

$$\text{Let } V_{AN} = 1 \angle 30^\circ$$

(1)

$$V_{BN} = 1 \angle 150^\circ$$

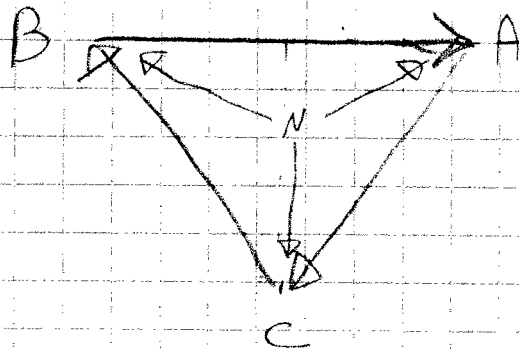
$$V_{CN} = 1 \angle 270^\circ$$

CONVERTING TO Phase TO Phase.

$$V_{AB} = \sqrt{3} \angle 0^\circ$$

$$V_{BC} = \sqrt{3} \angle 120^\circ$$

$$V_{CA} = \sqrt{3} \angle 240^\circ$$



$$V_{CB} = -V_{BC} = 1 \angle (120 - 180) = 1 \angle -60^\circ$$

$$I_a = 1 \angle \theta + 30^\circ$$

$$I_b = 1 \angle \theta + 150^\circ$$

$$I_c = 1 \angle \theta + 270^\circ$$

Where  $\theta = \cos^{-1}(\text{PF})$

Now connect a 2 element meter (2)  
where

$$S_1 = V_{AB} I_A^* = (\sqrt{3} \angle 0^\circ) (1 \angle -\theta - 30^\circ)$$

$$S_2 = V_{CB} I_C^* = (\sqrt{3} \angle -60^\circ) (1 \angle -\theta - 270^\circ)$$

$$\operatorname{Re}\{S_1\} = \sqrt{3} \cos(-\theta - 30^\circ)$$

$$\operatorname{Re}\{S_2\} = \sqrt{3} \cos(-\theta + 30^\circ)$$

Let  $\theta = 0$

$$\operatorname{Re}\{S_1\} = \sqrt{3} \cdot \frac{\sqrt{3}}{2} = \frac{3}{2}$$

$$\operatorname{Re}\{S_2\} = \sqrt{3} \cdot \frac{\sqrt{3}}{2} = \frac{3}{2}$$

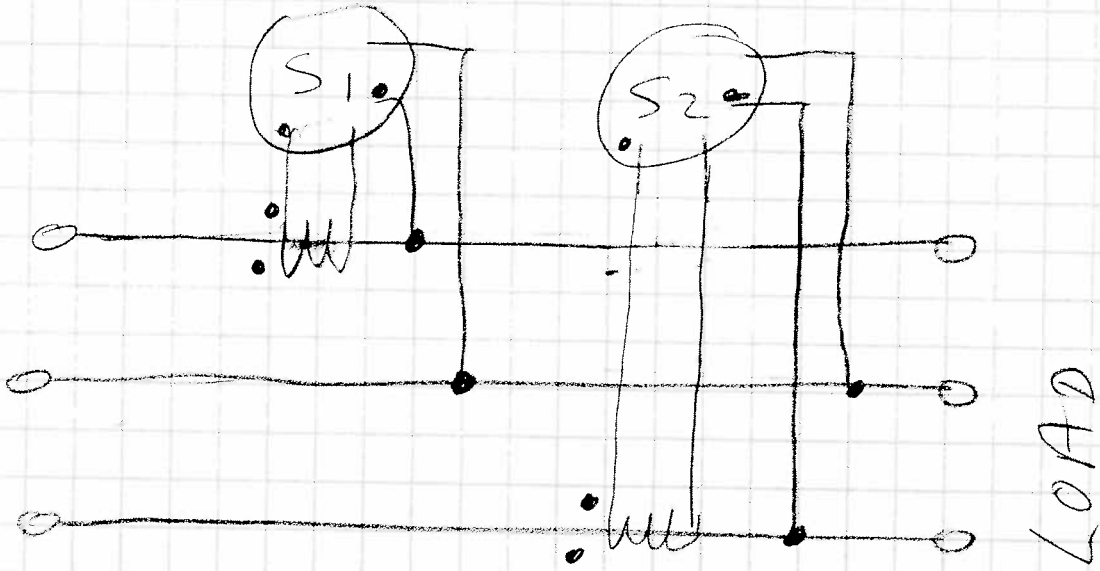
$$\operatorname{Re}\{S\} = P = \operatorname{Re}\{S_1\} + \operatorname{Re}\{S_2\} = \frac{3}{2} + \frac{3}{2} = \boxed{3}$$

