

Vectors and Transformations

Exercise 6.3 — Complete Solutions

Class 10th Mathematics

Step-by-step worked solutions for Exercise 6.3

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EXERCISE 6.3

1. Plot $A(-5, 4)$, $B(-6, 1)$ and $C(-3, 1)$ to form a $\triangle ABC$. Also translate $\triangle ABC$ to $\triangle A'B'C'$ by translation vector $8\mathbf{i} - 6\mathbf{j}$.
 2. Plot $A(-6, -2)$, $B(-6, -5)$, $C(-3, -5)$ and $D(-3, -2)$ to form a square $ABCD$. Also translate square $ABCD$ to square $A'B'C'D'$ by translation vector $9\mathbf{i} + 7\mathbf{j}$.
 3. Plot $A(-6, 3)$, $B(-4, 0)$, $C(-2, 3)$ and $D(-4, 4)$ to form a kite $ABCD$. Also translate kite $ABCD$ to kite $A'B'C'D'$ by translation vector $6\mathbf{i} - 6\mathbf{j}$.
 4. The coordinates of A , B and D are $(1, 2)$, $(6, 3)$ and $(2, 8)$ respectively. Find the coordinates of C by using vector method if $ABCD$ is a parallelogram.
 5. In parallelogram $ABCD$, the vectors representing two opposite sides are $\vec{AB} = 6\mathbf{i} + 2\mathbf{j}$, $\vec{DC} = -6\mathbf{i} - 2\mathbf{j}$. Show that the opposite sides are equal in magnitude and parallel.
 6. Points $A(1, 2)$, $B(4, 6)$ and $C(7, 2)$ form a triangle. Check whether triangle ABC is an isosceles by using vector magnitude.
 7. Use vectors to show that $PQRS$ is a parallelogram, where the points P , Q , R and S have coordinates $(1, 2)$, $(5, 2)$, $(7, 6)$ and $(3, 6)$ respectively.
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8. Use vectors to show that triangle XYZ is an isosceles, where the points X , Y , Z have the coordinates $(0, 0)$, $(2, 0)$ and $(1, 3)$ respectively.
 9. A ball is projected with an initial velocity vector $\mathbf{v}_0 = 10\mathbf{i} + 20\mathbf{j}$. The horizontal component is in the x -direction and gravity is $\mathbf{g} = 0\mathbf{i} - 10\mathbf{j}$. Find the maximum height and horizontal range.
 10. A car enters a loop with velocity vector $\mathbf{v} = 30\mathbf{j}$ and exits with velocity $\mathbf{v}' = 30\mathbf{i}$. What is the change in velocity vector?
 11. An aeroplane has airspeed $\mathbf{v}_p = 20\mathbf{i}$ and there is a crosswind $\mathbf{v}_w = 50\mathbf{j}$. Find the resultant velocity and its magnitude.

EXERCISE 6.3 - Vectors and Transformations

Question 1: Translate Triangle ABC

Given: , ,

Translation Vector: (Shift: +8 in x , -6 in y)

Solution:

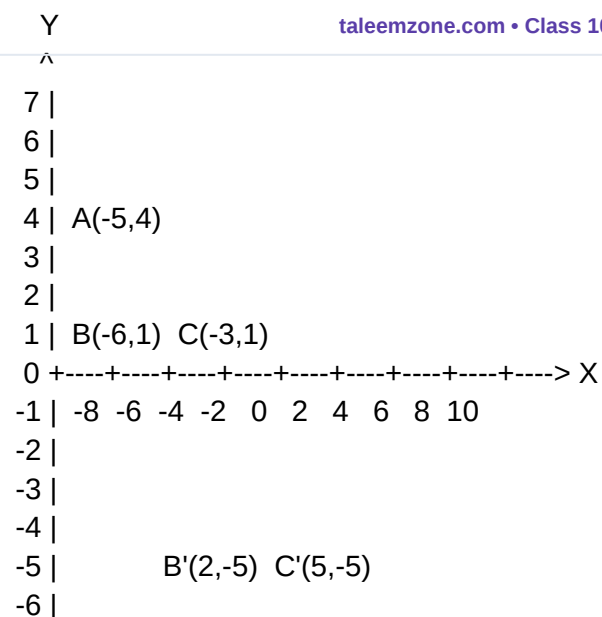
Translating each point:

Answer:

- $A'(3, -2)$
- $B'(2, -5)$
- $C'(5, -5)$

Graph:

text



(Note: The triangle shape is maintained after translation)

Question 2: Translate Square ABCD

Given: , , ,

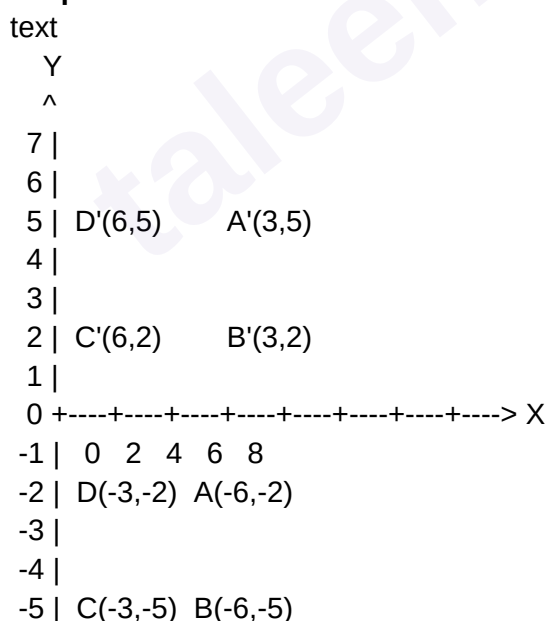
Translation Vector: (Shift: +9 in x, +7 in y)

