

## 5.8.10

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# Question

Narayan tells his daughter, 'Seven years ago, I was seven times as old as you were then. Also, 3 years from now, I shall be 3 times as old as you will be.' Find their ages.

## given data

Let present age of Narayan =  $N$  and

Present age of daughter =  $D$ .

7 years ago:

$$(N - 7) = 7(D - 7) \quad (1)$$

$$N - 7 = 7D - 49 \quad (2)$$

$$7D - N = 42 \quad (3)$$

and 3 years from now:

$$(N + 3) = 3(D + 3) \quad (4)$$

$$N + 3 = 3D + 9 \quad (5)$$

$$3D - N = -6 \quad (6)$$

## finding the present age of Narayan and his daughter:

expressing the given information in matrix form

$$\begin{pmatrix} 7 & -1 \\ 3 & -1 \end{pmatrix} \begin{pmatrix} D \\ N \end{pmatrix} = \begin{pmatrix} 42 \\ -6 \end{pmatrix} \quad (7)$$

Augmented matrix:

$$\left( \begin{array}{cc|c} 7 & -1 & 42 \\ 3 & -1 & -6 \end{array} \right) \quad (8)$$

By row reductions:

$$\left( \begin{array}{cc|c} 7 & -1 & 42 \\ 3 & -1 & -6 \end{array} \right) \xrightarrow{R_2 \rightarrow R_2 - \frac{3}{7}R_1} \left( \begin{array}{cc|c} 7 & -1 & 42 \\ 0 & -\frac{4}{7} & -24 \end{array} \right) \quad (9)$$

$$\text{rank}(A) = \text{rank}(A|b) = 2 \quad (10)$$

$$N = \frac{-24 \times 7}{-4} \quad (11)$$

$$= 42$$

$$D = 12. \quad (12)$$

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

# Create a range of x-values (Narayan's age) to plot over
# np.linspace creates an array of evenly spaced numbers over a
  specified interval
x = np.linspace(0, 60, 400)

# --- Define the Equations ---

# We rearrange the original equations to solve for y, the
  standard  $y = f(x)$  format for plotting.
```

```
# Equation 1 from "Seven years ago...":  $x - 7y = -42 \Rightarrow y = (x + 42) / 7$ 
y1 = (x + 42) / 7

# Equation 2 from "Three years from now...":  $x - 3y = 6 \Rightarrow y = (x - 6) / 3$ 
y2 = (x - 6) / 3

# --- Plotting the Graph ---

# Set up the plot size for better visibility
plt.figure(figsize=(10, 8))
```

```
# Plot the two lines representing the equations
plt.plot(x, y1, label='x - 7y = -42 (Seven years ago)')
plt.plot(x, y2, label='x - 3y = 6 (Three years from now)')

# --- Mark the Solution ---
# The solution to the problem is the single point where the two
    lines intersect.
# We can calculate this point algebraically and plot it.
intersection_x = 42
intersection_y = 12
plt.plot(intersection_x, intersection_y, 'ro', label=f'
    Intersection ({intersection_x}, {intersection_y})') # 'ro'
    means red circle
```



```
# --- Formatting the Graph for Clarity ---
# Add a title and labels for the x and y axes
plt.title("Graphical Solution to the Age Problem", fontsize=16)
plt.xlabel("Narayan's Current Age (x)", fontsize=12)
plt.ylabel("Daughter's Current Age (y)", fontsize=12)

# Display the legend to identify each line
plt.legend()

# Add a grid to make the coordinates easier to read
plt.grid(True, which='both', linestyle='--', linewidth=0.5)
```

```
# Set the visible range for the axes to focus on the solution
area
plt.xlim(0, 50)
plt.ylim(0, 20)
# Add an annotation with an arrow to clearly point out the
solution
plt.annotate(
    f'Solution: ({intersection_x}, {intersection_y})', # The text
    to display
    xy=(intersection_x, intersection_y), # The point to annotate
    xytext=(intersection_x - 15, intersection_y + 3), # Where to
    place the text
    arrowprops=dict(facecolor='black', shrink=0.05), # Arrow
    style
    fontsize=12
)
```

