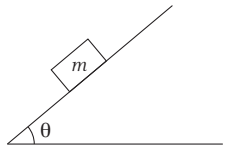
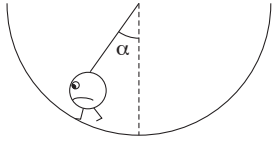
13 A block of mass m is at rest on an inclined plane which is making angle θ with the horizontal. The coefficient of friction between the block and plane is $\propto$. Then, frictional force acting between the surfaces is



(a) $\propto mg$ (b) $\propto mg \sin\theta$
(c) $\propto (mg \sin\theta - mg \cos\theta)$ (d) $mg \sin\theta$

14 If a body loses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest?
(a) 1cm (b) 2 cm
(c) 3 cm (d) 4 cm

15 An insect crawls up a hemispherical surface very slowly (see the figure). The coefficient of friction between the insect and the surface is 1/3. If the line joining the centre of the hemispherical surface to the insect makes an angle α with the vertical, the maximum possible value of α is given by

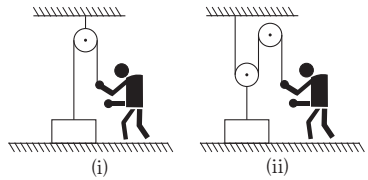


(a) $\cot\alpha = 3$ (b) $\tan\alpha = 3$
(c) $\sec\alpha = 3$ (d) $\text{cosec}\,\alpha = 3$

16 A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. The force that acts on the player is
(a) frictional force along westward
(b) muscle force along southward
(c) frictional force along south-west
(d) muscle force along south-west

17 A car of mass m starts from rest and acquires a velocity along east $\mathbf{v} = v\hat{\mathbf{i}} (v > 0)$ in two seconds. Assuming the car moves with uniform acceleration, the force exerted on the car is
(a) $\frac{mv}{2}$ eastward and is exerted by the car engine
(b) $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road
(c) more than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road
(d) $\frac{mv}{2}$ exerted by the engine

18 In the figure shown, a person wants to raise a block lying on the ground to a height h. In both the cases, if time required is the same, then in which case, he has to exert more force. (Assume pulleys and strings are light)



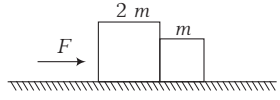
(a) (i) (b) (ii)
(c) Same in both (d) Cannot be determined

19 A body of mass 2kg travels according to the relation $x(t) = pt + qt^2 + rt^3$, where $q = 4\,\text{ms}^{-2}$, $p = 3\,\text{ms}^{-1}$ and $r = 5\,\text{ms}^{-3}$. The force acting on the body at $t = 2$ s is
(a) 136 N (b) 134 N (c) 158 N (d) 68 N

20 A body with mass 5 kg is acted upon by a force $\mathbf{F} = (-3\hat{\mathbf{i}} + 4\hat{\mathbf{j}})$ N. If its initial velocity at $t = 0$ is $\mathbf{u} = (6\hat{\mathbf{i}} - 12\hat{\mathbf{j}})\,\text{ms}^{-1}$, the time at which it will just have a velocity along the Y-axis is
(a) zero (b) 10 s (c) 2 s (d) 15 s

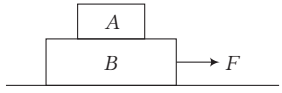
21 A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 ms^{-1}. To give an initial upward acceleration of 20 ms^{-2}, the amount of gas ejected per second to supply the needed thrust will be (Take, $g = 10\ \text{ms}^{-2}$)
(a) 127.5 kgs^{-1} (b) 187.5 kgs^{-1}
(c) 185.5 kgs^{-1} (d) 137.5 kgs^{-1}

22 Two blocks are in contact on a frictionless table. One has mass m and the other $2m$. A force F is applied on $2m$ as shown in the figure. Now, the same force F is applied from the right on m. In the two cases, the ratio of force of contact between the two blocks will be



(a) same (b) 1: 2 (c) 2 : 1 (d) 1 : 3

23 A 4 kg block A is placed on the top of 8 kg block B which rests on a smooth table.



A just slips on B when a force of 12 N is applied on A. Then, the maximum horizontal force F applied on B to make both A and B move together, is
(a) 12 N (b) 24 N (c) 36 N (d) 48 N