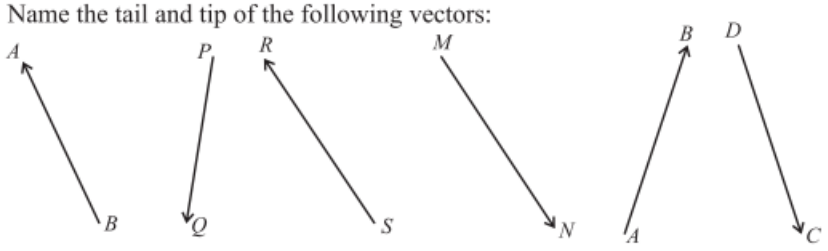
EXERCISE 6.1

1. Name the quadrant in which each point lies.
   (i) (4, 3) (ii) (5, –4) (iii) (–6,2) (iv) (–4, –4)
2. Plot the following points on the coordinate plane:
   (i) $A(3,-3)$ (ii) $B(-3,3)$ (iii) $C(5,7)$ (iv) $D(-2,-4)$
3. Name the tail and tip of the following vectors:



(i) (ii) (iii) (iv) (v) (vi)

4. Write the vector AB in the form of $x\underline{i}+y\underline{j}$:
   (i) $A(1,-7), B(-2,4)$ (ii) $A(8,9), B(12,3)$
5. Find the magnitude of the $\underline{a}$:
   (i) $\underline{a}=-3\underline{i}+2\underline{j}$ (ii) $\underline{a}=4\underline{i}-3\underline{j}$ (iii) $\underline{a}=\frac{1}{2}\underline{i}+\frac{3}{2}\underline{j}$
6. Find a unit vector in the direction of the vector given below:
   (i) $\underline{a}=-4\underline{i}+5\underline{j}$ (ii) $\underline{a}=6\underline{i}+8\underline{j}$
   (iii) $\underline{a}=\frac{1}{\sqrt{6}}\underline{i}+\frac{1}{\sqrt{6}}\underline{j}$ (iv) $\underline{a}=\frac{1}{2}\underline{i}-\frac{3}{4}\underline{j}$
7. If $\underline{a}=5\underline{i}-7\underline{j}$, $\underline{b}=-\underline{i}-\underline{j}$ and $\underline{c}=2\underline{i}+3\underline{j}$, then find unit vector parallel to $\underline{a}+\underline{b}-3\underline{c}$.
8. If $\underline{a}=3\underline{i}-\underline{j}$, $\underline{b}=-2\underline{i}+4\underline{j}$ and $\underline{c}=\underline{i}+2\underline{j}$, then find unit vector parallel to $3\underline{a}-2\underline{c}+4\underline{b}$.
9. Which of the following vectors are parallel?
   (i) $\underline{a}=6\underline{i}+\underline{j}$, $\underline{b}=12\underline{i}+2\underline{j}$ (ii) $\underline{a}=-2\underline{i}+3\underline{j}$, $\underline{b}=6\underline{i}-9\underline{j}$
   (iii) $\underline{a}=5\underline{i}-4\underline{j}$, $\underline{b}=6\underline{i}-3\underline{j}$ (iv) $\underline{a}=3\underline{i}-7\underline{j}$, $\underline{b}=6\underline{i}-14\underline{j}$
10. Find a vector thrice in length of $3\underline{i}-2\underline{j}$, but opposite in direction.
11. Find two vectors that are double in magnitude of $3\underline{i}-5\underline{j}$, one in the same direction of it and other in its opposite direction.

EXERCISE 6.1 - Coordinate Geometry and Vectors

Question 1: Name the quadrant in which each point lies

Solution:

Coordinate Plane Quadrants:

- **Quadrant I:** (+, +)
- **Quadrant II:** (-, +)
- **Quadrant III:** (-, -)

- **Quadrant IV:** (+, -)

Point	Coordinates	Quadrant
(i)	(4, 3)	**Quadrant I** (+, +)
(ii)	(5, -4)	**Quadrant IV** (+, -)
(iii)	(-6, 2)	**Quadrant II** (-, +)
(iv)	(-4, -4)	**Quadrant III** (-, -)

Question 2: Plot the following points on the coordinate plane

text

Y

^

8 |

7 | C(5, 7)

6 |

5 |

4 |

3 |

2 | B(-3, 3)