```
# Save the finished plot to a PNG image file
plt.savefig('age_problem_solution_graph.png')

print("Graph has been successfully generated and saved as
      age_problem_solution_graph.png")
```

```
#include <stdio.h>
#include <math.h>

/*f(lambda) = (lambda + 6)^2 - (lambda + 2)^2 - 40
   We need f(lambda) = 0 */
double f(double lambda) {
    return (lambda + 6.0)*(lambda + 6.0)
        - (lambda + 2.0)*(lambda + 2.0)
        - 40.0;}
int main(void) {
    double left = -10.0; // lower bound for search
    double right = 10.0; // upper bound for search
    double mid;
    double tol = 1e-8; // desired accuracy
```

```
#include <stdio.h>

int main() {
    int narayan_age, daughter_age;
    int solution_found = 0;

    // Let's iterate through possible ages.
    // We assume Narayan is older than his daughter.
    for (narayan_age = 1; narayan_age <= 150; narayan_age++) {
        for (daughter_age = 1; daughter_age < narayan_age;
            daughter_age++) {
```

```
// Condition 1: Seven years ago, Narayan was 7 times his
// daughter's age.
// (narayan_age - 7) == 7 * (daughter_age - 7)
int is_condition1_met = (narayan_age - 7) == 7 * (daughter_age -
7);
// Condition 2: Three years from now, Narayan will be 3 times his
// daughter's age.
// (narayan_age + 3) == 3 * (daughter_age + 3)
int is_condition2_met = (narayan_age + 3) == 3 * (daughter_age +
3);
```

```
// If both conditions are true, we've found the answer.
if (is_condition1_met && is_condition2_met) {
printf("Solution Found:\n");
printf("Narayan's current age is: %d\n", narayan_age);
printf("Daughter's current age is: %d\n", daughter_age);
solution_found = 1;
break; // Exit the inner loop
    }
}
```

```
if (solution_found) {  
    break; // Exit the outer loop  
}  
}  
if (!solution_found) {  
    printf("No solution found within the specified age range  
        .\n");  
}  
return 0;  
}
```



```
import ctypes

def main():
    narayan_age = ctypes.c_int()
    daughter_age = ctypes.c_int()
    solution_found = ctypes.c_int(0)
    for narayan in range(1, 151):
        for daughter in range(1, narayan):
            narayan_age.value = narayan
            daughter_age.value = daughter
```

```
# Condition 1
is_condition1_met = (narayan_age.value - 7) == 7 * (daughter_age.
    value - 7)
# Condition 2
is_condition2_met = (narayan_age.value + 3) == 3 * (daughter_age.
    value + 3)

if is_condition1_met and is_condition2_met:
    print("Solution Found:")
    print(f"Narayan's current age is: {narayan_age.value}")
    print(f"Daughter's current age is: {daughter_age.value}")
    solution_found.value = 1
    break
```

```
if solution_found.value:
    break

if not solution_found.value:
    print("No solution found within the specified age range.")
)

if __name__ == "__main__":
    main()
```

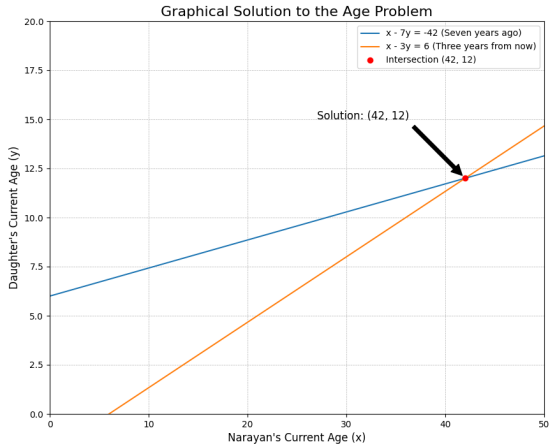


Figure: Plot