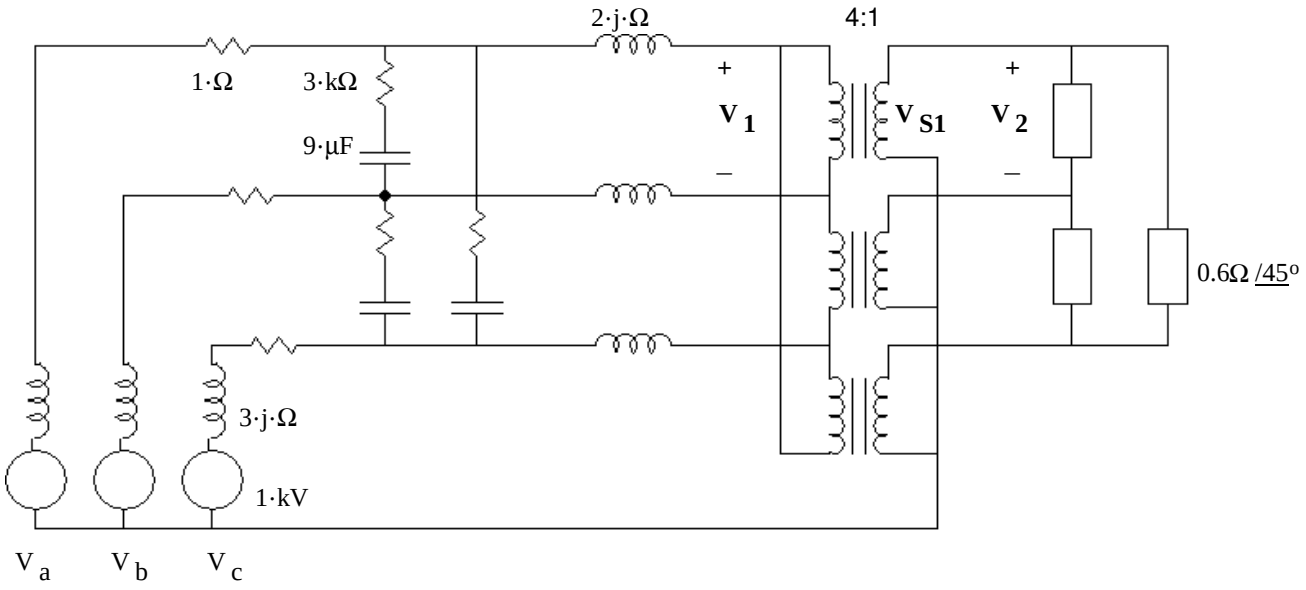
ECE 3600 homework 9B 3-phase Transformers c

