~~Simulta~~ Equation, Inequality and Graph

~~Equ~~

Simultaneous equations

Methods of solving simultaneous equations.

i) Graphical Method
ii) Elimination Method
iii) Substitution Method.

Ex-12.6

1. Solve the following simultaneous equations by elimination method.

a) $x+y=3$ and $x-y=1$

-> Soln,

Here,

$x+y=3$ ——— eqn(i)

$x-y=1$ ——— eqn(ii)

Adding ~~equations (I) and (II)~~ eqn(I) and eqn(II) to eliminate y,

$$x + y = 3$$
$$+ \quad x - y = 1$$
$$2x = 4$$

or, $x = \frac{4}{2} = 2$

Sustituting the value of x in eqn(I), we get,

$$2 + y = 3$$

or, $y = 3 - 2 = 1$

$\therefore x = 2$ and $y = 1$

b) $x + y = 5$ and $x - y = 1$

→ Soln,

$x + y = 5$ ———— (I)

$x - y = 1$ ———— (II)

Adding equations (I) and (II) to eliminate y,

→

$$x+y = 5$$
$$+\ \underline{x-y = 1}$$
$$2x = 6$$

or, $x = \dfrac{6}{2} = 3$

Substituting the value of x in (1),

$$3+y = 5$$

or, $y = 5-3 = 2$

$\therefore x = 3$ and $y = 2$.

c) $x+y=5$ and $x-y=7$

→ Soln,

$$x+y = \cancel{7}5 \text{ ——— (1)}$$
$$x-y = 7 \text{ ——— (11)}$$

Adding (1) and (11) to eliminate y.

$$x+\cancel{y} = 5$$
$$+\ \underline{x-\cancel{y} = 7}$$
$$2x = 12$$

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or, $x = \frac{12}{2} = 6$

Substituting the value of x in ①.

$\cancel{x}\ 6 + y = 5$

or, $y = 5 - 6 = -1$

$\therefore x = 6$ and $y = -1$.

d) $x + y = 6$ and $x - y = 4$

→ Soln,

$x + y = 6$ —— eqn(1)

$x - y = 4$ —— eqn(11)

Adding eqn(1) and eqn(11) to eliminate y.

$$\begin{array}{r} x + y = 6 \\ \underline{x - y = 4} \\ 2x = 10 \end{array}$$

or, $x = \frac{10}{2} = 5$

→

Substituting the value of x in eqn(1).

$$5+y=6$$
or, $y=6-5=1$

$\therefore x=5$ and $y=1$

) $x+y=8$ and $x-y=10$

Soln:

$x+y=8$ ——— eqn(1)
$x-y=10$ ——— eqn(11)

Adding eqn(1) and eqn(11) to eliminate y.

$$\begin{array}{r} x+\cancel{y}=8 \\ x-\cancel{y}=10 \\ \hline 2x=18 \end{array}$$

or, $x=\frac{18}{2}=9$

$\rightarrow$

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Substituting the value of x in eqn(I)

$$9+y=8$$

or, $y=8-9=-1$

$\therefore x=9$ and $y=-1$

f) $x+y=9$ and $x-y=3$

→ Soln,

$x+y=9$ —— eqn(I)
$x-y=3$ —— eqn(II)

Adding eqn(I) and eqn(II) to eliminate y.

$$\begin{array}{r} x+\cancel{y}=9 \\ x-\cancel{y}=3 \\ \hline 2x=12 \end{array}$$

or, $x=\frac{12}{2}=6$

→

Substituting the value of x in eqn(i).

$~~x+y=9~~$

~~or,~~ $6+y=9$

or, $y=9-6=3$

$\therefore x=6$ and $y=3$.

g) $x+y=7$ and $2x+y=10$

→ Soln

$x+y=7$ ——— eqn(i)

$2x+y=10$ ——— eqn~~(2)~~(ii)

~~Multiplying eqn~~ Subtracting eqn(i) from eqn(ii).

$$2x+y=10$$
$$\cancel{(+)}x\,\cancel{(+)}y=7$$
$$(-)\quad(-)$$

or, $x=3$

Substituting the value of x in eqn(i),

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$\cancel{x}$ $3+y=7$
or, $y=7-3=4$

