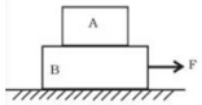
QUES 01:-

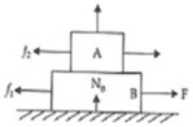
In Fig., the co-efficient of friction between the floor and the body B is 0.1. The co-efficient of friction between the bodies B and A is 0.2. A force F is applied as shown on B. The mass of A is m/2 and of B is m. Which of the following statements are true?



a. The bodies will move together if F = 0.25 mg.
b. The body A will slip with respect to B if F = 0.5 mg.
c. The bodies will move together if F = 0.5 mg.
d. The bodies will be at rest if F = 0.1 mg.
e. The maximum value of F for which the two bodies will move together is 0.45 mg.

Sol. We have given $m_1 = \frac{m}{2}, m_2 = m$ Let acceleration in body A and B is 'a'

Body A will move along with body B by force F till the force of friction between the surface of A and B is larger or equal to zero.



Now taking system A + B then acceleration will be

$\Rightarrow a = \frac{F-f_1}{m_1+m_2}$

$\Rightarrow a = \frac{F-f_1}{\frac{m}{2}+m}$

$\Rightarrow a = \frac{2(F-f_1)}{3m}$

So force on A

$\Rightarrow F_{AB} = m_1 a$

$\Rightarrow F_{AB} = \frac{m}{2}\frac{2(F-f_1)}{3m}$

$\Rightarrow F_{AB} = \frac{(F-f_1)}{3}$

If F_{AB} is equal or smaller than f_2 then body A will move along with body B.

So $f_2 = F_{AB}$ or $\mu N = \frac{F-f_1}{3}$

$0.2 \times m_1 g = \frac{F-f_1}{3}$ ...(i)

N = Reaction force by B on A

$f_1 = \mu N_2 = \mu(m_1 + m_2)\, g$

[N_2 = Normal reaction on B along with A by surface]

$f_1 = 0.1(m_1 + m_2)\, g = 0.1 \times \frac{3}{2}$ mg = 0.15 mg ...(ii)

From (i)

$F - f_1 = 3 \times 0.2 \times \frac{m}{2} g$ = 0.3 mg so adding this with equation (ii) we can say F = 0.45 mg ...(iii)

F = 0.45 mg Newton is the maximum force on B. so that A and B can move together. So option (e) is correct.

Both bodies can move together if F is less than or equal to 0.45 mg Newton.

So options (a) and (b) are also correct and rejects the option (c) as 0.5 mg > 0.45 mg

For option (d): Minimum force which can move A and B together

$\Rightarrow F_{\min} \geq f_1 + f_2$

$\Rightarrow F_{\min} \geq 0.15mg + 0.2 \times \frac{mg}{2}$

$\Rightarrow F_{\min} \geq 0.25$ m g N

Given force in option (d) 0.1 mg Newton < 0.25 mg Newton. So body A and B will not move i.e. Bodies A and B will remain in rest hence option (d) is also correct.