Name_____

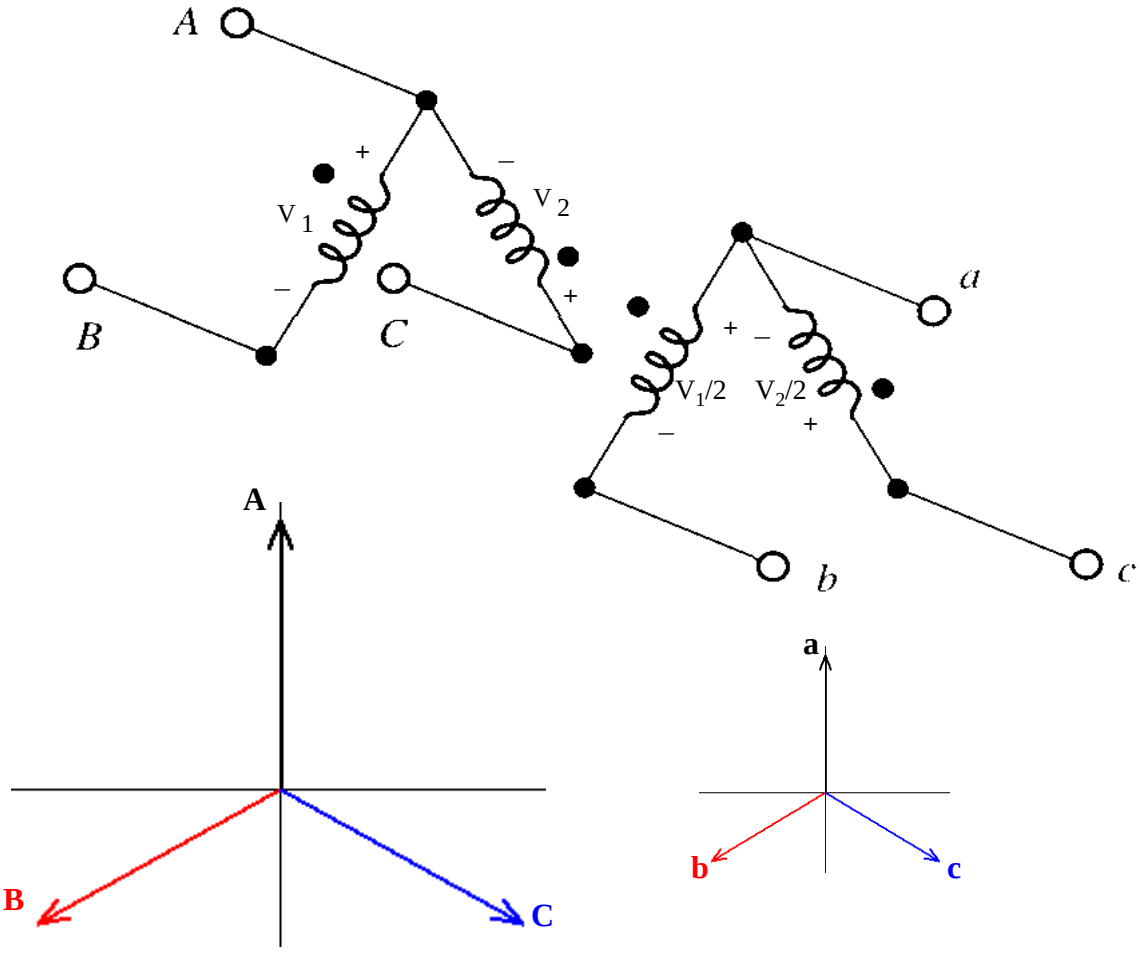
1. a) Draw a per-phase drawing of for the balanced 3-phase, 60-Hz system shown. You may neglect phase issues introduced by Y-Δ and Δ-Y connections. You may need to modify the turns ratio of the transformer to reflect Y-Δ and Δ-Y connections. Be sure to show values of the source, passive components and turns ratio on your drawing.



b) Find $\frac{\mathbf{V_1}}{\mathbf{V_2}}$ incuding phase angle Modify turns ratio to reflect Δ-Y transformer connection

2. The configuration shown is called the “open-delta” or "V" connection, for obvious reasons. Identical $2{:}1$ transformers are used.

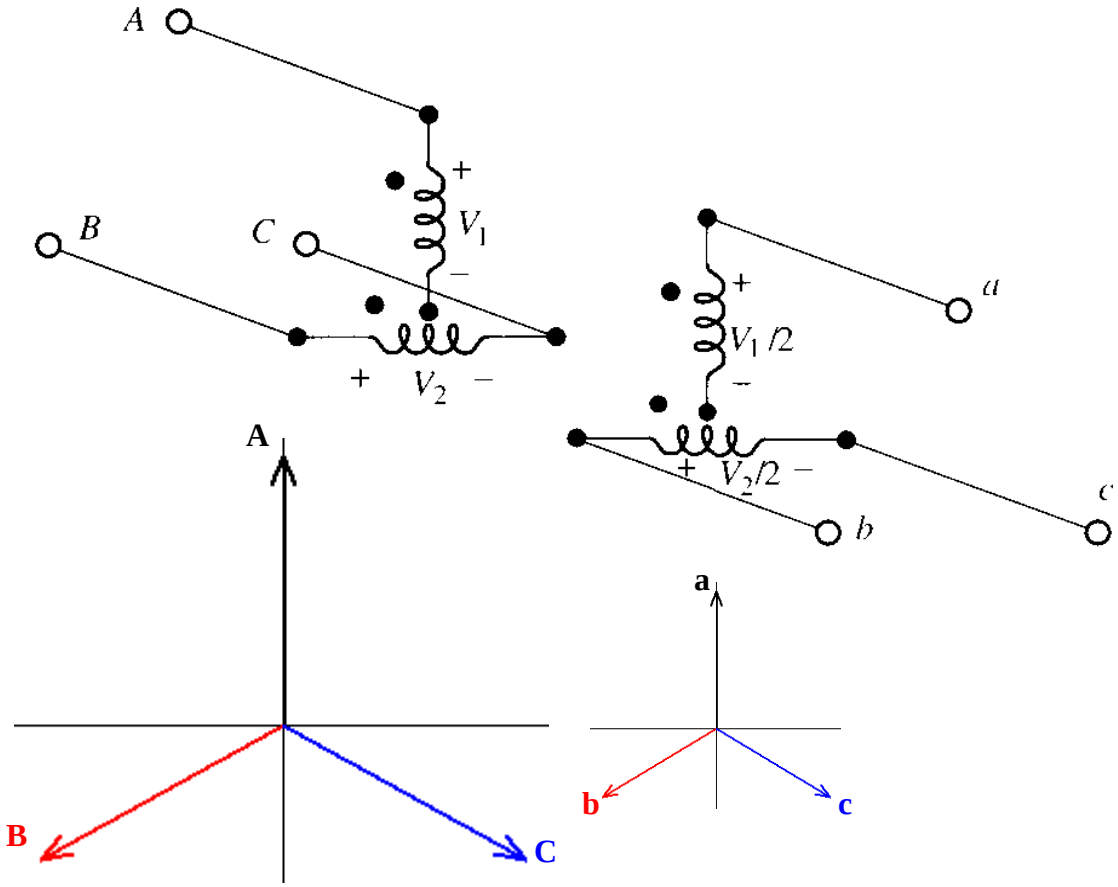
a) Show that if ABC is 480-V balanced three phase, abc is 240-V balanced three-phase. Consider the ABC voltages to be a three-phase set and prove the abc set is three-phase.



