Phasor algebra

To Represent R, X_L, X_C in rectangular form

$Z_R = R + j0$.

$Z_L = 0 + jX_L$.

$Z_C = 0 - jX_C$.

To represent R, X_L, X_C in polar form.

$Z_R = R\angle 0^\circ$

$Z_L = X_L \angle 90^\circ$

$Z_C = X_C \angle -90^\circ$.

converting rectangular to polar form.

Eg: $Z = (10 + j15)\Omega$ convert this into polar form.

soln:

1. Display 10
2. press [shift] key
3. press [R → P]
4. Display 15
5. press [=] It shows 18.03 Ω

6. Press $x \rightarrow y$ It shows the angle 56.31°.

7. In polar form now z is written as

$Z = 18.03 \angle 56.31^\circ$.

converting polar to Rectangular form.

Eg: Convert $10 \angle 60^\circ$ into rectangular form.

Solution:

1. Display 10
2. press shift key
3. press $P \rightarrow R$
4. Display 60°
5. press = It shows 5 (active part)
6. press $x \rightarrow y$ It shows 8.66 (reactive part)
7. so $Z = 5 + j\,8.66$.

Note: The calculator must be set in 'deg' mode for conversions.

Addition and subtraction should be in Rectangular form.

Multiplication and division should be in polar form.

$$A\angle\theta + B\angle\phi = AB\angle\theta+\phi.$$

$$A\angle\theta \div B\angle\phi = \frac{A}{B}\angle\theta-\phi.$$

$$(A+jB)+(C+jD) = (A+C)+j(B+D)$$

$$(A+jB)-(C+jD) = (A-C)+j(B-D)$$

write the result in polar form.

$$10\angle 60^\circ + 8\angle -45^\circ.$$

$$= 5+j8.66 + 5.66 - j5.66$$

$$= 10.66\angle 3^\circ$$

$$= 11.07\angle 15.72^\circ.$$

1. $Z_1 = 10+j10$ & $Z_2 = 20-j30$, are in series. Find Z_T in polar form.

Soln:

$$Z_T = Z_1 + Z_2.$$
$$= 10+j10+20-j30$$
$$= 30-j20.$$
$$= 36.1 \angle -33.7^\circ.$$

2. The total impedance of a circuit in which Z_1, Z_2 are in series is equal to $(30+j40)\Omega$. $Z_1 = (20+j60)\Omega$. Find Z_2.

$$Z_T = Z_1 + Z_2.$$
$$Z_2 = Z_T - Z_1$$
$$= 30+j40-20-j60.$$
$$= 10-j20 \text{ (Rectangular form)}$$
$$= 22.36 \angle -63.43 \text{ (polar form)}$$

3. In a given circuit $I = 10\angle 60^\circ$, $z = 20\angle 30$. Find V.

solution.

$$V = IZ$$

$$= 10\angle 60^\circ \cdot 20\angle 30^\circ$$

$$= (10 \times 20)\angle 60+30^\circ$$

$$= 200\angle 90^\circ.$$

4. In a circuit $V = 200V$. $I = 10\angle 30^\circ$. Find z both in polar form and rectangular form.

$$I = \frac{V}{z}$$

$$= \frac{200\angle 0^\circ}{10\angle 30^\circ} = 20\angle 0-30^\circ = 20\angle -30^\circ.$$

$$= 17.32 - j10$$