$\therefore x=3$ and $y=4$.

n) $x-y=-3$ and $y-2x=1$

→ Soln,
Here,
$x-y=-3$ ——— eqn(I)
$y-2x=1$ ——— eqn(II)
or, $-2x+y=1$ ——— eqn(III)
~~Subtracting~~ eqn (III) ~~from~~ eqn(I).
Adding with

$\cancel{x-y=-3}$
$\cancel{-2x+y=1}$

$x-\cancel{y}=-3$
$-2x+\cancel{y}=1$
or, $-x=-3+1=-2$
or, $x=2$

Substituting the value of x in eqn(I)
$2-y=-3$
or, $-y=-3-2$ or, $-y=-5$ or, $\therefore y=5$
$\therefore x=2$ & $y=5$.

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i) $2x-3y=1$ & $x+2y=18$

→ Soln,

Here,

$$2x-3y=1 \text{ ——— eqn(I)}$$
$$x+2y=18 \text{ ——— eqn(II)}$$

The LCM of 2 & 1 is 2.

Multiplying eqn (II) by 2 on both sides.

So,

$$2(x+2y)=18\times 2$$
or, $2x+4y=36$ ——— eqn (III)

Now,

Subtracting eqn (III) from eqn (I).

$$\cancel{2x}-3y=1$$
$$\cancel{(+)2x}\ (+)4y=36$$
$$(-)\quad(-)$$

~~$-7y=$~~

$$-3y-4y=1-36$$
or, $-7y=-35$

or, $7y=35$ or, $y=\frac{35}{7}=5$

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Now,

Substituting the value of y in eqn(ii),

$x + 2 \times 5 = 18$

or, $x + 10 = 18$

or, $x = 18 - 10$

or, $x = 8$

$\therefore x = 8$ and $y = 5$.

j. $3x + 4y = 16$ and $x + 3y = 7$.

→ Soln,

Here,

$3x + 4y = 16$ —— eqn(i)

$x + 3y = 7$ —— eqn(ii)

LCM of 3 and 1 is 3.

Multiplying eqn(ii) by 3 on both sides.

$3(x + 3y) = 7 \times 3$

or, $3x + 9y = 21$ —— eqn(iii)

Now,

Subtracting eqn(III) from eqn(I)

$$\begin{array}{r} \cancel{3x}+4y=16 \\ (\cancel{+})\ \cancel{3x}+9y=21 \\ (-)\quad(-)\quad\quad\ \\ \hline \end{array}$$

$\cancel{-5y =}$

$4y-9y=16-21$

or, $-5y=-5$

or, $5y=5$

or, $y=\frac{5}{5}=1$

Substituting the value of y in eqn(II).

$x+3\times1=7$

or, $x+3=7$

or, $x=7-3=4$

$\therefore$ $\cancel{y}$ $x=4$ & $y=1$.

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2. Solve the following ~~sima~~ simultaneous equations by substitution method.

a) $y = x - 2$ and $x + y = 4$

→ Sol^n,

$y = x - 2$ —— eqn (I)

$x + y = 4$ —— eqn (II)

From eqn (I),

$\cancel{y = x - 2}$

$x = y + 2$ —— (III)

Substituting for x in eqn (II) we get,

$(y+2) + y = 4$

or, $y + 2 + y = 4$

or, $2y + 2 = 4$

or, $2y = 4 - 2$

or, $2y = 2$

or, $y = \frac{2}{2}$

$\therefore y = 1$

Now,
Substituting the value of ~~x~~ y in eqn(iii), we get,

~~x~~
$x = 1 + 2 = 3$

$\therefore x = 3$ and $y = 1$

b) $y = x - 2$ & $x + y = 6$.

→ Sol^n,

$y = x - 2$ —— eqn(i)

$x + y = 6$ —— eqn(ii)

From eqn(i),

$x = y + 2$ —— eqn(iii)

Substituting the value of $\cancel{y}$ x in eqn(ii) we get,

$(y+2) + y = 6$

or, $y + 2 + y = 6$

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or, $2y+2=6$
or, $2y=6-2$
or, $2y=4$
or, $y=\frac{4}{2}$

$\therefore y=2.$

Now,
Substituting the value of y in eqn (III)
we get,

$x=2+2=4$

$\therefore x=4$ & $y=2.$

c) $y=x+2$ and $x+y=8$
→ Soln.

