 12 J. (b) 3m along the y-axis is 6 J.
(c) 4m along the z-axis and then 3m along the y-axis is 18 J.
(d) 4m along the z-axis and then 3m along the y-axis is $\sqrt{(12)^2 + (6)^2}$ J.

5. Figure shows the force F acting on a body as a function of x. The work done in moving the body



(a) from x = 0 to x = 1m is 2.5 J.
(b) from x = 1 m to x = 3 m is 10 J.
(c) from x = 0 to x = 4m is 15 J.
(d) from x = 0 to x = 4 m is 12.5 J.

6. A block of mass 2kg, initially at rest on a horizontal floor, moves under the action of a horizontal force of 10N. The coefficient of friction between the block and the floor is 0.2. If $g = 10\ ms^{-2}$
(a) the work done by the applied force in 4 s is 240 J.
(b) the work done by the frictional force in 4 s is 96 J.
(c) the work done by the net force in 4 s is 336 J.
(d) the change in kinetic energy of the block in 4 s is 144 J.

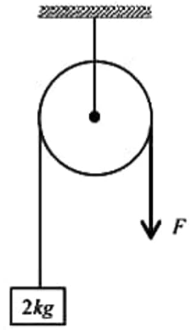
7. Which of the following can be negative

(a) Kinetic energy (b) Potential energy (c) Mechanical energy (d) All of these

8. Which of the following may not be conserved for an isolated system

(a) Energy (b) Potential energy (c) Mechanical energy (d) Kinetic energy

9. A block of mass 2 kg 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 = 40N. The kinetic energy of the particle increases 40 J in a given interval of time. Then ($g = 10\ m/s^2$)



(a) tension in the string is 40 N
(b) displacement of the block in the given interval of time is 2m
(c) work done by gravity is - 20 J
(b) work done by tension is 80 J

10. A particle moves in a straight line with constant acceleration under a constant force F . Select the correct alternative (s)

(a) Power developed by this force varies linearly with time
(b) Power developed by this force varies parabolically with time
(c) Power developed by this force varies linearly with displacement
(d) Power developed by this force varies parabolically with displacement

11. One end of a light spring of force constant k is fixed to a wall and other end is tied to a block placed on a smooth horizontal surface. For displacement x, the work done by the spring is $\frac{1}{2}kx^2$.

The possible case (s) may be

(a) the spring was initially stretched by a distance x and finally was in its natural length
(b) the spring was initially in its natural length and finally it was compressed by a distance x
(c) the spring was initially compressed by a distance x and finally was in its natural length
(d) the spring was initially in its natural length and finally stretched by a distance x

12. In projectile motion, power of gravitational force

(a) is constant throughout
(b) is negative for first half, zero at topmost point and positive for rest half
(c) varies linearly with time (d) is positive for complete path

13. The potential energy U of a particle of mass 1 kg moving in x-y plane obeys the law $U = 3x + 4y$, where (x, y) are the co-ordinates of the particles in metre. If the particle is at rest at (6, 4) at time t = 0 then

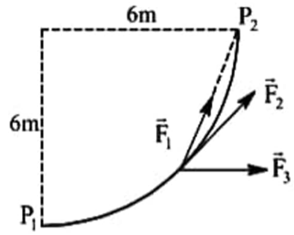
(a) the particle has constant acceleration
(b) the particle has zero acceleration
(c) the speed of particle when its crosses the y-axis 10 m/s
(d) co-ordinate of particle at t = 1s are (4.5, 2)

14. A block is suspended by an ideal spring of force constant k. If the block is pulled down by applying a constant force F and if the maximum displacement of the block from its initial mean position of rest is x_0 then :

(a) increase in energy stored in spring is $k x_0^2$ (b) $x_0 = \frac{3F}{2K}$

(c) $x_0 = \frac{2F}{k}$ (d) work done by applied force F is Fx_0

15. A smooth track in the form of a quarter circle of radius 6 m lies in a vertical plane. A particle moves from P_1 to P_2 under the action of force $\vec{F}_1$, $\vec{F}_2$ and $\vec{F}_3$. Force $\vec{F}_1$ is always towards P_2 and is always 20N in magnitude. Force $\vec{F}_2$ always acts tangentially and is always 15N in magnitude. Force $\vec{F}_3$ always acts horizontally and is of magnitude 30N. Select the correct alternative (s)



