Free-Body Force Diagrams

1.

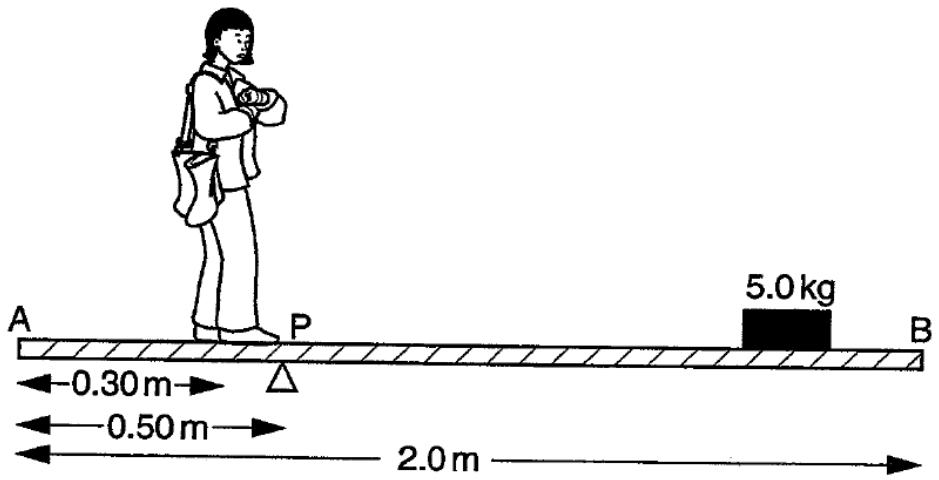


Figure 1

Figure 1 shows a student standing at rest on a plank of wood. The plank itself rests on a support at point P.

Draw separate free-body force diagrams showing the forces acting on each of the following objects. Label the forces on your diagrams.

(a) The student

(b) The 5.0 kg object

2.

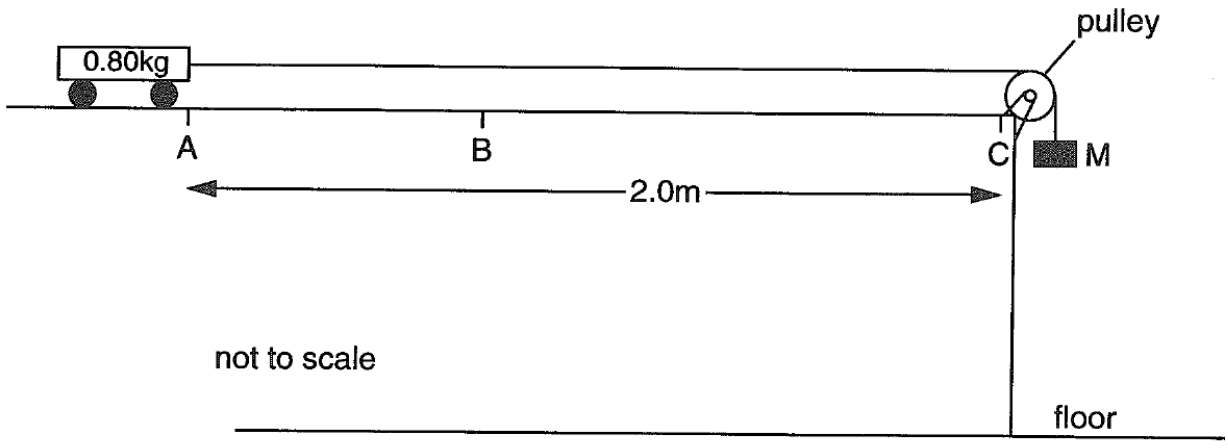


Figure 2

Figure 2 shows a trolley which is connected to a mass M by a light string. The string passes over a smooth pulley. The trolley is on a surface above the floor.

Draw separate free-body force diagrams showing the forces acting on each of the following objects. Label the forces on your diagrams.

(a) The trolley

(b) The mass M

State where in your diagrams/answers above you used the facts that the string is light and the pulley is smooth.