$y=x+2$ —— eqn (I)
$x+y=8$ —— eqn (II)

From eqn (I),

$x=y-2$ —— eqn (III)

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~~Substitutin~~

Substituting the value of x in eqn(ii).
We get,

$$(y-2)+y=8$$
or, $y-2+y=8$
or, $2y-2=8$
or, $2y=8+2$
or, $2y=10$
or, $y=\frac{\cancel{10}\,5}{\cancel{2}}$

$\therefore y=5.$

Now, substituting the value of y in eqn(iii) we get,

$$x=5-2=3$$

$\therefore x=3$ and $y=5.$

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d) $y = x + 6$ and $x + y = 14$

→ Soln, Here,

$y = x + 6$ — eqn(1)

$x + y = 14$ — eqn(11)

From eqn(1),

$x = y - 6$ — eqn(111)

Substituting the value of x in eqn (11) we get,

$(y-6) + y = 14$ or, $y - 6 + y = 14$ or, $2y = 14 + 6$

or, $2y = 20$

or, $y = \frac{20}{2} = 10$

Substituting the value of y in eqn(111) we get.

$x = 10 - 6 = 4$

$\therefore x = 4$ & $y = 10$

e) $x - y = 5$ and $y = 11 - x$

→ Soln

$x - y = 5$ — eqn(1)

$y = 11 - x$ — eqn(11)

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From eqn(I)

$x = 5 + y$ —— eqn(III)

Substituting the value of x in eqn(II),

$y = 11 - (5 + y)$

or, $y = 11 - 5 - y$

or, $y + y = 11 - 5$

or, $2y = 6$

or, $y = \frac{\cancel{6}3}{\cancel{2}1} = 3$

or, $y = 3$

Substituting the value of y in eqn(III),

$x = 5 + 3 = 8$

$\therefore x = 8$ & $y = 3$

f) $2x - y = 3$ & $y = 9 - x$

Soln,

$2x - y = 3$ —— eqn(I)

$y = 9 - x$ —— eqn(II)

From eqn(I),

$y = 2x - 3$

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Substituting the value of y in eqn(II)

$$2x-3=9-x$$
or, $2x+x=9+3$
or, $3x=12$
or, $x=\frac{12}{3}=4$

Substituting the value of x in eqn(II),

$$y=2\times4-3=8-3=5$$

$\therefore x=4$ & $y=5$

g) $x+2y=19$ & $x+y=13$
→ Soln,
$x+2y=19$ —— eqn(I)
$x+y=13$ —— eqn(II)
From eqn(I),
$x=19-2y$ —— eqn(III)
Substituting the value of x in eqn(II),
$(19-2y)+y=13$
or, $19-2y+y=13$
or, $-y=13-19$ or, $\cancel{-}y=\cancel{-}6$ or, $y=6$

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Substituting the value of y in eqn (III),

$x = 19 - 2 \times 6 = 19 - 12 = 7$

$\therefore x = 7$ & $y = 6$

h) $2x - y = 2$ & $x - y = -3$

→ Soln

$2x - y = 2$ —— eqn (I)

$x - y = -3$ —— eqn (II)

From eqn (I),

$y = 2x - 2$ —— eqn (III)

Substituting the value of y in eqn (II),

$x - (2x - 2) = -3$

or, $x - 2x + 2 = -3$

or, $-x = -3 - 2$

or, $\cancel{-}x = \cancel{-}5$

or, $x = 5$

Substituting the value of x in eqn (III)

$y = 2 \times 5 - 2 = 10 - 2 = 8$

$\therefore x = 5$ & $y = 8$

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i) $3x+2y=5$ & $x-y=-10$

→ Soln

$3x+2y=5$ — eqn(I)

$x-y=-10$ — eqn(II)

From eqn(II),

$x=-10+y$ — eqn(III)

Substituting the value of x in eqn(I)

$3(-10+y)+2y=5$

or, $-30+3y+2y=5$

or, $5y=5+30$

or, $5y=35$

or, $y=\frac{35}{5}=7$

Substituting the value of y in eqn (III),

$x=-10+7=-3$

∴ $x=-3$ & $y=7$.