1 |

0 +----+----+----+----+----+----+----+----+----+----> X

-1 | -5 -4 -3 -2 -1 0 1 2 3 4 5 6

-2 |

-3 | A(3, -3)

-4 | D(-2, -4)

-5 |

-6 |

Points plotted:

- **A(3, -3):** 3 units right, 3 units down (Quadrant IV)
- **B(-3, 3):** 3 units left, 3 units up (Quadrant II)
- **C(5, 7):** 5 units right, 7 units up (Quadrant I)
- **D(-2, -4):** 2 units left, 4 units down (Quadrant III)

Question 3: Name the tail and tip of the following vectors

(Note: Vectors were not shown in the image. The tail is the starting point and the tip is the ending point of a vector.)

For a vector $\overrightarrow{AB}$:

- **Tail:** Point A (starting point)

- **Tip:** Point B (ending point)

General Rule:

- In vector notation $\overrightarrow{PQ}$, **P** is the tail and **Q** is the tip.
- The arrow always points from tail to tip.

Question 4: Write the vector AB in the form of x_i+y_j

4(i) $\mathbf{A(1,-7), B(-2,4)}$

Solution:

$$\overrightarrow{AB} = \begin{pmatrix} x_2 - x_1 \\ y_2 - y_1 \end{pmatrix} = (x_2 - x_1)i + (y_2 - y_1)j \overrightarrow{AB} = (-2-1)i + (4-(-7))j \overrightarrow{AB} = -3i + 11j$$

Answer: $\overrightarrow{AB} = -3i + 11j$

4(ii) $\mathbf{A(8,9), B(12,3)}$

Solution:

$$\overrightarrow{AB} = (12-8)i + (3-9)j \overrightarrow{AB} = 4i - 6j$$

Answer: $\overrightarrow{AB} = 4i - 6j$

Question 5: Find the magnitude of vector a

Formula: For vector $a = xi + yj$, magnitude is:

$$| a | = \sqrt{x^2 + y^2}$$

5(i) $\mathbf{a = -3i + 2j}$

Solution:

$$| a | = \sqrt{(-3)^2 + (2)^2} | a | = \sqrt{9+4} | a | = \sqrt{13}$$

Answer: $\sqrt{13}$

5(ii) $\mathbf{a = 4i - 3j}$

Solution:

$$| a | = \sqrt{(4)^2 + (-3)^2} | a | = \sqrt{16+9} | a | = \sqrt{25} | a | = 5$$

Answer: 5

5(iii) $\mathbf{a = \frac{1}{2}i + \frac{3}{2}j}$

Solution:

$$| a | = \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{3}{2}\right)^2} | a | = \sqrt{\frac{1}{4} + \frac{9}{4}} | a | = \sqrt{\frac{10}{4}} | a | = \frac{\sqrt{10}}{2}$$

Answer: $\frac{\sqrt{10}}{2}$

Question 6: Find a unit vector in the direction of the given vector

Formula: Unit vector $\hat{a} = \frac{a}{|a|}$

6(i) a = −4i + 5j

Solution:

$$| a |= \sqrt{(-4)^2 + (5)^2} = \sqrt{16 + 25} = \sqrt{41}\hat{a} = \frac{-4i + 5j}{\sqrt{41}} = -\frac{4}{\sqrt{41}}i + \frac{5}{\sqrt{41}}j$$

Answer: $-\frac{4}{\sqrt{41}}i + \frac{5}{\sqrt{41}}j$

6(ii) a = 6i + 8j

Solution:

$$| a |= \sqrt{(6)^2 + (8)^2} = \sqrt{36 + 64} = \sqrt{100} = 10\hat{a} = \frac{6i + 8j}{10} = \frac{3}{5}i + \frac{4}{5}j$$

Answer: $\frac{3}{5}i + \frac{4}{5}j$

6(iii) a =$\frac{1}{\sqrt{6}}$i+$\frac{1}{\sqrt{6}}$j

Solution:

$$| a |= \sqrt{\left(\frac{1}{\sqrt{6}}\right)^2 + \left(\frac{1}{\sqrt{6}}\right)^2} | a |= \sqrt{\frac{1}{6} + \frac{1}{6}} = \sqrt{\frac{2}{6}} = \sqrt{\frac{1}{3}} = \frac{1}{\sqrt{3}}\hat{a} = \frac{\frac{1}{\sqrt{6}}i + \frac{1}{\sqrt{6}}j}{\frac{1}{\sqrt{3}}}\hat{a} = \frac{\sqrt{3}}{\sqrt{6}}i + \frac{\sqrt{3}}{\sqrt{6}}j = \frac{1}{\sqrt{2}}i + \frac{1}{\sqrt{2}}j$$

