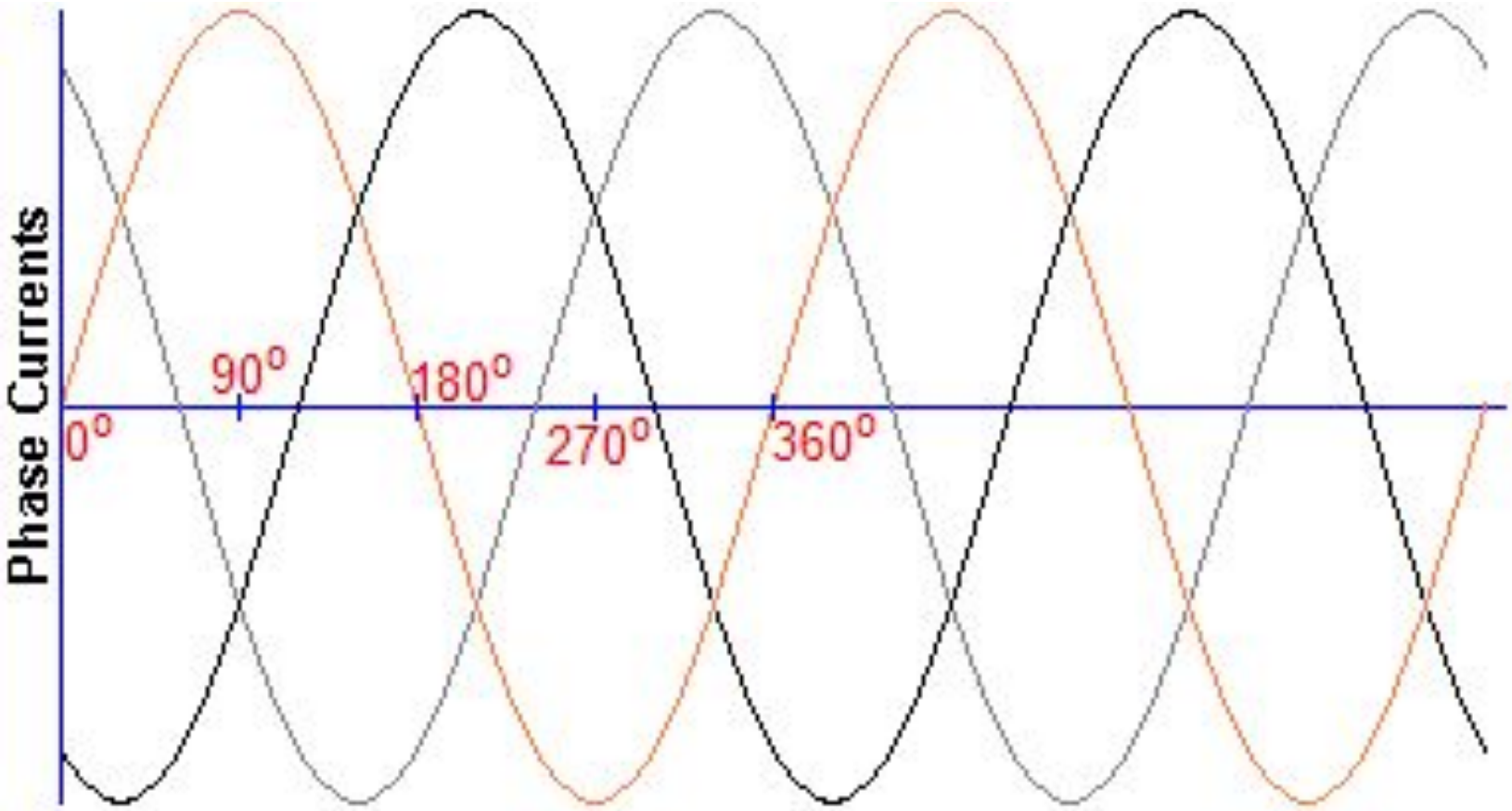
City & Guilds SmartScreen

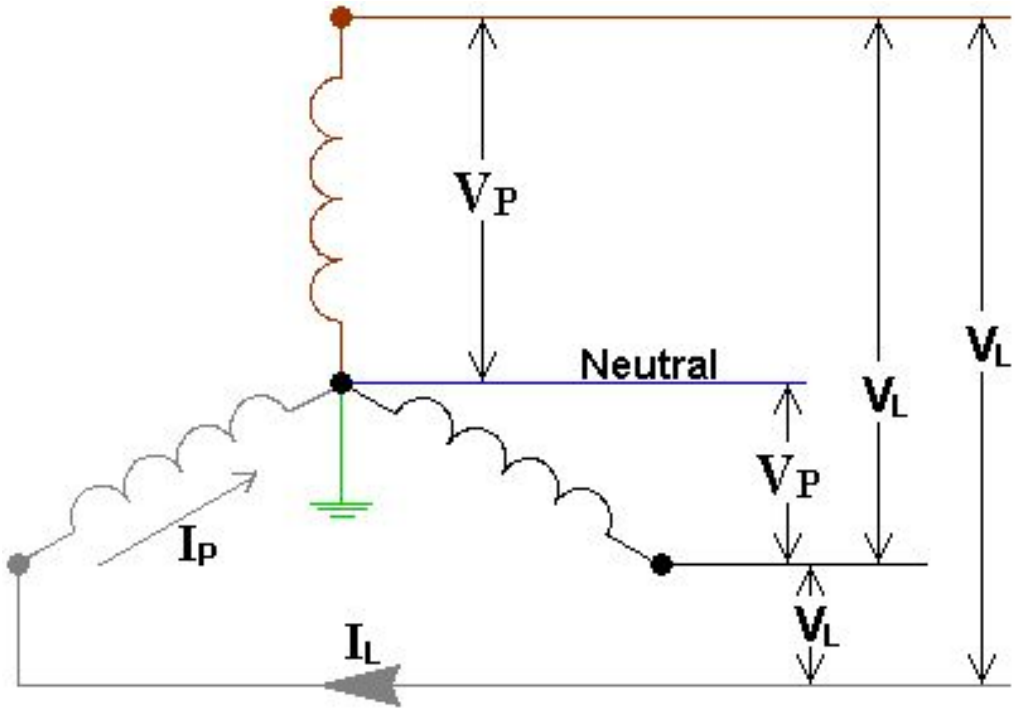
Unit 302: Principles of electrical science

Star–delta configurations

Three-phase supplies



Star connection



$$V_L = \sqrt{3} \times V_P$$

$$I_L = I_P$$

EXAMPLE 1 – A three-phase, four-wire Star connected transformer has a line voltage of 520 volts and supplies a line current of 25 amps. Calculate:

) the phase voltage of the transformer

) the phase current in each winding.

