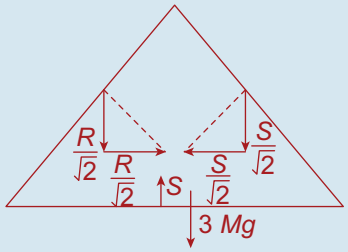
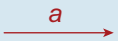
The Wedge:

Forces



Acceleration



Along the horizontal: $\frac{R}{\sqrt{2}} - \frac{S}{\sqrt{2}} = 3Ma$

$\Rightarrow R - S = 3\sqrt{2}\,Ma$

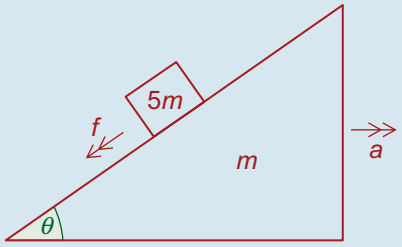
$\Rightarrow \sqrt{2}Mg - \sqrt{2}Ma - \frac{Ma}{\sqrt{2}} - \frac{Mg}{\sqrt{2}} = 3\sqrt{2}Ma$

(from ② and ④)

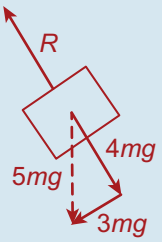
$\Rightarrow 2Mg - 2Ma - Ma - Mg = 6Ma$

$\Rightarrow a = \frac{1}{9}g$ m/s^2

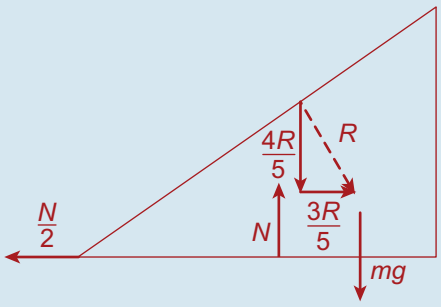
Q. 8. (i) $\tan\theta = \frac{3}{4}$, $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$



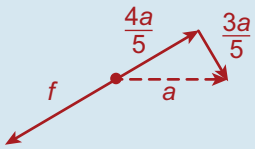
Forces on 5*m* mass



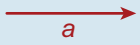
Forces on wedge



Acceleration of 1 kg mass



Acceleration of wedge



5 kg mass along slope:

$F = ma$

$\Rightarrow 3mg = 5m\left(f - \frac{4a}{5}\right)$

$\Rightarrow 3g = 5\left(f - \frac{4a}{5}\right)$ … ①

5 kg mass perpendicular to slope:

$F = ma$

$\Rightarrow 4mg - R = 5m\left(\frac{3a}{5}\right)$

$\Rightarrow 4mg - R = 3ma$ … ②

Wedge horizontal:

$F = ma$

$\Rightarrow \frac{3R}{5} - \frac{N}{2} = ma$ … $N = mg + \frac{4R}{5}$

$\Rightarrow \frac{3R}{5} - \frac{1}{2}\left(mg + \frac{4R}{5}\right) = ma$

$\Rightarrow 6R - 5mg - 4R = 10ma$

$\Rightarrow 2R = 5m(2a + g)$

$\Rightarrow R = \frac{5m}{2}(2a + g)$ … ③

Putting this result into equation ② gives:

$4mg - \frac{5m}{2}(2a + g) = 3ma$

… multiply by $\frac{2}{m}$

$\Rightarrow 8g - 10a - 5g = 6a$

$\Rightarrow 16a = 3g$

$\Rightarrow a = \frac{3}{16}g$ … acceleration of wedge

Putting this result into equation ① gives

$3g = 5\left(f - \frac{4}{5}\left(\frac{3g}{16}\right)\right)$

$\Rightarrow 3g = 5f - \frac{3g}{4}$

$\Rightarrow 12g = 20f - 3g$

$\Rightarrow 20f = 15g$

$\Rightarrow f = \frac{3}{4}g$ … acceleration of the particle relative to the wedge