j) $2x+5y=8$ and $x+y=6$

→ Soln

$2x+5y=8$

$x+y=6$

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From eqn(II),

$x = 6 - y$ — eqn(III)

Substituting the value of x in eqn(I),

$2(6-y) + 5y = 8$

or, $12 - 2y + 5y = 8$

or, $3y = 8 - 12$

or, $3y = -4$

or, $y = \frac{-4}{3}$

Substituting the value of y in eqn(III),

$x = \frac{6}{1} - \frac{4}{3} = \frac{18-4}{3} = \frac{14}{3}$

$\therefore x = \frac{14}{3}$ & $y = \frac{4}{3}$ #

3. (a) The sum of two no. is 14 and their difference is 2. Find the numbers.

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→ Soln, Let the greater no. be x and the smaller no. be y.

From condition 1,

$$x+y=14$$

or, $y=14-x$ —— eqn(i)

From condition 2,

$$x-y=2 \text{ —— eqn(ii)}$$

Substituting the value of y from eqn(i) in eqn(ii),

$$x-[14-x]=2$$

or, $x-14+x=2$

or, $2x=2+14$

or, $2x=16$

or, $x=\frac{\cancel{16}^{8}}{\cancel{2}_{1}}=8$

Substituting the value of x in eqn(i),

$$y=14-8=6$$

∴ So Reqd. no. $=8$ & 6.

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b) The Sum of two numbers is 40. If the greater number is 8 more than the smaller one, find the numbers.

→ Soln,

Here,

let the greater no. be x and the smaller no. be y.

First condition,

$x+y=40$ — eqn(I)

2nd condition,

$x=(y+8)$ — eqn(II)

from eqn(II)

Substituting the value of x in eqn(I).

$y+(y+8)=40$ or; $x+x=40-8$

or, $2y=40-8$

or, $2y=32$

or, $y=\frac{32}{2}$ 16 ∴ $y=16$

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Substituting the value of y in eqn(ii),

$\therefore x = 16 + 8 = 24$ #

$$\begin{array}{r} 16 \\ +8 \\ \hline 24 \end{array}$$

$\therefore x = 24$ & $y = 16$

d) The sum of two no. is ~~16~~ 46 If the smaller no. is 10 less than the greater one, find the numbers.

→ Sol^n,

Let the two no. be x & y respectively.

First condition,

$x + y = 46$ —— eqn(i)

2nd Condition,

$y = x - 10$ — eqn(ii)

Substituting the value of y in eqn(ii),

$x + (x - 10) = 46$

or, $x + x - 10 = 46$

or, $2x - 10 = 46$

or, $2x = 46 + 10$

or, $2x = 56$ or, $x = \frac{\cancel{56}^{28}}{\cancel{2}} = 28$ #

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Substituting the value of ~~x~~ x in eqn(ii)

$y = 28 - 10 = 18$

$\therefore x = 28$ & $y = 18$

d) The difference of two numbers is 6. If three times the smaller number is equal to two times the greater one, find the numbers.

→ Soln,

Let the numbers be x & y.

1st condition,

$x - y = 6$ — eqn(i) or, $x = 6 + y$ — eqn(iii)

2nd condition

$3y = 2x$ — eqn(ii)

Substituting the value of x in eqn(ii),

$3y = 2(6 + y)$

or, $3y = 12 + 2y$

or, $3y - 2y = 12$

or, $y = 12$

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Substituting the value of y in eqn(ii),

$x = 6+12 = 18$

$3\times18=$
2×18

$\therefore x=18$ & $y=12$.

4(a) The total cost of a packet of biscuit and a toffee is Rs. 22. If the cost of biscuit is Rs. 14 more than the cost of toffee, find their cost.

→ Sol^n,

Let the cost of 1 packet of biscuit be Rs. x and that of the toffee be Rs y.

From 1st condition,

$x + y = 22$ —— eqn(i)

~~or $x = 22 - y$ —— eqn(i)~~

From 2nd condition,

$x = 14+y$ —— eqn(ii)

Substituting the value of $\overset{x}{\cancel{y}}$ in eqn (I).