a) In star

$$V_L = \sqrt{3} \times V_P$$

$$V_P = \frac{V_L}{\sqrt{3}}$$

$$= \frac{520}{\sqrt{3}}$$

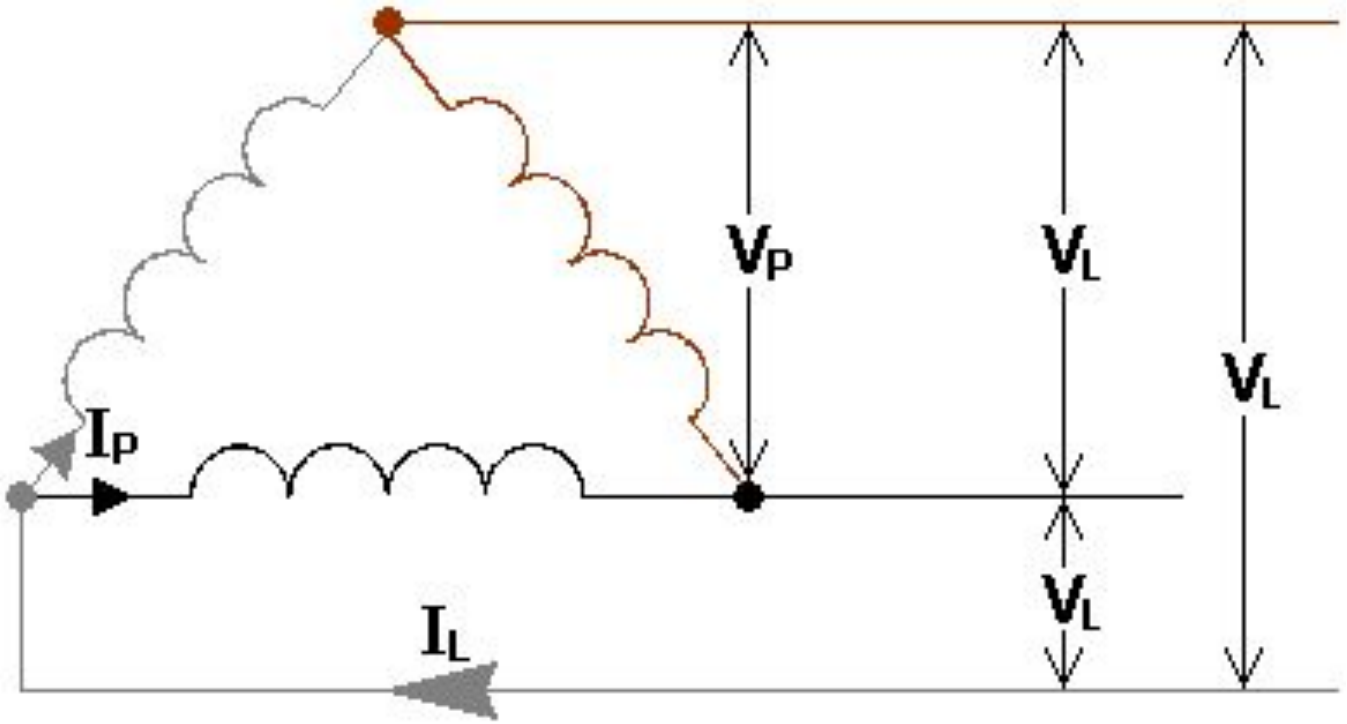
$$= \mathbf{300\ volts}$$

b) In star

$$I_L = I_P$$

$$= \mathbf{25\ amperes}$$

Delta connection



$$V_L = V_P$$

$$I_L = \sqrt{3} \times I_P$$

EXAMPLE 2 – A three-phase balanced Delta connected resistive load is supplied from a transformer at a line voltage of 400 volts and draws a line current of 13.86 amps. Calculate:

a) the phase voltage
b) the phase current