3.

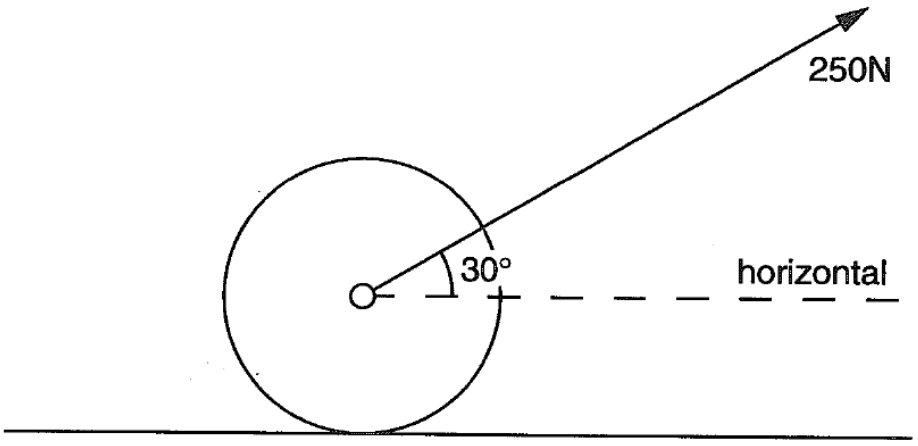


Figure 3

Figure 3 shows a garden roller being pulled with a force of 250 N at an angle of 30^0 to the horizontal.

Draw a free-body force diagram showing the forces acting on the garden roller. Label the forces on your diagram.

4.

Figure 4.1

Figure 4.1 shows a ball at rest, hanging on a vertical thread from a fixed support, S.

Draw a free-body force diagram showing the forces acting on the ball. Label the forces on your diagram.

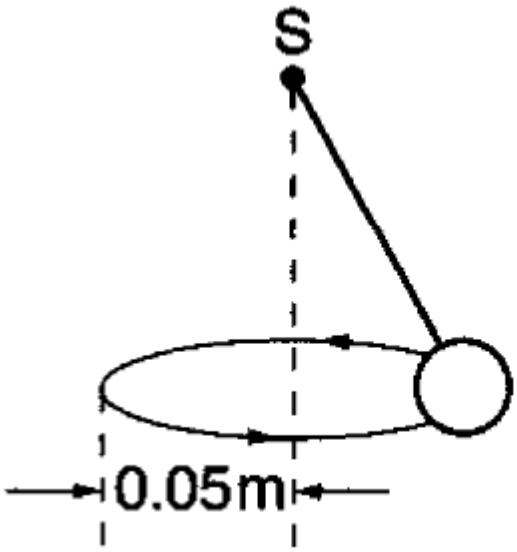


Figure 4.2

Figure 4.2 shows the ball moving on a horizontal circle about a vertical axis through S.

Draw a free-body force diagram showing the forces acting on the ball while it is moving. Label the forces on your diagram.

5.

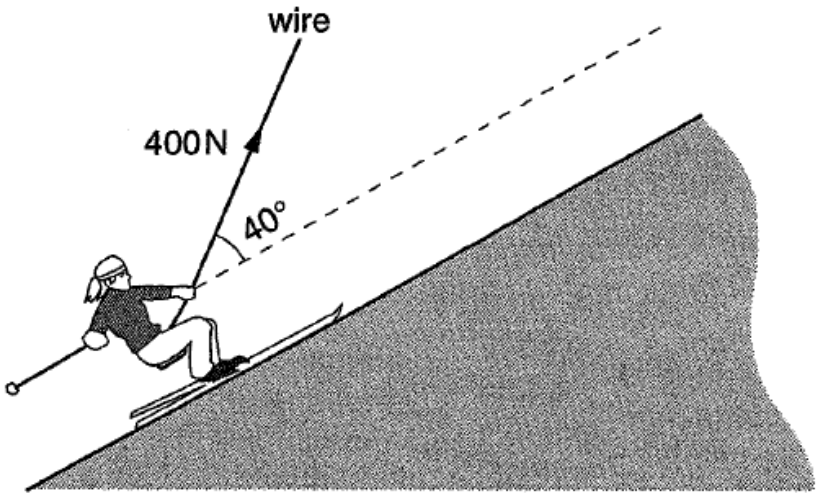


Figure 5

Figure 5 shows a skier being pulled up a slope.

