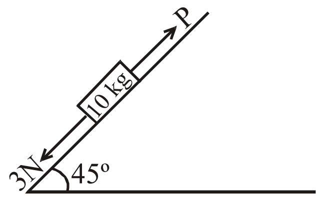
NLM & FRICTION

1. A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is ($g = 10\ ms^{-2}$)

(1) 200 N (2) 100 N (3) 140 N (4) 70 N

2. A block of mass 10 kg is kept on a rough inclined plane as shown in the figure. A force of 3 N is applied on the block. The coefficient of static friction between the plane and the block is 0.6. What should be the minimum value of force P, such that the block doesnot move downward ? (take $g = 10\ ms^{-2}$)

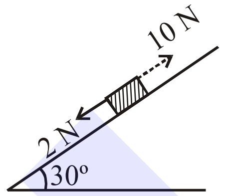


(1) 32 N (2) 25 N (3) 23 N (4) 18 N

3. A particle of mass m is moving in a straight line with momentum p. Starting at time t = 0, a force F = kt acts in the same direction on the moving particle during time interval T so that its momentum changes from p to 3p. Here k is a constant. The value of T is :-

(1) $2\sqrt{\frac{p}{k}}$ (2) $\sqrt{\frac{2p}{k}}$ (3) $\sqrt{\frac{2k}{p}}$ (4) $2\sqrt{\frac{k}{p}}$

4. A block kept on a rough inclined plane, as shown in the figure, remaias at rest upto a maximum force 2 N down the inclined plane. The maximum external force up the inclined plane that does not move the block is 10 N. The coefficient of static friction betwreen the block and the plane is : [Take $g = 10\ m/s^2$]



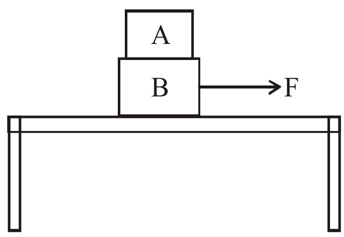
(1) $\frac{2}{3}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{\sqrt{3}}{4}$ (4) $\frac{1}{2}$

5. A bullet of mass 20 g has an initial speed of $1\ ms^{-1}$, just before it starts penetrating a mud wall of thickness 20 cm. if the wall offers a mean resistance of 2.5×10^{-2} N, the speed of the bullet after emerging from the other side of the wall is close to :

(1) $0.4\ ms^{-1}$ (2) $0.1\ ms^{-1}$

(3) $0.3\ ms^{-1}$ (4) $0.7\ ms^{-1}$

6. Two blocks A and B of masses $m_A = 1$ kg and $m_B = 3$ kg are kept on the table as shown in figure. The coefficient of friction between A and B is 0.2 and between B and the surface of the table is also 0.2. The maximum force F that can be applied on B horizontally, so that the block A does not slide over the block B is: (Take $g = 10\ m/s^2$)



(1) 16 N (2) 40 N (3) 12 N (4) 8 N

7. A ball is thrown upward with an initial velocity V_0 from the surface of the earth. The motion of the ball is affected by a drag force equal to $m\gamma\upsilon^2$ (where m is mass of the ball, υ is its instantaneous velocity and γ is a constant). Time taken by the ball to rise to its zenith is :

(1) $\frac{1}{\sqrt{\gamma g}}\sin^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

(2) $\frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

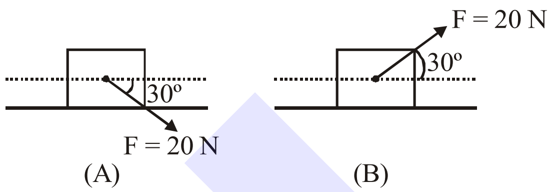
(3) $\frac{1}{\sqrt{2\gamma g}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{g}}V_0\right)$

(4) $\frac{1}{\sqrt{\gamma g}}\ln\left(1+\sqrt{\frac{\gamma}{g}}V_0\right)$

8. A spring whose unstretched length is l has a force constant k. The spring is cut into two pieces of unstretched lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be :

(1) $\frac{1}{n^2}$ (2) n^2 (3) $\frac{1}{n}$ (4) n

9. A block of mass 5 kg is (i) pushed in case (A) and (ii) pulled in case (B), by a force F = 20 N, making an angle of 30º with the horizontal, as shown in the figures. The coefficient of friction between the block and floor is μ = 0.2. The difference between the accelerations of the block, in case (B) and case (A) will be : (g = 10 ms^{-2})

