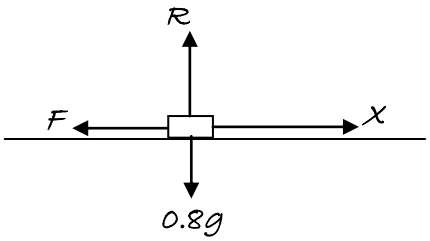
Section 1: Friction

Solutions to Exercise level 2

1. (i)



Resolving vertically: $R - 0.8g = 0$

$$R = 0.8 \times 10 = 8$$

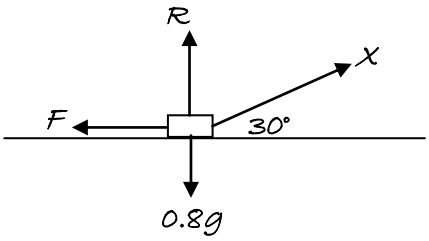
Friction is limiting so $F = \mu R = 0.5 \times 8 = 4$

Resolving horizontally: $X - F = 0$

$$X = F = 4$$

The least force required is 4 N.

(ii)



Resolving vertically: $R + X\sin 30° - 0.8g = 0$

$$R = 0.8 \times 10 - \tfrac{1}{2}X = 8 - 0.5X$$

Friction is limiting so $F = \mu R = 0.5(8 - 0.5X) = 4 - 0.25X$

Resolving horizontally: $X\cos 30° - F = 0$

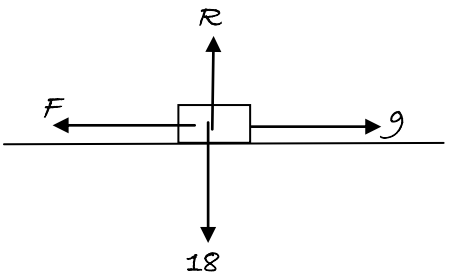
$$\tfrac{1}{2}\sqrt{3}X = 4 - 0.25X$$

$$\sqrt{3}X + 0.5X = 8$$

$$X = \frac{8}{\sqrt{3} + 0.5} = 3.58$$

The least force required is 1.66 N.

2. (i)

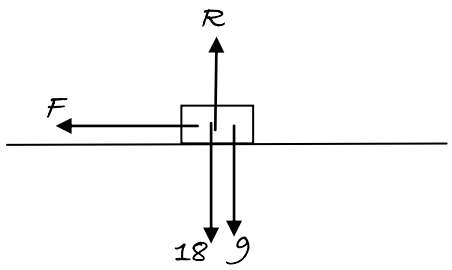


Resolving horizontally: $9 - F = 0$

$F = 9$

The magnitude of the frictional force is 9 N.

(ii)

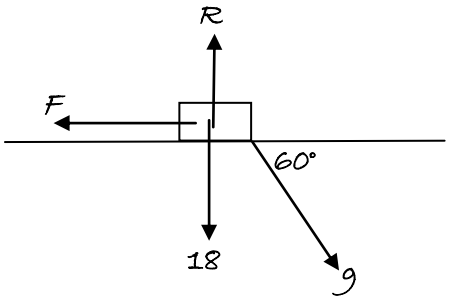


There is no tendency to move so no frictional force is required.

Resolving horizontally: $F = 0$

The magnitude of the frictional force is 0 N.

(iii)

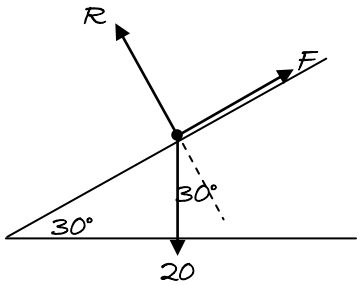


Resolving horizontally: $9\cos 60° - F = 0$

$F = 9 \times \frac{1}{2} = 4.5$

The magnitude of the frictional force is 4.5 N.

3. Since the block is on the point of sliding down the plane, the frictional force acts upwards.



Resolving perpendicular to the plane: $R - 20\cos 30° = 0$

$R = 20 \times \frac{1}{2}\sqrt{3} = 10\sqrt{3}$

Resolving parallel to the plane: $F - 20\sin 30° = 0$

$F = 20 \times \frac{1}{2} = 10$

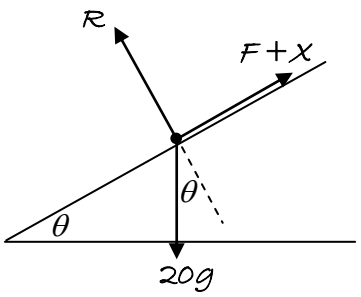
AQA A level Maths Friction 1 Exercise solutions

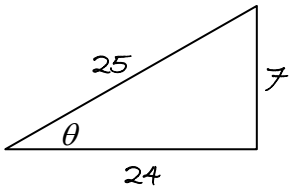
Friction is limiting so $F = \mu R$

$$10 = 10\sqrt{3}\mu$$

$$\mu = \frac{1}{\sqrt{3}} = 0.577$$

4. (i)





Resolving perpendicular to the plane: $R - 20g\cos\theta = 0$

$$R = 20 \times 9.8 \times \tfrac{24}{25} = 188.16$$

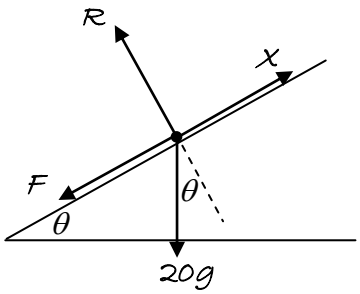
Friction is limiting so $F = \mu R = 0.2 \times 188.16 = 37.632$

Resolving parallel to the plane: $F + X - 20g\sin\theta = 0$

$$X = 20 \times 9.8 \times \tfrac{7}{25} - 37.632 = 17.248$$

The force required is 17.3 N (3 s.f.)

(ii)



As in (i) friction is limiting so $F = 37.632$

Resolving parallel to the plane: $X - F - 20g\sin\theta = 0$

$$X = 20 \times 9.8 \times \tfrac{7}{25} + 37.632 = 92.512$$

The force required is 92.5 N (3 s.f.)