Solution:

Answer:

- A'(3, 5)
- B'(3, 2)
- C'(6, 2)
- D'(6, 5)

Graph:



(Square shape is maintained after translation)

Question 3: Translate Kite ABCD

Given: , , ,

Translation Vector: (Shift: +6 in x, -6 in y)

Solution:

Answer:

- $A'(0, -3)$
- $B'(2, -6)$
- $C'(4, -3)$
- $D'(2, -2)$

Question 4: Find Coordinates of C using Vector Method

Given: Parallelogram , , ,

Solution:

In a parallelogram:

Since :

Alternative Method:

In a parallelogram, diagonals bisect each other:

Answer:

$C = (7, 9)$

Question 5: Show Opposite Sides are Equal and Parallel

Given: ,

Solution:

Step 1: Check if equal in magnitude:

Therefore, ✓

Step 2: Check if parallel:

Since , they are scalar multiples → **Parallel** ✓

Conclusion:

Opposite sides are **equal in magnitude** and **parallel**.

The negative sign indicates they point in opposite directions.

Question 6: Check if Triangle ABC is Isosceles

Given: , ,

Solution:

Step 1: Find the vectors for the sides:

Step 2: Find magnitudes (side lengths):

Step 3: Check:

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Conclusion:

Since , triangle ABC is **isosceles**.

Question 7: Show PQRS is a Parallelogram

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Given: , , ,

Solution:

Step 1: Find vectors:

Step 2: Check:

Conclusion:

Since both pairs of opposite sides are equal and parallel, **PQRS is a parallelogram.**

Summary Table

Question	Answer
1	
2	
3	
4	
5	(AB = DC = \sqrt{40}), → Equal and parallel
6	→ Isosceles triangle
7	, → Parallelogram

Key Formulas Used:

1. **Translation:**
2. **Vector from Points:**
3. **Magnitude:**
4. **Parallelogram Property:** Opposite sides are equal and parallel
5. **Diagonal Property of Parallelogram:**
6. **Isosceles Triangle:** At least two sides are equal in length

EXERCISE 6.3 (Continued) - Vector Applications

Question 8: Show Triangle XYZ is Isosceles

Given: , ,

Solution:

Step 1: Find the vectors for the sides:

Step 2: Find magnitudes (side lengths):

Step 3: Check:

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Conclusion:

Since , triangle XYZ is **isosceles**.

Question 9: Projectile Motion - Maximum Height and Horizontal Range

Given: ,

Solution:

Step 1: Identify components:

- Horizontal component: m/s
- Vertical component: m/s
- Acceleration due to gravity: m/s^2 (negative because downward)

Step 2: Find maximum height:

Using formula:

Step 3: Find time of flight:

Step 4: Find horizontal range:

Answer:

- **Maximum Height:** 20 m
 - **Horizontal Range:** 40 m
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Question 10: Change in Velocity

Given:

Initial velocity:

Final velocity:

Solution:

Step 1: Change in velocity = Final - Initial:

Step 2: Find magnitude:

Answer:

- **Change in velocity vector:**
 - **Magnitude of change:** m/s
-

Question 11: Resultant Velocity of Aeroplane

Given:

Plane airspeed:

Crosswind:

Solution:

Step 1: Resultant velocity = Vector sum:

Step 2: Find magnitude:

Step 3: Find direction (optional):

(Measured from the positive x-axis)

Answer:

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- **Resultant velocity vector:**
- **Magnitude:** $\text{m/s} \approx 53.85 \text{ m/s}$

Summary Table

Question	Answer
8	→ Isosceles triangle
9	Maximum height = 20 m, Horizontal range = 40 m
10	, Magnitude = m/s
11	, Magnitude = m/s

Key Formulas Used:

1. **Distance between points:**
2. **Projectile Motion:**
 - o Maximum Height:
 - o Time of Flight:
 - o Horizontal Range:
3. **Change in Velocity:**
4. **Resultant Vector:** Sum of all component vectors
5. **Magnitude of Vector:**

Key Concepts Explained:

Projectile Motion (Q9):

- Horizontal motion is uniform (no acceleration)
- Vertical motion is uniformly accelerated (gravity)
- Maximum height occurs when vertical velocity becomes zero
- Range depends on time of flight and horizontal velocity

Velocity Change (Q10):

- Change in velocity is a vector difference
- Direction changes from vertical to horizontal
- Magnitude of change depends on both components

Relative Velocity (Q11):

- Resultant velocity is the vector sum of all velocity components
- Crosswind affects the plane's ground track
- Magnitude is found using Pythagoras theorem