

# 1.5.27

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# Question

## Problem

If the coordinates of points **A** and **B** are  $(-2, 2)$  and  $(2, -4)$  respectively, find the coordinates of **P** such that

$$AP = \frac{3}{7}AB.$$

and **P** lies on line segment AB.

# Solution Process

**Given:**

$$\mathbf{A} = \begin{bmatrix} -2 \\ 2 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 2 \\ -4 \end{bmatrix}, \quad AP = \frac{3}{7}AB$$

**Step 1: Section formula**

$$\mathbf{P} = \mathbf{A} + \frac{AP}{AB}(\mathbf{B} - \mathbf{A})$$

**Step 2: Substitution**

$$\mathbf{P} = \mathbf{A} + \frac{3}{7}(\mathbf{B} - \mathbf{A})$$

$$\mathbf{B} - \mathbf{A} = \begin{bmatrix} 2 \\ -4 \end{bmatrix} - \begin{bmatrix} -2 \\ 2 \end{bmatrix} = \begin{bmatrix} 4 \\ -6 \end{bmatrix}$$

$$\frac{3}{7}(\mathbf{B} - \mathbf{A}) = \begin{bmatrix} \frac{12}{7} \\ -\frac{18}{7} \end{bmatrix}$$

$$\mathbf{P} = \begin{bmatrix} -2 \\ 2 \end{bmatrix} + \begin{bmatrix} \frac{12}{7} \\ -\frac{18}{7} \end{bmatrix} = \begin{bmatrix} -\frac{2}{7} \\ -\frac{4}{7} \end{bmatrix}$$

$$\mathbf{P} = \begin{bmatrix} -\frac{2}{7} \\ -\frac{4}{7} \end{bmatrix} \Rightarrow \mathbf{P} \left( -\frac{2}{7}, -\frac{4}{7} \right)$$

```
// Function to find section point  $P = A + (m/(m+n))*(B-A)$ 
#include <stdio.h>

void find_section_point(double x1, double y1, double x2, double y2,
                        double m, double n, double* x, double* y)
{
    *x = (m * x2 + n * x1) / (m + n);
    *y = (m * y2 + n * y1) / (m + n);
}
```

# Python Code (1/2)

```
import ctypes

# Load shared library
lib = ctypes.CDLL('./libsection_formula.so')
lib.find_section_point.argtypes = [
    ctypes.c_double, ctypes.c_double, ctypes.c_double,
    ctypes.c_double, ctypes.c_double, ctypes.c_double,
    ctypes.POINTER(ctypes.c_double), ctypes.POINTER(ctypes.c_double)
]
lib.find_section_point.restype = None

def find_section_point(x1, y1, x2, y2, m, n):
    x = ctypes.c_double()
    y = ctypes.c_double()
    lib.find_section_point(x1, y1, x2, y2, m, n, ctypes.byref(x), ctypes.byref(y))
    return (x.value, y.value)
```

## Python Code (2/2)

```
# Given points
A = (-2, 2)
B = (2, -4)

# Find P such that AP:PB = 3:4
P = find_section_point(A[0], A[1], B[0], B[1], 3, 4)
P_formatted = (round(P[0],2), round(P[1],2))
print(f"P: {P_formatted}")
```

# Plot of Line Segment AB and Point P

Points A, B and P with P on segment AB ( $AP = \frac{3}{7} AB$ )