Answer: $\frac{1}{\sqrt{2}}i + \frac{1}{\sqrt{2}}j$

6(iv) a =$\frac{1}{2}$i−$\frac{3}{4}$j

Solution:

$$| a |= \sqrt{\left(\frac{1}{2}\right)^2 + \left(-\frac{3}{4}\right)^2} | a |= \sqrt{\frac{1}{4} + \frac{9}{16}} = \sqrt{\frac{4}{16} + \frac{9}{16}} = \sqrt{\frac{13}{16}} = \frac{\sqrt{13}}{4}\hat{a} = \frac{\frac{1}{2}i - \frac{3}{4}j}{\frac{\sqrt{13}}{4}}\hat{a} = \frac{4}{\sqrt{13}} \cdot \frac{1}{2}i - \frac{4}{\sqrt{13}} \cdot \frac{3}{4}j\hat{a} = \frac{2}{\sqrt{13}}i - \frac{3}{\sqrt{13}}$$

Answer: $\frac{2}{\sqrt{13}}i - \frac{3}{\sqrt{13}}j$

Question 7: Find unit vector parallel to a + b − 3c

Given: $a = 5i - 7j, b = -i - j, c = 2i + 3j$

Solution:

Step 1: Calculate $a + b - 3c$:

$$a + b - 3c = (5i - 7j) + (-i - j) - 3(2i + 3j) = 5i - 7j - i - j - 6i - 9j = (5 - 1 - 6)i + (-7 - 1 - 9)j = -2i - 17j$$

Step 2: Find magnitude:

$$| a + b - 3c | = \sqrt{(-2)^2 + (-17)^2} = \sqrt{4 + 289} = \sqrt{293}$$

Step 3: Unit vector:

$$\hat{u} = \frac{-2i - 17j}{\sqrt{293}} = -\frac{2}{\sqrt{293}}i - \frac{17}{\sqrt{293}}j$$

Answer: $-\frac{2}{\sqrt{293}}i - \frac{17}{\sqrt{293}}j$

Question 8: Find unit vector parallel to $\mathbf{3a - 2c + 4b}$

Given: $a = 3i - j, b = -2i + 4j, c = i + 2j$

Solution:

Step 1: Calculate $3a - 2c + 4b$:

$$3a = 3(3i - j) = 9i - 3j - 2c = -2(i + 2j) = -2i - 4j 4b = 4(-2i + 4j) = -8i + 16j$$

Step 2: Add:

$$3a - 2c + 4b = (9i - 3j) + (-2i - 4j) + (-8i + 16j) = (9 - 2 - 8)i + (-3 - 4 + 16)j = -1i + 9j = -i + 9j$$

Step 3: Find magnitude:

$$| 3a - 2c + 4b | = \sqrt{(-1)^2 + (9)^2} = \sqrt{1 + 81} = \sqrt{82}$$

Step 4: Unit vector:

$$\hat{u} = \frac{-i + 9j}{\sqrt{82}} = -\frac{1}{\sqrt{82}}i + \frac{9}{\sqrt{82}}j$$

Answer: $-\frac{1}{\sqrt{82}}i + \frac{9}{\sqrt{82}}j$

Summary Table

1(i)	Quadrant I
1(ii)	Quadrant IV
1(iii)	Quadrant II
1(iv)	Quadrant III
4(i)	$-3i + 11j$
4(ii)	$4i - 6j$
5(i)	$\sqrt{13}$
5(ii)	5
5(iii)	$\frac{\sqrt{10}}{2}$
6(i)	$-\frac{4}{\sqrt{41}}i + \frac{5}{\sqrt{41}}j$
6(ii)	$\frac{3}{5}i + \frac{4}{5}j$
6(iii)	$\frac{1}{\sqrt{2}}i + \frac{1}{\sqrt{2}}j$
6(iv)	$\frac{2}{\sqrt{13}}i - \frac{3}{\sqrt{13}}j$

