Question 1) Add the following phasors –

A) $v_1(t) = 10\cos(\omega t) + 10\sin(\omega t)$

B) $i_1(t) = 10\cos(\omega t + 30°) + 5\sin(\omega t + 30°)$

C) $i_2(t) = 20\sin(\omega t + 90°) + 15\cos(\omega t - 60°)$

(a) $v_1(t) = 10\cos(\omega t) + 10\sin(\omega t)$

STEP-1

$$v_1(t) = 10\cos(\omega t + 0) + 10\cos(\omega t - 90^\circ)$$

STEP-2

$$v_1(t) = 10\angle 0^\circ + 10\angle -90^\circ$$

STEP-3

$$v_1(t) = 10(\cos 0^\circ + i\sin 0^\circ) + 10(\cos(-90)^\circ + i\sin(-90^\circ))$$

$$= 10 + (-i)10 = 10 - 10i$$

STEP-4

$$v_1(t) = 10 - 10i = z \text{ (Let)}$$

$$|z| = \sqrt{10^2 + 10^2} = \sqrt{200} = 10\sqrt{2} = 14.142$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{-10}{10}\right)$$

$$= \tan^{-1}(-1) = -45$$

$$\Rightarrow v_1(t) = |z|\angle\theta = 10\sqrt{2}\left[\cos(-45)^\circ + i\sin(-45^\circ)\right]$$

$$= 10\sqrt{2}\left[\frac{1}{\sqrt{2}} -\right.$$

$$\Rightarrow v_1(t) = |z|\angle\theta = 10\sqrt{2}\angle -45^\circ$$

STEP-5

$$v_1(t) = 10\sqrt{2}\left(\cos(\omega t) + (-45^\circ)\right)$$

$$= 14.142(\cos(\omega t - 45^\circ))$$

(b) $i_1(t) = 10\cos(\omega t + 30^\circ) + 5\sin(\omega t + 30^\circ)$

STEP-1

$$i_1(t) = 10\cos(\omega t + 30^\circ) + 5\cos(\omega t + 30^\circ - 90^\circ)$$

$$= 10\cos(\omega t + 30^\circ) + 5\cos(\omega t - 60^\circ)$$

STEP-2

$$i_1(t) = 10\angle 30^\circ + 5\angle -60^\circ$$

STEP-3

$$i_1(t) = 10(\cos 30^\circ + i\sin 30^\circ) + 5(\cos(-60^\circ) + i\sin(-60^\circ))$$

$$= 10\left(\frac{\sqrt{3}}{2} + i\frac{1}{2}\right) + 5\left(\frac{1}{2} - i\frac{\sqrt{3}}{2}\right)$$

$$= 5\sqrt{3} - 5i + \frac{5}{2} + \frac{5\sqrt{3}}{2}i = 11.1602 + (+0.6698i)$$

STEP-4

$$i_1(t) = 11.1602 + 0.6698i = A \text{ (Let)}$$

$$|A| = \sqrt{(11.1602)^2 + (0.6698)^2}$$

$$= \sqrt{0.4487 + 124.5512} = 11.1851$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{+0.6698}{11.1602}\right)$$

$$= \tan^{-1}(+0.006002309 4) = +3.4349$$

$$\Rightarrow i_1(t) = |A|\angle\theta = 11.18\angle +3.4349$$

STEP-5

$$i_1(t) = 11.18\cos(\omega t + 3.4349^\circ)$$

(c) $i_2(t) = 20\sin(\omega t + 90^\circ) + 15\cos(\omega t - 60^\circ)$

STEP-1

$i_2(t) = 20\cos(\omega t + 90^\circ - 90^\circ) + 15\cos(\omega t - 60^\circ)$

$= 20\cos(\omega t) + 15\cos(\omega t - 60^\circ)$

STEP-2

$i_2(t) = 20\angle 0^\circ + 15\angle -60^\circ$

STEP-3

$i_2(t) = 20(\cos 0^\circ + i\sin 0^\circ) + 15(\cos(-60^\circ) + i\sin(-60^\circ))$

$= 20 + 15(0.5 - \frac{\sqrt{3}}{2}i) = 20 + 7.5 - 12.990i$

$= 27.5 - 12.99i$

STEP-4

$i_2(t) = 27.5 - 12.99i$

$|i_2| = \sqrt{27.5^2 + 12.99^2} = \sqrt{924.9901}$

$= 30.4136$

$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{-12.99}{27.5}\right)$

$= -25.2843$

$\Rightarrow i_2(t) = 30.4136\angle -25.2843$

STEP-5

$i_2(t) = 30.4136\cos(\omega t - 25.2843)$

Question 2)

