Exercise 10.2 Forces As Vectors (Year 1 Applied Maths)

1 *A forces* $\boldsymbol{F} = (9\boldsymbol{i} + a\boldsymbol{j})$ *N acts on a particle on a bearing of* $135°$*, where* $\boldsymbol{j}$ *is assumed to represent the unit vector due north.*

(a) Find the value of $\boldsymbol{a}$.

(b) Find the magnitude of the force $\boldsymbol{F}$.

2 *Two forces* $\boldsymbol{F_1}$ *and* $\boldsymbol{F_2}$ *act on a particle. Given that* $\boldsymbol{F_1} = (-7\boldsymbol{i} + 2\boldsymbol{j})$ *N and* $\boldsymbol{F_2} = (a\boldsymbol{i} + 2a\boldsymbol{j})$ *N, where* $\boldsymbol{a}$ *is a positive constant.*

(a) Find the angle between $\boldsymbol{F_2}$ *and* $\boldsymbol{i}$.

The resultant of $\boldsymbol{F_1}$ *and* $\boldsymbol{F_2}$ *is* $\boldsymbol{R}$.

(b) Given that $\boldsymbol{R}$ *is parallel* $11\boldsymbol{i} - 10\boldsymbol{j}$*, find the value of* $\boldsymbol{a}$.

3 Three forces $\boldsymbol{F_1}$, $\boldsymbol{F_2}$ and $\boldsymbol{F_3}$ acting on a particle Q are given by $\boldsymbol{F_1} = \begin{pmatrix} -10 \\ -7 \end{pmatrix} N$, $\boldsymbol{F_2} = \begin{pmatrix} 4 \\ 3 \end{pmatrix} N$ and $\boldsymbol{F_3} = \begin{pmatrix} a \\ b \end{pmatrix} N$, where $\boldsymbol{a}$ and $\boldsymbol{b}$ are constants. Given that Q is in equilibrium,

(a) find the values of $\boldsymbol{a}$ and $\boldsymbol{b}$.

(b) The force $\boldsymbol{F_1}$ is now removed. The resultant of $\boldsymbol{F_2}$ and $\boldsymbol{F_3}$ is $\boldsymbol{R}$. Find:

(i) the magnitude of $\boldsymbol{R}$.

(ii) the angle, to the nearest degree, that the direction of $\boldsymbol{R}$ makes with the horizontal.