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# Substitution Method

chapter: 3, exercise: 3.3

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Example 7 : Solve the following pair of equations :  
 $7x - 15y = 2$  and  $x + 2y = 3$

Given  $7x - 15y = 2$  — (i)  $y = \frac{19}{29}$   
 $x + 2y = 3$  — (ii)

$x = 3 - 2y$  — (iii)

Put the value of (iii) in (i)

$$7(3 - 2y) - 15y = 2$$

$$21 - 14y - 15y = 2$$

$$-29y = 2 - 21 \Rightarrow y = \frac{-19}{-29}$$

$$\begin{array}{r} 29 \\ \times 3 \\ \hline 78 \\ - 38 \\ \hline 49 \end{array}$$

$$x = \frac{49}{29}, y = \frac{19}{29}$$

Use the value of (y) in (iii)

$$x = 3 - 2\left(\frac{19}{29}\right)$$

$$= 3 - \frac{38}{29}$$

$$= \frac{3 \times 29 - 38}{29}$$

$$x = \frac{87 - 38}{29} = \frac{49}{29}$$



Solve the following pair of equations:

$$s - t = 3, \quad \frac{s}{3} + \frac{t}{2} = 6$$

$$\underline{s - t = 3} \quad \text{--- ①} \Rightarrow \underline{s = 3 + t} \quad \text{--- ③}$$

$$\underline{\frac{s}{3} + \frac{t}{2} = 6} \quad \checkmark$$

$$\underline{2s + 3t = 6}$$

$$\overset{6}{2s + 3t = 36} \quad \text{--- ②}$$

Use equation ① in ②

$$2(3 + t) + 3t = 36$$

$$6 + 2t + 3t = 36$$

$$5t = 36 - 6$$

$$5t = 30$$

$$t = \frac{30}{5}$$

$$\boxed{t = 6} \quad \checkmark$$

Using  $t$  in equation ③

$$s = 3 + t$$

$$s = 3 + 6$$

$$\boxed{s = 9} \quad \checkmark$$

$$\frac{9 - 6 = 3}{\underline{\hspace{1cm}}}$$

$$\frac{9^3}{8} + \frac{6^3}{2}$$

$$\underline{3 + 3 = 6}$$



Solve the following pair of equations:

$$0.2x + 0.3y = 1.3, \quad 0.4x + 0.5y = 2.3$$

→

$$0.2x + 0.3y = 1.3$$

$$\frac{2x}{10} + \frac{3y}{10} = \frac{13}{10}$$

$$2x + 3y = 13 \quad \text{--- (I) ✓}$$

$$4x + 5y = 23 \quad \text{--- (II)}$$

$$2x = 13 - 3y$$

$$x = \frac{13 - 3y}{2} \quad \text{--- (III) ✓}$$

Using eqn (I) in (II)

$$4\left(\frac{13 - 3y}{2}\right) + 5y = 23$$

$$26 - 6y + 5y = 23$$

$$-y = 23 - 26$$

$$+y = +3$$

$$\boxed{y = 3} \quad \checkmark$$

$$0.2(2) + 0.3(3) = 1.3 \quad \checkmark$$

$$x = \frac{13 - 3(3)}{2}$$

$$= \frac{13 - 9}{2}$$

$$= \frac{4}{2}$$

$$\boxed{x = 2} \quad \checkmark$$

$$0.4 + 0.9 = 1.3 \quad \checkmark$$



Solve the following pair of equations

$$\sqrt{2}x + \sqrt{3}y = 0, \quad \sqrt{3}x - \sqrt{8}y = 0$$

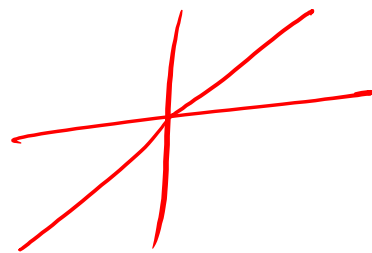
$$\sqrt{2}x + \sqrt{3}y = 0 \quad \text{--- (i)}$$

$$\sqrt{3}x + \sqrt{8}y = 0 \quad \text{--- (ii)}$$

$$\sqrt{2}x + \sqrt{3}y = 0$$

$$x = \frac{\sqrt{3}}{\sqrt{2}}y \quad \text{--- (iii)}$$

Using the value of (x) in (ii)



$$x=0, y=0$$

$$\sqrt{2} \left( \frac{\sqrt{3}}{\sqrt{2}} \right) y + \sqrt{3}y = 0$$

$$\sqrt{3}y + \sqrt{3}y = 0$$

$$2\sqrt{3}y = 0 \quad \rightarrow \boxed{y=0}$$

Using y in (iii)

$$x = \frac{\sqrt{3}}{\sqrt{2}} (0) \Rightarrow \boxed{x=0}$$

Example 9 : The cost of 2 pencils and 3 erasers is ₹ 9 and the cost of 4 pencils and 6 erasers is ₹ 18. Find the cost of each pencil and each eraser.

