Section 1: Friction

Solutions to Exercise level 1

1. (a) (i) Resolving vertically: $R - 10g = 0$
$$R = 10 \times 9.8 = 98 \text{ N}$$

(ii) Resolving horizontally:
$$14 - F = 0$$
$$F = 14$$
$$F = \mu R$$
$$14 = 98\mu$$
$$\mu = \tfrac{1}{7}$$

(b) (i) Resolving vertically:
$$R + 21\sin 30° - 10g = 0$$
$$R = 10 \times 9.8 - 21 \times \tfrac{1}{2} = 87.5 \text{ N}$$

(ii) Resolving horizontally:
$$21\cos 30° - F = 0$$
$$F = 21 \times \tfrac{1}{2}\sqrt{3}$$
$$F = \mu R$$
$$\tfrac{21}{2}\sqrt{3} = 87.5\mu$$
$$\mu = 0.208 \ (3 \text{ s.f})$$

(c) (i) Resolving vertically:
$$R - 10\sin 20° - 10g = 0$$
$$R = 98 + 10\sin 20° = 101 \text{ N } (3 \text{ s.f.})$$

(ii) Resolving horizontally:
$$10\cos 20° - F = 0$$
$$F = 10\cos 20°$$
$$F = \mu R$$
$$10\cos 20° = (98 + 10\sin 20°)\mu$$
$$\mu = 0.0927 \ (3 \text{ s.f})$$

(d) (i) Resolving vertically:
$$R + 15\sin 60° - 10g = 0$$
$$R = 98 - 15 \times \tfrac{1}{2}\sqrt{3} = 85.0 \text{ N } (3 \text{ s.f.})$$

(ii) Resolving horizontally:
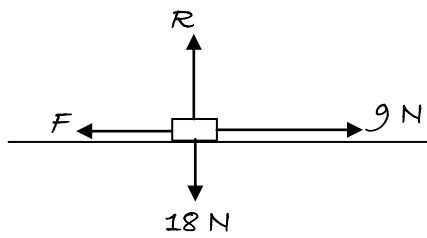$$15\cos 60° - F = 0$$
$$F = \tfrac{15}{2}$$
$$F = \mu R$$
$$\tfrac{15}{2} = (98 - \tfrac{15}{2}\sqrt{3})\mu$$
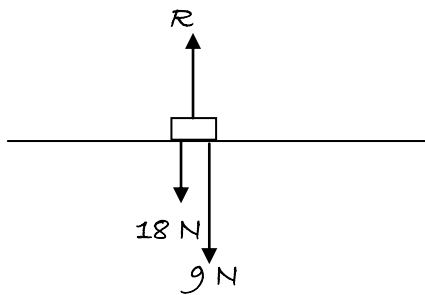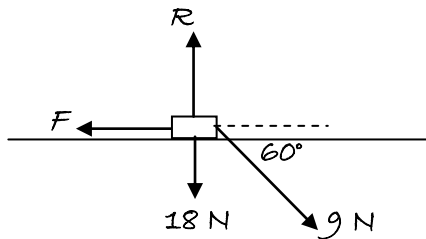$$\mu = 0.0882 \ (3 \text{ s.f})$$

2.   (i)

Resolving horizontally: $F = 9$
The frictional force is 9N.

(ii)

There are no horizontal forces, so there is no frictional force.

(iii)

Resolving horizontally: $F = 9\cos 60° = 4.5$
The frictional force is 4.5 N.

05/11/18   © MEI