Forces in Two Dimensions Exam Questions

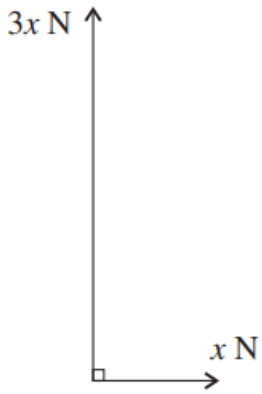
Q1, (OCR 4728, Jan 2008, Q3)

Two horizontal forces **X** and **Y** act at a point O and are at right angles to each other. **X** has magnitude 12 N and acts along a bearing of 090°. **Y** has magnitude 15 N and acts along a bearing of 000°.

(i) Calculate the magnitude and bearing of the resultant of **X** and **Y**. [6]

(ii) A third force **E** is now applied at O. The three forces **X**, **Y** and **E** are in equilibrium. State the magnitude of **E**, and give the bearing along which it acts. [2]

Q2, (OCR 4728, Jun 2009, Q1)

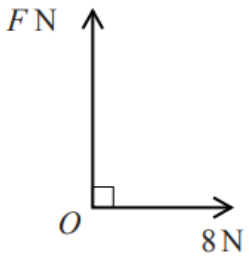


Two perpendicular forces have magnitudes x N and $3x$ N (see diagram). Their resultant has magnitude 6 N.

(i) Calculate x. **[3]**

(ii) Find the angle the resultant makes with the smaller force. **[3]**

Q3, (OCR 4728, Jun 2012, Q1)



Two perpendicular forces of magnitudes F N and 8 N act at a point O (see diagram). Their resultant has magnitude 17 N.

(i) Calculate F and find the angle which the resultant makes with the 8 N force. **[4]**

A third force of magnitude E N, acting in the same plane as the two original forces, is now applied at the point O. The three forces of magnitudes E N, F N and 8 N are in equilibrium.

(ii) State the value of E and the angle between the directions of the E N and 8 N forces. **[2]**

Q4, (OCR 4761, Jun 2005, Q3)

A particle rests on a smooth, horizontal plane. Horizontal unit vectors **i** and **j** lie in this plane. The particle is in equilibrium under the action of the three forces $(-3\mathbf{i} + 4\mathbf{j})$ N and $(21\mathbf{i} - 7\mathbf{j})$ N and **R** N.

(i) Write down an expression for **R** in terms of **i** and **j**. [2]

(ii) Find the magnitude of **R** and the angle between **R** and the **i** direction. [4]

Q5, (OCR 4761, Jan 2006, Q3)

A force **F** is given by $\mathbf{F} = (3.5\mathbf{i} + 12\mathbf{j})$ N, where **i** and **j** are horizontal unit vectors east and north respectively.

(i) Calculate the magnitude of **F** and also its direction as a bearing. [3]

(ii) **G** is the force $(7\mathbf{i} + 24\mathbf{j})$ N. Show that **G** and **F** are in the same direction and compare their magnitudes. [2]

(iii) Force $\mathbf{F}_1$ is $(9\mathbf{i} - 18\mathbf{j})$ N and force $\mathbf{F}_2$ is $(12\mathbf{i} + q\mathbf{j})$ N. Find q so that the sum $\mathbf{F}_1 + \mathbf{F}_2$ is in the direction of **F**. [2]

Q6, (OCR 4761, Jan 2008, Q2i,ii) [Modified]

The force acting on a particle of mass 1.5 kg is given by the vector $\begin{pmatrix} 6 \\ 9 \end{pmatrix}$ N.

(i) Give the acceleration of the particle as a vector. [2]

(ii) Calculate the angle that the acceleration makes with the direction $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$. [2]

Q7, (OCR 4761, Jun 2008, Q2)

A particle has a position vector **r**, where $\mathbf{r} = 4\mathbf{i} - 5\mathbf{j}$ and **i** and **j** are unit vectors in the directions east and north respectively.

(i) Sketch **r** on a diagram showing **i** and **j** and the origin O. [1]

(ii) Calculate the magnitude of **r** and its direction as a bearing. [4]

(iii) Write down the vector that has the same direction as **r** and three times its magnitude. [1]

Q8, (OCR 4761, Jan 2012, Q5)

The vectors **p** and **q** are given by

$$\mathbf{p} = 8\mathbf{i} + \mathbf{j} \text{ and } \mathbf{q} = 4\mathbf{i} - 7\mathbf{j}.$$

(i) Show that **p** and **q** are equal in magnitude. **[3]**

(ii) Show that $\mathbf{p} + \mathbf{q}$ is parallel to $2\mathbf{i} - \mathbf{j}$. **[2]**

(iii) Draw $\mathbf{p} + \mathbf{q}$ and $\mathbf{p} - \mathbf{q}$ on a set of axes.

Write down the angle between these two vectors. **[3]**

Q9, (OCR 4761, Jun 2014, Q2)

The unit vectors **i** and **j** shown in Fig. 2 are in the horizontal and vertically upwards directions.

Fig. 2

Forces **p** and **q** are given, in newtons, by $\mathbf{p} = 12\mathbf{i} - 5\mathbf{j}$ and $\mathbf{q} = 16\mathbf{i} + 1.5\mathbf{j}$.

(i) Write down the force $\mathbf{p} + \mathbf{q}$ and show that it is parallel to $8\mathbf{i} - \mathbf{j}$. **[3]**

(ii) Show that the force $3\mathbf{p} + 10\mathbf{q}$ acts in the horizontal direction. **[2]**

(iii) A particle is in equilibrium under forces $k\mathbf{p}$, $3\mathbf{q}$ and its weight **w**.

Show that the value of k must be -4 and find the mass of the particle. **[3]**