Mechanics 1: Forces
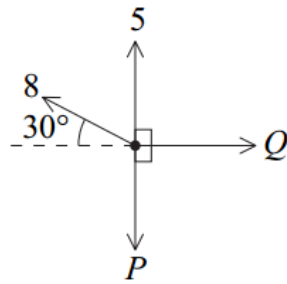
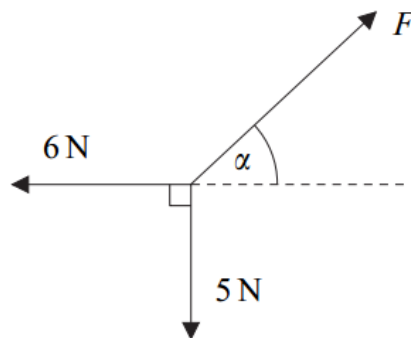Past Paper Questions
2006 - 2013

Name:

2 A particle is in equilibrium under the action of four horizontal forces of magnitudes 5 newtons, 8 newtons, P newtons and Q newtons, as shown in the diagram.

(a) Show that $P = 9$. *(3 marks)*

(b) Find the value of Q. *(2 marks)*

3 The diagram shows three forces which act in the same plane and are in equilibrium.

(a) Find F. *(3 marks)*

(b) Find α. *(3 marks)*

3 A sign, of mass 2 kg, is suspended from the ceiling of a supermarket by two light strings. It hangs in equilibrium with each string making an angle of 35° to the vertical, as shown in the diagram. Model the sign as a particle.
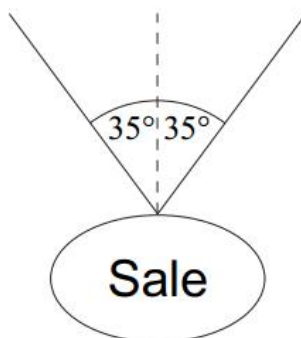
(a) By resolving forces horizontally, show that the tension is the same in each string.

(2 marks)

(b) Find the tension in each string. *(5 marks)*

(c) If the tension in a string exceeds 40 N, the string will break. Find the mass of the heaviest sign that could be suspended as shown in the diagram. *(3 marks)*

3 A particle, of mass 4 kg, is suspended in equilibrium by two light strings, *AP* and *BP*. The string *AP* makes an angle of 30° to the horizontal and the other string, *BP*, is horizontal, as shown in the diagram.
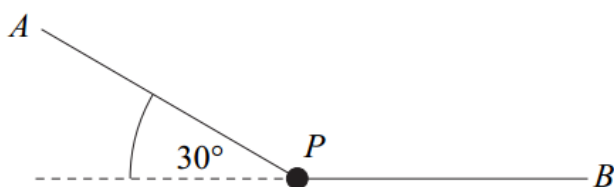
(a) Draw and label a diagram to show the forces acting on the particle. *(1 mark)*

(b) Show that the tension in the string *AP* is 78.4 N. *(3 marks)*

(c) Find the tension in the horizontal string *BP*. *(2 marks)*

2 The diagram shows three forces and the perpendicular unit vectors **i** and **j**, which all lie in the same plane.
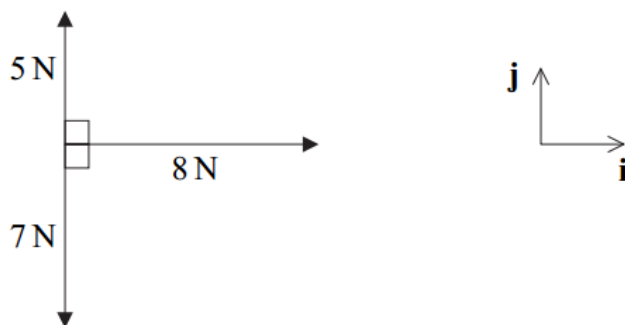
(a) Express the resultant of the three forces in terms of **i** and **j**. *(2 marks)*

(b) Find the magnitude of the resultant force. *(2 marks)*

(c) Draw a diagram to show the direction of the resultant force, and find the angle that it makes with the unit vector **i**. *(3 marks)*

6 Two forces, **P** = (6**i** − 3**j**) newtons and **Q** = (3**i** + 15**j**) newtons, act on a particle. The unit vectors **i** and **j** are perpendicular.

