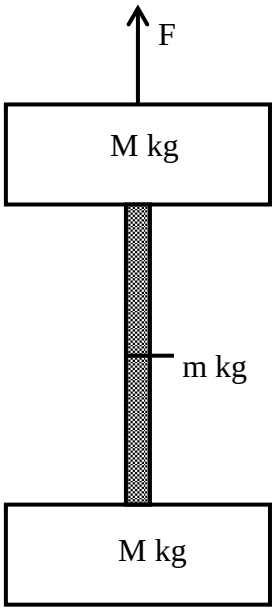
The two blocks, each of mass M kg, are connected by a heavy uniform rope of mass m kg. An upward force of F N is applied as shown in figure due to which the system accelerates upwards. The tension (in Newton) at the midpoint of the rope is given by:

(A) F (B) 0 (C) $\frac{F}{2}$ (D) $\frac{m+M}{m+2M}F$



Solution

Let a be the acceleration of the system.

Let T be the tension at the midpoint of the rope. Consider, the system as the lower half of the rope and the lower block M. This tension T is responsible to accelerate this system upwards.

$$T-\left(M+\frac{m}{2}\right)g=\left(M+\frac{m}{2}\right)a$$

$$\therefore T=\left(M+\frac{m}{2}\right)(a+g) \ \ldots\ldots\ldots\ldots(*)$$

Now, consider the system as all the three masses M + m + M.

$$F-(M+m+M)g=(M+m+M)a$$

$$\therefore a=\frac{F}{2M+m}-g$$

From (*), $T=\left(M+\frac{m}{2}\right)\left(\frac{F}{2M+m}-g+g\right)=\frac{F}{2}$

Hence, (C)

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