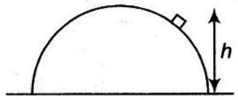
1. A small body of mass m slides without friction from the top of a hemisphere of radius r. At what height will the body be detached from the centre of the hemisphere



(a) $h = \frac{r}{2}$ (b) $h = \frac{r}{3}$

(c) $h = \frac{2r}{3}$ (d) $h = \frac{r}{4}$

2. A particle of mass 1 g executes an oscillatory motion on the concave surface of a spherical dish of radius 2 m placed on a horizontal plane. If the motion of the particle begins from a point on the dish at a height of 1 cm from the horizontal plane and the coefficient of friction is 0.01, the total distance covered by the particle before it comes to rest, is approximately

(a) 2.0 m (b) 10.0 m

(c) 1.0 m (d) 20.0 m

3. A mass-spring system oscillates such that the mass moves on a rough surface having coefficient of friction μ. It is compressed by a distance a from its normal length and, on being released, it moves to a distance b from its equilibrium position. The decrease in amplitude for one half-cycle ($-a$ to b) is

(a) $\frac{\mu mg}{K}$ (b) $\frac{2\mu mg}{K}$

(c) $\frac{\mu g}{K}$ (d) $\frac{K}{\mu mg}$

4. A uniform flexible chain of mass m and length l hangs in equilibrium over a smooth horizontal pin of negligible diameter. One end of the chain is given a small vertical displacement so that the chain slips over the pin. The speed of chain when it leaves pin is

(a) $\sqrt{\frac{gl}{2}}$ (b) $\sqrt{gl}$

(c) $\sqrt{2gl}$ (d) $\sqrt{3gl}$

5. The potential energy of a particle of mass 1 kg is, $U = 10 + (x-2)^2$. Here U is in joule and x in metre on the positive x-axis. Particle travels upto $x = +6$ m. Choose the correct statement.

(a) On negative x-axis particle travels upto $x = -2$ m

(b) The maximum kinetic energy of the particle is 16 J

(c) Both (a) and (b) are correct

(d) Both (a) and (b) are wrong

6. A body is moving down an inclined plane of slope 37°. The coefficient of friction between the body and plane varies as $\mu = 0.3x$, where x is the distance travelled down the plane by the body. The body will have maximum speed. $\left(\sin 37° = \frac{3}{5}\right)$

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

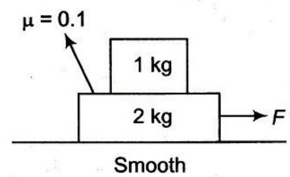
(a) At $x = 1.16$m

(b) At $x = 2$ m

(c) At bottom of plane

(d) At $x = 2.5$ m

7. A force of $F = 0.5$ N is applied on lower block as shown in figure . The work done by lower block on upper block for a displacement of 3 m of the upper block with respect to ground is [Take $g = 10 \text{ m/s}^2$]



(a) -0.5 J (b) 0.5 J

(c) 2 J (d) -2 J

8. The potential energy between the atoms in a molecule is given by

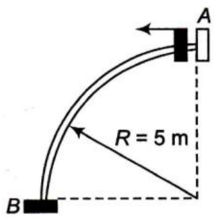
$$U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$$

where a and b positive constants and x is the distance between the atoms . The atom is in equilibrium when

(a) $x = 0$ (b) $x = \left(\frac{a}{2b}\right)^{\frac{1}{6}}$

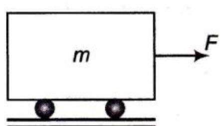
(c) $x = \left(\frac{2a}{b}\right)^{\frac{1}{6}}$ (d) $x = \left(\frac{11a}{5b}\right)^{\frac{1}{6}}$

9. A bead of mass $\frac{1}{2}$ kg starts from rest from A to move in a vertical plane along a smooth fixed quarter ring of radius 5 m, under the action of a constant horizontal force $F = 5\text{ N}$ as shown. The speed of bead as it reaches the point B is [Take $g = 10\text{ m/s}^2$]



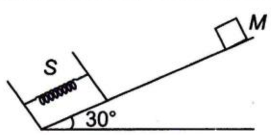
(a) 14.14 m/s (b) 7.07 m/s (c) 5 m/s (d) 25 m/s

10. A car of mass m is accelerating on a level smooth road under the action of a single force F. The power delivered to the car is constant and equal to P. If the velocity of the car at an instant is v, then after travelling how much distance it becomes double?



(a) $\frac{7mv^3}{3P}$ (b) $\frac{4mv^3}{3P}$
(c) $\frac{mv^3}{P}$ (d) $\frac{18mv^3}{7P}$

11. An ideal massless spring S can be compressed 1 m by a force of 100 N in equilibrium. The same spring is placed at the bottom of a frictionless inclined plane inclined at 30° to the horizontal. A 10 kg block M is released from rest at the top of the incline and is brought to rest momentarily after compressing the spring by 2 m. If $g = 10\text{ m/s}^2$, what is the speed of mass just before it toucheds the spring?



(a) $\sqrt{20}$ m/s (b) $\sqrt{30}$ m/s
(c) $\sqrt{10}$ m/s (d) $\sqrt{40}$ m/s

12. A pendulum of mass 1 kg and length $l = 1\text{ m}$ is released from rest at angle $\theta = 60°$. The power delivered by all the forces acting on the bob at angle $\theta = 30°$ will be ($g = 10\text{ m/s}^2$).

(a) 13.4 W (b) 20.4 W
(c) 24.6 W (d) zero

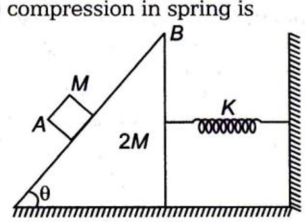
13. A small block of mass m is kept on a rough inclined surface of inclination θ fixed in an elevator. The elevator goes up with a uniform velocity v and the block does not slide on the wedge. The work done by the force of friction on the block in a time t will be

(a) zero (b) $mgvt\cos^2\theta$
(c) $mgvt\sin^2\theta$ (d) $\frac{1}{2}mgvt\sin 2\theta$

14. In position A kinetic energy of a particle is 60 J and potential energy is – 20 J. In position B, kinetic energy is 100 J and potential energy is 40 J. Then, in moving the particle from A to B

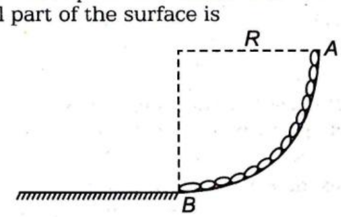
(a) work done by conservative forces is – 60 J
(b) work done by external forces is 40 J
(c) net work done by all the forces is 40 J
(d) net work done by all the forces is 100 J

15. A block A of mass M rests on a wedge B of mass $2M$ and inclination θ. There is sufficient friction between A and B so that A does not slip on B. If there is no friction between B and ground, the compression in spring is



(a) $\frac{Mg\cos\theta}{K}$ (b) $\frac{Mg\cos\theta\sin\theta}{K}$
(c) $\frac{Mg\sin\theta}{K}$ (d) zero

16. A smooth chain AB of mass m rests against a surface in the form of a quarter of a circle of radius R. If it is released from rest, the velocity of the chain after it comes over the horizontal part of the surface is



(a) $\sqrt{2gR}$ (b) $\sqrt{gR}$
(c) $\sqrt{2gR\left(1-\frac{2}{\pi}\right)}$ (d) $\sqrt{2gR(2-\pi)}$