c) the resistance of the load.

a) In delta

$$V_P = V_L$$

$$= \mathbf{400\ volts}$$

b) In delta

$$I_L = \sqrt{3} \times I_P$$

$$I_P = \frac{I_L}{\sqrt{3}}$$

$$= \frac{13.86}{\sqrt{3}}$$

$$= \mathbf{8\ amperes}$$

EXAMPLE 2 – A three-phase balanced Delta connected resistive load is supplied from a transformer at a line voltage of 400 volts and draws a line current of 13.86 amps. Calculate:

a) the phase voltage
b) the phase current
c) the resistance of the load.

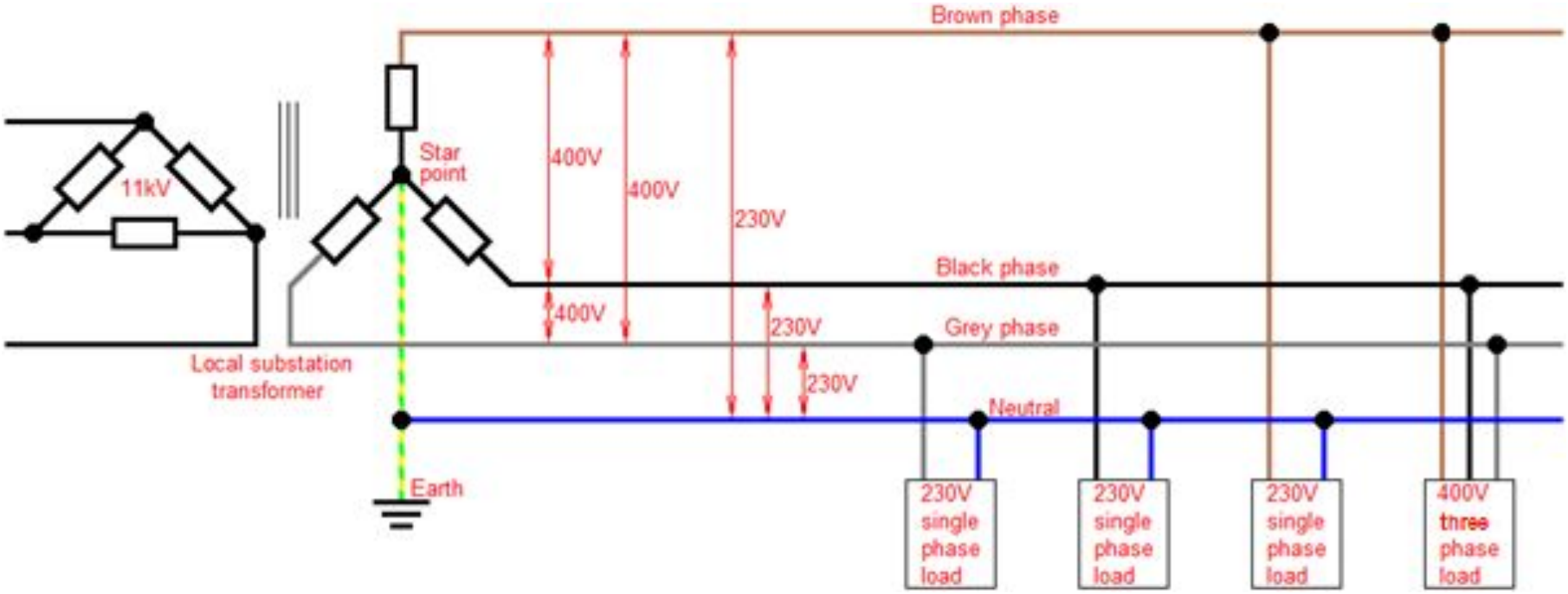
c)