Let Cost of each pencil =  $x$  ₹  
" of each eraser =  $y$  ₹

A.T.O

$$2x + 3y = 9 \quad \text{--- (i)}$$

$$4x + 6y = 18 \quad \text{--- (ii)}$$

equation (i) becomes

$$2x = 9 - 3y$$

$$x = \frac{(9 - 3y)}{2} \quad \text{--- (iii)}$$

Put the value of (iii) in (ii)

$$2 \left( \frac{9 - 3y}{2} \right) + 6y = 18$$

$$2(9 - 3y) + 6y = 18$$

$$18 - 6y + 6y = 18$$

$$18 = 18$$

$$\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$$

$$\frac{b_1}{b_2} = \frac{3}{6} = \frac{1}{2}$$

$$\frac{c_1}{c_2} = \frac{9}{18} = \frac{1}{2}$$



Solve  $2x + 3y = 11$  and  $2x - 4y = -24$  and hence find the value of 'm' for which  $y = mx + 3$ . — (iv)

$$\begin{aligned} 2x + 3y &= 11 \quad \text{--- (i)} \\ 2x - 4y &= -24 \quad \text{--- (ii)} \\ 2x &= -24 + 4y \\ x &= \frac{-24 + 4y}{2} \quad \text{--- (iii)} \end{aligned}$$

Put the value of (iii) in (i)

$$\begin{aligned} 2\left(\frac{-24 + 4y}{2}\right) + 3y &= 11 \\ -24 + 4y + 3y &= 11 \end{aligned}$$

$$\begin{aligned} -24 + 7y &= 11 \\ 7y &= 11 + 24 \\ 7y &= 35 \\ y &= \frac{35}{7} \\ y &= 5 \end{aligned}$$

Put the value  $y = 5$  in (ii)

$$\begin{aligned} x &= \frac{-24 + 4(5)}{2} \\ &= \frac{-24 + 20}{2} \end{aligned}$$

$$x = \frac{-4}{2} \Rightarrow x = -2$$

Put  $x = -2, y = 5$  in (iv)

$$5 = m(-2) + 3$$

$$5 - 3 = m(-2)$$

$$2 = m(-2)$$

$$m = \left(\frac{2}{-2}\right)$$

$$m = -1$$



The difference between two numbers is 26 and one number is three times the other. Find them.

Let the two numbers are  $x$  and  $y$

A.T. Q

$$x - y = 26 \quad \text{--- (i)}$$

$$x = 3y \quad \text{--- (ii)}$$

Put the value of  $x$  in (i)

$$3y - y = 26$$

$$2y = 26$$

$$y = \frac{26}{2} = 13$$

$$y = 13$$

Using  $y$  in (ii)

$$x = 13(3)$$

$$x = 39$$

$$\begin{array}{r} 39 \\ 13 \\ \hline 26 \end{array}$$



The larger of two supplementary angles exceeds the smaller by 18 degrees. Find them.

$$\begin{array}{r} 7 \\ 180 \\ \underline{18} \\ 162 \end{array}$$

Let the two angles  $x$  and  $y$   
 A.T.  $\theta$  let  $(x > y)$

$$x + y = 180 \quad \text{--- (i)}$$

$$x - y = 18 \quad \text{--- (ii)}$$

$$x = 18 + y \quad \text{--- (iii)}$$

Using equation (iii) in (i)

$$18 + y + y = 180$$

$$2y = 180 - 18$$

$$2y = 162 \quad \rightarrow$$

$$y = \frac{162}{2} = 81$$

$$\begin{array}{r} 18 \\ \underline{99} \end{array}$$

Using  $y$  in (iii)

$$x = 18 + 81$$

$$x = 99$$

$$\begin{array}{r} 1 \\ 99 \\ 81 \\ \hline 180 \end{array}$$



The coach of a cricket team buys 7 bats and 6 balls for ₹3800.

Later, she buys 3 bats and 5 balls for ₹1750. Find the cost of each bat and each ball.