(a) Find the resultant of **P** and **Q**. *(2 marks)*

(b) Calculate the magnitude of the resultant of **P** and **Q**. *(2 marks)*

3 A particle of mass 3 kg is on a smooth slope inclined at 60° to the horizontal. The particle is held at rest by a force of T newtons parallel to the slope, as shown in the diagram.
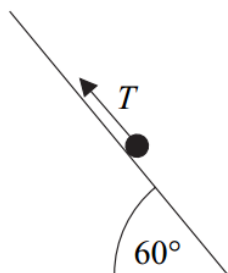
(a) Draw a diagram to show all the forces acting on the particle. *(1 mark)*

(b) Show that the magnitude of the normal reaction acting on the particle is 14.7 newtons. *(2 marks)*

(c) Find T. *(2 marks)*

4   A particle, of mass m kg, remains in equilibrium under the action of three forces, which act in a vertical plane, as shown in the diagram. The force with magnitude 60 N acts at 48° above the horizontal and the force with magnitude 50 N acts at an angle θ above the horizontal.
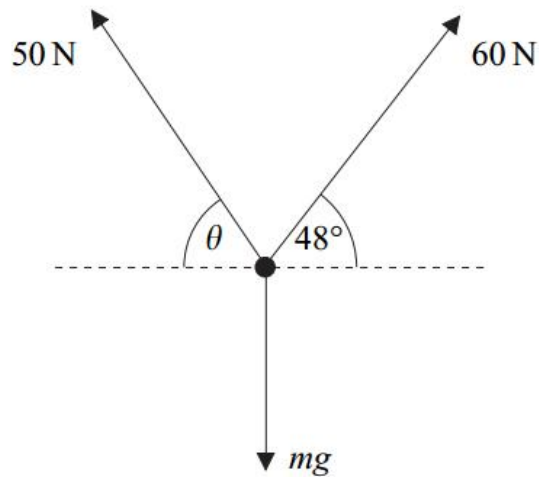
(a)   By resolving horizontally, find θ.   *(4 marks)*

(b)   Find m.   *(3 marks)*

4   A particle, of weight W newtons, is held in equilibrium by two forces of magnitudes 10 newtons and 20 newtons. The 10-newton force is horizontal and the 20-newton force acts at an angle θ above the horizontal, as shown in the diagram. All three forces act in the same vertical plane.
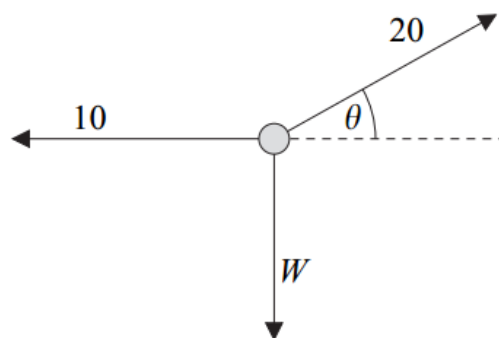

(a)   Find θ.   *(3 marks)*

(b)   Find W.   *(2 marks)*

(c)   Calculate the mass of the particle.   *(2 marks)*

January 2013

| 2 | Three forces act on a particle. These forces are $(9\mathbf{i} - 3\mathbf{j})$ newtons, $(5\mathbf{i} + 8\mathbf{j})$ newtons and $(-7\mathbf{i} + 3\mathbf{j})$ newtons. The vectors $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors. |

    (a)   Find the resultant of these forces.   *(2 marks)*

    (b)   Find the magnitude of the resultant force.   *(2 marks)*

    (c)   Given that the particle has mass 5 kg, find the magnitude of the acceleration of the particle.   *(2 marks)*

    (d)   Find the angle between the resultant force and the unit vector $\mathbf{i}$.   *(3 marks)*

June 2013

| 4 | Two forces, acting at a point, have magnitudes of 40 newtons and 70 newtons. The angle between the two forces is 30°, as shown in the diagram. |
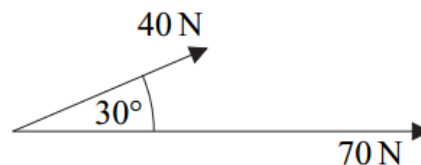
    (a)   Find the magnitude of the resultant of these two forces.   *(4 marks)*

    (b)   Find the angle between the resultant force and the 70 newton force.   *(3 marks)*