SECTION A

1 A graph is plotted by taking kinetic energy along the y-axis and speed along the x-axis for a constant mass. The slope of the graph at an instant represents:
1. mass
2. velocity
3. momentum
4. acceleration

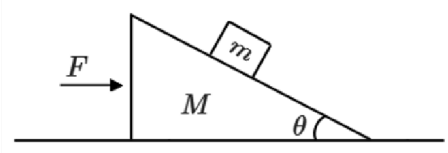
2 Given below are two statements:

Assertion (A):	Work done by friction on a body sliding down an inclined plane is negative.
Reason (R):	Work done is less than zero if the angle between force and displacement is acute or both are in the same direction.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

3 A car moves on an inclined plane and covers 10 km path under the action of a horizontal force of 5 N. The work done on the car is 25 kJ. The inclination of the plane to horizontal is:
1. 75°
2. 60°
3. 45°
4. 30°

4 A small block of mass m lies on a frictionless wedge of mass M, which is pushed horizontally to the right by means of a constant force F. There is no relative motion between block and the wedge. Let the work done by F on M be W_F. The work done by the normal force (between M & m) on m be W_m. Both are measured for the same time interval.

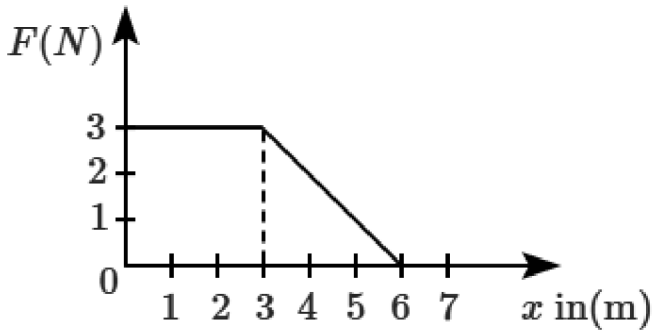


1. $\frac{W_F}{M} = \frac{W_m}{m}$
2. $W_F \cdot M = W_m \cdot m$
3. $\frac{W_F}{M+m} = \frac{W_m}{m}$
4. $\frac{W_F}{M} = \frac{W_m}{m+M}$

5 A constant force $\vec{F}$ given, $\vec{F} = 2\hat{i} - \hat{j} + 5\hat{k}$ N acts on a body to move it along the x-axis. The work done by the force to move it by 2 m along the x-axis will be:
1. 12 J
2. 16 J
3. 0
4. 4 J

6 If a force F applied on an object moving along the y-axis varies with the y-coordinate as $F = 3 + 2y^2$. The work done in displacing the body from $y = 2$ m to $y = 5$ m is:
1. 87 J
2. 0
3. 57 J
4. 72 J

7 A force F acting on an object varies with distance x as shown below:



The force is in newton and x is in meter. The work done by the force in moving the object from $x = 0$ to $x = 6$ m is:
1. 18.0 J
2. 13.5 J
3. 4.5 J
4. 9.0 J

8 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking $g = 10\ \mathrm{m/s^2}$, work done against friction is:
1. 1000 J
2. 200 J
3. 100 J
4. zero

9 A particle experiences a variable force $\vec{F} = (4x\hat{i} + 3y^2\hat{j})$ in a horizontal x-y plane. Assume distance in meters and force is in newton. If the particle moves from point $(1, 2)$ to point $(2, 3)$ in the x-y plane, the kinetic energy changes by:
1. 50.0 J
2. 12.5 J
3. 25.0 J
4. 0

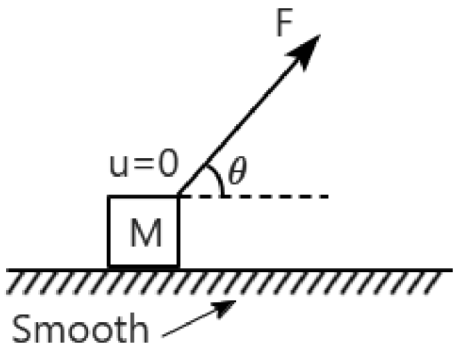
10 A body of mass 8 kg and another of mass 2 kg are moving with equal kinetic energy. The ratio of their respective momenta will be:
1. 1 : 1
2. 2 : 1
3. 1 : 4
4. 4 : 1

11 The total work done on a particle is equal to the change in its kinetic energy:

1.	always
2.	only if the forces acting on it are conservative
3.	only if gravitational force alone acts on it
4.	only if elastic force alone acts on it

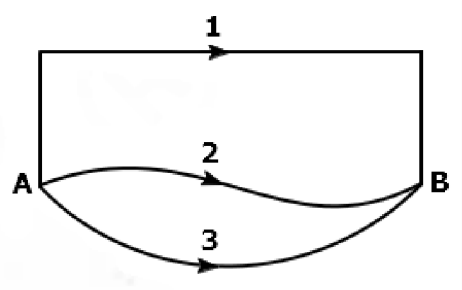
12 Under the action of a force, a mass of 2 kg moves such that its position x at any time t is given by $x = t^3/3$, where x is in meters and t is in seconds. The work done by the force in first two seconds is:
1. 16 J
2. 1.6 J
3. 160 J
4. 16 kJ

13 It is given that the block never loses contact with the smooth horizontal surface, and the force always acts at an angle θ with the horizontal. The speed of the block when it covers a horizontal distance l will be:



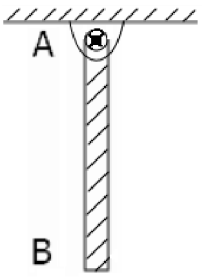
1. $\sqrt{\frac{lF\cos\theta}{m}}$
2. $\frac{2l\ \mathrm{F}\cos\theta}{\mathrm{m}}$
3. $\sqrt{\frac{2l}{m}F\cos\theta}$
4. $\frac{l\ \mathrm{F}\cos\theta}{\mathrm{m}}$

14 A gravitational field is present in a region and a mass is shifted from A to B through different paths as shown. If W_1, W_2 and W_3 represent the work done by the gravitational force along their respective paths, then:



1. $W_1 = W_2 = W_3$
2. $W_1 > W_2 > W_3$
3. $W_1 > W_3 > W_2$
4. $W_1 < W_2 < W_3$

15 A rod of mass M and length L is suspended vertically at its highest point. The rod is held so that it is horizontal and free to rotate about A and then released. There is no friction anywhere.



