



Statics of a Particle

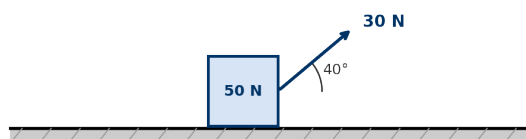
Questions

Suitable for:
Pearson Edexcel International A-Level (iAL) — Mechanics 1



Question 1

A particle of weight 50 N is in equilibrium on a smooth horizontal surface. Two forces act on the particle: a force of 30 N acting at 40° above the horizontal, and a horizontal force of magnitude P N. Both forces act in the same vertical plane.



(a) Find the value of P .

(2 marks)

(b) Find the normal reaction of the surface on the particle.

(2 marks)

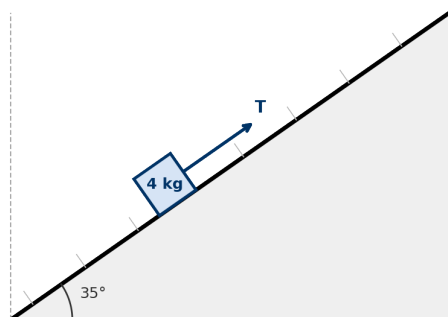
Total for question = 4 marks



Question 2

A particle of mass 4 kg rests in equilibrium on a smooth plane inclined at 35° to the horizontal. The particle is held by a light inextensible string which lies along the plane, as shown in Figure 1. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 1



(a) Find the tension in the string.

(2 marks)

(b) Find the normal reaction of the plane on the particle.

(2 marks)

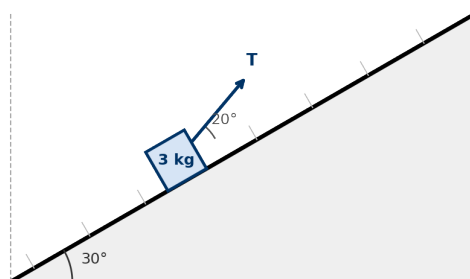
Total for question = 4 marks



Question 3

A particle of mass 3 kg rests in equilibrium on a smooth plane inclined at 30° to the horizontal. The particle is held by a light inextensible string inclined at 20° above the slope, as shown in Figure 2. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 2



(a) Find the tension T in the string.

(3 marks)

(b) Find the normal reaction R of the plane on the particle.

(2 marks)

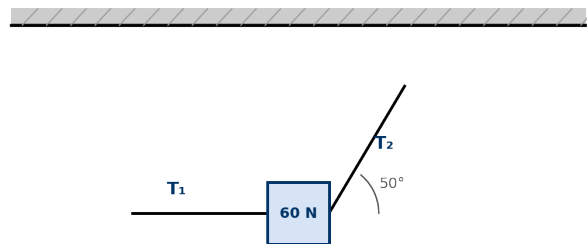
Total for question = 5 marks



Question 4

A particle of weight 60 N hangs in equilibrium from a fixed point by two light inextensible strings, as shown in Figure 3. One string is horizontal. The other string makes an angle of 50° with the horizontal.

Figure 3



(a) Find the tension T_2 in the angled string.

(2 marks)

(b) Find the tension T_1 in the horizontal string.

(2 marks)

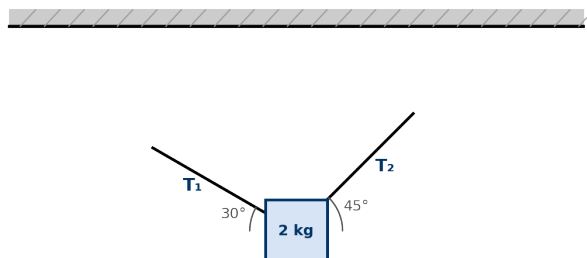
Total for question = 4 marks



Question 5

A particle of mass 2 kg is attached to two light inextensible strings whose other ends are fixed to a horizontal ceiling. The particle hangs in equilibrium. One string makes an angle of 30° with the ceiling and the other makes an angle of 45° with the ceiling, as shown in Figure 4. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 4



Find the tension in each string.

(5 marks)

Total for question = 5 marks



Question 6

A particle rests in equilibrium on a smooth horizontal plane under the action of three forces:

$$\mathbf{F}_1 = (3c\mathbf{i} + 4c\mathbf{j}) \text{ N} \quad \mathbf{F}_2 = (-14\mathbf{i} + 7\mathbf{j}) \text{ N} \quad \mathbf{F}_3 = (b\mathbf{i} - 5b\mathbf{j}) \text{ N}$$

(a) Find the values of c and b .

(4 marks)

The force $\mathbf{F}_3$ is removed. Given that c has the value found in part (a),

(b) find the magnitude of the resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$.

