

## 1.3.4

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# Question

If  $A(1, 3)$ ,  $B(-1, 2)$ ,  $C(2, 5)$  and  $D(x, 4)$  are the vertices of a parallelogram  $ABCD$ , then the value of  $x$  is \_\_\_\_\_ (10, 2012)

# Theoretical Solution

In a parallelogram, the opposite sides are equal. Therefore, the length of side AC equals to the length of side BD:

$$\mathbf{D - B = C - A} \quad (1)$$

$$\mathbf{D = B + C - A} \quad (2)$$

Substituting the coordinates:

# Theoretical Solution

$$\begin{pmatrix} x \\ 4 \end{pmatrix} = \begin{pmatrix} -1 \\ 2 \end{pmatrix} + \begin{pmatrix} 2 \\ 5 \end{pmatrix} - \begin{pmatrix} 1 \\ 3 \end{pmatrix} \quad (3)$$

$$= \begin{pmatrix} -1 + 2 - 1 \\ 2 + 5 - 3 \end{pmatrix} \quad (4)$$

$$= \begin{pmatrix} 0 \\ 4 \end{pmatrix} \quad (5)$$

This gives us the equations:

$$x = 0 \quad (6)$$

$$4 = 4 \quad (7)$$

**Answer:  $x=0$**

# Main C Code

```
// main.c
#include <stdio.h>

// function declaration
int find_x(int Ax, int Ay, int Bx, int By, int Cx, int Cy, int Dy
);

int main() {
    int Ax=1, Ay=3, Bx=-1, By=2, Cx=2, Cy=5, Dy=4;
    int x = find_x(Ax, Ay, Bx, By, Cx, Cy, Dy);

    printf("The value of x is: %d\n", x);
}
```

# Main C Code

```
// save coordinates to file for Python
FILE *fp = fopen("coords.dat", "w");
fprintf(fp, "%d %d\n", Ax, Ay);
fprintf(fp, "%d %d\n", Bx, By);
fprintf(fp, "%d %d\n", x, Dy);
fprintf(fp, "%d %d\n", Cx, Cy);
fclose(fp);

return 0;
}
```

# C Function

```
// parallelogram.c
#include <stdio.h>

int find_x(int Ax, int Ay, int Bx, int By, int Cx, int Cy, int Dy)
{
    int Dx=Bx+Cx-Ax;

    return Dx;
}
```

# Python Code

```
from ctypes import CDLL
import matplotlib.pyplot as plt

# load shared library
lib = CDLL("./libparallelogram.so")

# run C main program to generate coords.dat
import os
os.system("./main")

# read coords
coords = []
with open("coords.dat") as f:
    for line in f:
        x,y = map(int,line.split())
        coords.append((x,y))

# close polygon
coords.append(coords[0])
```



```
# plot
xs, ys = zip(*coords)
plt.plot(xs, ys, marker='o')
plt.text(1,3,"A(1,3)")
plt.text(-1,2,"B(-1,2)")
plt.text(0,4,"D(0,4)")
plt.text(2,5,"C(2,5)")
plt.title("Parallelogram ABCD")
plt.grid(True)
plt.savefig("/home/r-nikhil/ee1030-2025/ai25btech11025/matgeo
           /1.3.4/figs/plotc.png")
plt.show()
```

# Plot