(a) Work done by $\vec{F}_1$ is 120 J
(b) Work done by $\vec{F}_2$ is 45 π
(c) Work done by $\vec{F}_3$ is 180 J
(d) $\vec{F}_1$ is conservative in nature

16. A small spherical ball is suspended through a string of length l. The whole arrangement is placed in a vehicle which is moving with velocity v. Now suddenly the vehicle stops and balls starts moving along circular path. If tension in the string at the highest point is twice the weight of the ball then

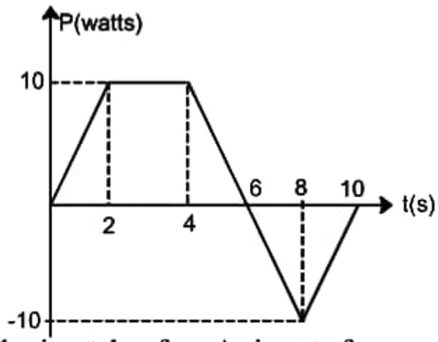
(a) $v = \sqrt{5gl}$
(b) $v = \sqrt{7gl}$
(c) velocity of the ball at highest point is $\sqrt{gl}$
(d) velocity of the ball at the highest point is $\sqrt{3gl}$

17. A particle is acted upon by a conservative force $\vec{F} = (6\hat{i} - 6\hat{j})$N (no other force is acting on the particle). Under the influence of this force particle moves from (0, 0) to (–3m, 4m) then :

(a) work done by the force is 3 J
(b) work done by the force is –42 J
(c) at (0, 0) speed of the particle must be zero
(d) at (0, 0) speed of the particle must not be zero

18. Power of a non-zero force acting on block varies with time t as shown in figure. Then angle between force acting on the block and its velocity is

(a) acute at $t = 1$s
(b) 90° at $t = 3$s
(c) obtuse at $t = 7$s
(d) change in kinetic energy from $t = 0$ to $t = 10$s is 20 J



19. A strip of wood mass M and length l is placed on a smooth horizontal surface. An insect of mass m starts at one end of the strip and walks to the other end in time t, moving with a constant speed.

(a) The speed of the insect as seen from the ground is $< \dfrac{\ell}{t}$

(b) The speed of the strip as seen from the ground is $\dfrac{\ell}{t}\left(\dfrac{M}{M+m}\right)$

(c) The speed of the strip as seen from the ground is $\dfrac{\ell}{t}\left(\dfrac{m}{M+m}\right)$

(d) The total kinetic energy of the system is $\dfrac{1}{2}(m+M)\left(\dfrac{\ell}{t}\right)^2$

20. $U(r) = \frac{A}{r^2} - \frac{B}{r}$: Where r is the distance from the centre of the force and A and B are positive constants.

(a) The equlibrium distance is given by $\frac{2A}{B}$

(b) The work required to move the particle from equilibrium distance to infinity is $\frac{B^2}{4A}$

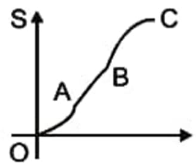
(c) The work required to move the particle from equilibrium distance to infinity is $\frac{B}{4A}$

(d) Only (A)

21. In the figure shown upper block is given a velocity of 6m/s and lower block 3 m/s. When relative motion between them is stopped.

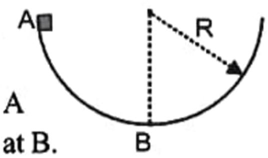
(a) Work done by friction on upper block is negative
(b) Work done by friction on both blocks is positive
(c) Work done by friction on upper block is –10J
(d) Net work done by friction is zero.

