Adding equations **1** and **2** we get:

$3g = 7a$

$\Rightarrow a = \frac{3}{7}g$ m/s^2

After 3 seconds, the speed of each particle will be given by

$v = u + at$

$\Rightarrow v = 0 + \left(\frac{3}{7}g\right)(3)$

$\Rightarrow v = \frac{9}{7}g$ m/s

At this point, the 2 kg mass picks up a particle of mass 4 kg.

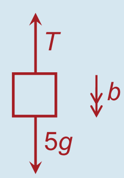
$m_1u = m_2v$

$\Rightarrow 7\left(\frac{9}{7}g\right) = 11v$

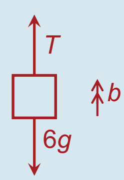
$\Rightarrow 9g = 11v$

$\Rightarrow v = \frac{9}{11}g$ m/s … speed directly after 4 kg mass is picked up.

Let b = the new common acceleration of the particles.



$5g - T = 5b$ **Equation 3**



$T - 6g = 6b$ **Equation 4**

Adding equations **3** and **4** we get:

$-g = 11b$

$\Rightarrow b = -\frac{1}{11}g$ m/s^2

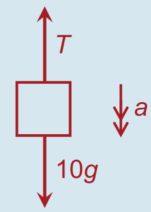
$\Rightarrow$ The distance travelled by the 5 kg mass before stopping is given by

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

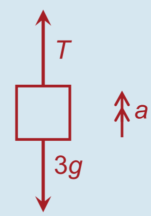
$$\Rightarrow s = \frac{0^2 - \left(\frac{9}{11}g\right)^2}{2\left(-\frac{1}{11}g\right)} = \frac{\frac{81g^2}{121}}{\frac{2g}{11}}$$

$$= \frac{81g^2}{121} \times \frac{11}{2g} = \frac{81}{22}g \text{ m}$$

Q. 3. (i) Let a = the common acceleration of the particles during the first 2 seconds.



$10g - T = 10a$ **Equation 1**



$T - 3g = 3a$ **Equation 2**

Adding equations **1** and **2** we get:

$7g = 13a$

$\Rightarrow a = \frac{7}{13}g$ m/s^2

After 2 seconds, the distance travelled by the 10 kg particle will be given by

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

$\Rightarrow s = (0)(2) + \frac{1}{2}\left(\frac{7}{13}g\right)(2)^2$

$\Rightarrow s = \frac{14}{13}g$ m

(ii) Firstly, we must calculate the speed just before the 2 kg mass is picked up:

$v = u + at = 0 + \left(\frac{7}{13}g\right)(2)$

$= \frac{14}{13}g$ m/s

$m_1u = m_2v$

$\Rightarrow 13\left(\frac{14}{13}g\right) = 15v$

$\Rightarrow 15v = 14g$

$\Rightarrow v = \frac{14}{15}g$ m/s … speed directly after 2 kg mass is picked up.