$$P = V_{AN} I_A^* + V_{BN} I_B^* + V_{CN} I_C^* = 1 + 1 + 1 = \boxed{3}$$

Proves a 3 $\phi$ , 3 wire system only requires  
2 ELEMENTS.

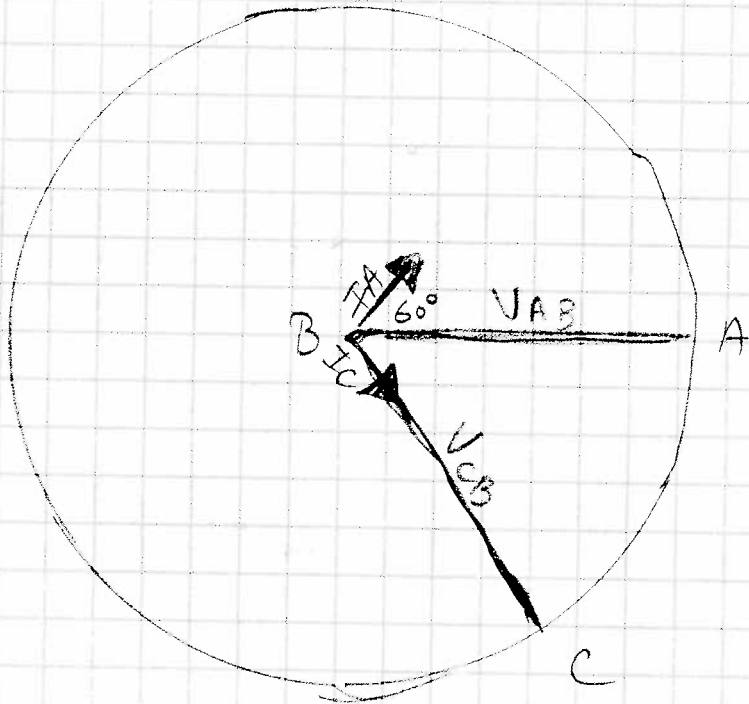
3

Line



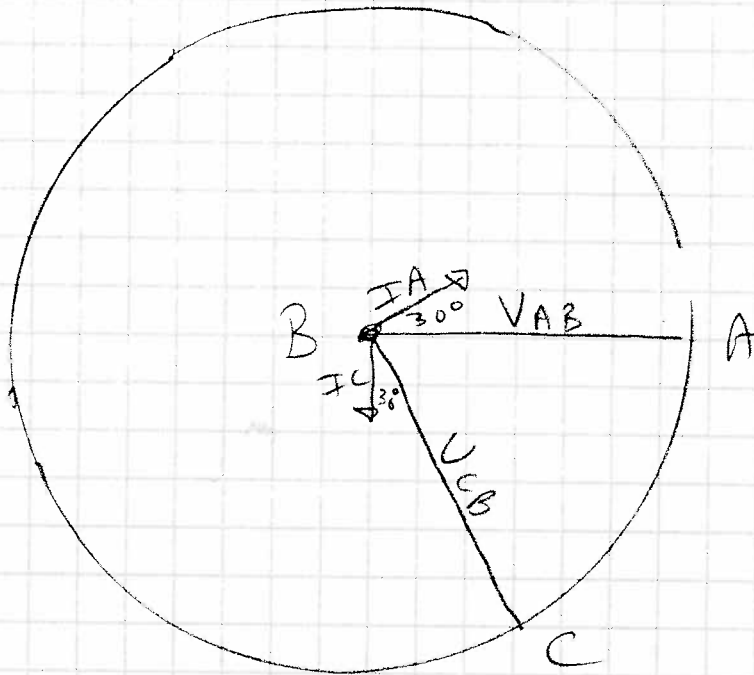
Element wiring

Phasor for  $30^\circ$  Leading Pf



# Phasor for Unity PF.

(4)



# Phasor for $30^\circ$ Lagging PF