$(14+y)+y=22$

or, $14+y+y=22$

or, $2y+14=22$

or, $2y=22-14$

or, $2y=8$

or, $y=\frac{\cancel{8}^{4}}{\cancel{2}_{1}}=4$

Substituting the value of y in eqn (II)

$x=14+4=18$

$\therefore x=18$ & $y=4$.

4(b) The total cost of a box and a pen is Rs.50. If the cost of 3 boxes is same as the cost to 7 pens, find the cost of a box and a pen.

→ Soln: Here,

Let the cost of a box be Rs. x & that of a pen be Rs. y.

From 1st condition,

$$x+y = Rs. 50 \text{ —— eqn(1)}$$

or, $x = 50-y$ —— eqn(111)

From 2nd condition,

$$3x = 7y \text{ —— eqn(11)}$$

Substituting the value of x in ~~from~~ eqn(11)

$$3\times(50-y) = 7y$$

or, $150 - 3y = 7y$

or, $-3y - 7y = -150$

or, $\cancel{-}10y = \cancel{-}150$

or, $y = \frac{150}{10} = 15$

Substituting the value of y in eqn(111)

$$x = 50 - 15 = 35$$

$\therefore x = 35$ & $y = 15$

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5(a) The sum of the age of a father and his son is 40 years. If the father is 28 years older than his son, find their age.

→ Soln,

Let the age of father and son be x & y respectively.

Acc. to 1st condition,

$x+y=40$ —— eqn(I)

Acc. to 2nd condition,

$x=28+y$ —— eqn(II)

Substituting the value of x in eqn(I)

$(28+y)+y=40$

or, $28+y+y=40$

or, $2y=40-28$

or, $2y=12$ or, $y=\frac{12}{2}=6$

5(b)

→

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Substituting the value of y in eqn(II),

$$x = 28+6 = 32$$

$\therefore x=32$ & $y=6$

5(b) The ~~st~~ sum of the age of two sisters is 20 years. If one of them is 4 years younger than other, find their age.

→ Soln,

Let the two sisters be x & y respectively.

Acc. to 1st condition,

$$x+y=20 \quad \text{——— eqn(I)}$$

Acc. to 2nd condition,

$$y = x-4 \quad \text{——— eqn(II)}$$

Substituting the value of y in eqn(I),

$$x+(x-4)=20$$

or, $x+x-4=20$

or, $2x = 20+4 = 24$

or, $x = \frac{\cancel{24}^{12}}{\cancel{2}_1} = 12$

Substituting the value of x in eqn(II),

$$y = 12 - 4 = 8$$

$\therefore x = 12$ & $y = 8$ #

c) Father is three times as old as his son. If the difference of their age is 24 years, find their age.

→ Soln:

Let the age of father & son be x & y ~~be~~ respectively.

From 1st condition,

$$x = 3y \text{ —— eqn(I)}$$

From 2nd condition,

$$x - y = 24 \text{ —— eqn(II)}$$

Substituting the value of x in eqn(II),

$$3y - y = 24$$

or, $2y = 24$. or, $y = \frac{\cancel{24}^{12}}{\cancel{2}_1} = 12$ #

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Substituting the value of y in eqn(1),

$$x = 3 \times 12 = 36 \; \#$$

$\therefore x = 36$ & $y = 12 \; \#$

d) The sum of the age of a father & his son is 48 years. Four years ago, the father was 9 times as old as his ~~som~~ son was. Find their present ages.

→ Sol^n, Here,

Let the age of the father & son be x & y respectively.

From 1st condition,

$$x + y = 48$$

or, $y = 48 - x$ —— eqn(1)

From 2nd condition,

$$x - \cancel{6}4 = 9(y - \cancel{6}4)$$

or, $x - \cancel{5}4 = 9y - \cancel{54}\,36$

or, $x - 9y = -\cancel{51}\,36 + \cancel{6}4$

or, $x - 9y = \cancel{-48}\;\cancel{50}\;-32$ —— eqn(11)

Substituting the value of y in eqn(ii).

$$x - 9(\overset{48}{\cancel{32}} - \overset{x}{\cancel{y}}) = -32$$

$$\text{or, } x - 432 + 9x = -32$$

$$\text{or, } 10x = -32 + 432$$

$$\text{or, } x = \frac{40\cancel{0}}{1\cancel{0}} = 40$$

Substituting the value of x in eqn(i).

$$y = 48 - 40 = 8$$ #

$\therefore x = 40$ & $y = 8$ #

e) A father is 30 years older than his son. After six years he will be 3 times as old as his son will be. Find their present age.