7	$-\frac{2}{\sqrt{293}}i - \frac{17}{\sqrt{293}}j$
8	$-\frac{1}{\sqrt{82}}i + \frac{9}{\sqrt{82}}j$

Key Formulas Used:

1. **Vector from points:** $\overrightarrow{AB} = (x_2 - x_1)i + (y_2 - y_1)j$
2. **Magnitude:** $| a | = \sqrt{x^2 + y^2}$
3. **Unit Vector:** $\hat{a} = \frac{a}{|a|}$
4. **Vector Addition/Subtraction:** Add/subtract corresponding components
5. **Scalar Multiplication:** Multiply each component by the scalar

EXERCISE 6.1 (Continued) - Parallel Vectors and Vector Operations

Question 9: Which of the following vectors are parallel?

Concept: Two vectors a and b are parallel if one is a scalar multiple of the other, i.e., $b = ka$ for some scalar k.
For vectors $a = a_1 i + a_2 j$ and $b = b_1 i + b_2 j$, they are parallel if:

$$\frac{b_1}{a_1} = \frac{b_2}{a_2}$$

9(i) $\mathbf{a = 6i + j, b = 12i + 2j}$

Solution:

$$\frac{12}{6} = 2, \frac{2}{1} = 2$$

Since ratios are equal, $b = 2a$.

Answer: Parallel

9(ii) $\mathbf{a = -2i + 3j, b = 6i - 9j}$

Solution:

$$\frac{6}{-2} = -3, \frac{-9}{3} = -3$$

Since ratios are equal, $b = -3a$.

Answer: Parallel

9(iii) $\mathbf{a = 5i - 4j, b = 6i - 3j}$

Solution:

$$\frac{6}{5} = 1.2, \frac{-3}{-4} = 0.75$$

Since ratios are not equal, vectors are not parallel.

Answer: Not Parallel

9(iv) $\mathbf{a = 3i - 7j, b = 6i - 14j}$

Solution:

$$\frac{6}{3} = 2, \frac{-14}{-7} = 2$$

Since ratios are equal, $b = 2a$.

Answer: **Parallel**

Question 10: Find a vector thrice in length of $\mathbf{3i - 2j}$, but opposite in direction

Concept: To get a vector k times in length but opposite in direction, multiply by $-k$.

Solution:

Given: $a = 3i - 2j$

Thrice in length = multiply by 3
Opposite in direction = multiply by -1
Total scalar = -3

$$b = -3(3i - 2j)b = -9i + 6j$$

Answer: $-9i + 6j$

Question 11: Find two vectors that are double in magnitude of $\mathbf{3i - 5j}$

Given: $a = 3i - 5j$

11(i) Same direction (double in magnitude)

Solution:

$$b = 2(3i - 5j) = 6i - 10j$$

Answer: $6i - 10j$

11(ii) Opposite direction (double in magnitude)

Solution:

$$c = -2(3i - 5j) = -6i + 10j$$

Answer: $-6i + 10j$

Summary Table

	Given Vectors	Parallel?
9(i)	$a = 6i + j,\ b = 12i + 2j$	**Yes** $(b = 2a)$
9(ii)	$a = -2i + 3j,\ b = 6i - 9j$	**Yes** $(b = -3a)$
9(iii)	$a = 5i - 4j,\ b = 6i - 3j$	**No**
9(iv)	$a = 3i - 7j,\ b = 6i - 14j$	**Yes** $(b = 2a)$

	Required Vector	
10	Thrice length, opposite direction of $3i - 2j$	$-9i + 6j$
11(i)	Double magnitude, same direction of $3i - 5j$	$6i - 10j$
11(ii)	Double magnitude, opposite direction of $3i - 5j$	$-6i + 10j$

Key Concept Summary

Parallel Vectors

Two vectors are parallel if:

- One is a scalar multiple of the other
- $b = ka$ where k is any real number
- $\frac{b_1}{a_1} = \frac{b_2}{a_2}$

Vector Operations

Operation	Effect
ka	k times the length, same direction (if $k > 0$)
$-ka$	k times the length, opposite direction (if $k > 0$)
(k a) (k)	) times the length, direction depends on sign of k

Visual Representation

text

For vector a = xi + yj:

→ a = xi + yj

→ 2a = 2xi + 2yj (same direction, double length)

→ -2a = -2xi - 2yj (opposite direction, double length)