Exercise Section II
(AC circuits analysis)

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1. Find the current in an inductance of 5.0 mH, given the voltage across the element,

$$v = 75\sin(5000t - 45^\circ) \quad V$$

Ans. $i = 3.0\sin(5000t - 135^\circ)$ A

2. In Fig.1, $i = 2.5\cos(1.5\times10^6 t + 45^\circ)$ A. Obtain the voltage v.

Ans. $150\cos(1.5\times10^6 t - 45^\circ)$ V

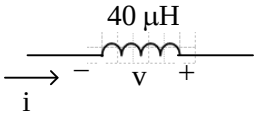

Fig.1

3. The circuit element in Fig.2 has a current $i = 2.5\cos(2500t - 30^\circ)$ A and a voltage $v = 5\sin(2500t - 30^\circ)$ V. What is the element ?

Ans. 200 μF capacitor

Fig.2

4. The voltage and current sine waves in Fig.3 both pass through zero every 1.26 ms, and the maximum values are 120 V and 0.40 A. What single circuit element does this indicate ?

Ans. a 120 mH inductor

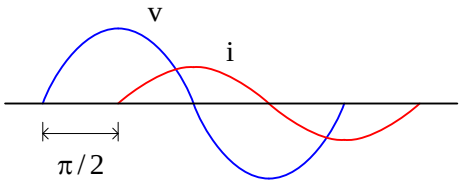

Fig.3

5. Two circuit elements in a series connection have current and total voltage

$$i = 13.42\sin(500t - 53.4^\circ) \quad A \qquad v = 150\sin(500t + 10^\circ) \quad V$$

Identify the two elements. Ans. R = 5 Ω, L = 20 mH

6. Two circuit elements in a series connection have current and total voltage

$$i = 4.0\cos(2000t + 13.2^\circ) \quad A \qquad v = 200\sin(2000t + 50^\circ) \quad V$$

Identify the two elements. Ans. R = 30 Ω, C = 12.5 μF

7. The circuit shown in Fig.4 has a current $i = 5.0\sin 2500t$ mA. Find the maximum values of

   (a) v_R

   (b) v_L

   (c) $v_R + v_L$

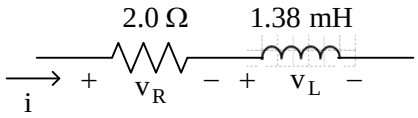

Fig.4

Ans. (a) 10 mV; (b) 17.3 mV; (c) 20 mV

8. A series RC circuit, with R = 27.5 Ω and C = 66.7 μF, has sinusoidal voltage and current, with angular frequency 1500 rad/s. Find the phase angle by which the current leads the voltage.

   Ans. 20°

9. A series RLC circuit, with R = 15 Ω, L = 80 mH, C = 30 μF, has a sinusoidal current at angular frequency 500 rad/s. determine the phase angle and whether the current leads or lags the total voltage.

   Ans. 60.6°, leads

10. In Fig.5, $i = 12.5\cos(3000t - 55^\circ)$ A and $v = 353.5\cos(3000t - 10^\circ)$ V. Find R and C

    Ans. 20 Ω, 33.3 μF

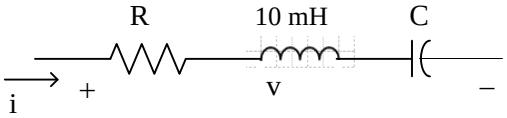

Fig.5

11. A resistance R = 10 Ω and an inductance L = 5.0 mH are in parallel . The inductive – branch current is

$$i_L = 5.0\sin(2000t - 45^\circ) \quad A$$

Obtain the total current, $i_T = i_R + i_L$, and the angle by with i_T lag the voltage v.

Ans. $7.07\sin(2000t)$ A, 45°

12. A two – branch parallel circuit, with R = 10 Ω in one branch and C = 100 μF in the other, has a voltage

$$v = 150\cos(5000t - 30^\circ) \quad V$$

Find the total current, $i_T = i_R + i_C$

Ans. $76.5\cos(5000t + 48.7^\circ)$ A

13. A capacitor C = 35 μF is in parallel with a certain element. Identify the element, given that the voltage and total current are

$$v = 150\sin 2000t \quad V \qquad i_T = 16.5\sin(3000t + 72.4^\circ) \quad A$$

Ans. R = 30.1 Ω

14. three parallel branches respectively contain R = 300 Ω, L = 0.50 H, C = 10 μF. Given the voltage $v = 200\sin 1000t$ V, determine if the total current leads or lags the voltage, and by how much.

Ans. Leads by 67.4°

15. Use phasor methods to obtain the current i in Fig.6, given

$$i = 14.14\cos(800t - 45^\circ) \quad \text{A}$$

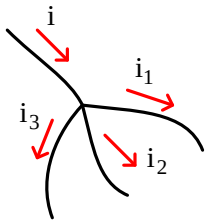

Fig.6

Ans. $32.4\cos(800t + 8.9^\circ)$ A

16. Use phasor methods to obtain the current v_1 in Fig.7, given

$$v_2 = 50\sin(\omega t + 63.4^\circ) \quad \text{V} \qquad v = 67.1\cos(\omega t - 8.48^\circ) \quad \text{V}$$