→ Soln, Here,

Let the age of father and son be x & y respectively.

From 1^{st} condition,

$$x = 30 + y \text{ — eqn(1)}$$

From 2^{nd} condition,

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

or, $x + 6 = 3y + 18$

or, $x - 3y = 18 - 6$

or, $x - 3y = 12$ — eqn(ii)

Substituting the value of x ~~y~~ in ~~equation(ii)~~ eqn(ii).

$$(30 + y) - 3y = 12$$

or, $30 + y - 3y = 12$

or, $-3y + y = 12 - 30$

or, $-2y = -18$

or, $y = \frac{\cancel{18}\,9}{\cancel{2}\,1} = 9$

Substituting the value of y in eqn(1)

$x = 30 + 9 = 39$ #

$\therefore x = 39$ & $y = 9$.

8) If twice the son's age in years is added to his father's age, the sum is 70. But if twice the father's age is added to the son's age, the sum is 95. Find the present age of the father and the son.

→ Soln. Here,

Let the age of the father and son be x & y respectively.

From 1st condition,

$$x+2y=70 \quad \text{— eqn(1)}$$

~~or, $2y=70-x$~~

~~or, $y=\frac{70-x}{2}$ — eqn(1)~~

From 2nd condition,

$$2x+y=95$$

or, $2x=95-y$

or, $x=\frac{95-y}{2}$ — eqn(ii)

Substituting the value of x in eqn(1),

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$$\left(\frac{95-y}{2}\right)+\frac{2y}{1}=70$$

$$\text{or, } \frac{95-y}{2}+\frac{2y}{1}=70$$

$$\text{or, } \frac{95-y+4y}{2}=70$$

$$\text{or, } 3y+95=70\times 2$$

$$\text{or, } 3y+95=140$$

$$\text{or, } 3y=140-95=45 \ \#$$

$$\text{or, } y=\frac{45}{3}=15 \ \#$$

Substituting the value of y in eqn (ii);

$$x=\frac{95-15}{2}=\frac{80}{2}=40$$

$$\therefore x=40 \ \& \ y=15 \ \#$$

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6 a) The length of a rectangular garden is two times its breadth. If the perimeter of the garden is 72m, find the length and breadth of the garden.

→ Soln,
Let the length be x m & breadth be ym.

From 1st condition,
$x = 2y$ —— eqn(1)

From 2nd condition,
$P = 72m$
$2(l+b) = 72m$
or, $2(x+y) = 72m$
or, $x+y = \frac{\cancel{72}^{36}m}{\cancel{2}_{1}}$
or, $x+y = 36m$ —— eqn(11)

Substituting the value of x in eqn(11),
$2y+y = 36m$ or, $3y = 36m$ or, $y = \frac{\cancel{36}^{12}}{\cancel{3}_{1}}m = 12m$ //

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Substituting the value of y in eqn(1),

$x = 2 \times 12 = 24$

$\therefore$ The length is 24m & breadth is 12m.

b) The perimeter of a rectangular field in 120m. If the field is 10m longer than its breadth, find the length and breadth of the field.

→ Soln,

Let the length be x m & breadth be y m.

From 1st condition,

$P = 120m$

$2(l+b) = 120m$

or, $2(x+y) = 120m$

or, $x+y = \frac{\cancel{120}^{60}}{\cancel{2}_1} m = 60m$ ——— eqn(1)

From 2nd condition,

$x = 10 + y$ ——— eqn(11)

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Substituting the value of x in eqn(i),

$$(10+y)+y = 60m$$
or, $10+y+y = 60m$
or, $2y = 60m - 10 = 50m$
or, $y = \frac{\cancel{50}^{25} m}{\cancel{2}_{1}} = 25$ //

Substituting the value of y in eqn(ii),

$$x = 10+25 = 35m$$ //

$\therefore$ $x = 35m$ & $y = 25m$. //