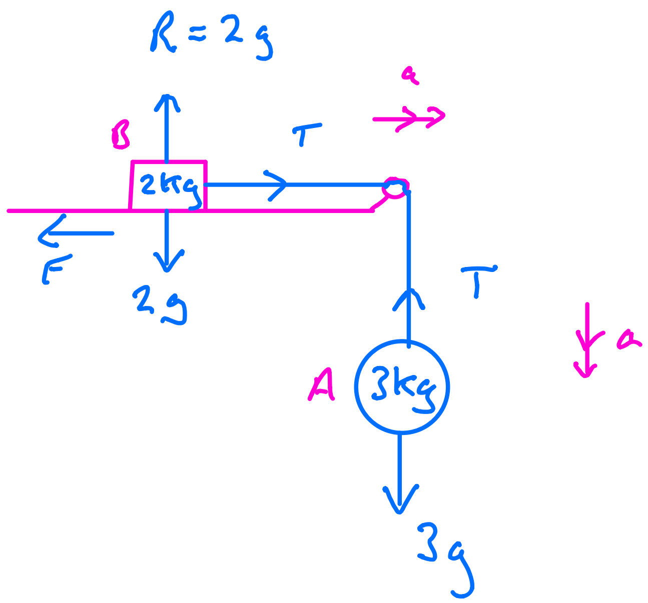



Coefficient of friction

$\mu = \frac{1}{2}$

$F \le \mu R$

Find T and a

N2L For A $\quad 3g - T = 3a \quad$ (1)

For B $\quad T - F = 2a$

$T - \mu R = 2a$

$T - \frac{1}{2} \times 2g = 2a$

$T - g = 2a \quad$ (2)

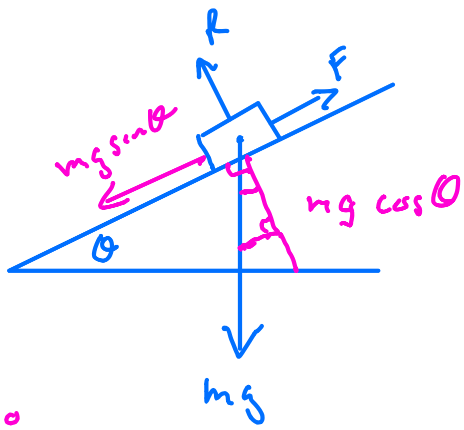
(1) + (2) $\quad 3g - g = 5a$

$a = \frac{2}{5} g \quad ms^{-2}$

Sub in (2) $\quad T - g = 2 \times \frac{2}{5} g$

$T = \frac{9}{5} g \quad N$

# Friction on an inclined plane




θ is angle of incline to horizontal

Weight component parallel to slope $= mg\sin\theta$

Weight component perpendicular to slope $= mg\cos\theta$

Suppose block is on the point of slipping

then $F = \mu R = \mu mg\cos\theta$

On point of slipping $mg\sin\theta = F$

$$\therefore \quad mg\sin\theta = \mu mg\cos\theta$$

$$\frac{mg\sin\theta}{mg\cos\theta} = \mu$$

$$\underline{\mu = \tan\theta}$$

$\therefore$ $\mu$ is the tan of the angle where slipping would first occur. Bear in mind

$\tan 45^\circ = 1$ $\quad\quad$ $\tan 27^\circ = \frac{1}{2}$

$\tan 63^\circ = 2$

$\tan 72^\circ = 3$

**4.**

$\mu = 0.3$

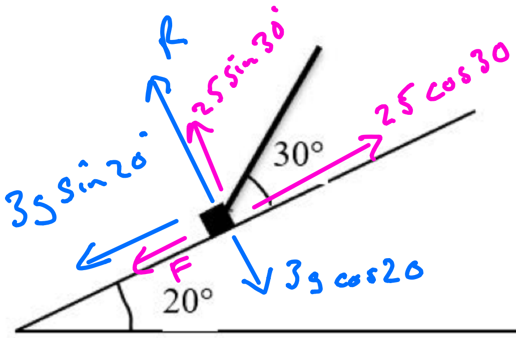



**Figure 1**

A small box of mass 3 kg moves on a rough plane which is inclined at an angle of 20° to the horizontal.

The box is pulled up a line of greatest slope of the plane using a rope which is attached to the box.

The rope makes an angle of 30° with the plane, as shown in Figure 1.

The rope lies in the vertical plane which contains a line of greatest slope of the plane.
The coefficient of friction between the box and the plane is 0.3.
The tension in the rope is 25 N.

The box is modelled as a particle, the rope is modelled as a light inextensible string and air resistance is ignored.

(a) Using the model, find the acceleration of the box.

**(7)**

(b) Suggest one improvement to the model that would make it more realistic.

**(1)**

The rope now breaks and the box slows down and comes to rest.

(c) Show that, after the box comes to rest, it immediately starts to move down the plane.

**(3)**

a) Resolve ⊥ to slope

$$3g\cos 20 = R + 25\sin 30°$$

$$3g\cos 20 - 25\sin 30 = R$$

$R = 15.127 \text{ N}$

N2L parallel to slope

Resultant = mass × acc

$25\cos 30 - F - 3g\sin 20 = 3a$

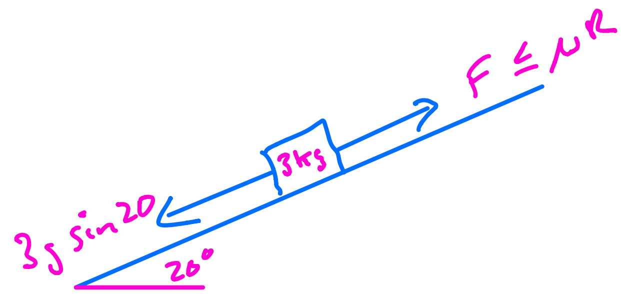
$25\cos 30 - \mu R - 3g\sin 20 = 3a$

$$\frac{25\cos 30 - 0.3 \times 15.127 - 3g\sin 20}{3} = a$$

$$a = 2.35 \text{ ms}^{-2}$$

b) Take air resistance into account

c)




Limiting Friction

$F = \mu R = \mu \times 3g\cos 20$

$= 0.3 \times 3g\cos 20$

$= 8.29 \text{ N}$

$3g\sin 20 = 10.1 \text{ N}$

Gravitational force down slope exceeds limiting friction so box accelerates down slope

$10.1 > 8.29$