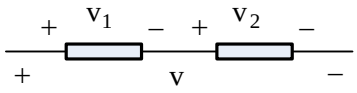

Fig.7

Ans. $25\cos(800t + 30^\circ)$ V

17. For the circuit shown in Fig.8, obtain Z_{eq} and compute I

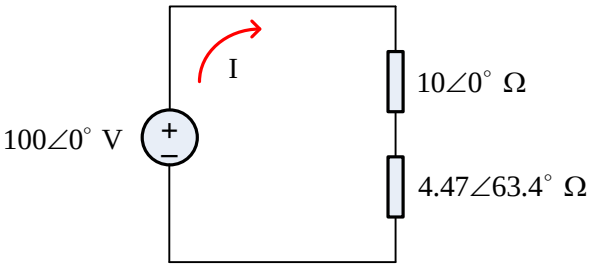

Fig.8

Ans. $7.91\angle -18.43^\circ$ A

18. Evaluate the impedance Z_1 in the circuit of Fig.9

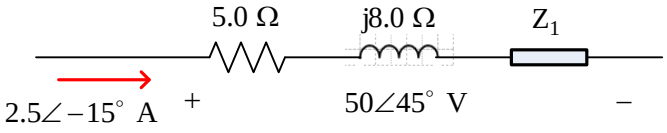

Fig.9

Ans. $5.0 + j9.3\ \Omega$

19. Compute the equivalent impedance Z_{eq} and admittance Y_{eq} for the four-branch circuit of Fig.10

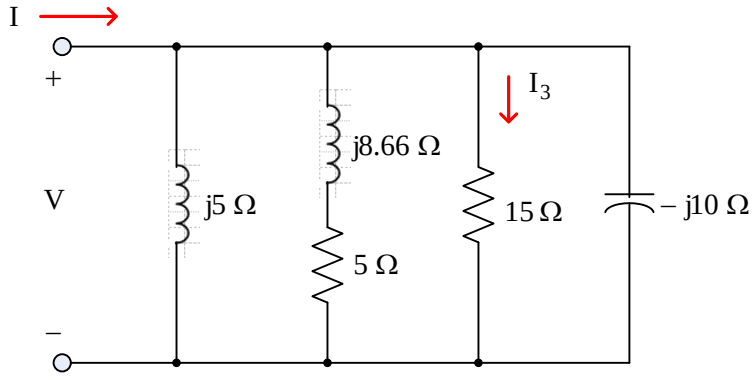

Fig.10

Ans. $Z_{eq} = 4.53\angle 58^\circ\ \Omega$, $Y_{eq} = 0.22\angle -58^\circ$ S

20. The total current I entering the circuit shown in Fig.10 is $33\angle 13^\circ$ A. Obtain the branch current I_3 and the voltage V.

ans. $I_3 = 9.97\angle 45^\circ$ A, $V = 149.5\angle 45^\circ$ V

21. Find I_1 and I_2 in the parallel circuit of Fig.11

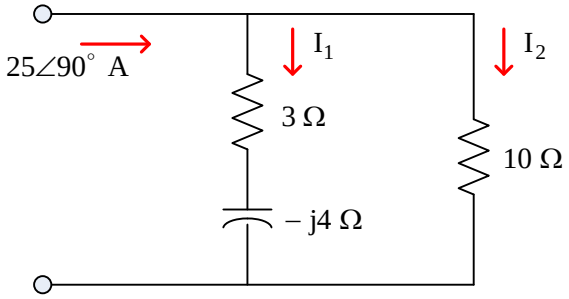

Fig.11

Ans. $I_1 = 18.4\angle 107.1^\circ$ A, $I_2 = 9.19\angle 54^\circ$ A,

22. For the network of Fig.12 . Obtain I_1, I_2, I_3

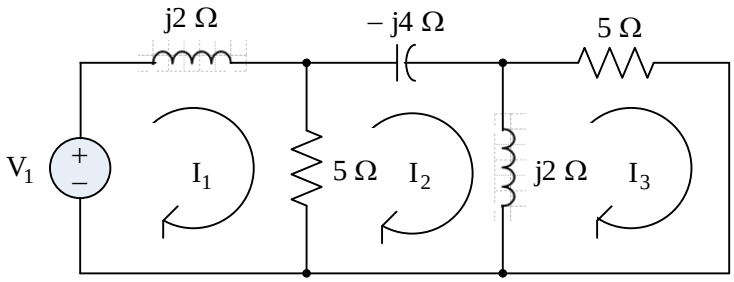

Fig.12

23. Using the node voltage method, find the voltage of node 1 in Fig.13 with respect to the reference.

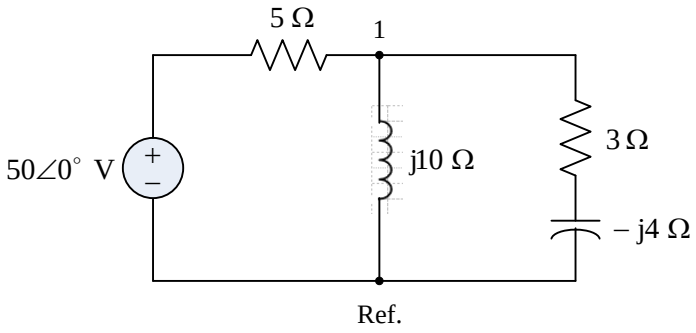

Fig.13

Ans. $30.7\angle -10.6^{\circ}$ V