Q1. \( e = \begin{pmatrix} 4 \\ -1 \end{pmatrix} \) \( f = \begin{pmatrix} 6 \\ 2 \end{pmatrix} \)

Write \( e + f \) as a column vector.

Q2. \( a = \begin{pmatrix} 2 \\ a \end{pmatrix} \) \( b = \begin{pmatrix} 2b \\ -3 \end{pmatrix} \)

Write \( 3a - 2b \) as a column vector.

Q3.

The diagram is a sketch.

\( P \) is the point (2, 4)
\( Q \) is the point (4, 8)

Find the vector \( \vec{PQ} \)

Give your answer as a column vector
Q4.

The diagram is a sketch.

P is the point (2, 4)
Q is the point (4, 8)

\[ \overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix} \]

M is the midpoint of PQ.
N is the midpoint of QR.

Find the vector \( \overrightarrow{MN} \)
Give your answer as a column vector

Q5. Find the length of the vector \( \begin{pmatrix} 4 \\ -6 \end{pmatrix} \). Give your answer in surd form.
Q6.

\[ OAB \] is a triangle.
\[ M \] is the midpoint of \( OA \).
\[ N \] is the midpoint of \( OB \).

\[ \overrightarrow{OM} = m \]
\[ \overrightarrow{ON} = n \]

Show that \( AB \) is parallel to \( MN \).
Q7.

$OAB$ is a triangle.
$P$ is the point on $AB$ such that $AP : PB = 5:3$

$\vec{OA} = 2a$
$\vec{OB} = 2b$
$\vec{OP} = k(3a + 5b)$ where $k$ is a scalar quantity.

Find the value of $k$. 

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$OAB$ is a triangle.
$P$ is the point on $AB$ such that $AP : PB = 5:3$

$\vec{OA} = 2a$
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$\vec{OP} = k(3a + 5b)$ where $k$ is a scalar quantity.

Find the value of $k$. 

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Q8. **OACB** is a parallelogram.

\[ \overrightarrow{OA} = \mathbf{a} \text{ and } \overrightarrow{OB} = \mathbf{b} \]

D is the point such that \( \overrightarrow{AC} = \overrightarrow{CD} \)

The point N divides AB in the ratio 2 : 1

Write an expression for \( \overrightarrow{ON} \) in terms of \( \mathbf{a} \) and \( \mathbf{b} \).

Q9. From the diagram in question 8, prove that OND is a straight line.
Q10.

$CAYB$ is a quadrilateral.

$\vec{CA} = 3a$

$\vec{CB} = 6a$

$\vec{BY} = 5a - b$

$X$ is the point on $AB$ such that $AX : XB = 1 : 2$

Prove that $\vec{CX} = \frac{2}{5} \vec{CY}$
Topics listed in objectives

- Understand and use vector notation, including column notation, and understand and interpret vectors as displacement in the plane with an associated direction.
- Understand that $2\mathbf{a}$ is parallel to $\mathbf{a}$ and twice its length, and that $\mathbf{a}$ is parallel to $-\mathbf{a}$ in the opposite direction.
- Represent vectors, combinations of vectors and scalar multiples in the plane pictorially.
- Calculate the sum of two vectors, the difference of two vectors and a scalar multiple of a vector using column vectors (including algebraic terms).
- Find the length of a vector using Pythagoras’ Theorem.
- Calculate the resultant of two vectors.
- Solve geometric problems in 2D where vectors are divided in a given ratio.
- Produce geometrical proofs to prove points are collinear and vectors/lines are parallel.

Answers

Q1. \[
\begin{pmatrix}
10 \\
1
\end{pmatrix}
\]
Q2. \[
\begin{pmatrix}
6 - 4b \\
3a + 6
\end{pmatrix}
\]
Q3. \[
\begin{pmatrix}
2 \\
4
\end{pmatrix}
\]
Q4. \[
\begin{pmatrix}
4 \\
0
\end{pmatrix}
\]
Q5. $2\sqrt{13}$
Q6. $\overrightarrow{MN} = \mathbf{n} - \mathbf{m}$ and $\overrightarrow{AB} = 2\mathbf{n} - 2\mathbf{m}$, so lines are parallel
Q7. $k = \frac{1}{4}$
Q8. $\overrightarrow{ON} = \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$
Q9. $\overrightarrow{OD} = 3\overrightarrow{ON}$
Q10. $\overrightarrow{CY} = 5\mathbf{a} + 5\mathbf{b}$, $\overrightarrow{CX} = 2\mathbf{a} + 2\mathbf{b}$