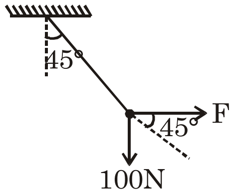


(1) 0 ms^{-2} (2) 0.8 ms^{-2}

(3) 0.4 ms^{-2} (4) 3.2 ms^{-2}

SOLUTION

1. Ans. (2)

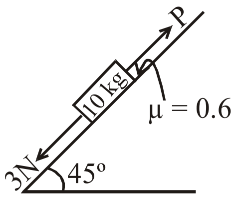


at equation

$\tan 45^\circ = \dfrac{100}{F}$

F = 100 N

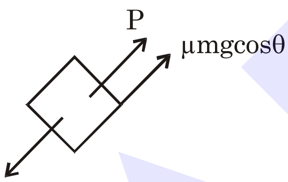
2. Ans. (1)



$$mg\sin 45^\circ = \frac{100}{\sqrt{2}} = 50\sqrt{2}$$

$$\mu mg\cos\theta = 0.6 \times mg \times \frac{1}{\sqrt{2}} = 0.6 \times 50\sqrt{2}$$

$$P = 31.28 \simeq 32N$$



73.7=3+mgsinθ

3. Ans. (1)

$$\frac{dp}{dt} = F = kt$$

$$\int_P^{3P} dP = \int_O^T kt\ dt$$

$$2p = \frac{KT^2}{2}$$

$$T = 2\sqrt{\frac{P}{K}}$$

4. Ans. (2)

2 + mg sin30 = μmg cos30°

10 = mgsin 30 + μ mg cos30°

= 2μmg cos30 –2

6 = μmg cos 30

4 = mg sin 30

$$\frac{3}{2} = \mu \times \sqrt{3}$$

$$\mu = \frac{\sqrt{3}}{2}$$

5. Ans. (4)

Sol. m = 20 g , u = 1 m/s, v = ?

$S = 20 \times 10^{-2}$ m $\qquad a = \dfrac{-2.5\times10^{-2}}{20\times10^{-3}} m/s^2$

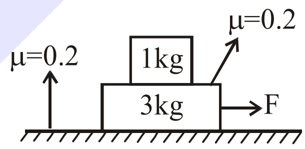
$v^2 = u^2 + 2as$

$$v^2 = 1 - 2\times\frac{2.5\times10^{-2}}{20\times10^{-3}}\times\frac{20}{100}$$

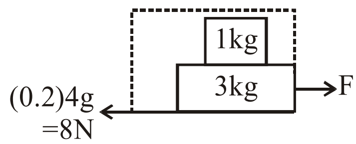
$$v = \frac{1}{\sqrt{2}} \simeq 0.7\ m/s$$

6. Ans. (1)

Sol.



$a_{Amax} = \mu g = 2\ m/s^2$



F – 8 = 4 × 2

F = 16 N

7. Ans. (2)

Sol. $-(g + \gamma v^2) = \frac{dv}{dt}$

$$-gdt = \frac{g}{\gamma}\left(\frac{dv}{\frac{g}{\gamma} + v^2}\right)$$

Integrating $0 \to t$ & $V_0 \to 0$:-

$$-gt = -\sqrt{\frac{g}{\gamma}}\tan^{-1}\left(\frac{V_0}{\sqrt{\frac{g}{\gamma}}}\right)$$

$$t = \frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$$

8. Ans. (3)

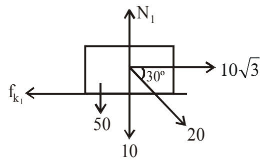
Sol. $k_1 = \frac{C}{\ell_1}$

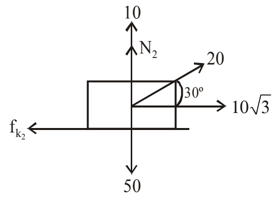
$$k_2 = \frac{C}{\ell_2}$$

$$\frac{k_1}{k_2} = \frac{C\ell_2}{\ell_1 C}\ \ell_2 = \frac{\ell_2}{n\ell_2} = \frac{1}{n}$$

9. Ans. (2)

Sol.





$N_1 = 60$ $\qquad$ $N_2 = 40$

$a_1 = \frac{10\sqrt{3} - 0.2 \times 60}{5}$ $\qquad$ $a_2 = \frac{10\sqrt{3} - 0.2 \times 40}{5}$

$a_1 - a_2 = 0.8$