5.8.38

Naman Kumar-EE25BTECH11041

26 September,2025

Question)

Alwar tells his daughter,“Seven years ago, I was seven times as old as you were then. Also, three years from now, I shall be three times as old as you will be” Represent this situation algebraically and graphically.

Solution

from given statements, we can write

$$y - 7 = 7 \times (x - 7) \quad \& \quad y + 3 = 3 \times (x + 3) \tag{1}$$

$$7x - y = 42 \quad \& \quad 3x - y = -6 \tag{2}$$

This can be written as

$$\begin{pmatrix} 7 & -1 \\ 3 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 42 \\ -6 \end{pmatrix} \tag{3}$$

$$\mathbf{Ax} = \mathbf{c} \tag{4}$$

Solution

Row reduced form of $[\mathbf{A}|\mathbf{I}]$

$$\left(\begin{array}{cc|cc} 7 & -1 & 42 \\ 3 & -1 & -6 \end{array}\right) \xrightarrow{R_2 - \frac{3}{7}R_1} \left(\begin{array}{cc|cc} 7 & -1 & 42 \\ 0 & -\frac{4}{7} & -24 \end{array}\right) \tag{5}$$

$$\xrightarrow{\frac{-7}{4}R_2} \left(\begin{array}{cc|cc} 7 & -1 & 42 \\ 0 & 1 & 42 \end{array}\right) \tag{6}$$

Therefore

$$\begin{pmatrix} 7 & -1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 42 \\ 42 \end{pmatrix} \tag{7}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 12 \\ 42 \end{pmatrix} \tag{8}$$

Figure

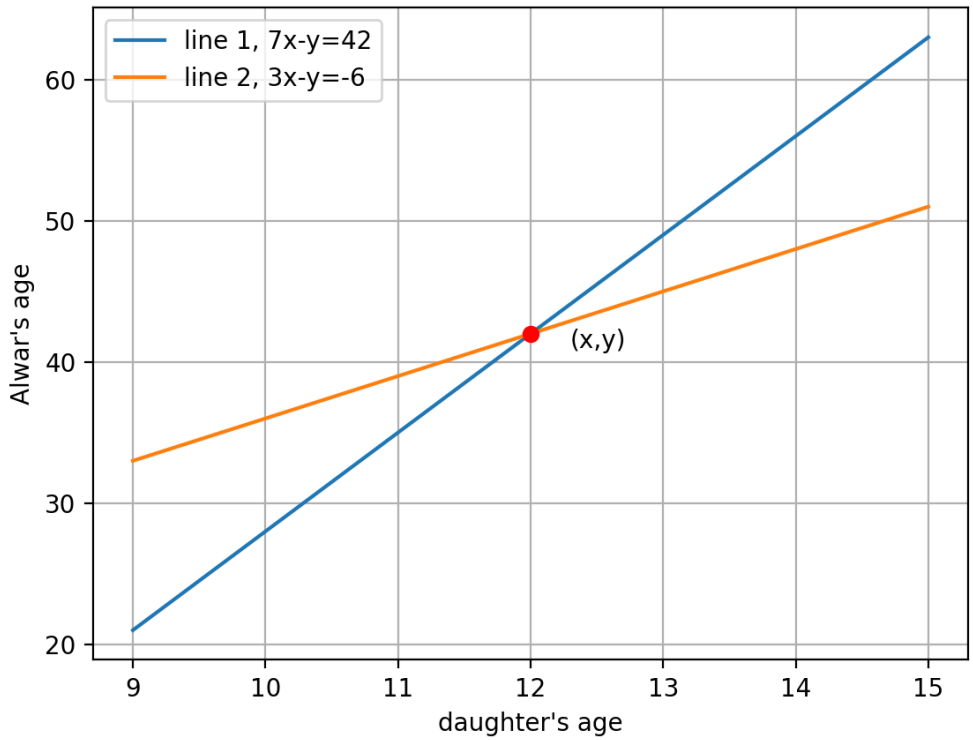

Figure:

Direct Python

```
import numpy as np
import matplotlib.pyplot as plt

c=np.array([42,-6])
a= np.array([[7,-1],[3,-1]])

inv=np.linalg.inv(a)

ans=np.dot(inv,c)

print("x=", ans[0],"y=",ans[1])

x=np.linspace(9,15,200)
l1=7*x-42
l2=3*x+6
```

Direct python code

```
plt.plot(x,l1, label="line 1, 7x-y=42")
plt.plot(x,l2,label="line 2, 3x-y=-6")
plt.scatter(12,42, c='r', zorder=5)
plt.text(12.3,41, "(x,y)")
plt.xlabel("daughter")
plt.ylabel("father")
plt.legend()
plt.grid()
plt.savefig("figure.png", dpi=200)
plt.show()
```

C code

```c
#include <stdio.h>

typedef struct {
    double A; // Alwar's age
    double D; // Daughter's age
} Solution;

Solution solve_ages() {
    Solution S;

    // Coefficients:
    // eqn1: 1*A -7*D = -42
    // eqn2: 1*A -3*D = 6
    double a1 = 1, b1 = -7, c1 = -42;
    double a2 = 1, b2 = -3, c2 = 6;
```

C code

```
    // Solve using Cramer's rule
    double det = a1*b2 - a2*b1;
    double detA = c1*b2 - c2*b1;
    double detD = a1*c2 - a2*c1;

    S.A = detA / det;
    S.D = detD / det;

    return S;
}
```

C code

```c
#ifdef TEST_C
int main(){
    Solution S = solve_ages();
    printf("Alwar's age: %.2f\n", S.A);
    printf("Daughter's age: %.2f\n", S.D);
    return 0;
}
#endif
```

Python code with shared object

```
# main.py
import ctypes
from ctypes import Structure, c_double
import numpy as np
import matplotlib.pyplot as plt

class Solution(Structure):
    _fields_ = [("A", c_double), ("D", c_double)]

# Load the shared object
lib = ctypes.CDLL("./libsolver.so")
lib.solve_ages.restype = Solution
```

Python code with shared object

```
# Call C function
sol = lib.solve_ages()
print(f"Alwar's present age: {sol.A}")
print(f"Daughter's present age: {sol.D}")

# Graphical representation
D_vals = np.linspace(0, 30, 400)

# From eqn (1): A = 7D - 42
A1 = 7*D_vals - 42
# From eqn (2): A = 3D + 6
A2 = 3*D_vals + 6
```

Python code with shared object

```
plt.figure(figsize=(6,6))
plt.plot(D_vals, A1, label="A - 7D = -42")
plt.plot(D_vals, A2, label="A - 3D = 6")

# Plot solution from C
plt.scatter(sol.D, sol.A, c="red", zorder=5)
plt.text(sol.D+0.5, sol.A, f"({int(sol.D)}, {int(sol.A)})",
    fontsize=10)

plt.xlabel("Daughter's Present Age (D)")
plt.ylabel("Alwar's Present Age (A)")
plt.title("Graphical Solution of Age Problem")
plt.grid(True)
plt.legend()
plt.show()
```