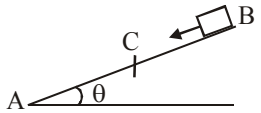
NLM & FRICTION

1. A mass of 10 kg is suspended by a rope of length 4 m, from the ceiling. A force F is applied horizontally at the mid-point of the rope such that the top half of the rope makes an angle of 45° with the vertical. Then F equals: (Take g= 10 ms^{-2} and the rope to be massless)
(1) 100 N (2) 90 N (3) 75 N (4) 70 N

2. 

A small block starts slipping down from a point B on an inclined plane AB, which is making an angle θ with the horizontal section BC is smooth and the remaining section CA is rough with a coefficient of friction μ. It is found that the block comes to rest as it reaches the bottom (point A) of the inclined plane. If BC = 2AC, the coefficient of friction is given by $\mu = k \tan\theta$). The value of k is _____.

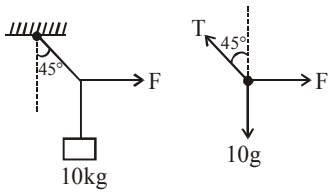
3. A block starts moving up an inclined plane of inclination 30° with an initial velocity of v_0. It comes back to its initial position with velocity $\frac{v_0}{2}$. The value of the coefficient of kinetic friction between the block and the inclined plane is close to $\frac{I}{1000}$, The nearest integer to I is _____ .

4. An insect is at the bottom of a hemispherical ditch of radius 1 m. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefficient of friction between the ground and the insect is 0.75, then h is : ($g = 10ms^{-2}$)
(1) 0.80 m (2) 0.60 m
(3) 0.45 m (4) 0.20 m

SOLUTION

1. NTA Ans. (1)

Sol.



For equilibrium,

T sin 45° = F ....(1)

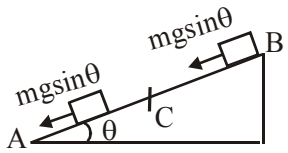
and T cos 45° = 10g ....(2)

equation (1)/(2)

we get F = 10g = 100 N

2. Official Ans. by NTA (3)

Sol.



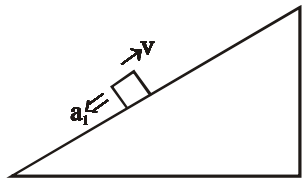
Apply work energy theorem

$mgsin\theta (AC + 2AC) - \mu mg\cos\theta AC = 0$

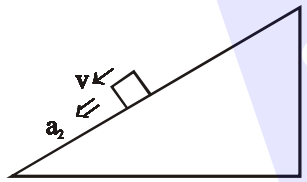
$\mu = 3\tan\theta$

3. Official Ans. by NTA (346)

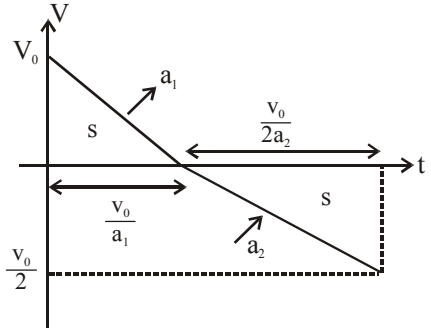
Sol.



$a_1 = g(\sin\theta + \mu\cos\theta)$



$a_2 = g(\sin\theta + \mu\cos\theta)$



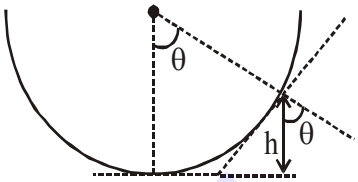
$\therefore \frac{1}{2}v_0\frac{v_0}{a_1} = \frac{1}{2}\left(\frac{v_0}{2}\right)\left(\frac{v_0}{2a_1}\right)$

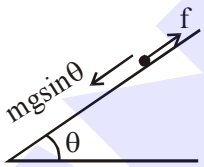
$\Rightarrow 3\sin\theta = 5\mu\cos\theta$

$\therefore \mu = \sqrt{3}/5$

4. Official Ans. by NTA (4)

Sol.



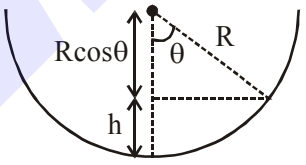


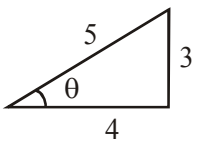
For balancing $mgsin\theta = f$

$mgsin\theta = \mu mgcos\theta$

$\tan\theta = \mu$

$\tan\theta = \frac{3}{4}$





$h = R - R\cos\theta$

$= R - R\left(\frac{4}{5}\right) = \frac{R}{5}$

$h = \frac{R}{5} = 0.2m$

$\therefore$ correct option is (4)