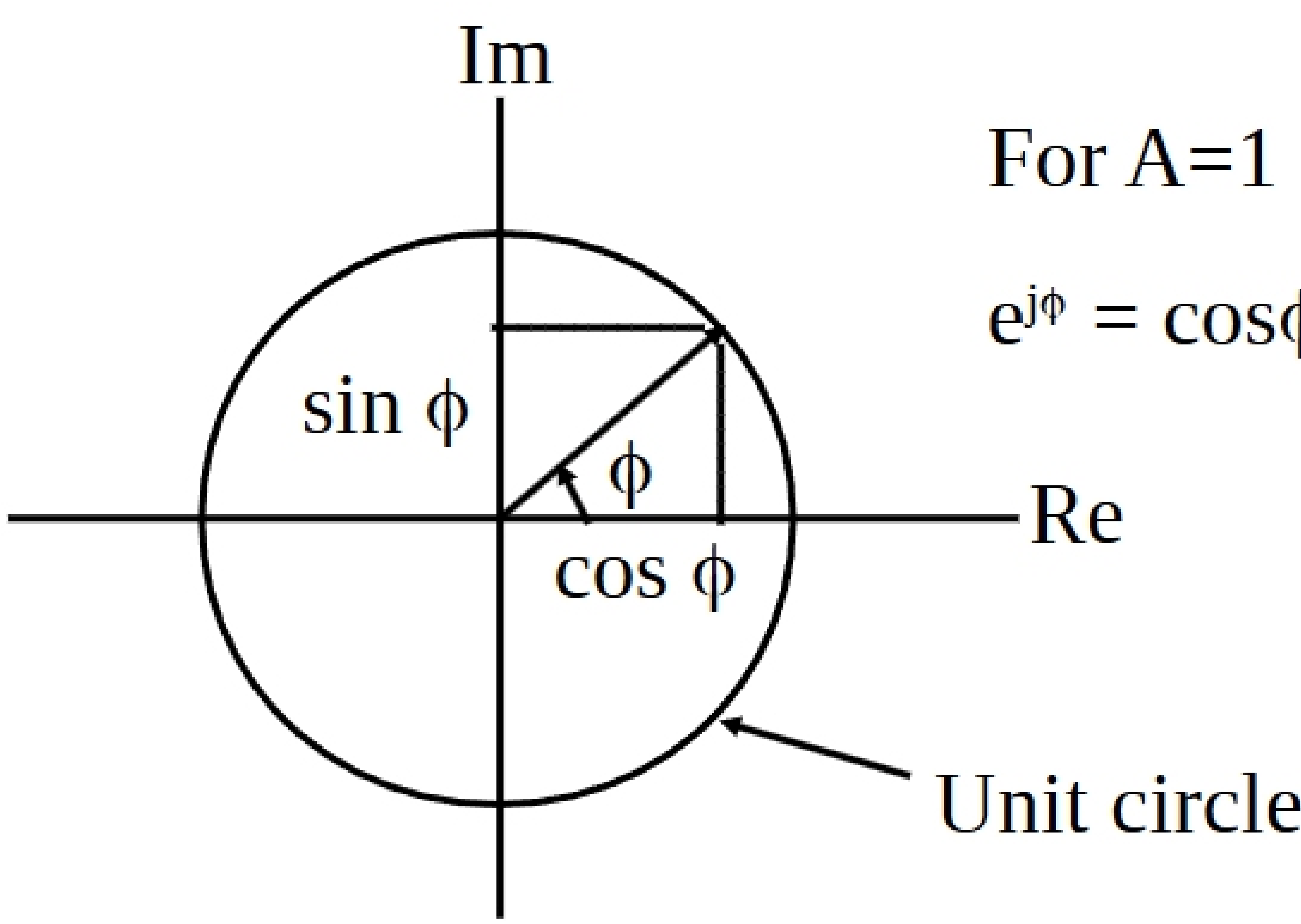
Phasors

Phasors: Complex number representations of sinusoidal signals at fixed frequency, ω.

Complex number $= Ae^{j\omega t+\phi} = A(e^{j\omega t} e^{j\phi})$

But if ω is constant: $Ae^{j\phi} \equiv A\angle\phi$



For A=1

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

$|e^{j\phi}| = e^{j\phi} e^{-j\phi} = \cos^2\phi + \sin^2\phi = 1$

$A \angle \phi$ completely specifies the quantity
$A \cos(\omega t+\phi)$ for <u>known ω</u>.

Phasor voltage : $\underline{V} = V_m \angle \phi$
Phasor current: $\underline{I} = I_m \angle \phi$
} Denoted by bold type in text.

