1.5.16

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August 2025

Question

Question:
Write the coordinates of a point **P** on the x-axis which is equidistant from the points $\mathbf{A}(-\mathbf{2}, \mathbf{0})$ and $\mathbf{B}(\mathbf{6}, \mathbf{0})$.

Theoretical solution

Let the point P lie on the x-axis with coordinates

$$\mathbf{P} = (x, 0) \tag{1}$$

The position vectors of points A, B, and P are

$$\mathbf{A} = \langle -2, 0 \rangle \tag{2}$$
$$\mathbf{B} = \langle 6, 0 \rangle \tag{3}$$
$$\mathbf{P} = \langle x, 0 \rangle \tag{4}$$

Since P is equidistant from A and B, their distances are equal:

$$|\mathbf{P} - \mathbf{A}| = |\mathbf{P} - \mathbf{B}| \tag{5}$$

Theoretical solution

Using vector subtraction:

$$\mathbf{P} - \mathbf{A} = \langle x - (-2), 0 - 0 \rangle = \langle x + 2, 0 \rangle \tag{6}$$

$$\mathbf{P} - \mathbf{B} = \langle x - 6, 0 - 0 \rangle = \langle x - 6, 0 \rangle \tag{7}$$

Now equate the magnitudes:

$$\sqrt{(x+2)^2 + 0^2} = \sqrt{(x-6)^2 + 0^2} \tag{8}$$

Simplifying, we get:

$$|x + 2| = |x - 6| \tag{9}$$

Solving Cases

Consider the two cases:

Case 1:

$$x + 2 = x - 6 \implies 2 = -6 \quad \text{(not possible)} \tag{10}$$

Case 2:

$$x + 2 = -(x - 6) \implies x + 2 = -x + 6 \implies 2x = 4 \implies x = 2 \tag{11}$$

Answer

Therefore, the coordinates of point P are

$$\boxed{(2,0)} \tag{12}$$

Python Code

```
import matplotlib.pyplot as plt

def setup_plot():
    # Points A, P, and B
    A = (-2, 0)
    P = (2, 0)
    B = (6, 0)

    fig, ax = plt.subplots(figsize=(8, 3))

    # Set axis limits and aspect ratio
    ax.set_xlim(-4, 8)
    ax.set_ylim(-1, 2)
    ax.set_aspect('equal')

    # Remove ticks and spines except left and bottom
    ax.set_xticks([])
    ax.set_yticks([])
    for spine in ['top', 'right']:
```

Python Code

```
def draw_elements(ax, A, P, B):
    # Plot points
    ax.plot(A[0], A[1], 'ro') # red
    ax.plot(P[0], P[1], 'go') # green
    ax.plot(B[0], B[1], 'bo') # blue

    # Labels below points
    ax.text(A[0], A[1] - 0.25, r'$A(-2,0)$', color='red', ha='
        center', fontsize=12)
    ax.text(P[0], P[1] - 0.25, r'$P(2,0)$', color='green', ha='
        center', fontsize=12)
    ax.text(B[0], B[1] - 0.25, r'$B(6,0)$', color='blue', ha='
        center', fontsize=12)

    # Dashed line between A and B
    ax.plot([A[0], B[0]], [A[1], B[1]], 'k--', linewidth=1)

    # Annotation above dashed line
    ax.text(2, 0.3, r'$P$ is equidistant from $A$ and $B$',
```

Python Code

```
def add_caption_and_show(fig):
    fig.text(0.5, 0.02, 'Fig. 0', ha='center', fontsize=14,
        weight='bold')
    plt.show()

if __name__ == "__main__":
    fig, ax, A, P, B = setup_plot()
    draw_elements(ax, A, P, B)
    add_caption_and_show(fig)
```

C Code

```c
// Part 1: Problem Setup and Case 1 Checking
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

int main() {
    // Coordinates of points A and B
    int Ax = -2, Ay = 0;
    int Bx = 6, By = 0;

    // Point P lies on the x-axis, so P = (x, 0)
    int x;

    // Case 1: x + 2 = x - 6 --> 2 = -6 (not possible)
    int lhs1 = 0 + 2; // placeholder for demonstration
    int rhs1 = 0 - 6;

    if (lhs1 == rhs1) {
        printf("Case 1 valid, unexpected result\n");
```

C Code

```
    // Case 2: x + 2 = -(x - 6) => x + 2 = -x + 6
    // => 2x = 4 => x = 2
    x = 2;

    // Output result
    printf("The point P that is equidistant from A and B on the x
        -axis is: (%d, 0)\n", x);

    // Optional: verify the distances
    double distance_PA = sqrt(pow(x - Ax, 2) + pow(0 - Ay, 2));
    double distance_PB = sqrt(pow(x - Bx, 2) + pow(0 - By, 2));

    printf("Distance PA = %.2f\n", distance_PA);
    printf("Distance PB = %.2f\n", distance_PB);

    return 0;
}
```

Python and C Code

```
# Compile the C program
subprocess.run(["gcc", "equidiistance.c", "-o", "equidistance"])

# Run the compiled C program
result = subprocess.run(["./equidistance"], capture_output=True,
    text=True)

# Print the output from the C program
print(result.stdout)
```

Graphical Representation:

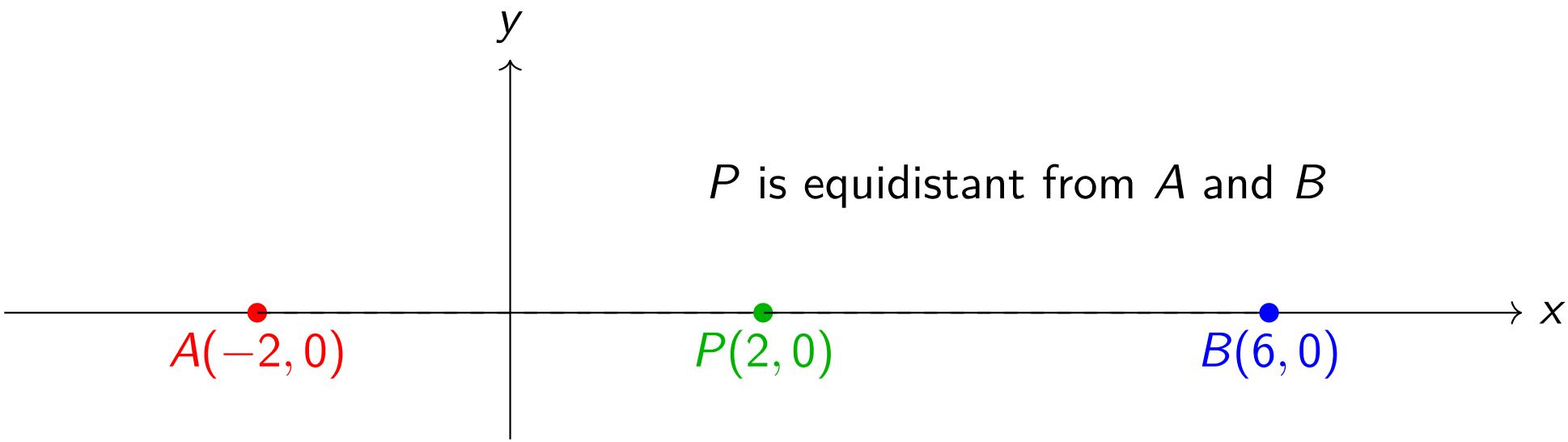

Fig. 0