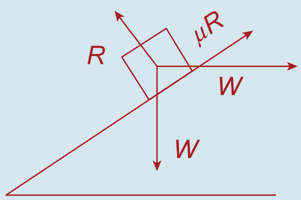
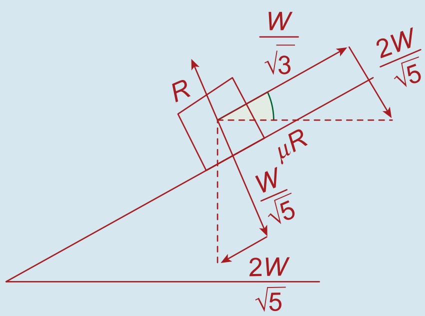
Q. 4. $\tan \alpha = 2$

$\Rightarrow \sin \alpha = \dfrac{2}{\sqrt{5}} \quad \cos \alpha = \dfrac{1}{\sqrt{5}}$

Forces



Resolved



① $R = \dfrac{2W}{\sqrt{5}} + \dfrac{W}{\sqrt{5}} = \dfrac{3W}{\sqrt{5}}$

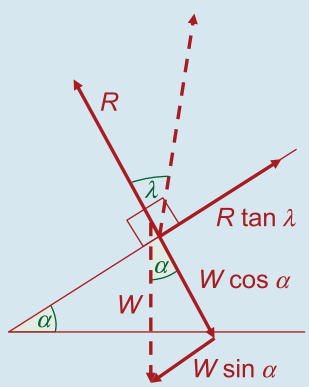
② $\mu R + \dfrac{W}{\sqrt{5}} = \dfrac{2W}{\sqrt{5}}$

$\Rightarrow \mu R = \dfrac{W}{\sqrt{5}}$

Dividing ① by ②

$\Rightarrow \mu = \dfrac{1}{3}$

Q. 5.



The diagram shows the forces on the particle. Since $\mu = \tan \lambda$, the friction force is $R \tan \lambda$ as shown.

Particle will slip down the plane if

$W \sin \alpha > R \tan \lambda \quad \ldots$ but $R = W \cos \alpha$

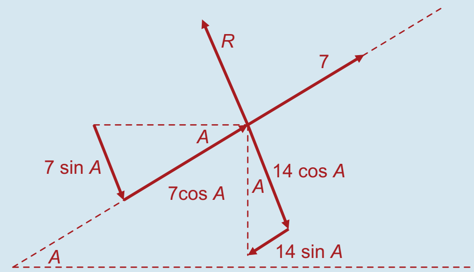
$\Leftrightarrow W \sin \alpha > W \cos \alpha \tan \lambda$

$\ldots$ divide by $W \cos \alpha$

$\Leftrightarrow \tan \alpha > \tan \lambda$

$\Leftrightarrow \alpha > \lambda$

Q. 6. Here is a diagram of the resolved forces acting on the body:



$7 \cos A + 7 = 14 \sin A$

$\Rightarrow \cos A + 1 = 2 \sin A$

$\Rightarrow \cos A + 1 = 2\sqrt{1 - \cos^2 A}$

$\ldots$ square both sides

$\Rightarrow \cos^2 A + 2 \cos A + 1 = 4(1 - \cos^2 A)$

$\Rightarrow \cos^2 A + 2 \cos A + 1 = 4 - 4 \cos^2 A$

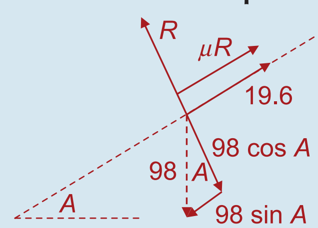
$\Rightarrow 5 \cos^2 A + 2 \cos A - 3 = 0$

$\Rightarrow (5 \cos A - 3)(\cos A + 1) = 0$

$\Rightarrow \cos A = \dfrac{3}{5}$ **OR** $\cos A = -1$

$\cos A = -1$ is excluded because A is an acute angle.

Q. 7. (i) **Particle about to slip down the plane**



$R = 98 \cos A$

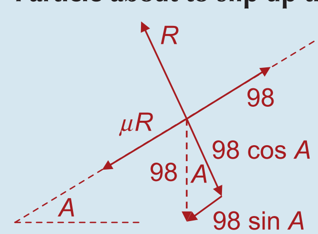
$19.6 + \mu R = 98 \sin A$

$\Rightarrow 19.6 + 98\,\mu \cos A = 98 \sin A$

$\Rightarrow 2 + 10\,\mu \cos A = 10 \sin A$

$\Rightarrow 10 \sin A - 10\,\mu \cos A = 2 \quad \ldots$ ①

Particle about to slip up the plane



$R = 98 \cos A$

$98 = \mu R + 98 \sin A$

$\Rightarrow 98 = 98\,\mu \cos A + 98 \sin A$

$\Rightarrow 10 = 10\,\mu \cos A + 10 \sin A$