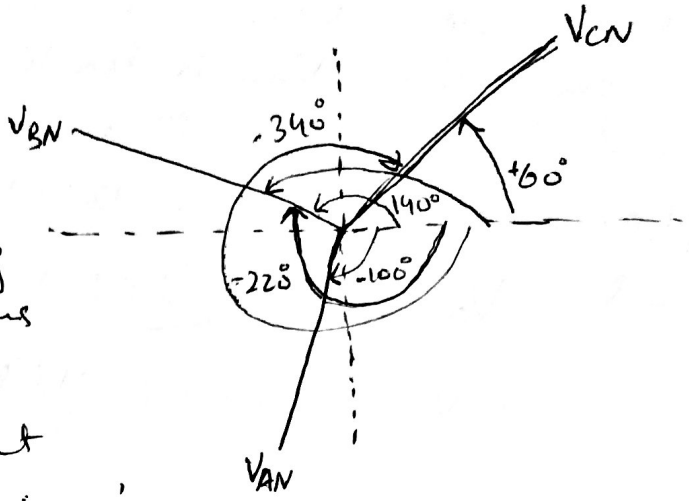
12.1: Find phase sequence of a three-phase motor for which $V_{AN} = 220\angle -100°\ V$ and $V_{BN} = 220\angle 140°\ V$.

Solution:-

If we draw it roughly, we can see that V_{AN} is leading V_{BN} and which in turns is leading V_{CN}.

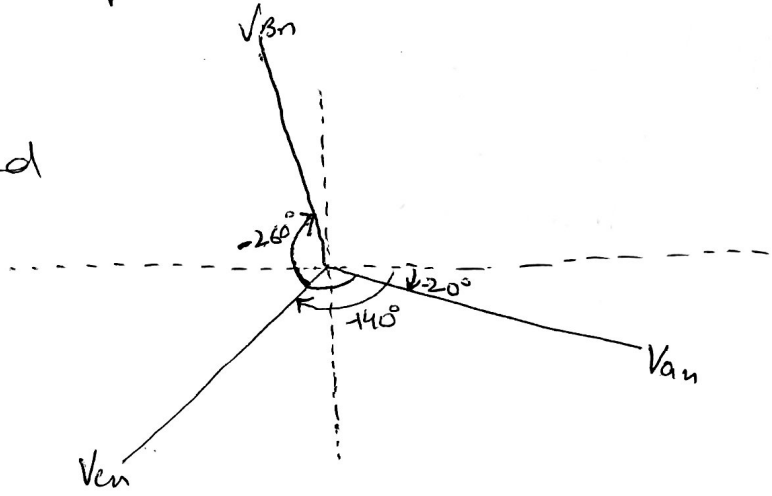
So we can say that the phase sequence is 'abc'.



12.3: If in an 'acb' phase sequence, $V_{an} = 100\angle -20°$, then find V_{cn} and V_{bn}.

Solution: $V_{an} = 100\angle -20°$

When we draw Van and plot Vcn and Vbn w.r.t 'acb' phase sequence we can see that value of $V_{cn} = 100\angle -140°$ and $V_{bn} = 100\angle -260°$ or $V_{bn} = 100\angle 100°$



Problems:

12.2: Find phase sequence? $V_{an} = 120\angle 30°\ V$, $V_{cn} = 120\angle -90°\ V$

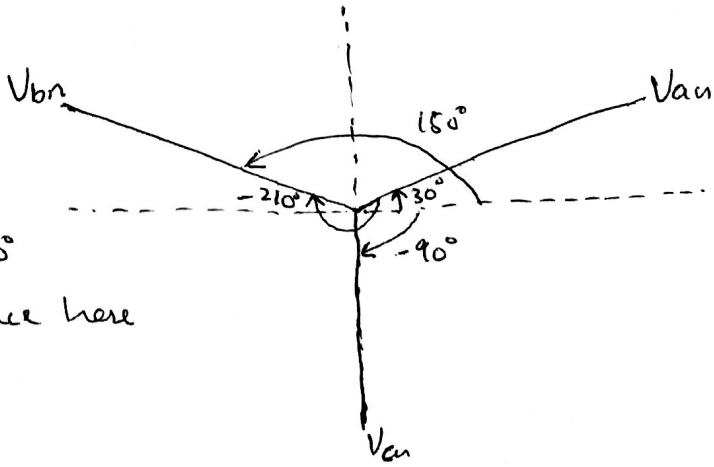
Find $V_{bn} = ?$

Solution:- After drawing the given Van and Vcn we can easily say that Vcn is lagging Van by 120°

So, the phase sequence here is "acb".

