Chapter 9

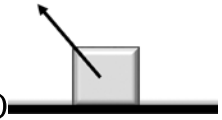
Work Power Energy

Exercise

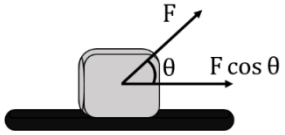
Q.1 A man weighing 50 Kg is walking on a horizontal surface (assumed smooth) for a distance of 1Km. What is the work done by his weight?

(A) Zero **(B)** Positive **(C)** Negative **(D)** Nothing can be said

Q.2 Figure shows four situations in which a force acts on a box while the box slides rightward a distance d across a frictionless floor. The magnitude of the forces are identical under their orientations as shown. Identify under which condition the work done on the box during the displacement will be negative

(A)  **(B)**  **(C)**  **(D)** 

Q.3 A force of 5 N, making an angel θwith the horizontal,acting on an object and displaces it by 0.4 m along the horizontal direction. If the work done by the force is 1J. Then the horizontal component of the force is.

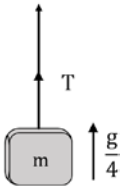


(A)1.5 N **(B)** 2.5 N **(C)** 3.5 N **(D)** 4.5 N

Q.4 A particle move from position $\vec{r}_1 = 3\hat{\imath} + 2\hat{\jmath} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{\imath} + 13\hat{\jmath} - 9\hat{k}$ under the action of force $(4\hat{\imath} + \hat{\jmath} + 3\hat{k})$N calculate the work done.

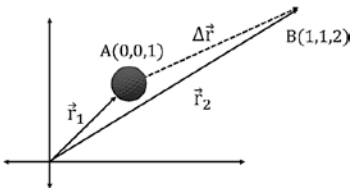
(A)51 J **(B)** 100 J **(C)** 46 J **(D)** 42 J

Q.5 A string is used to pull a block of mass m vertically up by a distance h at a constant acceleration $\frac{g}{4}$. the work done by the tension in the string is.



(A) $+\frac{3}{4}$mgh **(B)** $-\frac{1}{4}$mgh **(C)** $+\frac{5}{4}$mgh **(D)** +mgh

Q.6 A particle is shifted from point (0,0,1 m) to (1m,1m,2m), under the simultaneous action of several force. Two of the force are $\vec{F}_1 = (2\hat{\imath} + 3\hat{\jmath} - \hat{k})$N and $\hat{F}_2 = (\hat{\imath} - 2\hat{\jmath} + 2\hat{k})$N find the work done by these two forces.

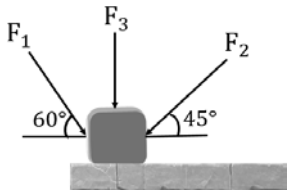


(A) 7J **(B)**5 J **(C)** 10 J **(D)** 12 J

Q.7 A constant force $\vec{F}_1 = (2\hat{\imath} - 4\hat{\jmath})$N displace a particle from (1,–1, 2) to (–1,–1, 3) and then another force of $\vec{F}_2 = (3\hat{\imath} + 4\hat{\jmath})$N displaces it from (–1,–1,3) to (5,5,5) (displacement being measure in matter) find the total work done.

(A) 46 J **(B)**38 J **(C)** 40 J **(D)** 36 J

Q.8 Three focus are acting on the block as show in figure. Find work done by net force if block moves 10 m in horizontal direction. Given that $[F_1 = 20\text{N}, F_2 = 5\sqrt{2}\text{N}, F_3 = 10\text{N}]$



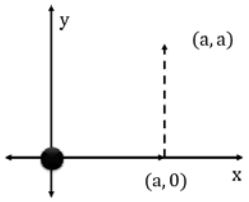
(A)50 J **(B)** 100 J

(C) 75 J **(D)** No work done as friction is absent

Q.9 A force $\vec{F} = (3\hat{\imath} + 4\hat{\jmath})$Nacts on a particle moving in x – y plane. Starting from origin, the particle first goes along x-axis to the point (4 m, 0) and then parallel to the y – axis to the point (4 m, 3 m). the total work done by the force on the particle is.

(A)+ 12 J **(B)**–6 J **(C)**+24 J **(D)**–12 J

Q.10 A force $F = -k(y\hat{\imath} + x\hat{\jmath})$ (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 F on the particle is.

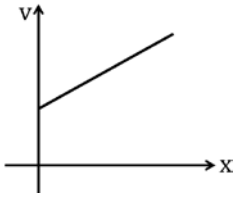


(A)$-2ka^2$ **(B)**. $2ka^2$ **(C)** $-ka^2$ **(D)**ka^2

WORK SHEET

V - X Graph

Q.11 The velocity (v) versus displacement (x) graph of a particle moving along a straight line is shown in figure. Identify the correct statement regarding the acceleration (a) of particle.



(A) Is constant **(B)** Increasing linearly with x

(C) Increase parabolically with x **(D)** None of these

Newton's law of motion

Q.12 A 20 Kg monkey slides down a vertical rope with a constant acceleration of $7 m/s^2$. If $g = 10 m/s^2$ What is the tension in the rope?

