5.3 Solving Simultaneous Linear Equations In Two Unknowns By Substitution Method

When two simultaneous linear equations are solved graphically, the solution obtained may be an approximation only. For instance, in Example 3, it is not possible to read the exact solution, $\left(\frac{8}{3}, -\frac{5}{3}\right)$, from the graphs. However, we can use an algebraic method, such as the **substitution method**, to obtain the exact solution.

Example 5 Use the substitution method to solve the simultaneous equations

$$x + 3y = 8,$$
$$2x + 5y = 13.$$

Solution

$$x + 3y = 8 \quad \text{..... (1)}$$
$$2x + 5y = 13 \quad \text{..... (2)}$$

From (1), $x = 8 - 3y$ ..... (3) — Express x in terms of y.

Substituting (3) into (2),

$$2(8 - 3y) + 5y = 13$$
$$16 - 6y + 5y = 13$$
$$16 - y = 13$$
$$y = 3$$

Substituting (8 – 3y) for x to remove the unknown x.

Substituting $y = 3$ into (3),

$$x = 8 - 3(3)$$
$$= -1$$

$\therefore$ the required solution is $x = -1$ and $y = 3$.

Check:
When $x = -1$ and $y = 3$:
$x + 3y = (-1) + 3(3)$
$= 8$
$2x + 5y = 2(-1) + 5(3)$
$= 13$
$\therefore$ the solution $(-1, 3)$ is correct.

Note:
- In the example above, the values of x and y satisfy **both** equations (1) and (2). Therefore, it is valid to substitute (3) into (2) to eliminate the unknown x.
- Do not forget to check the solution.

Try It 5! Use the substitution method to solve the simultaneous equations

$$x + 2y = 12,$$
$$3x - y = 1.$$