22. Displacement time graph of a particle moving in a straight line is as shown in figure. select the current alternative(s):



(a) Work done by all the forces in region OA and BC is positive
(b) Work done by all the forces in region AB is zero
(c) Work done by all the forces in region BC is negative
(d) Work done by all the forces in region OA is negative.

23. A small block of mass m is released from rest from position A inside a smooth hemispherical bowl of radius R as shown in figure. Choose the wrong option :



(a) acceleration of block is constant throughout (b) acceleration of block is g at A
(c) acceleration of block is 3g at B (d) acceleration of block is 2g at B.

24. A force $F = -kx^3$ is acting on a block moving along x-axis. Here, k is a positive constant. Work done by this force is :
(a) positive in displacing block from x = 3 to x = 1
(b) positive in displacing block from x = –1 to x = 3
(c) negative in displacing block from x = 3 to x = 1
(d) negative in displacing block from x = –1 to x = 3.

EXERCISE - III

1. Match the following:

Table 1	Table 2
(A) Work done by all the forces	(p) Change in potential energy
(B) Negative of work done by internal conservative forces	(q) Change in kinetic energy
(C) Work done by external forces +non conservative internal forces	(r) Change in mechanical energy
	(s) None

2. A particle is suspended from a string of length R. It is given a velocity $u = 3\sqrt{gR}$ at the bottom. Match the following:

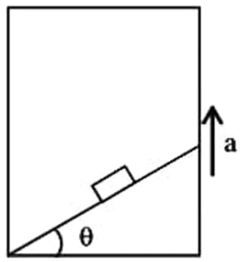
Table 1	Table 2
(A) Velocity at B	(p) $7mg$
(B) Velocity at C	(q) $\sqrt{5gR}$
(C) Tension in string at B	(r) $\sqrt{7gR}$
(D) Tension in string at C	(s) $5mg$
	(t) None

3. A force F = kx (where k is a positive constant) is acting on a particle. Work done:

Table 1	Table 2
(A) In displacing the body from $x = 2$ to $x = 4$	(P) Negative
(B) In displacing the body from $x = -4$ to $x = -2$	(Q) Positive
(C) In displacing the body from $x = -2$ to $x = +2$	(R) Zero

4. A block of mass m is stationary with respect to a rough wedge as shown in figure. Starting from rest in time t, $\left(m = 1kg, \theta = 30^o, a = 2m/s^2, t = 4s\right)$ work done on block:

Table 1	Table 2
(A) By gravity	(p) 144 J
(B) By normal reaction	(q) 32 J
(C) By friction	(r) 56 J
(D) By all forces	(s) 48 J
	(t) None



Comprehension - 1

Two physicists, both of mass 50kg, climb up identical ropes suspended form the ceiling of a gymnasium. The ropes are 15m long. Physicist 1 reaches the top twice as quickly as physicist 2 does. After physicist 2 also reaches the top, they argue about who did more work against gravity:

Physicist 1:-

"I did more work fighting gravity, because I was overcoming gravity more quickly. Your climb was lazier, and therefore, you did less work."

Physicist 2:-

"No way. I did more work fighting gravity, because I spend more time climbing the rope. Since we both ended up at the same height, but I spent more time getting there, I had to work harder."

5. Which physicist, if either, did more work against gravity while climbing from the floor to the ceiling?
(a) physicist 1 did more work (b) physicist 2 did more work
(c) Both physicist did the same work (d) neither physicist did any work

6. Physicist 1 climbed her rope in 30s. What average power did she exert fighting gravity?
(a) 25W (b) 250W (c) 1,500W (d) 15,000W

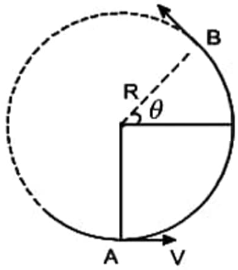
7. Physicist 2 started at rest from the floor and ended at rest near the ceiling. Which of the following best expresses the net energy transfer during this process?
(a) chemical to kinetic (b) chemical to potential
(c) kinetic to chemical (d) kinetic to potential

8. Physicist 2 now lets go of the rope and falls onto a heavily-padded cushion, safely coming to rest. During this process, the energy transfer is best described as:
(a) potential to kinetic to chemical (b) potential to kinetic to heat
(c) kinetic to potential to chemical (d) kinetic to potential to heat

9. When physicist 2 has fallen one third of the way from the ceiling to the floor, her kinetic energy is approximately:
(a) 10 J (b) 250 J (c) 1000 J (d) 2500 J

Comprehension - 2

A ball tied to a string of length R is given a speed V, when its hanging vertically. At some point B during its circular motion, the string gets slacked & after that the body passes through its initial point.



