

1.8 Solving Linear Systems by **Substitution**

1) Solve the simultaneous equations:

$$2x + 4y = 18 \quad \text{(i) and}$$

$$y = 3x - 13 \quad \text{(ii) using **substitution** .}$$

(a) Substitute $y = 3x - 13$ into (i)

$$2x + 4(\mathbf{3x - 13}) = 18 \quad \text{(i)}$$

$$2x + 12x - 52 = 18$$

$$14x = 18 + 52$$

$$14x = 70$$

$$x = 5$$

Solve the simultaneous equations:

$$2x + 4y = 18 \quad \text{(i) and}$$

$$y = 3x - 13 \quad \text{(ii) using substitution.}$$

(b) Substitute $x = 5$ into (ii)

$$y = 3(5) - 13 \quad \text{(ii)}$$

$$y = 15 - 13$$

$$y = 2$$

Solution: $(5, 2)$

2) Solve the simultaneous equations:

$$2x + 4y = 10 \quad (\text{i}) \text{ and}$$

$$3x - y = -6 \quad (\text{ii}) \text{ using } \mathbf{\text{substitution}}.$$

a) Isolate y in: $3x - y = -6 \quad (\text{ii})$

$$-y = -3x - 6$$

$$y = 3x + 6$$

(b) Substitute $y = 3x + 6$ into (i)

$$2x + 4(\mathbf{3x + 6}) = 10 \quad (\text{i})$$

solve

$$2x + 4y = 10 \quad (\text{i})$$

$$3x - y = -6 \quad (\text{ii})$$

$$2x + 4(3x + 6) = 10 \quad (\text{i})$$

$$2x + 12x + 24 = 10$$

$$14x + 24 = 10$$

$$14x = 10 - 24$$

$$14x = -14$$

$$x = -1$$

Substitute $x = -1$ into (i)

$$2(-1) + 4y = 10$$

$$-2 + 4y = 10$$

$$4y = 10 + 2$$

$$4y = 12$$

$$y = 3$$

$(-1, 3)$

- Isolate one of the variables
- Substitute this expression in the other equation;
- Solve the resulting equation;
- Find the value of the other variable, by substituting back into one of the original equations.

Ex 3: Solve the system of equations

$$x + 2y = 4 \quad (1) \quad \text{and} \quad 2x + 3y = 7 \quad (2)$$

Isolate x in (1)

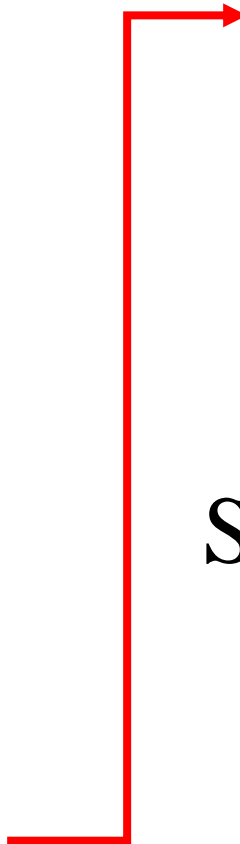
$$x = 4 - 2y$$

Sub in (2)

$$2(4 - 2y) + 3y = 7$$

$$8 - 4y + 3y = 7$$

$$8 - y = 7$$


$$-y = 7 - 8$$

$$-y = -1$$

$$y = 1$$

Sub $y = 1$ into (1)

Ex 3: Solve the system of equations

$$x + 2y = 4 \quad (1) \quad \text{and} \quad 2x + 3y = 7 \quad (2)$$

Sub $y = 1$ into (1)

$$x + 2(1) = 4$$

$$x + 2 = 4$$

$$x = 4 - 2$$

$$x = 2$$

Solution (2, 1)

4) Ace Heating charges \$40 service plus \$25/ h for labour. Bill's Repairs charges \$20 service plus \$30/ h . Determine when the charges will be equal.

$$\text{Ace: } C = 25h + 40 \quad (1)$$

$$\text{Bill: } C = 30h + 20 \quad (2)$$

Sub (2) into (1)

$$30h + 20 = 25h + 40$$

$$30h - 25h = 40 - 20$$

$$5h = 20$$

$$h = 4$$

Sub $h = 4$ in (1)

$$C = 25(4) + 40$$

$$C = 100 + 40$$

$$C = 140$$