Question 41
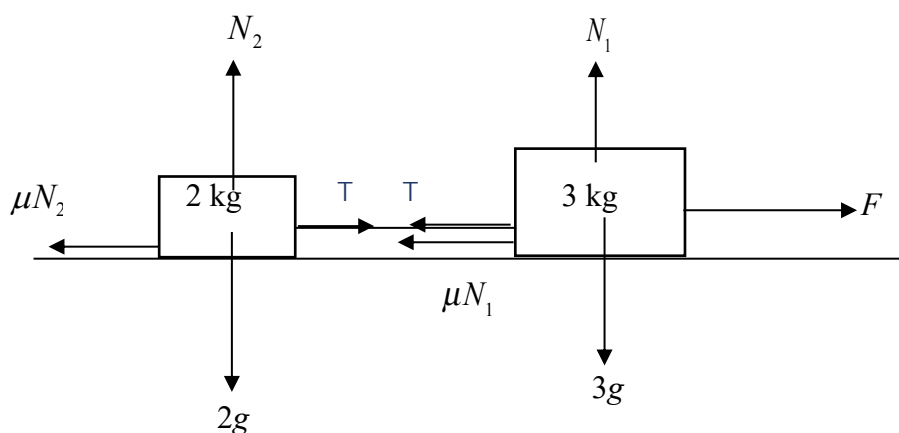
Two boxes of masses 2 kg and 3 kg are connected by a light horizontal string and are on a horizontal table, as shown in the diagram below. The coefficient of friction between both boxes and the table is $\frac{1}{7}$. The 3 kg box is pulled by a force of F, parallel to the table.

Which of the following is true?

A.   If $F > 7$ newtons, the boxes move with constant acceleration.

B.   If $5 < F < 7$ newtons, the boxes are on the point of moving.

C.   If $F = 7$ newtons, the boxes move with constant velocity.

D.   If $F > 7$ kg-wt, the boxes move with constant velocity.

E.   If $F = 7$ kg-wt, the boxes are not on the point of moving.

ANSWER A

Resolving horizontally around the 3 kg mass, $(1)\ F - T - \mu N_1 = 3a$

Resolving vertically around the 3 kg mass, $(2)\ N_1 - 3g = 0 \ \Rightarrow\ N_1 = 3g$

Resolving horizontally around the 2 kg mass, $(3)\ T - \mu N_2 = 2a$

Resolving vertically around the 2 kg mass, $(4)\ N_2 - 2g = 0 \ \Rightarrow\ N_2 = 2g$

(1) becomes $F - T - 3\mu g = 3a$

(3) becomes $T - 2\mu g = 2a$ adding to eliminate the tension T

$F - 5\mu g = 5a$ but $\mu = \dfrac{1}{7}$ $g = 9.8$ so that $F - 7 = 5a$

If $F > 7$ newtons then $a > 0$, the boxes move with constant acceleration.
All other options are false.