One force acting on the skier is shown in the diagram.

Draw a free-body force diagram showing all the forces acting on the skier. Label the forces on your diagram.

6.

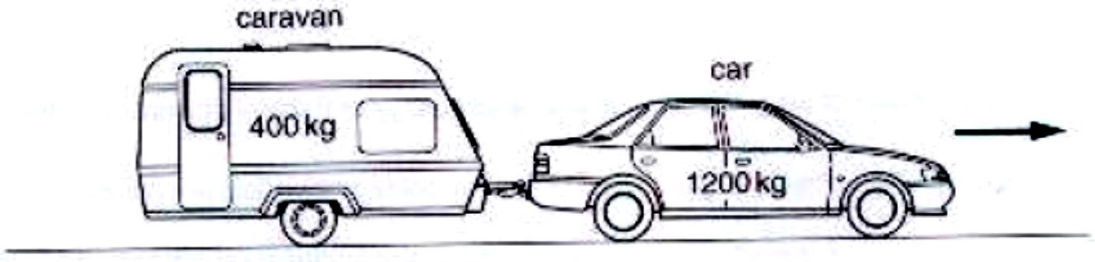


Figure 6

Figure 6 shows a car pulling a caravan.

Draw separate free-body force diagrams showing the forces acting on each of the following objects. Label the forces on your diagrams.

(a) The car

(b) The caravan

7.

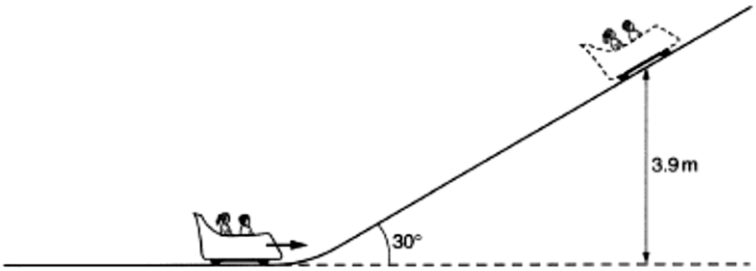
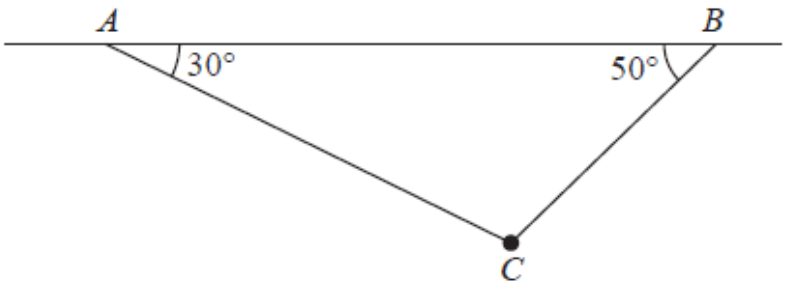


Figure 7

Figure 7 shows part of a fairground ride with a carriage on rails.

Draw separate free-body force diagrams showing the forces acting on the carriage on each of the positions marked A and B.

