Sheet (11)

Q1:- Answer the following questions

1. Convert each of the following to polar form:
   a. 5 + j12 b. 9 − j6 c. −8 + j15 d. −10 − j4

2. Convert each of the following to rectangular form:
   a. 6∠30° b. 14∠90° c. 16∠0° d. 6∠150°
   e. 20∠−140° f. −12∠30° g. −15∠−150°

3. Plot each of the following on the complex plane:
   a. 4 + j6 b. j4 c. 6∠−90° d. 10∠135°

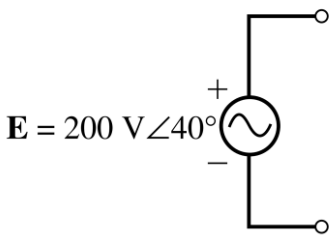
4. Simplify the following using powers of j:
   a. j(1 − j1) b. (−j)(2 + j5) c. j[j(1 + j6)] d. (j4)(−j2 + 4)
   e. (2 + j3)(3 − j4) f. (−2 − j3)(3 − j4)

5. Add or subtract as indicated. Express your answer in rectangular form.
   a. (4 + j8) + (3 − j2) b. (4 + j8) − (3 − j2)
   c. (4.1 − j7.6) + 12∠20° d. 2.9∠25° − 7.3∠−5°
   e. 9.2∠−120° − (2.6 + j4.1)

6. Multiply or divide as indicated. Express your answer in polar form.
   a. (37 + j9.8)(3.6 − j12.3) b. (41.9∠−80°)(16 + j2)
   c. (42 + j18.6)/(19.1− j4.8) d. (42.6 + j187.5)/(11.2∠38°)

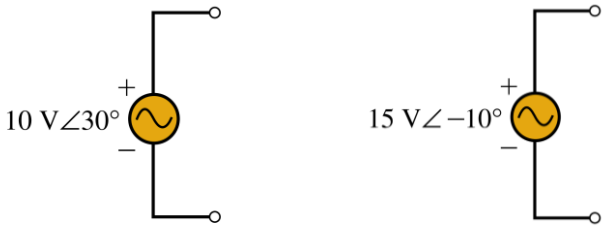
7. Reduce each of the following to polar form:
   a. $15 - j6 - \left[\dfrac{18\angle 40^\circ + (12 + j8)}{11 + j11}\right]$
   b. $\dfrac{21\angle 20^\circ - j41}{36\angle 0^\circ + (1 + j12) - 11\angle 40^\circ}$
   c. $\dfrac{18\angle 40^\circ - 18\angle -40^\circ}{7 + j12} - \dfrac{16 + j17 + 21\angle -60^\circ}{4}$

8. In the manner of the following figure, represent each of the following as transformed sources.
   a. e = 100 sin(ωt + 30°) V b. e = 15 sin(ωt − 20°) V
   c. e = 50 sin(ωt + 90°) V d. e = 50 cos ωt V
   e. e = 40 sin(ωt + 120°) V f. e = 80 sin(ωt − 70°) V



Transformed source

9. Determine the sinusoidal equivalent for each of the transformed sources of the following figure

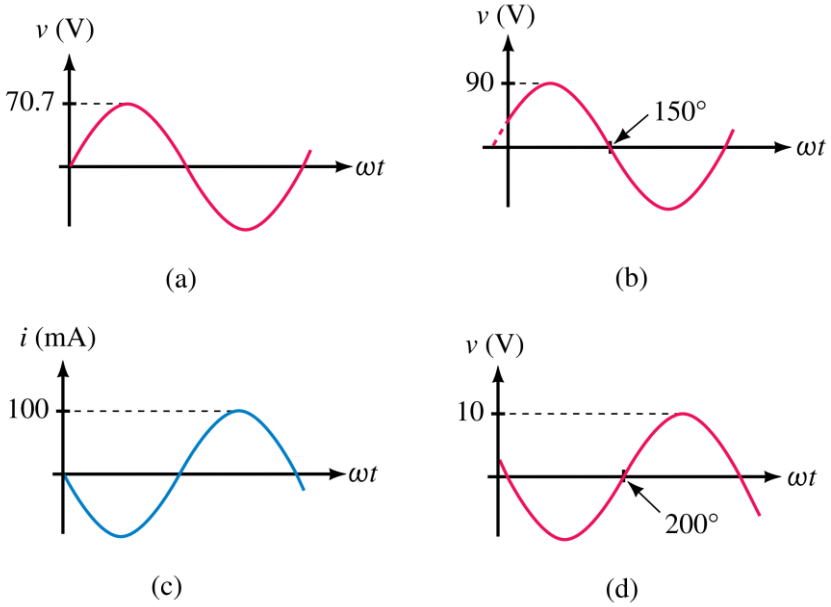


(a) (b)

10. Given: $e_1 = 10 \sin(\omega t + 30°)$ V and $e_2 = 15 \sin(\omega t - 20°)$ V. Determine their sum $v = e_1 + e_2$
    a. Convert e_1 and e_2 to phasor form.
    b. Determine $V = E_1 + E_2$.
    c. Convert V to the time domain.
    d. Sketch e_1, e_2, and v.

