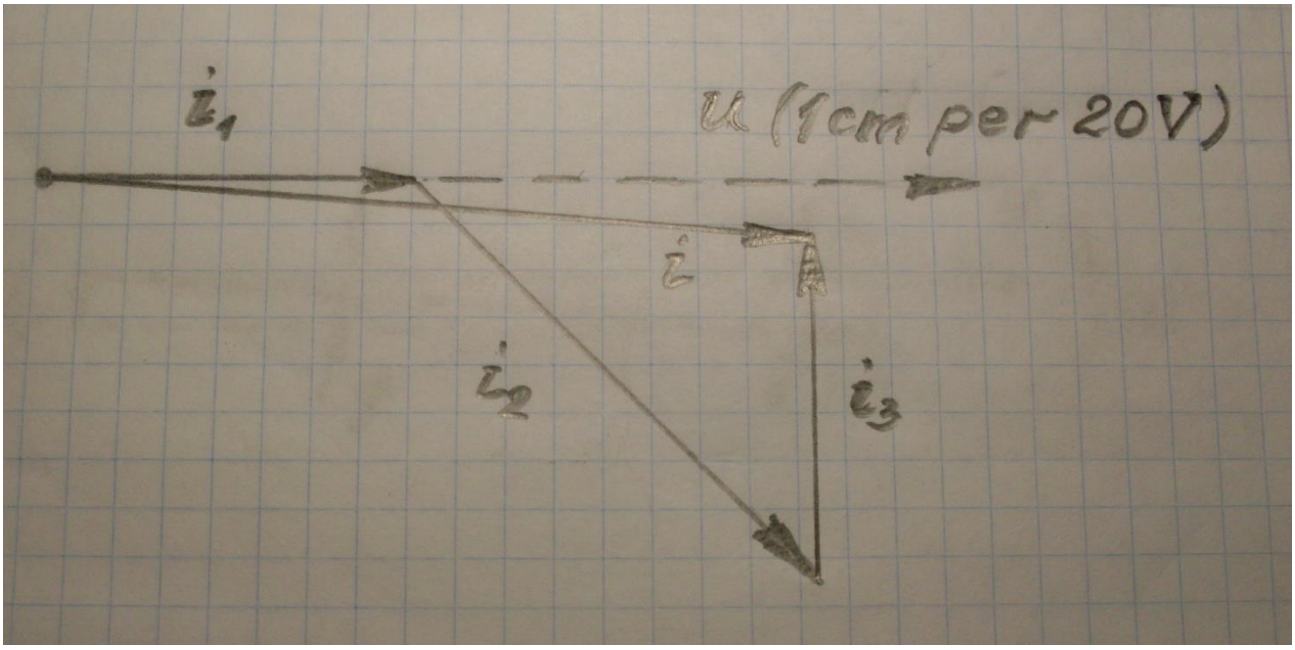
Answer on Question #52417 - Engineering, Other

Question

A single-phase circuit consists of three parallel branches, the currents in which are, respectively, in amperes: i1 = 20 sin(314t), i2 = 30 sin(314t-π/4), and i3 = 18 sin(314t+π/2). The supply voltage is u = 200 sin(314t) volts.

a) What is the frequency of the current?
b) Using the graph paper and a scale of 1 cm per 5 A, plot a phasor diagram and determine the overall current taken from the supply (r.m.s. value) and it phase angle.
c) Determine the active and reactive currents.
d) Express the total current in the trigonometric form similar to that for the branch currents.
e) Find the impedance, resistance and reactance of the circuit.
f) Find the conductance, admittance and susceptance of the circuit.

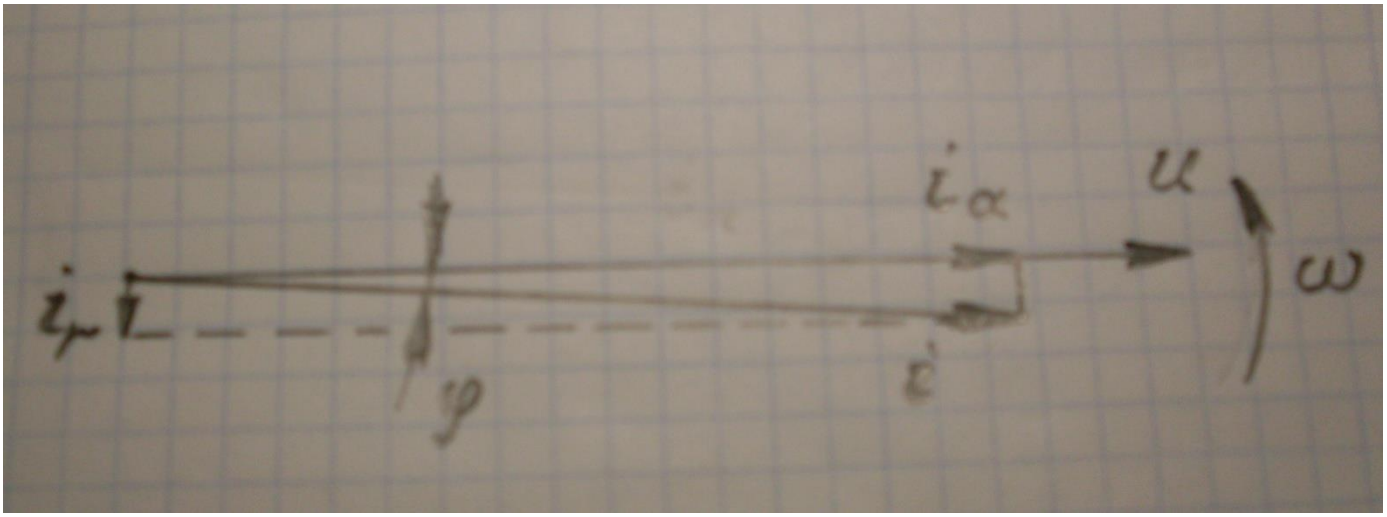
Solution



a) in general we have for harmonic oscillations:
$i = i_{max} \times \sin(\omega t + \varphi_0)$ or $u = u_{max} \times \sin(\omega t + \varphi_0)$,

comparing the general view of the data provided notice $\omega = 314$ rad/s – cyclic frequency,

because $\omega = 2\pi\upsilon$, therefore frequency $\upsilon = \frac{\omega}{2\pi} = \frac{314}{2\times 3,14} = 50(Hz)$;



b,c) the currents and phase angle:

the length of the segment corresponding to the total current is 8.4 cm,
therefore, the approximate value of the total current is $i = 8{,}4 \times 5 = 42\ (A)$,

similarly, the active current $i_a = 8{,}39 \times 5 = 41{,}9\ (A)$, reactive current $i_r = 0{,}6 \times 5 = 3(A)$,

phase angle $\varphi = \text{arctg}\frac{\text{i}_\text{r}}{\text{i}_\text{a}} = \text{arctg}\frac{3}{41{,}9} = 0{,}071\ (\text{rad})$;

d) the total current in the trigonometric will look like:

$$i = 42\sin(314\,t - 0{,}071)\,, A;$$

e) the impedance, resistance and reactance of the circuit are:

?

f) the conductance, admittance and susceptance of the circuit are:

?

Answer: 50 Hz, 42A, 0.071 rad, 41.9 A, 3 A, $i = 42\sin(314\,t - 0{,}071)$, ...