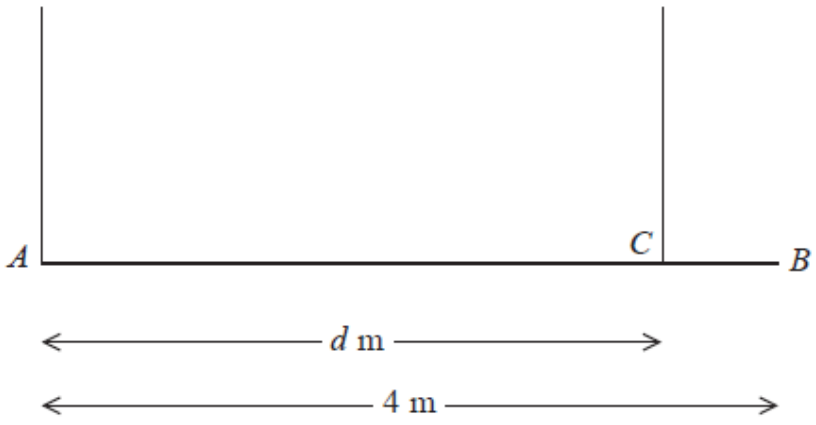
8.



A particle of weight W newtons is attached at C to two light inextensible strings AC and BC. The other ends of the strings are attached to fixed points A and B on a horizontal ceiling.

Draw a free body force diagram for the particle attached at C.

9.



A beam AB has weight W newtons and length 4 m. The beam is held in equilibrium in a horizontal position by two vertical ropes attached to the beam. One rope is attached to A and the other rope is attached to the point C on the beam, where $AC = d$ metres, as shown in Figure 3. The beam is modelled as a uniform rod and the ropes as light inextensible strings. The tension in the rope attached at C is double the tension in the rope attached at A.

Draw a free body force diagram for the beam.

10.

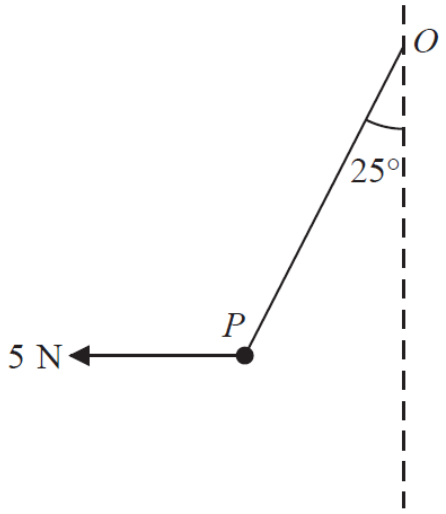


Figure 10

A particle P of weight W newtons is attached to one end of a light inextensible string. The other end of the string is attached to a fixed point O. A horizontal force of magnitude 5 N is applied to P. The particle P is in equilibrium with the string taut and with OP making an angle of 25^0 to the downward vertical, as shown in Figure 10.

Mark on the diagram and label with suitable letters all the forces that act on the particle P.

11.

