

Mathematics Questions by Topic

Motion and Force

Answer 19

Source: K14SM2Q19

Question 19

A particle of mass M kg is on a horizontal table and is connected by a light string to a particle of mass 2 kg hanging vertically at the edge of the table. The coefficient of friction between the table and the mass M is equal to $\frac{1}{3}$. Then if

- A. $M > 6$ both masses move with constant acceleration.
- B. $0 < M < 6$ both masses move with constant acceleration.
- C. $0 < M \leq 6$ the system is in limiting equilibrium.
- D. $M > 6$ both masses move with constant velocity.
- E. $0 < M < 6$ both masses move with constant velocity.

ANSWER B

resolving downwards for the 2 kg mass hanging over the edge of the table

$$(1) \quad 2g - T = 2a$$

resolving for the mass M on the table

$$(2) \quad N - Mg = 0$$

$$(3) \quad T - \mu N = Ma$$

$$(2) \Rightarrow N = Mg \text{ into } (3) \quad T - \mu Mg = Ma$$

adding to eliminate T

$$2g - \mu Mg = (M + 2)a \quad \text{but} \quad \mu = \frac{1}{3}$$

$$2g - \frac{1}{3}Mg = \frac{g(6 - M)}{3} = (M + 2)a$$

$$a = \frac{g(6 - M)}{3(M + 2)}$$

$$a > 0 \Rightarrow 0 < M < 6$$

$$a = 0 \Rightarrow M = 6$$

