

Concepts

①

① Real number — x

Complex number

$$x + jy$$

$$r \angle \theta$$

$$r = \sqrt{x^2 + y^2}$$

$$\theta = \underset{\text{sign}}{\nearrow} \tan^{-1}(y/x)$$

$$x = r \cos \theta$$

$$y = r \sin \theta$$

$$180^\circ \sim \pi'$$

$$\theta^\circ \sim \theta^\circ \times \frac{\pi}{180}$$

② Euler's formula

$$e^{j\theta} = \cos \theta + j \sin \theta$$

Trigonometry identities

②

① $\sin \theta = \cos\left(\frac{\pi}{2} - \theta\right)$

$\cos \theta = \sin\left(\frac{\pi}{2} - \theta\right)$

② $\sin(-\theta) = -\sin \theta$

$\cos(\theta) = \cos \theta$

③ All Silver Tea Cups

④ $\sin(A) + \sin(B)$

$\cos(A) + \cos(B)$

Refresh

$v(t)$ = Function

$V_0 \cos(\omega t + \phi)$

Number

+

$V_0 \angle \phi$

$V_0 \cos \phi + j V_0 \sin \phi$



TD

- small letters

$u, i, p,$

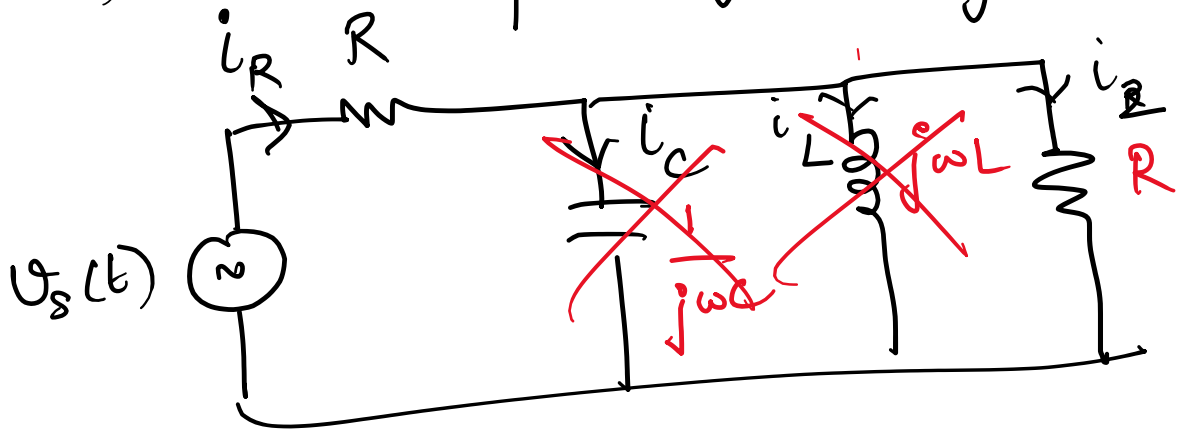
- R, L, C

FD

capital letters

V, I, P

+ $R, j\omega L, \frac{1}{j\omega C}$



Not understood the concept

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- ① Quizzer & Ename will be tough
 - ② Scientific calculator - acclimatize
 - ③ Do all problems from the textbook

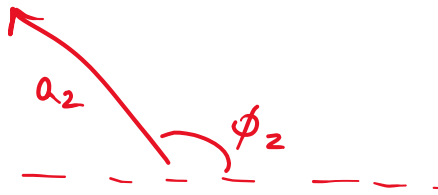
Law of Cosines - Triangle addition

(4)

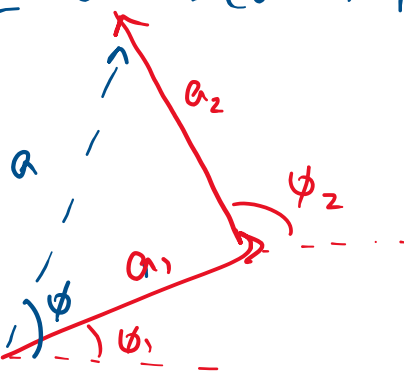
$$v_1(t) = a_1 \cos(\omega t + \phi_1)$$



$$v_2(t) = a_2 \cos(\omega t + \phi_2)$$



$$v_1 + v_2 = a \cos(\omega t + \phi)$$



$$a = \sqrt{a_1^2 + a_2^2 + 2a_1a_2 \cos(\phi_1 - \phi_2)}$$

$$\phi = \tan^{-1} \left(\frac{a_1 \sin \phi_1 + a_2 \sin \phi_2}{a_1 \cos \phi_1 + a_2 \cos \phi_2} \right)$$

(watch out for the signs)

Practice Sheet 1

Chapter 10 of Hayt – Kemmerly, 8th Editionradians
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- Evaluate $5 \sin(5t - 9^\circ)$ at $t = 0.01, 0.1$ s

$$5 \sin(5 \times 0.01 - 9^\circ) = -0.5344$$

↪ convert to radians

$$5 \sin(5 \times 0.1 - 9^\circ) = 1.6812$$

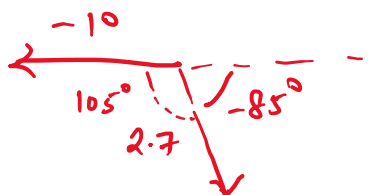
↪ convert to radians

- Express $2.7 \sin(50t + 5^\circ) - 10 \cos(50t)$ as a single cosine function

$$2.7 \sin(50t + 5^\circ) = 2.7 \cos(90^\circ - 50t - 5^\circ)$$

$$= 2.7 \cos(50t + 5^\circ - 90^\circ) = 2.7 \cos(50t - 85^\circ)$$

$$2.7 \cos(50t - 85^\circ) - 10 \cos(50t) \Rightarrow \text{Using cosine law of triangles}$$



$$= 10.1284 \angle -164^\circ$$

$$\rightarrow 10.1284 \cos(50t - 164^\circ)$$

- Determine which waveform in the following pair is lagging, $\cos(4t + 80^\circ)$, $\cos 4t + \sin 4t$

$$\cos(4t) + \sin(4t) \rightarrow \text{Using law of cosines}$$

$$\sqrt{2} \cos(4t - 45^\circ)$$

$$\cos(4t + 80^\circ), \sqrt{2} \cos(4t - 45^\circ)$$

↙
lagging

Phasors / Frequency Domain ⑥

Only for

— $A \cos(\omega t + \phi)$

Real valued time domain function

— Phasor representation
 $A \angle \phi$

constant complex number

$A \cos(\omega t + \phi) = A \angle \phi$

Wrong!

Phasor representation of $A \cos(\omega t + \phi)$
 $= A \angle \phi$ ✓

$$v(t) = A \cos(\omega t + \phi)$$

$$V(\omega) = A \angle \phi$$
 ✓