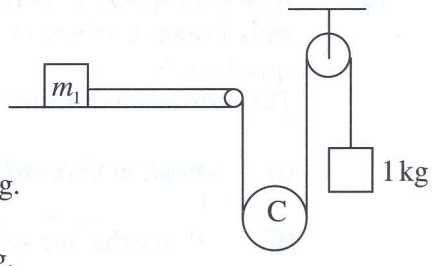
4 **(b)** A mass m_1 kg is at rest on a smooth horizontal table. It is attached to a light inextensible string. The string, after passing over a small fixed pulley at the edge of the table, passes under a small moveable pulley C, of mass m_2 kg. The string then passes over a smooth fixed pulley and supports a mass of 1 kg.



The system is released from rest.

(i) Find, in terms of m_1 and m_2, the tension in the string.

(ii) The pulley C will remain at rest if $\frac{2}{m_2} - \frac{1}{m_1} = k$.

Find the value of k.

(*i*) m_1

$$T = m_1(p) \qquad 5$$

1 kg

$$T - g = 1(q) \qquad 5$$

m_2

$$m_2 g - 2T = m_2\left\{\frac{p+q}{2}\right\} \qquad 5$$

$$m_2 g - 2T = \frac{m_2}{2}\left\{\frac{T}{m_1} + T - g\right\}$$

$$\frac{3m_2 g}{2} = 2T + \frac{m_2 T}{2m_1} + \frac{m_2 T}{2}$$

$$3m_1 m_2 g = 4m_1 T + m_2 T + m_1 m_2 T$$

$$T = \frac{3m_1 m_2 g}{4m_1 + m_2 + m_1 m_2} \qquad 5$$

(ii) C will remain at rest if $m_2 g - 2T = 0$ or if $\frac{p+q}{2} = 0$

$$m_2 g = \frac{6m_1 m_2 g}{4m_1 + m_2 + m_1 m_2}$$

$$4m_1 + m_2 + m_1 m_2 = 6m_1$$

$$m_1 m_2 = 2m_1 - m_2$$

$$1 = \frac{2}{m_2} - \frac{1}{m_1}$$

$$\Rightarrow k = 1 \qquad 5$$

25