$V_{bn} = 120\angle 150°\ V$

or $V_{bn} = 120\angle -210°\ V$

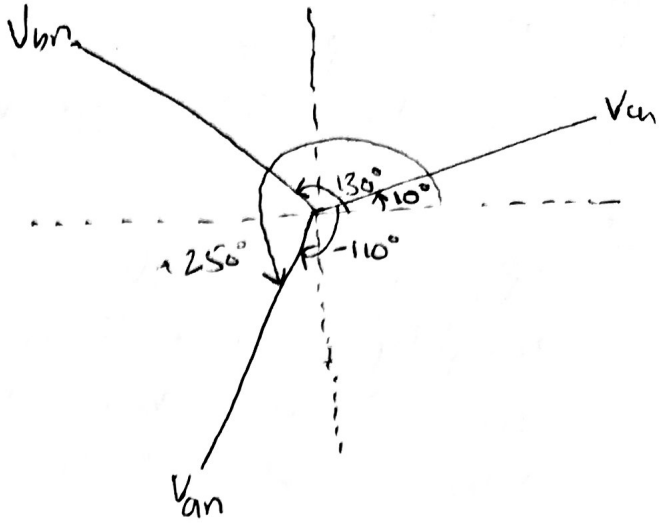


12.3 Find phase sequence, $V_{bn} = 440 \angle 130^\circ V$, $V_{cn} = 440 \angle 10^\circ V$.
Find $V_{an} = ?$

Soln:- From plotting the V_{bn} and V_{cn} we can see the V_{bn} is leading V_{cn} by 120°, so, the phase sequence is 'abc'.

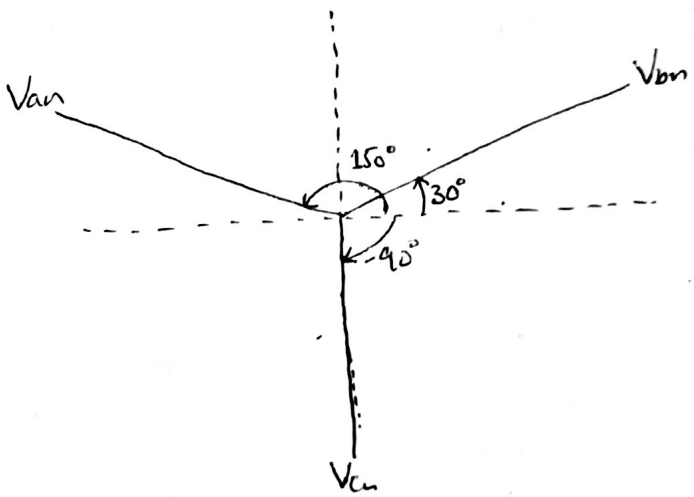
and $V_{an} = 440 \angle 250^\circ V$

or $V_{an} = 440 \angle -110^\circ V$.



PP. 12.1 Find V_{an} and V_{cn}, assume 'abc' phase sequence.
$V_{bn} = 110 \angle 30^\circ V$

Soln:- From the plot of V_{bn} we can find
$V_{an} = 110 \angle 150^\circ V$
$V_{cn} = 110 \angle -90^\circ V$.



⇒ Importance of Power Factor:-

* As discussed earlier that power factor is the ratio of active power to the apparent power.

$$PF = P/S$$

* e.g if PF is 0.8 : it means that induction motor will consume 80% of active power & 20% of reative power.

* Loads with low PF are costly to serve. because they require large currents.

Exp: 11.7: Industry consumes 200MWh in one month. Max demand is 16,00kW, calculate the electricity bill based on the following two-part rate:
Demand charges: $5.00 per month per kW of billing demand.
Energy charges: 8 cents per kWh for the first 50,000kWh, 5 cents per kWh for remaining energy.

Solution: The demand charge is:

$$\$5.00 \times 16,00 = \$8,000$$

200MWh = 200000kwh

The energy charge for first 50,000kWh is.

$$\$0.08 \times 50,000 = \$4,000$$

The remaing energy is 200,000kWh - 50,000kWh = 150,000kWh and it's energy charges: is:

$$\$0.05 \times 150,000 = \$7,500$$

Finally Total bill of math is.

$$= 8000 + 4000 + 7500 = \$19,500.$$

Ex: 11.8 A 300kW load supplied at 13KV (rms) operates 520 hrs a month at 80% PF. Calculate average cost per month based on this simplified tariff:

Energy charge: 6 cents per kWh

PF penalty: 0.1% of energy charge for every 0.01 that PF falls below 0.85.

PF credited: 0.1% of energy charge for every 0.01 that PF exceeds 0.85.

Solution: The energy consumed is.

$$W = 300\text{kW} \times 520\text{h} = 156{,}000\text{kWh}.$$

The operating PF = 80% i.e. = 0.8 is 5 × 0.01 below the tariff of 0.85. So the PF penalty charges is 0.5 percent.

This amount to an energy of:

$$\Delta W = 156{,}000 \times \frac{5 \times 0.1}{100} = 780\text{kWh}$$

Total energy is:

$$W_t = W + \Delta W = 156{,}000 + 780 = 156{,}780\text{kWh}.$$

The cost per month is.

$$\text{Cost} = 6\text{cents} \times W_t = 0.06 \times 156{,}780 = \$9{,}406.80$$