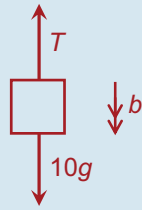
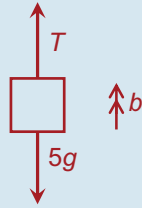


Let b = the new common acceleration of the particles.



$$10g - T = 10b \quad \text{Equation 3}$$



$$T - 5g = 5b \quad \text{Equation 4}$$

Adding equations 3 and 4 we get:

$$5g = 15b$$

$$\Rightarrow b = \frac{1}{3}g \text{ m/s}^2$$

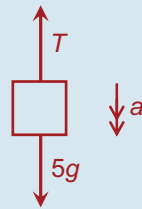
\Rightarrow The distance travelled in the next 2 second period is given by

$$s = ut + \frac{1}{2}at^2$$

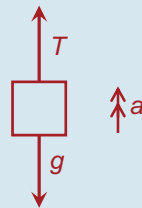
$$\Rightarrow s = \left(\frac{14}{15}g\right)(2) + \frac{1}{2}\left(\frac{1}{3}g\right)(2)^2$$

$$\Rightarrow s = \frac{38}{15}g \text{ m}$$

- Q. 4.** (i) Let a = the common acceleration of the particles during the first 2 seconds.



$$5g - T = 5a \quad \text{Equation 1}$$



$$T - g = a \quad \text{Equation 2}$$

Adding equations 1 and 2 we get:

$$4g = 6a$$

$$\Rightarrow a = \frac{2}{3}g \text{ m/s}^2$$

After 2 seconds, the 5 kg mass hits the table. The 1 kg mass now behaves like a projectile.

Firstly, we must find the speed of the two particles just as the 5 kg mass hits the table.

$$u = 0, \quad a = \frac{2}{3}g, \quad t = 2$$

$$v = u + at$$

$$\Rightarrow v = 0 + \left(\frac{2}{3}g\right)(2)$$

$$\Rightarrow v = \frac{4}{3}g \text{ m/s}$$

Now, examine the motion of the 1 kg mass after the 5 kg mass hits the table:

$$u = \frac{4}{3}g, \quad a = -g, \quad v = 0$$

$$s = \frac{v^2 - u^2}{2a}$$

$$\Rightarrow s = \frac{0 - \frac{16g^2}{9}}{-2g}$$

$$\Rightarrow s = \frac{8}{9}g \text{ m}$$

- (ii) The 1 kg mass falls back down. When the string becomes taut, the speed will once again be $\frac{4}{3}g \text{ m/s}$.

Using Conservation of Momentum for the system, we have:

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\Rightarrow (1)\left(\frac{4}{3}g\right) + (5)(0) = 6v$$

$$\Rightarrow 6v = \frac{4}{3}g$$

$$\Rightarrow v = \frac{2}{9}g \text{ m/s} \quad \dots \text{ speed at which 5 kg mass begins to rise.}$$

- Q. 5. Part 1:** Motion of 2 kg falling mass:

$$u = 0, \quad a = g, \quad s = 1$$

$$v = \sqrt{u^2 + 2as}$$

$$\Rightarrow v = \sqrt{0^2 + 2g(1)}$$

$$\Rightarrow v = \sqrt{2g} \text{ m/s}$$