(A) 140 N **(B)** 100 N **(C)** 60 N (D) 30 N

Circular Motion

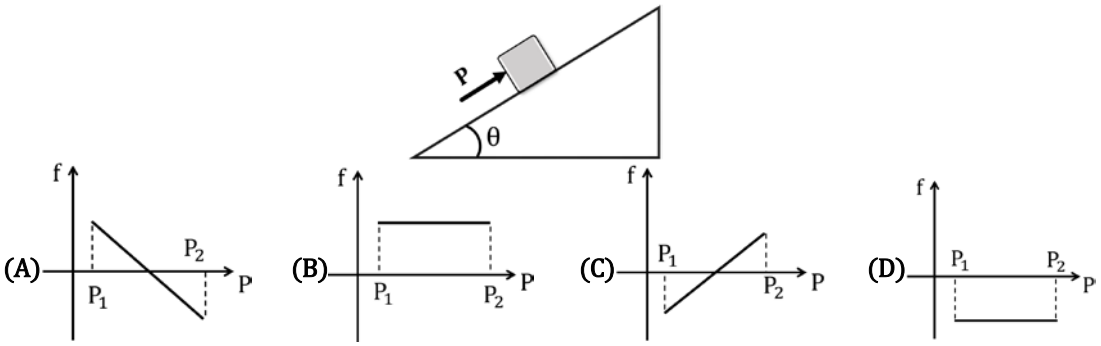
Q.13 A curve has a radius of 50 meters and a banking angle of 15°. What is the critical speed (the speed for which no friction is required between the cars tyre and the surface) for a car to travel safely on this curve? Take $g = 10\ m/s^2$.

(A) $16 m/s$ **(B)** $9 - \sqrt{2}\ m/s$ **(C)** $10\sqrt{5(2-\sqrt{3})} m/s$ **(D)** $\sqrt{15}\ m/s$

Newton's law of motion

Q.14 A block of mass m is on an inclined plane of angel θ the coefficient of friction between the block and the plane is μ and $\tan\theta > \mu$.The block is held stationary by applying a force P parallel to the plane. The direction of force pointing up the plane is taken to be positive. As P is varied from.

$P_1 = mg(\sin\theta - \mu\cos\theta)$ to $P_2 = mg(\sin\theta + \mu\cos\theta)$ the friction force f versus P graph will look like.



Acceleration

Q.15 The velocity of a particle moving along the positive x – axis is given by $v(t) = -t^3 + 6t^2 + 2t$ what is the magnitude of maximum acceleration and also find the time when it is attained?

(A) $a_{max} = 16 m/s^2, t = 12\ s$ **(B)** $a_{max} = 14\ m/s^2, t = 2\ s$

(C) $a_{max} = 38 m/s^2, t = 2\ s$ **(D)** $a_{max} = 14\ m/s^2, t = 12\ s$

Projectile Motion

Q.16 A particle is projected with certain velocity at an angle α above the horizontal from the foot of an inclined plane having inclination of 30°. If the particle strike the plane normally then α is.

(A) $\alpha = 30° + \tan^{-1}\frac{2}{\sqrt{3}}$ **(B)** 45° **(C)** 60° **(D)** $\alpha = 30° + \tan^{-1}\frac{\sqrt{3}}{2}$

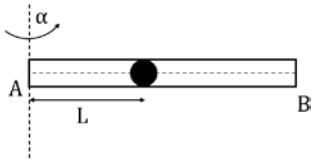
Relative Motion

Q.17 A man crosses the river, perpendicular to river in time t seconds. He can travel an equal distance in T seconds, if he swims down the stream with same speed as in initial case. The ratio of man's speed in still water to the speed of river water (with respect to ground) will be.

(A) $\frac{t^2-T^2}{t^2+T^2}$ **(B)** $\frac{T^2-t^2}{T^2+t^2}$ **(C)** $\frac{t^2+T^2}{t^2-T^2}$ **(D)** $\frac{T^2+t^2}{T^2-t^2}$

Friction

Q.18 A long horizontal rod has a bead which can slide along its length and initially placed at a distance L from one end A of the rod. The rod is set to rotate on a horizontal circular path, about a vertical axis passing through A with constant angular acceleration αIf the coefficient of static friction between the rod and the bead is μ. Then find the time when the bead starts slipping on rod. Neglect the effect of gravity.



(A) $\sqrt{\frac{\mu}{\alpha}}$ **(B)** $\frac{\mu}{\sqrt{\alpha}}$ **(C)** $\frac{1}{\sqrt{\mu\alpha}}$ **(D)** infinitesimal

Total Acceleration

Q.19 Tangential acceleration of a particle moving in a circle of radius 1 m varies with time t as shown in figure (initial velocity of particle is zero). Time after which total acceleration of the particle makes an angle of 30° with radial acceleration is .