$$R = \frac{V_P}{I_P}$$

$$= \frac{400}{8}$$

$$= \mathbf{50\ \Omega}$$

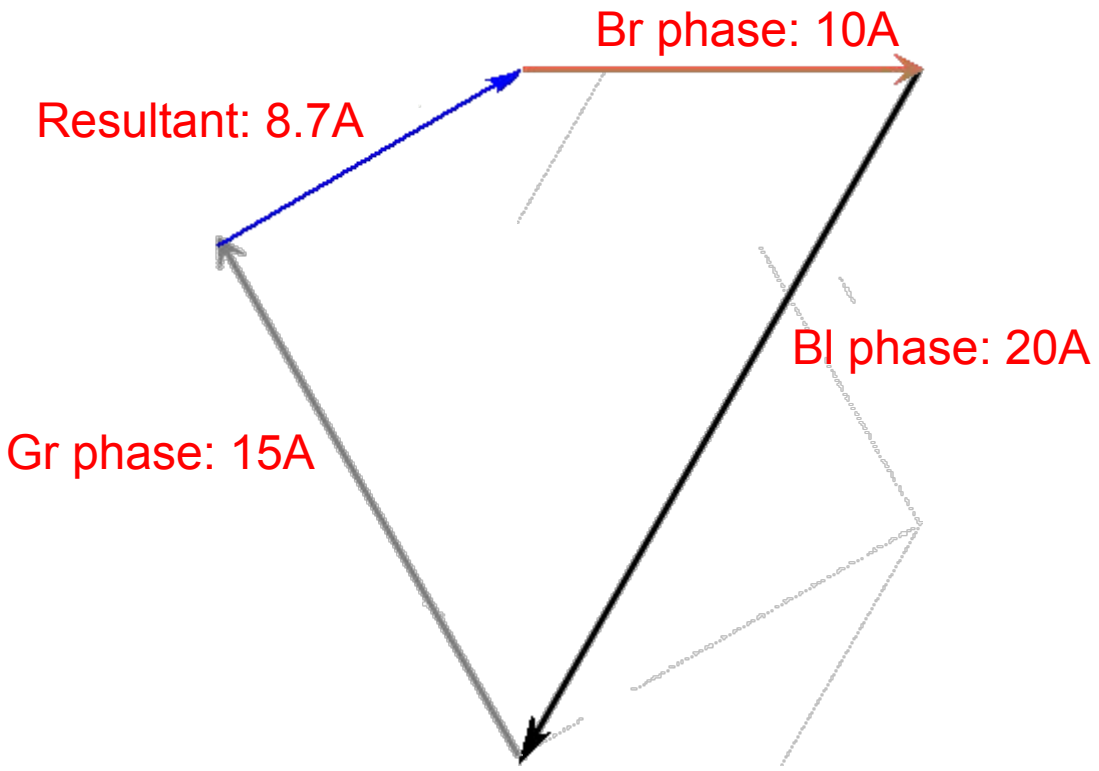
Balancing loads



EXAMPLE 3 – A three-phase unbalanced star connected system has the following loads connected to each phase:

- Brown phase – 10 amperes
- Black phase – 20 amperes
- Grey phase – 15 amperes

Using the graphical method (phasors) determine the neutral current.



$$In = \sqrt{((Ia^2 + Ib^2 + Ic^2) - (Ia \times Ib) - (Ib \times Ic) - (Ia \times Ic))}$$

Where: In = neutral current

Where: Ia = current in brown phase

Where: Ib = current in black phase

Where: Ic = current in grey phase

EXAMPLE 4 – Using the figures in Example 3, calculate the neutral current.

$$In = \sqrt{((Ia^2 + Ib^2 + Ic^2) - (Ia \times Ib) - (Ib \times Ic) - (Ia \times Ic))}$$

$$= \sqrt{((10^2 + 20^2 + 15^2) - (10 \times 20) - (20 \times 15) - (10 \times 15))}$$

$$= \sqrt{(725 - 200 - 300 - 150)}$$

$$= \sqrt{75}$$

$$= \mathbf{8.66\ amperes}$$

Any questions?