$v(t) = -15 \sin(\omega t - 60^\circ)$
$v(t) = 15 \cos(\omega t + 30^\circ)$
} $\underline{V} = 15 \angle 30^\circ$

$i(t) = 25 \cos(\omega t + 45^\circ)$ $\underline{I} = 25 \angle 45^\circ$

<u>Ohm's Law Relationships for SSS</u>

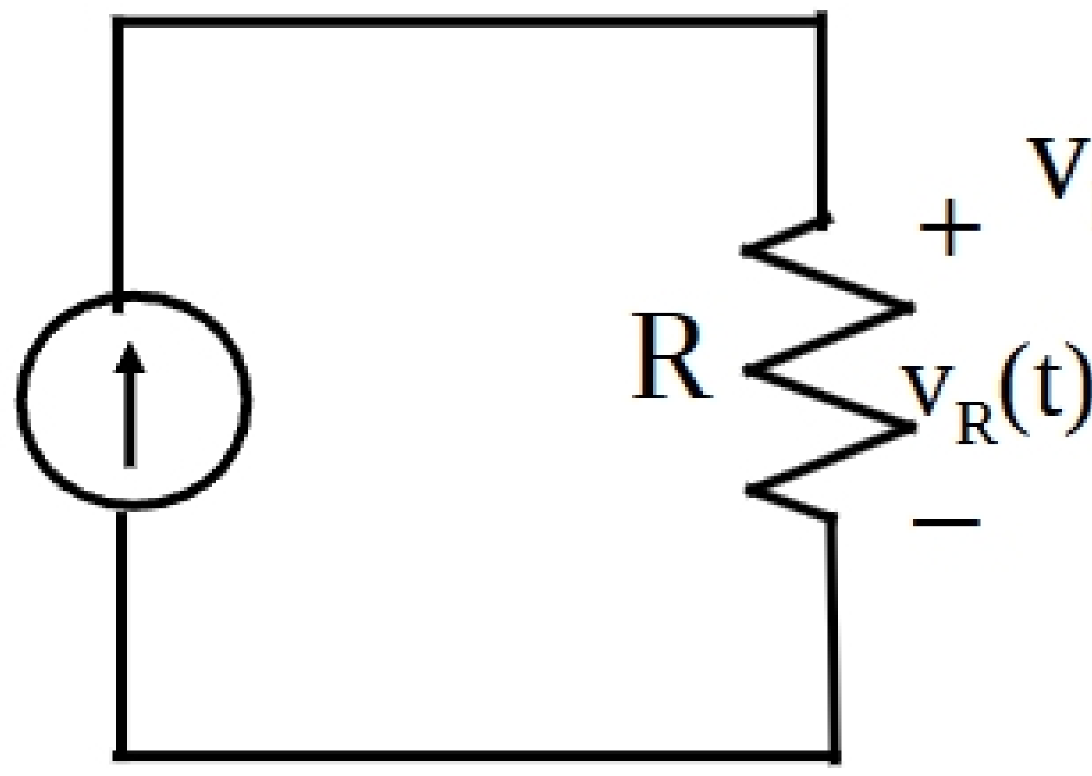
Exists for resistors, inductors & capacitors.

General form: $\underline{V} = z(j\omega)\, \underline{I}$

$z(j\omega)$- impedance (units: ohms)

Impedance concept for resistors

$i_R(t) = I_R e^{j(\omega t+\theta)}$ ⇓ $\underline{I}_R$



$v_R(t) = RI_R e^{j(\omega t+\theta)}$ ⇓ $\underline{V}_R$

$\underline{V}_R = z_R\ (j\omega)\ \underline{I}_R$

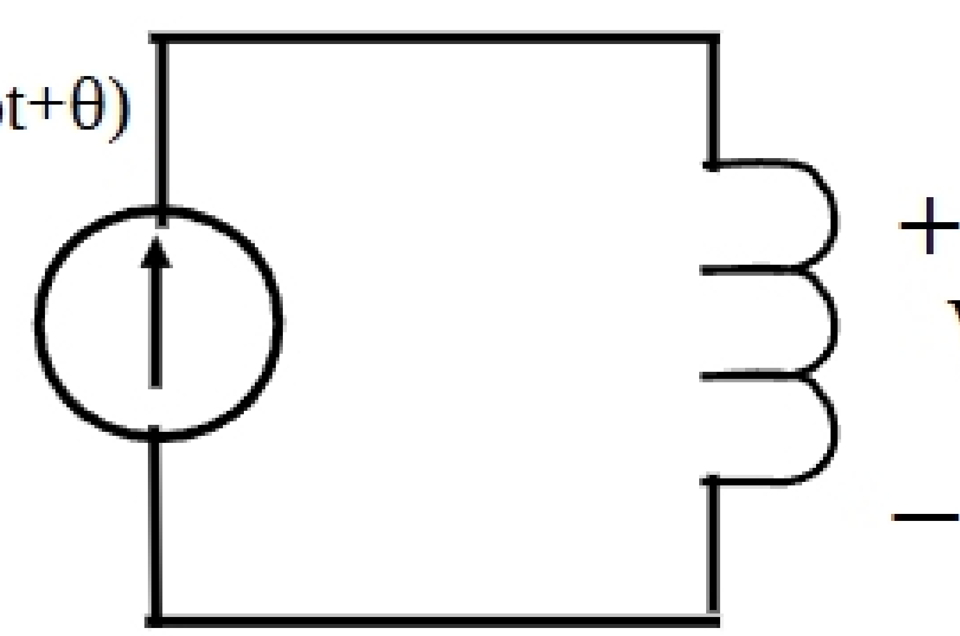
$$z_R\ (j\omega) = R$$

$\underline{V}_R = R\ \underline{I}_R$

Resistor impedance is independent of frequency

Impedance concept for inductors

$i_L(t) = I_L e^{j(\omega t+\theta)}$ ⇓ $\underline{I}_L$



$v_L(t) = V_L e^{j(\omega t+\phi)}$ ⇓ $\underline{V}_L$