Date: 22/08/2022

Subject: Physics | Class: Standard XII

Topic : Friction | Time: 00:20 hrs

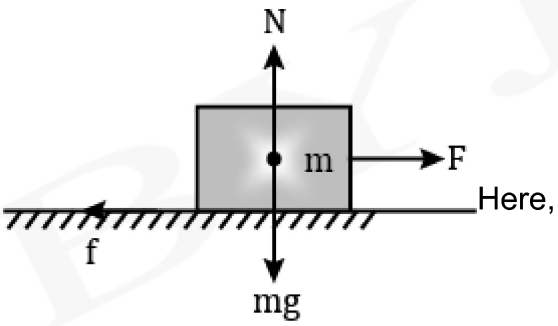
1. A block of mass $10\ \text{kg}$ is placed on rough horizontal surface whose coefficient of friction is 0.5. If a horizontal force of $100\ \text{N}$ is applied on it along the surface , then acceleration of block will be [Take $g = 10\ \text{ms}^{-2}$]

A. $10\ \text{ms}^{-2}$

B. $5\ \text{ms}^{-2}$

C. $15\ \text{ms}^{-2}$

D. $0.5\ \text{ms}^{-2}$



Here,

$m = 10\ \text{kg}, g = 10\ \text{ms}^{-2}, \mu = 0.5, F = 100\ \text{N}$

Force of friction, $f = \mu N = \mu mg$

$= 0.5 \times 10\ \text{kg} \times 10\ \text{ms}^{-2} = 50\ \text{N}$

Force that produces acceleration

$F' = F - f = 100\ \text{N} - 50\ \text{N} = 50\ \text{N}$

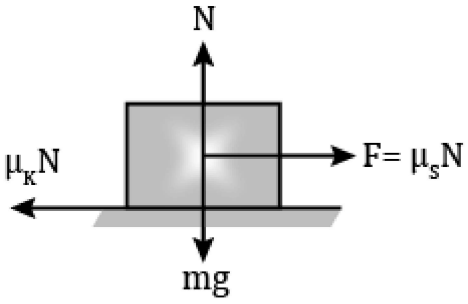
$a = \dfrac{F'}{m} = \dfrac{50\ \text{N}}{10\ \text{kg}} = 5\ \text{ms}^{-2}$

2. A block of mass $2\ \text{kg}$ is placed on the floor. The coefficient of static friction is 0.4. If a force of $2.8\ \text{N}$ is applied on the block parallel to the floor, the force of friction between the block and floor is (take $g = 10\ \text{ms}^{-2}$)

- ✔ **A.** $2.8\ \text{N}$
- ✘ **B.** $8\ \text{N}$
- ✘ **C.** $2\ \text{N}$
- ✘ **D.** zero

$f_{\text{max}} = \mu mg = 0.4 \times 2 \times 10 = 8\ \text{N}$
Since the applied force is less than f_{max} so block will remain at rest. Force of friction will be equal to the applied force which is $2.8\ \text{N}$.

3. For a body on a horizontal surface, coefficients of static and kinetic frictions are 0.4 and 0.2, respectively. When the body is in uniform motion on the surface, a horizontal force equal in magnitude to limiting friction is applied on it. The acceleration produced is



A. 0.4 g

B. 0.1 g

C. 0.2 g

D. 0.6 g

The magnitude of limiting friction $= \mu_S N = \mu_S mg$. This force is applied on the body towards right. Now, kinetic friction $\mu_K N$ opposes the motion and acts towards left.

$\therefore$ Net force towards right $\mu_S N - \mu_K N$

So acceleration produced $= \dfrac{(\mu_S N - \mu_K N)}{m}$

$= \dfrac{(\mu_S - \mu_K)mg}{m}$

$= (\mu_S - \mu_K)g = (0.4 - 0.2)\ \text{g} = 0.2\ \text{g}$

Hence, the correct answer is option (c).

4. While walking on ice, one should take small steps to avoid slipping. This is because smaller steps ensure

A. larger coefficient of friction

B. smaller coefficient of friction

C. larger normal force

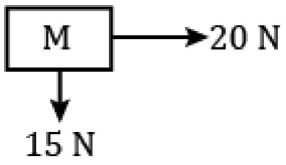
D. smaller Normal force

As we know ,
$f = \mu \times N$
Frictional force depends on coefficient of friction (roughness of surface) and the normal force (in case of ice the coefficient of friction is very small and it is independent of the normal force so independent of step size)

$f \propto N$
Case when u keep longer steps the angle of inclination of leg with vertical decreases and hence normal force decreases and so does the friction.

Case when u keep smaller steps the angle of inclination of leg with vertical increases and hence normal force increases and so does the friction.
so, smaller steps is taken to make sure the friction is larger

5. An object of mass M is kept on a rough table as seen from above. Forces are applied as shown. Find the direction (from the vertical) of static friction if the object does not move.



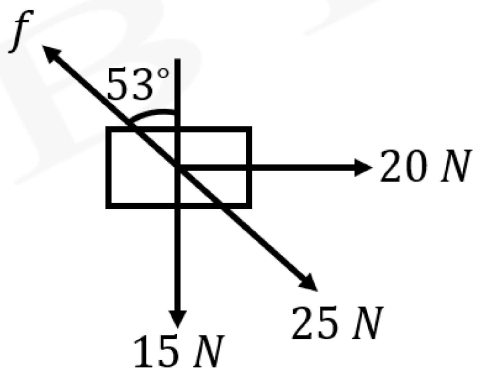
A. 30°

B. 37°

C. 45°

D. 53°

The net force acting on the block will be
Resultant force $= \sqrt{15^2 + 20^2} = 25\ N$
Angle with horizontal $\tan^{-1}(\frac{15}{20}) = 37^0$



The direction of static friction is opposite to the direction of the resultant force its magnitude is equal to $25\ N$ and it making an angle of 37^0 with horizontal and $90^0 - 37^0 = 53^0$ with vertical