RESULTANT FORCES
Question 1 (**) 

The figure above shows three forces which lie on the same plane, acting on a particle. The magnitudes of these forces and their relative directions are shown in the figure.

a) Find the magnitude of the resultant of the above three forces.

b) Give the direction of the resultant as a bearing.

\[ R \approx 11.22 \text{ N}, \approx 103^\circ \]
Question 2 (***)

The figure above shows four forces which lie on the same plane, acting on a particle. The magnitudes of these forces and their relative directions are shown in the figure.

a) Find the magnitude of the resultant of the above four forces.

b) Give the direction of the resultant as a bearing.

\[ R \approx 4.77 \text{ N}, \quad \approx 280^\circ \]
The figure above shows four forces which lie on the same plane, acting on a particle.

The magnitudes of these forces and their relative directions are shown in the figure.

a) Find the magnitude of the resultant of the above four forces.

b) Give the direction of the resultant as a bearing.

\[ R \approx 31.5 \text{ N}, \ 016.4^\circ \]
The figure above shows four forces which lie on the same plane, acting on a particle.

The magnitudes of these forces and their relative directions are shown in the figure.

a) Find the magnitude of the resultant of the above four forces.

b) Give the direction of the resultant as a bearing.

\[ R = 20.4 \text{ N}, \quad 240^\circ \]
The figure above shows three forces which lie on the same plane, acting on a particle. The magnitudes of these forces and their relative directions are shown in the figure.

a) Find the magnitude of the resultant of the above three forces.

b) Find the angle the resultant makes with the 5 N force.

The direction in which these three forces act can be changed.

c) State, with full justification, the least and the greatest magnitudes of the resultant force.

$$\vec{R} = 9.17 \text{ N}, \theta = 150.6^\circ, \quad R_{\text{max}} = 32 \text{ N}, \quad R_{\text{min}} = 0 \text{ N}$$
Question 6  (***)

Two forces, \( F_1 \) N and \( F_2 \) N, are acting on a particle at right angles to each other, as shown in the figure above. The resultant of the two forces has magnitude 41 N.

a) Given that the magnitude of \( F_1 \) is 9 N, find the magnitude of \( F_2 \).

b) Determine the angle the resultant makes with \( F_2 \).

A third force \( F_3 \) is added on the particle so that all three forces are in equilibrium.

c) State the magnitude of \( F_3 \).

d) Calculate the angle \( F_3 \) makes with \( F_2 \).

\[
\begin{align*}
&\quad, \quad |F_1| = 40, \quad \approx 12.68^\circ, \quad |F_2| = 41, \quad \approx 167.32^\circ
\end{align*}
\]
Question 7 (***)

Three coplanar forces $\mathbf{F}_1$, $\mathbf{F}_2$, and $\mathbf{F}_3$ act on a particle.

$\mathbf{F}_1$ has magnitude 25 N, acting in a bearing of 270°.

$\mathbf{F}_2$ has magnitude $X$ N, acting in a bearing of 180°.

$\mathbf{F}_3$ has magnitude $(X + 2)$ N, acting in a bearing of 90°.

The resultant of these three forces has magnitude 37 N.

Determine, as a bearing, the angle at which the resultant of these three forces is acting.

\[ \theta \approx 161° \]
Two forces, act on a particle $P$ so that the angle between the two forces is $150^\circ$.

The magnitude of one of these forces is $30\, \text{N}$ and the magnitude of the other force is $F\, \text{N}$, as shown in the figure above.

The resultant of these two forces has magnitude $R\, \text{N}$, and acts at $60^\circ$ to the force with magnitude $F\, \text{N}$.

Calculate in any order the value of $R$ and the value of $F$.

\[
R = 10\sqrt{3} \approx \frac{17.3}{\text{N}}, \quad R = 20\sqrt{3} \approx 34.6\, \text{N}
\]
Question 9  (***)

The figure above shows two forces $F_1$ and $F_2$, of magnitude 24 N and $x$ N respectively, acting on a particle $P$.

The angle between the lines of action of $F_1$ and $F_2$ is 120°.

The resultant of $F_1$ and $F_2$ is the force $R$, whose magnitude is $2x$ N.

a) Show clearly that $x = -4+4\sqrt{3}$.

b) Calculate the value of $|F_2 - F_1|$, correct to three significant figures.

$$|F_2 - F_1| \approx 30.6 \text{ N}$$
Question 10  (***)

Two forces, $F_1 \, \text{N}$ and $F_2 \, \text{N}$, are acting on a particle so that the resultant of the two forces has magnitude 120 N and acts on a bearing of 120°.

It is further given that the $F_1$ acts due North and has magnitude 80 N.

Calculate in any order …

a) … the magnitude of $F_2$

b) … the direction in which $F_2$ acts, giving the answer as a bearing.

$$|F_2| = 40 \sqrt{19} \approx 174 \, \text{N}, \quad \approx 143.4°$$