b) If the load is 30 kVA, find the required kVA rating of the transformers to avoid overload. [You can solve this independent of part a)]

3. The configuration shown is called the "T" connection. For this connection, the 2:1 transformers are not identical but have different voltage and kVA ratings. The bottom transformer is center-tapped so as to have equal, in-phase voltages for each half.

a) Show that if ABC is 480-V balanced three phase, abc is 240-V balanced three-phase. Consider the ABC voltages to be a three-phase set and prove the abc set is three-phase.



b) If the load is 30 kVA, find the required kVA rating of each transformer to avoid overload.

4. A phase-shifting transformer has a complex turns ratio of $\mathbf{t} := 4 \cdot e^{j \cdot 20 \cdot deg} = 4 \angle 20^o$

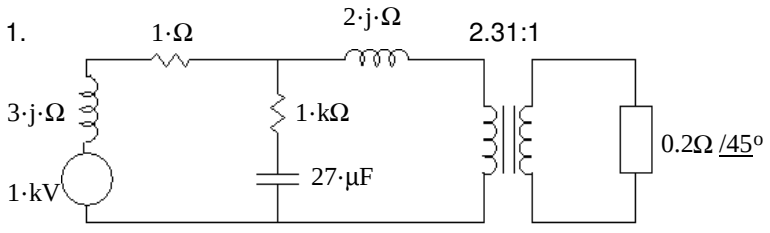
   It has a series impedance of $\mathbf{Z_S} := (0.05 + j \cdot 0.6) \cdot \Omega$
   Find the admittance matrix of this tranformer
   (see the last page of the transformer notes).

$$\mathbf{Y_S} := \frac{1}{\mathbf{Z_S}} =$$

$$\begin{bmatrix} \mathbf{Y_S} & -\frac{\mathbf{Y_S}}{\mathbf{t}} \\ -\frac{\mathbf{Y_S}}{\bar{\mathbf{t}}} & \frac{\mathbf{Y_S}}{(|\mathbf{t}|)^2} \end{bmatrix} = \begin{bmatrix} & \\ & \end{bmatrix} \frac{1}{\Omega}$$

Answers

1.



b) $2.309 \angle -30^o$

2. a) Calculate $\mathbf{V_{bc}}$ from the other two voltages and show that it has the correct magnitude and correct phase angle.

   b) $17.3 \cdot kVA$ per transformer, $34.6 \cdot kVA$ for both

3. a) $415 \cdot 7 \cdot V$ $480 \cdot V$ b) $15 \cdot kVA$ $17.3 \cdot kVA$ $32.3 \cdot kVA$ for both

4. $\begin{pmatrix} 0.138 - 1.655 \cdot j & 0.109 + 0.401 \cdot j \\ -0.174 + 0.377 \cdot j & 8.621 \cdot 10^{-3} - 0.103 \cdot j \end{pmatrix} \cdot \frac{1}{\Omega}$