10. Find angle θ.
(a) 30° (b) 60° (c) 45° (d) 270°

11. Find v.

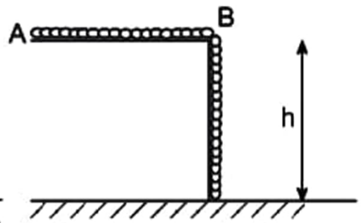
(a) $\sqrt{\frac{4+3\sqrt{3}}{2}gR}$ (b) $\sqrt{\frac{2\sqrt{2}+3}{\sqrt{2}}gR}$ (c) $\sqrt{\frac{7gR}{2}}$ (d) $\sqrt{5gR}$

12. Find speed at point B.

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

Comprehension - 3

A chain of length ℓ and mass m is in position as shown in the figure. All surfaces are frictionless.



13. Find speed of end A when it is at point B.

(a) $\sqrt{2g\left(h-\ell+(h+\ell)\ln\left(\frac{\ell}{h}\right)\right)}$ (b) $\sqrt{gh\left(1-\frac{2h}{\ell}+\frac{h}{\ell}\right)}$

(c) $\sqrt{2gh\ln\left(\frac{\ell}{h}\right)}$ (d) $\sqrt{3gh\left(1+\frac{\ell}{h}\right)}$

14. Find max kinetic energy of chain before end A reaches point B.

(a) $\frac{mgh}{e}$ (b) $\frac{2mgh}{e}$ (c) $\frac{mgh}{2e}$ (d) e mgh

15. Find energy lost as heat before end A reaches B.

(a) $\frac{mgh}{\ell}\left[\ell-h+h\ln\left(\frac{\ell}{h}\right)\right]$ (b) $\frac{mgh}{\ell}\left[\ell-h-h\ln\left(\frac{\ell}{h}\right)\right]$

(c) 0 (d) $\frac{mgh}{\ell}\left[\ell+h-h\ln\left(\frac{\ell}{h}\right)\right]$

Comprehension - 4

A single conservative force acts on a 1kg particle that moves along $x-$ axis. Potential energy U(x) is given by $U(x) = 20 + (x-3)^2$, where x is in m. At x = 0, particle has kinetic energy of 20J.

16. What is the mechanical energy of system

(a) 20J (b) 49 J (c) 100 J (d) 75 J

17. Find the greatest & least value of x between which particle can move $\left(\sqrt{29}=5.4\right)$

(a) 7.4m & –3.4m (b) 8.4 m & 4.4 m (c) 7m & 3m (d) 8m & 4m

18. Find maximum kinetic energy of particle & value of x at which it occurs.

(a) 20J & x = 0m (b) 29J & x = 3m (c) 49J & x = 1m (d) 29J & x = 0m

19. Find value of x at which body is in equilibrium

(a) 0m (b) –2m (c) 3m (d) 1m

Comprehension - 5

The work done by all forces on a body is equal to change of kinetic energy of the body. This is true for both constant and variable force (variable in both magnitude and direction). For a particle $W = \Delta K$. For a system, $W_{int} + W_{ext} = \Delta K_{cm}$ or $W_{ext} + W_{nonconservative} = \Delta K + \Delta U$

In the absence of external and nonconservative forces, total mechanical energy of system remains conserved.

20. I - Work done in raising a box on a platform depends on how fast it is raised

II - Work done by force depends on the frame of reference

(a) I - False II - True (b) I - False II - False

(c) I - True II - False (d) I - True II - True.

