

**Mathematics Questions by Topic**

Motion and Force

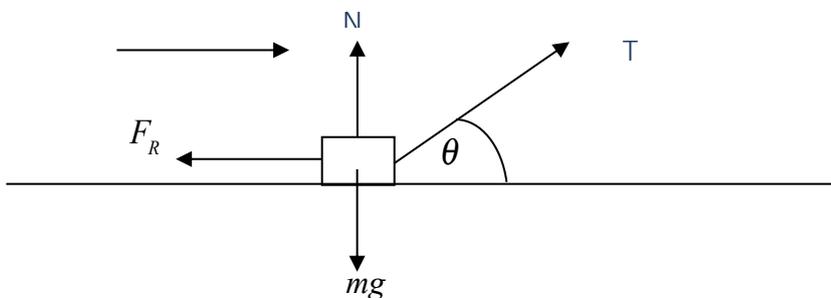
Answer 42

Source: K8SM2SQ13

**Question 42**

A box of mass 20 kg is at rest on a horizontal plane. A force of magnitude 10 kg-wt acting at an angle of  $30^\circ$  to the horizontal is applied to the block. For equilibrium to be maintained, the coefficient of friction between the box and the plane must be

- A. at least  $\frac{\sqrt{3}}{3}$
- B. less than  $\frac{\sqrt{3}}{3}$
- C. at least  $\frac{\sqrt{3}}{4}$
- D. at least  $\frac{\sqrt{3}}{4g}$
- E. less than  $\frac{\sqrt{3}}{4g}$

**ANSWER A**

$$T = 10g \text{ newtons} \quad \theta = 30^\circ \quad m = 20 \text{ kg} \quad \mu = ?$$

$$\text{resolving parallel to the plane} \quad (1) \quad T \cos(\theta) - F_R = 0$$

$$\text{resolving perpendicular to the plane} \quad (2) \quad T \sin(\theta) + N - mg = 0$$

$$\text{from (1)} \quad F_R = T \cos(\theta) = 10g \times \frac{\sqrt{3}}{2} = 5\sqrt{3}g$$

$$\text{from (2)} \quad N = mg - T \sin(\theta) = 20g - 10g \sin(30^\circ) = 15g$$

$$\text{for equilibrium to be maintained, } F_R \leq \mu N \text{ so that } 5\sqrt{3}g \leq 15\mu g \Rightarrow \mu \geq \frac{\sqrt{3}}{3}$$