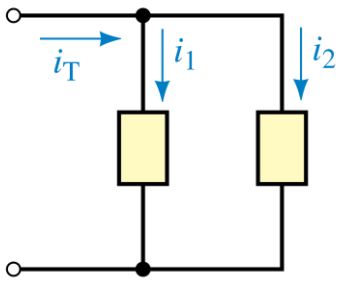
11. Repeat Problem 10 for $v = e_1 - e_2$.

12. Express the voltages and currents of the following figure as time domain and phasor domain quantities.



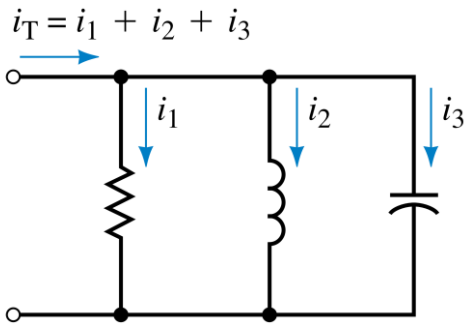
(a) (b) (c) (d)

13. For the following figure, $i_1 = 25 \sin(\omega t + 36°)$ mA and $i_2 = 40 \cos(\omega t - 10°)$ mA.
    a. Determine phasors I_1, I_2 and I_T.
    b. Determine the equation for i_T in the time domain.

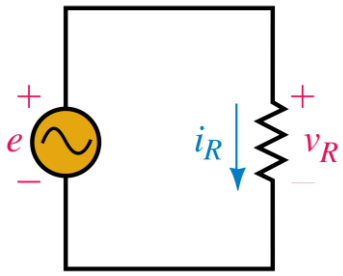


14. For the figure of problem (13), $i_T = 50 \sin(\omega t + 60°)$ A and $i_2 = 20 \sin(\omega t - 30°)$ A.
    a. Determine phasors I_T and I_2.
    b. Determine I_1.
    c. From (b), determine the equation for i_1.

15. For following figure, $i_1 = 7 \sin \omega t$ mA, $i_2 = 4 \sin(\omega t - 90°)$ mA, and $i_3 = 6 \sin(\omega t + 90°)$ mA.
    a. Determine phasors I_1, I_2, I_3 and I_T.
    b. Determine the equation for i_T in the time domain.



16. For the following figure, R = 12 Ω. For each of the following, determine the current or voltage and sketch.
    a. $v = 120 \sin \omega t$ V, i = ...
    b. $v = 120 \sin(\omega t + 27°)$ V, i = ...
    c. $i = 17 \sin(\omega t - 56°)$ mA, v = ...
    d. $i = -17 \cos(\omega t - 67°)$ mA, v = ...

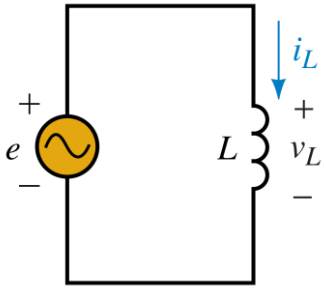


17. Given $v = 120 \sin(\omega t + 52°)$ V and $i = 15 \sin(\omega t + 52°)$ mA, what is R?

18. Two resistors $R_1 = 10$ kΩ and $R_2 = 12.5$ kΩ are in series. If $i = 14.7 \sin(\omega t + 39°)$ mA,
    a. What are v_{R1} and v_{R2}?
    b. Compute $v_T = v_{R1} + v_{R2}$ and compare to v_T calculated from $v_T = i\,R_T$.

19. The voltage across a certain component is $v = 120 \sin(\omega t + 55°)$ V and its current is $-18 \cos(\omega t + 145°)$ mA. Show that the component is a resistor and determine its value.

20. For the following figure, $V_m = 10$ V and $I_m = 5$ A. For each of the following, determine the missing quantity:
    a. $v_L = 10 \sin(\omega t + 60°)$ V, i_L = ...
    b. $v_L = 10 \sin(\omega t - 15°)$ V, i_L = ...
    c. $i_L = 5 \cos(\omega t - 60°)$ A, v_L = ...
    d. $i_L = 5 \sin(\omega t + 10°)$ A, v_L = ...

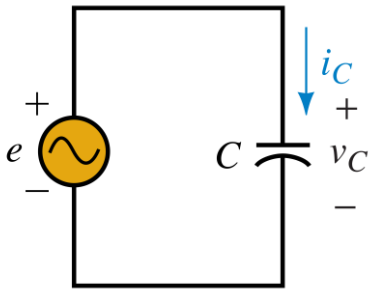


21. What is the reactance of a 0.5-H inductor at
    a. 60 Hz b. 1000 Hz c. 500 rad/s

22. For the figure of problem (20), $e = 100 \sin \omega t$ and $L = 0.5$ H. Determine i_L at
    a. 60 Hz b. 1000 Hz c. 500 rad/s

23. For the figure of problem (20), let $L = 200$ mH.
    a. If $v_L = 100 \sin 377t$ V, what is i_L ?
    b. If $i_L = 10 \sin(2\pi \times 400t - 60°)$ mA, what is v_L?
    c. $v_L = 40 \sin(\omega t + 30°)$ V, $i_L = 364 \sin(\omega t - 60°)$ mA, and $L = 2$ mH, what is f ?
    d. $i_L = 250 \sin(\omega t + 40°)$ mA, $v_L = 40 \sin(\omega t + \theta)$ V, and $f = 500$ kHz, what are L and θ ?