The kinetic energy of the rod, when it reaches the lowest position, is:

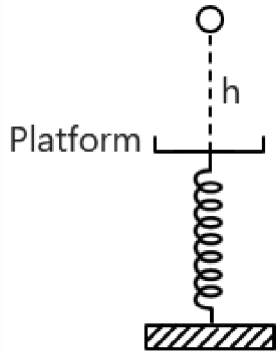
1. MgL
2. $\frac{MgL}{2}$
3. $\frac{2}{3}MgL$
4. $\frac{MgL}{12}$

16 _____ 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

17 A ball of mass 100 g is dropped from a height $h = 10$ cm on a platform fixed at the top of a vertical spring (as shown in the figure). The ball stays on the platform and the platform is depressed by a distance $\frac{h}{2}$. The spring constant is:

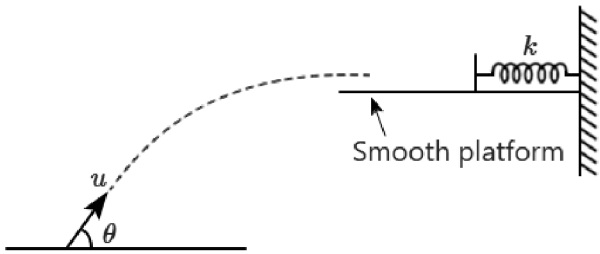
(Take $g = 10$ ms^{-2})



1. 100 Nm^{-1}
2. 110 Nm^{-1}
3. 120 Nm^{-1}
4. 130 Nm^{-1}

SECTION B

18 A ball of mass m is projected with a speed u, at an angle of θ with the horizontal. At its highest point, it moves on a smooth horizontal platform with a spring of spring constant k attached, and the ball compresses the spring. The maximum compression in the spring is x. Then:



1. $\frac{1}{2}mu^2 = \frac{1}{2}kx^2$
2. $\frac{1}{2}mu^2cos^2\theta = \frac{1}{2}kx^2$
3. $\frac{1}{2}mu^2 = \frac{1}{2}kx^2cos^2\theta$
4. $\frac{1}{2}mu^2sin^2\theta = \frac{1}{2}kx^2$

19 Potential energy as a function of r is given by $U = \frac{A}{r^{10}} - \frac{B}{r^5}$, where r is the interatomic distance, and A and B are positive constants. The equilibrium distance between the two atoms will be:

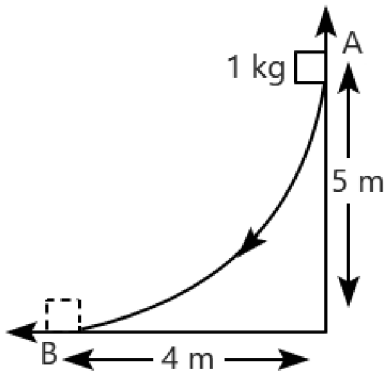
1. $\left(\frac{A}{B}\right)^{1/5}$
2. $\left(\frac{B}{A}\right)^{1/5}$
3. $\left(\frac{2A}{B}\right)^{1/5}$
4. $\left(\frac{B}{2A}\right)^{1/5}$

20 Given below are two statements:

Assertion (A):	Frictional forces are conservative forces.
Reason (R):	Potential energy can be associated with frictional forces.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

21 A block of mass 1 kg can slide down a smooth curved track (see the figure given below). If the block is released from point A, the velocity at point B will be:
(Take $g = 10$ ms^{-2})



1. 20 ms^{-1}
2. $10\sqrt{2}$ ms^{-1}
3. 10 ms^{-1}
4. $\sqrt{10}$ ms^{-1}

22 A boat of mass 200 kg is accelerated by an engine of power 16 kW. If the boat covers a distance of 72 km in 2 hr, the acceleration of the boat is:

1. 8×10^{-2} m/s^2
2. 8×10^{-1} m/s^2
3. 8 m/s^2
4. 80 m/s^2

23 A bullet hits a block kept at rest on a smooth horizontal surface and gets embedded into it. Which of the following does not change?

1.	linear momentum of the block
2.	kinetic energy of the block
3.	gravitational potential energy of the block
4.	temperature of the block

24 A particle of mass m collides with another particle of mass m', which is at rest and the combined mass moves with 10% reduction in velocity. The ratio of the masses is:

1. $\frac{m'}{m} = \frac{1}{10}$
2. $\frac{m'}{m} = \frac{1}{9}$
3. $\frac{m'}{m} = \frac{1}{8}$
4. $\frac{m'}{m} = \frac{1}{2}$

25 A man of mass m, standing at the bottom of the staircase, of height L, climbs it and stands at its top.

a.	work done by all forces on man is equal to the rise in energy mgL.
b.	work done by all forces on man is zero.
c.	work done by the gravitational force on man is mgL.
d.	the reaction force from a step does not do work because the point of the application of the force does not move while the force exists.

Choose the correct option:

1. (a, d)
2. (a, c)
3. (b, d)
4. (a, b, c)

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