3 voltages are given as -

$v_1(t) = \cos(\omega t - 30^o)$

$v_2(t) = \cos(\omega t + 30^o)$

$v_3(t) = \cos(\omega t + 45^o)$

State the phase relationship between each pair of voltages

3 voltages are given as

$v_1(t) = \cos(\omega t - 30^\circ)$

$v_2(t) = \cos(\omega t + 30^\circ)$

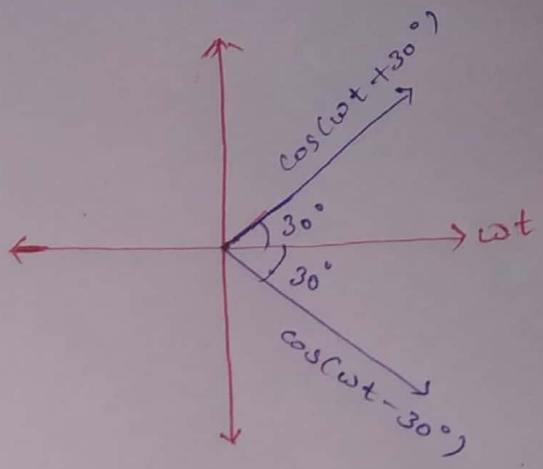
$v_3(t) = \cos(\omega t + 45^\circ)$

State the phase relationship between each pair of voltages.

* $v_1(t) = \cos(\omega t - 30^\circ)$

$v_2(t) = \cos(\omega t + 30^\circ)$

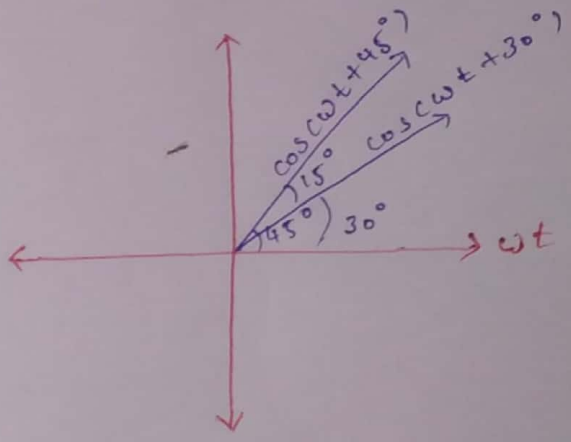
$\Rightarrow v_1(t)$ and $v_2(t)$ are 60° apart to each other (V_2 leads)



* $v_2(t) = \cos(\omega t + 30^\circ)$

$v_3(t) = \cos(\omega t + 45^\circ)$

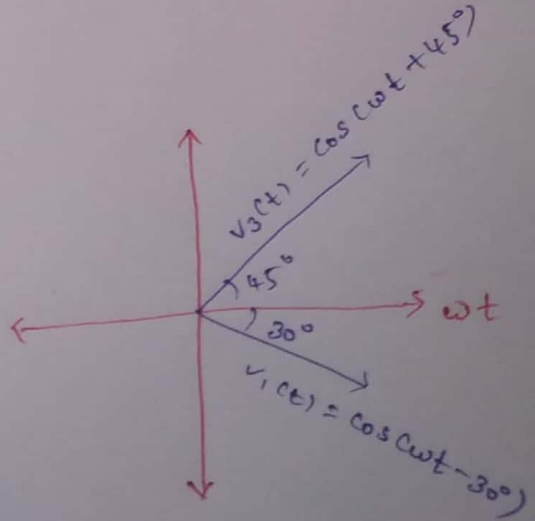
$\Rightarrow v_2(t)$ and $v_3(t)$ are 15° apart to each other (V_3 leads)