21. The total energy of a system is

(a) always conserved in presence of external forces.

(b) always conserved in absence of internal forces.

(c) always conserved in presence of no external force and no internal non conservative force

(d) none of the above.

22. Work done in motion of a body over a closed loop is

(a) always zero for any force (b) always zero for conservative forces

(c) only (a) (d) None of the above.

Comprehension - 6

Work done by a constant force acting on a particle is defined as $W = \vec{F}.\Delta\vec{r}$ where $\Delta\vec{r} = \vec{r}_f - \vec{r}_i, \vec{r}_f$ is the final position of particle and $\vec{r}_i$ is the initial position of particle. If the force is variable work done is defined as

$W = \int_{\vec{r}_i}^{\vec{r}_f} \vec{F}.\vec{d}r$, where $\vec{F}$ is the force at any general position $\vec{r}$ between $\vec{r}_i$ and $\vec{r}_f$, and $\vec{d}r$ is representing infinitesimal small displacement of particle. $\vec{d}r = dx\hat{i} + dy\hat{j} + dz\hat{k}$.

23. A particle is thrown from a tower of height h at an angle θ above horizontal. Work done by gravity during its time of flight is (mass of particle is m)

(a) 0 (b) mgh cos θ (c) mgh sin θ (d) mgh.

24. Given: $\vec{F} = 2\hat{i} + 4\hat{j}, \vec{r}_i = 2\hat{i} + 3\hat{j}$ and $\vec{r}_f = 3\hat{i} + 4\hat{j}$ Work done is (use SI units)

(a) 4 J (b) 6 J (c) 10 J (d) zero.

25. A particle thrown from ground with a velocity v at an angle θ above horizontal. Work done by gravity in $t = \frac{2v\sin\theta}{g}$ equals

(a) $\frac{mgv^2\sin^2\theta}{2g}$ (b) $\frac{mgv^2\sin^2\theta}{g}$ (c) zero (d) $\frac{2mgv^2\sin^2\theta}{g}$

ANSWER KEY

EXERCISE 1

1.	(d)	**2.**	(a)	**3.**	(b)	**4.**	(b)	**5.**	(d)
6.	(b)	**7.**	(b)	**8.**	(c)	**9.**	(d)	**10.**	(b)
11.	(c)	**12.**	(c)	**13.**	(a)	**14.**	(d)	**15.**	(d)
16.	(c)	**17.**	(c)	**18.**	(c)	**19.**	(c)	**20.**	(d)
21.	(c)	**22.**	(c)	**23.**	(d)	**24.**	(a)	**25.**	(d)

EXERCISE 2

1.	(c, d)	**2.**	(b, c)	**3.**	(b, c)	**4.**	(b, c)
5.	(a, b, c)	**6.**	(a, d)	**7.**	(b, c)	**8.**	(b, c, d)
9.	(a, b, d)	**10.**	(a, d)	**11.**	(a, c)	**12.**	(b, c)
13.	(a, c, d)	**14.**	(c, d)	**15.**	(b, c, d)	**16.**	(b, d)
17.	(b, d)	**18.**	(a, c, d)	**19.**	(a, c)	**20.**	(a, b)
21.	(a, c)	**22.**	(b, d)	**23.**	(a, c)	**24.**	(a, d)

EXERCISE 3

1. (A - q), (B - s), (C - r)

2. (A - r), (B - q), (C - p), (D - t

3. (A - q), (B - p), (C - r)

4. (A - t), (B - p), (C - s), (D - q)

5.	(c)	**6.**	(b)	**7.**	(b)	**8.**	(b)	**9.**	(d)
10.	**(a)**	**11.**	**(c)**	**12.**	**(a)**	**13.**	**(c)**	**14.**	**(a)**
15.	**(b)**	**16.**	**(b)**	**17.**	**(a)**	**18.**	**(b)**	**19.**	**(c)**
20.	**(a)**	**21.**	**(c)**	**22.**	**(b)**	**23.**	**(d)**	**24.**	**(b)**
25.	**(c)**								