(A) 4 sec **(B)** $\frac{4}{3}$ sec **(C)** $2^{2/3}$ sec **(D)** $\sqrt{2}$ sec

Equilibrium position

Q.20 A piece of wire is bent in the shape of a parabola $y = kx^2$ (y – axis vertically) with a bead of mass m placed on it. The bead can slide on the wire without friction. It stays at the lowest point of the parabola when the wire is at rest. The wire is now accelerated parallel to the positive x-axis with a constant acceleration α. The distance of new equilibrium position of the bead from y – axis where the bead can stay at rest with respect to the wire will be:

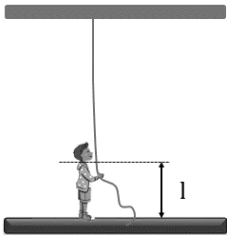
(A) $\frac{a}{gk}$ **(B)** $\frac{a}{2gk}$ **(C)** $\frac{2a}{gk}$ **(D)** $\frac{a}{4gk}$

Work Done

Q.21 At the point of contact, work done by the normal reaction when a person climbs up the stairs is.

(A) Positive **(B)** Negative **(C)** Zero **(D)** None of these

Q.22 One end of a light rope is tied directly to the ceiling. A man of mass M initially at rest on the ground starts climbing the rope hand over hand up to a height l. From the time he starts at rest on the ground to the time he is hanging at rest at a height l. How much work was done on the man by the rope?



(A) 0 **(B)** M gl

(C) – Mgl **(D)** It depends on how fast the man goes up

Q.23 An imaginary force $\vec{F} = \vec{B} \times \vec{V}$ given as the cross product of vector $\vec{B}$ (force field) and $\vec{V}$ (velocity). Then the work done by the force is.

(A) Always greater than zero. **(B)** Always equal to zero
(C) Always less than zero **(D)** Can have any finite value

Q.24 A ball is thrown vertically upwards, it reaches the height h and then returns to the initial position. Work done by gravity when ball moves upwards is W_1 and W_2 when ball moves in downward direction. Then.
(A) $W_1 = mgh, W_2 = mgh$ **(B)** $W_1 = mgh, W_2 = -mgh$
(C) $W_1 = -mgh, W_2 = mgh$ **(D)** $W_1 = -mgh, W_2 = -mgh$

Q.25 A body constrained to move along the z-axis of a co-ordinate system is subjected to a constant force $\vec{F} = (-\hat{\imath} + 2\hat{\jmath} + 3\hat{k})$N. What is the work done by the force in moving the body over a distance of 4 m along the z – axis?
(A) 6 J **(B)** 8 J **(C)** 16 J **(D)** 12 J

Q.26 A force $F = (3\hat{\imath} + c\hat{\jmath} + 2\hat{k})$N acting on a particle causes a displacement of $\vec{S} = (-4\hat{\imath} + 2\hat{\jmath} - 3\hat{k})$m. If the work is 6 J. then the value of 'C' is.
(A) 0 **(B)** 1 **(C)** 6 **(D)** 12

Q.27 Three constant forces are applied on a body are given as $\vec{F}_1 = 3\hat{\imath}$N, $\vec{F}_2 = 4\hat{\jmath}$N, $\vec{F}_3 = 6\hat{k}$N If these forces displace the body by 5 m in negative y-axis direction from origin. Then total work done by the force is
(A) 20 N **(B)** 65 N **(C)** –5 N **(D)** – 20 N

Q.28 The total work done by three forces on a block is 60 J If block is displaced by a force from position A(1,2,3) to B(7,6,5) Find out the third force if the other two forces are $\vec{F}_1 = (7\hat{\imath} + 3\hat{\jmath} + 2\hat{k})$N and $\vec{F}_2 = (-2\hat{\imath} + 2\hat{\jmath} + \hat{k})$N assume that $\vec{F}_3$ is perpendicular to XY plane.
(A) $\vec{F}_3 = \hat{k}$ **(B)** $\vec{F}_3 = 2\hat{k}$ **(C)** $\vec{F}_3 = 3\hat{k}$ **(D)** $\vec{F}_3 = 4\hat{k}$

Q.29 A constant force $F_1 = 10\sqrt{3}$N applied at an angle 30° ° with horizontal on body (m = 5 kg) at rest for 8 second. In this time interval body move from position A to B. to move from position B to A another constant force $F_2 = 20$ N is applied on body. If work done by this force is 960 J, then the angel at which the force is acting on the body with horizontal.

(A) 30° **(B)** 45° **(C)** 60° **(D)** 90°

Q.30 A constant force 10 N acts on a ball of mass 2 Kg for 2 s. then another force 18 N acts on the same ball for $\frac{10}{9}$ second. If ball is initially at rest then find the total work done.
(A) 400 J **(B)** 300 J **(C)** 200 J **(D)** 100

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(A)	(B)	(C)	(C)	(B)	(B)	(A)	(C)	(C)
WORK SHEET										
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(B)	(C)	(C)	(A)	(B)	(D)	(C)	(A)	(C)	(B)
Q.	21	22	23	24	25	26	27	28	29	30
Sol.	(C)	(B)	(B)	(C)	(D)	(D)	(D)	(B)	(C)	(A)