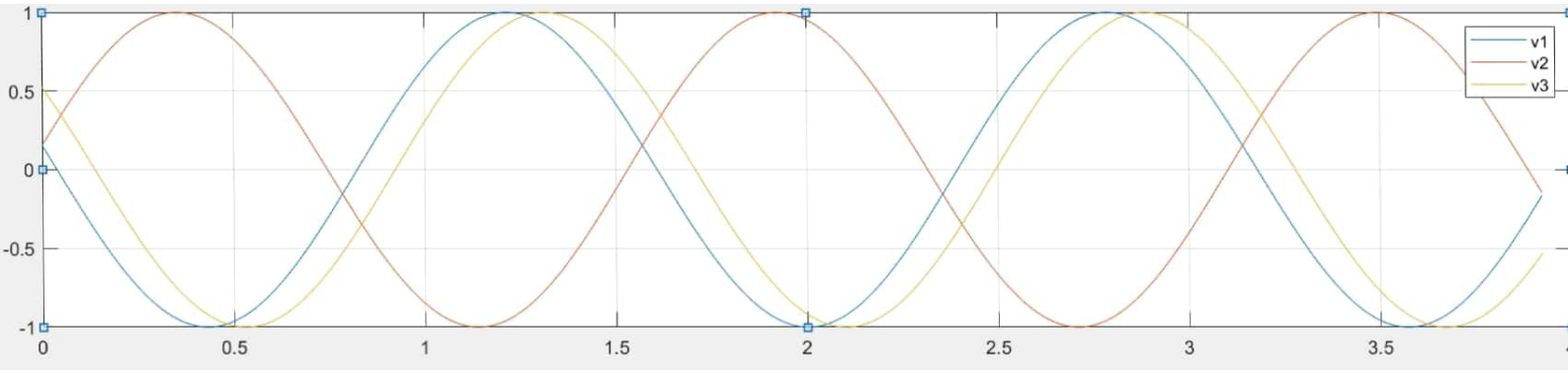


* $v_1(t) = \cos(\omega t - 30^\circ)$

$v_3(t) = \cos(\omega t + 45^\circ)$

$\Rightarrow v_1(t)$ and $v_3(t)$ are 75° apart to each other (V_3 leads)





Question 3)

A voltage $v_L(t) = 100\cos(100t)$ is applied to a 0.25H inductance. Notice that ω=200 rad/s.

a) Find impedance of inductance, phasor current and phasor voltage (of inductor)
b) Draw phasor diagram

Question - 3

A voltage $V_L(t) = 100\cos(200t)$ is applied to a 0.25 H inductance. Notice that $\omega = 200$ rad/

(a) Find impedance of inductance, phasor current and phasor voltage (of inductor)

(b) Draw phasor diagram.

(a) Impedance, $Z_L = j\omega L$

$= (200)(0.25)\, j = 50j = 50\angle 90^\circ = 50\cos(200t$

Phasor Voltage, $V_L(t) = 100\cos(200t)$

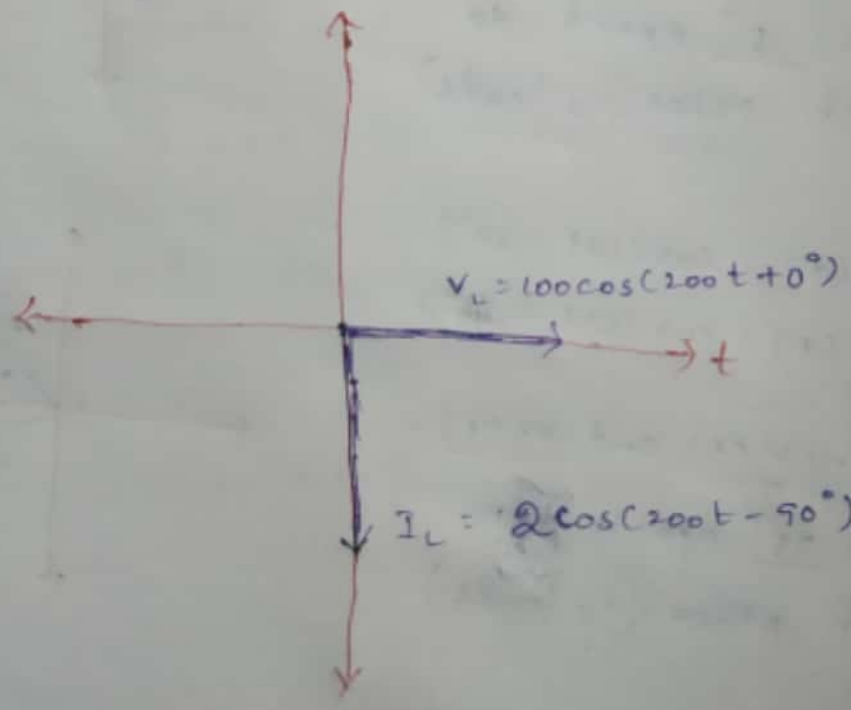
$= 100\angle 0^\circ$

Phasor current, $I_L = \frac{V_L}{Z_L} = \frac{100\angle 0^\circ}{50\angle 90^\circ}$

$= 2\angle 0^\circ - 90^\circ = 2\angle -90^\circ$

$= 2\cos(200t - 90^\circ)$

(b)



Question 4)

A voltage $v_C(t) = 100\cos(100t)$ is applied to a 100μF capacitance.

a) Find impedance of capacitance, phasor current and phasor voltage (of capacitor)
b) Draw phasor diagram

Question-4

A voltage $V_c(t) = 100\cos(200t)$ is applied to a 100μF capacitance.

(a) Find impedance of capacitance, phasor current and phasor voltage (of capacitor)

(b) Draw phasor diagram

(a) Impedance, $Z_c = -j\frac{1}{\omega C} = -j\frac{1}{200\times 100\times 10^{-6}}$

$= 0.5\times 10^{2}\times -j = +50j$

$= +50\angle -90^\circ = +50\cos(200t - 90^\circ)$

Phasor voltage, $V_c(t) = 100\cos(200t + 0^\circ)$

$= 100\angle 0^\circ$

Phasor current $= \frac{V_c}{Z_c} = \frac{100\angle 0^\circ}{50\angle -90^\circ} = 2\angle 90^\circ$

$= 2\cos(200t + 90^\circ)$

(b)