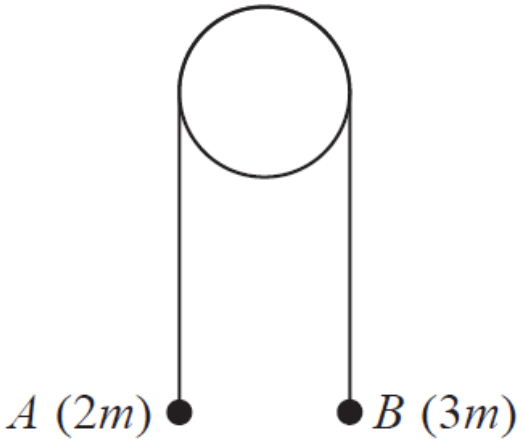


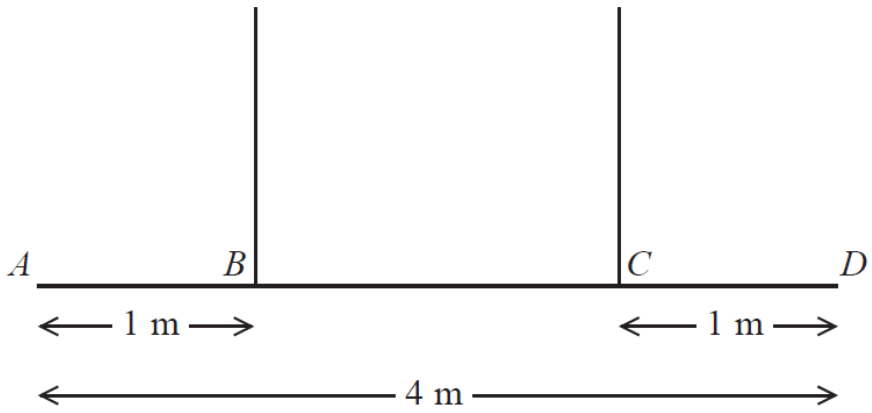
Figure 11

Two particles A and B have masses $2m$ and $3m$ respectively. The particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut. The hanging parts of the string are vertical and A and B are above a horizontal plane, as shown in Figure 11.

(a) Mark on the diagram and label with suitable letters, the forces acting on the particle A

(b) Mark on the diagram and label with suitable letters, the forces acting on the particle B.

12.

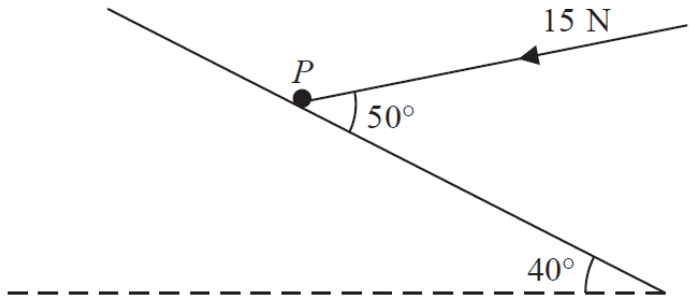


A non-uniform beam AD has weight W newtons and length 4 m. It is held in equilibrium in a horizontal position by two vertical ropes attached to the beam. The ropes are attached to two points B and C on the beam, where AB = 1m and CD = 1m as shown in the figure.

The tension in the rope attached to C is double the tension in the rope attached to B. The beam is modelled as a rod and the ropes are modelled as light inextensible strings.

Mark on the diagram and label with suitable letters, the forces acting on the beam AD.

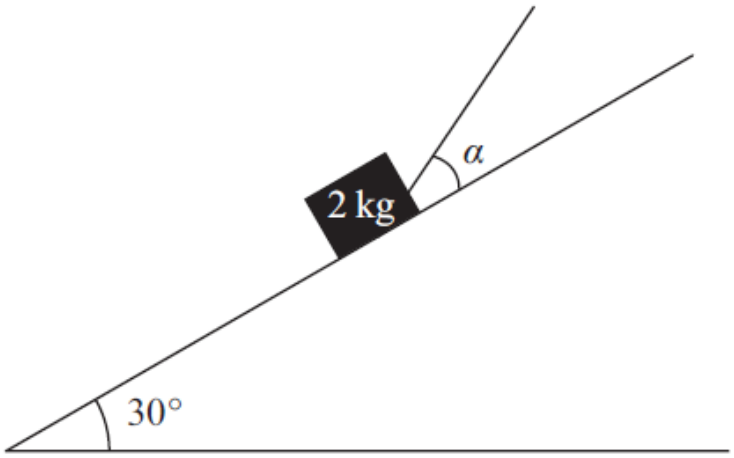
13.



A particle P of mass 2.7 kg lies on a rough plane inclined at 40° to the horizontal. The particle is held in equilibrium by a force of magnitude 15 N acting at an angle of 50° to the plane, as shown in the figure. The force acts in a vertical plane containing a line of greatest slope of the plane.

Mark on the diagram and label with suitable letters, the forces acting on the particle P.

14.



A box of mass 2 kg is held in equilibrium on a fixed rough inclined plane by a rope. The rope lies in a vertical plane containing a line of greatest slope of the inclined plane. The rope is inclined to the plane at an angle α, where $\tan \alpha = \frac{3}{4}$, and the plane is at an angle of 30^0 to the horizontal, as shown in the figure.

Mark on the diagram and label with suitable letters, the forces acting on the box.