Let the cost of bat =  $x$   
Cost of ball =  $y$

A.T.O

$$7x + 6y = 3800 \quad \text{--- (i)}$$

$$3x + 5y = 1750 \quad \text{--- (ii)}$$

using (ii)

$$3x = 1750 - 5y$$

$$x = \frac{1750 - 5y}{3} \quad \text{--- (iii)}$$

using (iii) in (i)

$$7\left(\frac{1750 - 5y}{3}\right) + 6y = 3800$$

$$7(1750 - 5y) + 18y = 3800 \times 3$$

$$\frac{12250 - 35y + 18y}{3} = 3800 \times 3$$

$$-17y = 11400 - 12250$$

$$17y = 850$$

$$y = \frac{850}{17} \Rightarrow y = 50$$

Put  $y = 50$  in (iii)

$$x = \frac{1750 - 5(50)}{3}$$

$$= \frac{1750 - 250}{3}$$

$$= \frac{1500}{3}$$

$$x = 500$$

$$\frac{3500 + 350}{3800}$$



The taxi charges in a city consist of a fixed charge together with the charge for the distance covered. For a distance of 10 km, the charge paid is ₹ 105 and for a journey of 15 km, the charge paid is ₹ 155. What are the fixed charges and the charge per km? How much does a person have to pay for travelling a distance of 25 km?

Let the fixed price is  $x$

and charge per km =  $y$ .

$$x + 10y = 105 \quad \text{--- (i)}$$

$$x + 15y = 155 \quad \text{--- (ii)}$$

from eqn (i)

$$x = 105 - 10y \quad \text{--- (iii)}$$

Put the value of (iii) in eqn (ii)

$$105 - 10y + 15y = 155$$

$$5y = 155 - 105$$

$$5y = 50$$

$$y = \frac{50}{5}$$

$$\boxed{y = 10}$$

$$\text{Put } y = 10 \text{ in (iii)}$$

$$x = 105 - 10(10)$$

$$x = 105 - 100$$

$$\boxed{x = 5}$$

$$\underline{x + 25y}$$

$$5 + 25(10)$$

$$5 + 250$$

$$\boxed{₹ 255}$$



A fraction becomes  $\frac{9}{11}$ , if 2 is added to both the numerator and the denominator. If, 3 is added to both the numerator and the denominator it becomes  $\frac{5}{6}$ . Find the fraction.

$$\frac{7+3}{9+3} = \frac{10}{12}$$

$$\frac{5}{6}$$

Let Numerator =  $x$ , denominator =  $y$

A. i. ①

$$\frac{x+2}{y+2} = \frac{9}{11} \Rightarrow 11(x+2) = 9(y+2)$$

$$11x + 22 = 9y + 18$$

$$11x - 9y = 18 - 22$$

$$11x - 9y = -4 \quad \text{--- ①}$$

equation ② became

$$6x = -3 + 5y$$

$$x = \frac{5y-3}{6} \quad \text{--- ③}$$

$$\frac{x+3}{y+3} = \frac{5}{6}$$

$$6(x+3) = 5(y+3)$$

$$6x + 18 = 5y + 15$$

$$6x - 5y = 15 - 18 = -3$$

$$6x - 5y = -3 \quad \text{--- ②}$$

Put the value ③ in ①

$$11\left(\frac{5y-3}{6}\right) - 9y = -4$$

$$11(5y-3) - 54y = -24$$

$$55y - 33 - 54y = -24$$

$$y = -24 + 33$$

$$y = 9$$

Put  $y = 9$  in ③

$$x = \frac{5(9) - 3}{6}$$

$$x = \frac{45 - 3}{6}$$

$$x = \frac{42}{6} = 7$$

$$x = 7$$

$$\frac{7}{9} = \frac{9}{11}$$



Five years hence, the age of Jacob will be three times that of his son. Five years ago, Jacob's age was seven times that of his son. What are their present ages?

Let ~~present age~~

$$\text{Jacob's age} = x$$

$$\text{Son's age} = y$$

Five years hence

$$\text{Jacob's age} = x + 5$$

$$\text{Son's age} = y + 5$$

$$(x + 5) = 3(y + 5)$$

$$x + 5 = 3y + 15$$

$$x - 3y = 15 - 5$$

$$x - 3y = 10 \quad \text{--- (i)}$$

~~Five years ago~~

$$\text{Jacob's age} = x - 5$$

$$\text{Son's age} = y - 5$$

(A.T.O)

$$(x - 5) = 7(y - 5)$$

$$x - 5 = 7y - 35$$

$$x - 7y = -35 + 5$$

$$x - 7y = -30 \quad \text{--- (ii)}$$

Jam (i)

$$x = 10 + 3y \quad \text{--- (iii)}$$

we in (ii)

$$10 + 3y - 7y = -30$$

$$3y - 7y = -30 - 10$$

$$-4y = -40$$

$$y = \frac{-40}{-4}$$

$$\boxed{y = 10}$$

Put in equation (iii)

$$x = 10 + (3)(10)$$

$$= 10 + 30 \Rightarrow \boxed{x = 40}$$



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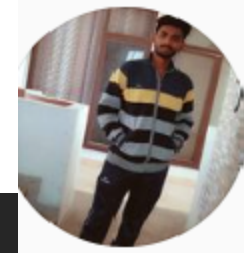


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