(2 marks)

Total for question = 6 marks



Question 7

Two forces act on a particle:

$$\mathbf{F}_1 = (6\mathbf{i} - 2\mathbf{j}) \text{ N} \quad \mathbf{F}_2 = (p\mathbf{i} + 2p\mathbf{j}) \text{ N}$$

The resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$ is parallel to $\mathbf{i}$.

(a) Find the value of p .

(2 marks)

(b) Find the magnitude of the resultant.

(2 marks)

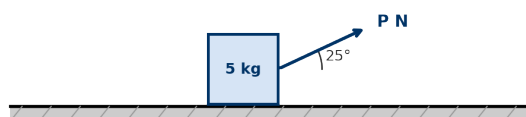
Total for question = 4 marks





Question 8

A particle of mass 5 kg rests on a rough horizontal surface. A force of magnitude P N acts on the particle at an angle of 25° above the horizontal. The particle is in limiting equilibrium. The coefficient of friction between the particle and the surface is 0.4. Take $g = 9.8 \text{ m s}^{-2}$.



Find the value of P .

(5 marks)

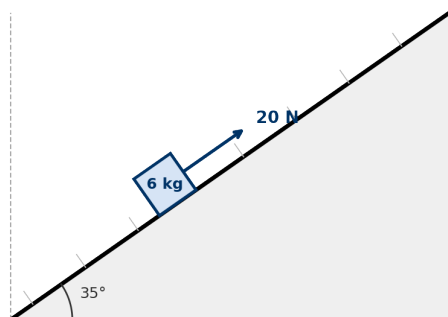
Total for question = 5 marks



Question 9

A particle of mass 6 kg rests in equilibrium on a rough plane inclined at 35° to the horizontal. A light string acts parallel to the plane with tension 20 N, holding the particle in limiting equilibrium on the point of sliding down the plane. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 5



Find the coefficient of friction between the particle and the plane.

(5 marks)

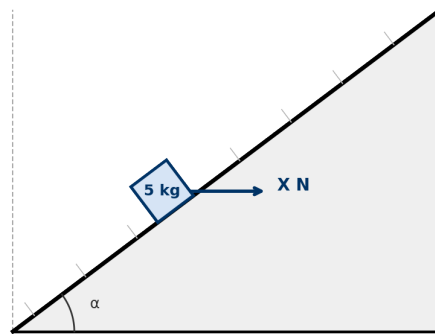
Total for question = 5 marks



Question 10

A particle of mass 5 kg rests in equilibrium on a rough plane inclined at angle α to the horizontal, where $\tan \alpha = 3/4$. A horizontal force of magnitude X N acts on the particle, as shown in Figure 6. The normal reaction of the plane on the particle is 68.6 N. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 6



(a) Find the value of X .

(3 marks)

(b) State, with justification, the direction in which friction acts on the particle.

(2 marks)

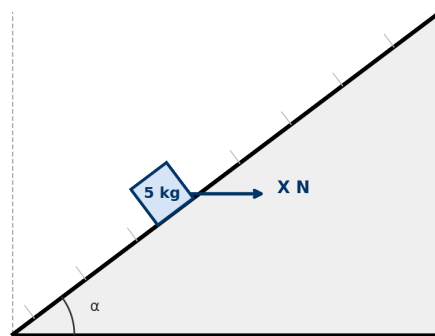
Total for question = 5 marks



Question 11

A block B of mass 5 kg rests in equilibrium on a rough plane inclined at angle α to the horizontal, where $\tan \alpha = 3/4$. A horizontal force of magnitude X N acts on B in the vertical plane containing the line of greatest slope, as shown in Figure 7. The coefficient of friction between B and the plane is 0.5. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 7



- (a) Find the value of X for which B is on the point of sliding up the plane.

(6 marks)

The horizontal force is now removed.

- (b) Find the acceleration of B as it slides down the plane.

(4 marks)

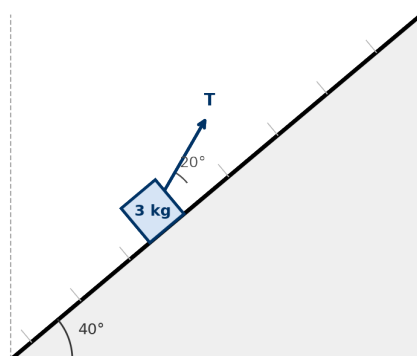
Total for question = 10 marks



Question 12

A particle P of mass 3 kg rests in equilibrium on a rough plane inclined at 40° to the horizontal. P is held by a light inextensible string inclined at 20° above the slope, as shown in Figure 8. The particle is on the point of sliding up the plane. The coefficient of friction between P and the plane is 0.3. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 8



Find the tension T in the string.

(6 marks)

Total for question = 6 marks