24. For the following figure, $V_m = 10$ V and $I_m = 5$ A. For each of the following, determine the missing quantity:
    a. $v_C = 10 \sin(\omega t + 60°)$ V, i_C = ...
    b. $v_C = 10 \sin(\omega t - 15°)$ V, i_C = ...
    c. $i_C = 5 \cos(\omega t - 60°)$ A, v_C = ...
    d. $i_C = 5 \sin(\omega t + 10°)$ A, v_C = ...



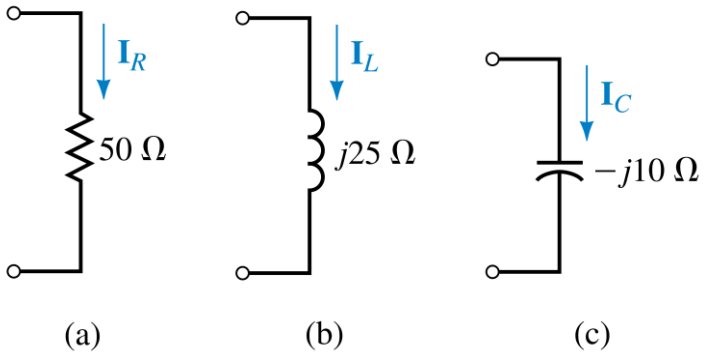
25. What is the reactance of a 5-μF capacitor at
    a. 60 Hz b. 1000 Hz c. 500 rad/s

26. For the figure of problem (24), $e = 100 \sin \omega t$ and $C = 5$ mF. Determine i_C at
    a. 60 Hz b. 1000 Hz c. 500 rad/s

27. For the figure of problem (24), let $C = 50$ mF.
    a. If $v_C = 100 \sin 377t$ V, what is i_C ?
    b. If $i_C = 10 \sin(2\pi \times 400t - 60°)$ mA, what is v_C?

28. For the figure of problem (24), if
    a. $v_C = 362 \sin(\omega t - 33°)$ V, $i_C = 94 \sin(\omega t + 57°)$ mA, and $C = 2.2$ mF, what is f ?
    b. $i_C = 350 \sin(\omega t + 40°)$ mA, $v_C = 3.6 \sin(\omega t + \theta)$ V, and $f = 12$ kHz, what are C and θ?

29. If E = 100V∠0° is applied across each of the circuit elements of the following figure:
    a. Determine each current in phasor form.
    b. Express each current in time domain form

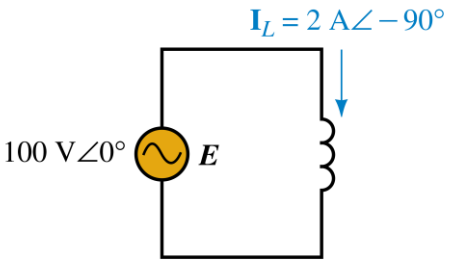


30. If the current through each circuit element of the figure of problem (29) is 0.5 A∠0°:
    a. Determine each voltage in phasor form.
    b. Express each voltage in time domain form.

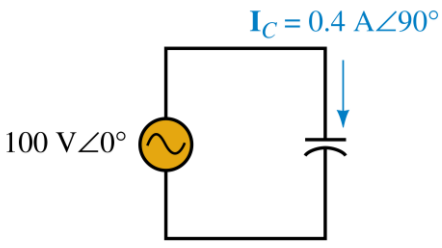
31. For each of the following, determine the impedance of the circuit element and state whether it is resistive, inductive, or capacitive.
    a. V = 240 V∠−30°, I = 4 A∠−30°.
    b. V = 40 V∠30°, I = 4 A∠−60°.
    c. V = 60 V∠−30°, I = 4 A∠60°.
    d. V = 140 V∠−30°, I = 14 mA∠−120°.

32. For each circuit of the following figure, determine the unknown.

a. If V_L = 120 V ∠67°,	L = 600 mH,	and f = 10 kHz,	what is I_L?
b. If I_L = 48 mA ∠−43°,	L = 550 mH,	and f = 700 Hz,	what is V_L?
c. If V_C = 50 V ∠−36°,	C = 390 pF,	and f = 470 kHz,	what is I_C?
d. If I_C = 95 mA ∠87°,	C = 6.5 nF,	and f = 1.2 MHz,	what is V_C?



(a) L = 0.2 H.
Determine f.



(b) f = 100 Hz.
Determine C.