Complex numbers 001

Problem has been graded.

$$\frac{\mathbf{V_1} + 6j}{2j} + \frac{\mathbf{V_1}}{-cj} + \frac{\mathbf{V_1}}{c} = 0$$

Find $\mathbf{V_1}$ in cartesian coordinates, i.e., find a and b:

$$\mathbf{V_1} = a + bj$$

Solve without a calculator

Given Variables:

c : 4 .

Calculate the following:

a (.) :

-6 ✓

b (.) :

-6 ✓

Hint: Solve in cartesian coordinates.

$$\frac{\mathbf{V_1} + 6j}{2j} + \frac{\mathbf{V_1}}{-cj} + \frac{\mathbf{V_1}}{c} = 0$$

c : 4

Find $\mathbf{V_1}$ in cartesian coordinates, i.e., find a and b:

$\mathbf{V_1} = a + bj$

$$\frac{V_1 + 6j}{2j} + \frac{V_1}{-4j} + \frac{V_1}{4} = 0$$

$$\frac{2V_1 + 12j}{4j} + \frac{(-V_1)}{4j} + \frac{V_1 \cdot j}{4j} = 0$$

$$V_1 + jV_1 = -12j$$

$$V_1 = -\frac{12j}{1+j} \cdot \frac{1-j}{1-j} = \frac{-12(j+1)}{1+1} = -6(1+j)$$

$$\boxed{a = -6}$$

$$\boxed{b = -6}$$

Complex numbers 002

Problem has been graded.

Find A_1 and B_1.

$$\mathbf{V_1} = b\sqrt{2} \cdot j \qquad \mathbf{Z_1} = \left(aj + \frac{a}{1+j}\right)^{-1} \qquad \mathbf{I_1} = \frac{\mathbf{V_1}}{\mathbf{Z_1}}$$

$$\mathbf{I_1} = A_1 \cdot e^{jB_1} \quad \text{with} \quad 0 \leq A_1 \quad \text{and} \quad -180° \leq B_1 \leq 180$$

Solve without a calculator

Given Variables:

a : 1 .

b : 2 .

Calculate the following:

A1 (.) :

2 ✓

B1 (degrees) :

135 ✓

Hint: Write Z1 in polar coordinates.

Find A_1 and B_1.

a : 2 .

b : 2 .

$$\mathbf{V_1} = b\sqrt{2}\cdot j \qquad \mathbf{Z_1} = \left(aj + \frac{a}{1+j}\right)^{-1} \qquad \mathbf{I_1} = \frac{\mathbf{V_1}}{\mathbf{Z_1}}$$

$\mathbf{I_1} = A_1 \cdot e^{jB_1}$ with $0 \leq A_1$ and $-180^\circ \leq B_1 \leq 180$

$$I_1 = \left(2\sqrt{2}\,j\right) \cdot Z^{-1}$$

$$= \left(2\sqrt{2}\,j\right)\left(2j + \frac{2}{1+j}\right)$$

$$= 4\sqrt{2}\,j\left(\frac{j\cancel{-1+1}}{1+j}\right)$$

$$= -\frac{4\sqrt{2}}{1+j}$$

$$= \frac{4\sqrt{2}\,e^{j\pi}}{\frac{2}{\sqrt{2}}\,e^{j\frac{\pi}{4}}}$$

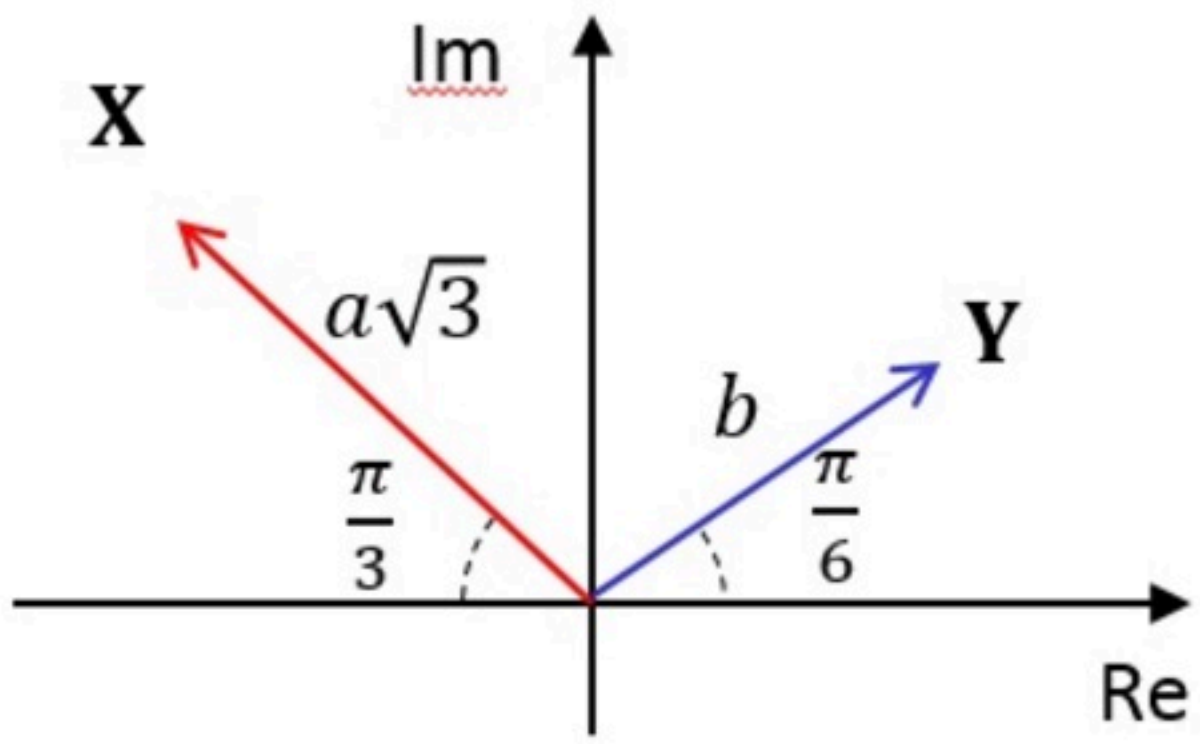
$$= 4\,e^{j\frac{3\pi}{4}}$$

$$\boxed{A_1 = 4}$$

$$\boxed{B_1 = 135^\circ}$$

Complex numbers 003

Problem has been graded.



$$\mathbf{A} = \mathbf{X} + \mathbf{Y}$$

Find $d = |\mathbf{A}|^2$

Solve without a calculator.

Given Variables:

a : 1 .

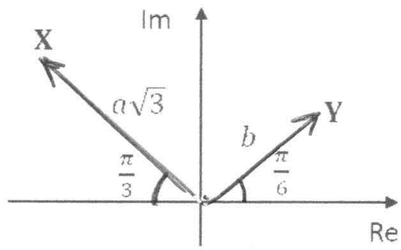
b : 3 .

Calculate the following:

d (.) :

12

Hint: Convert to cartesian coordinates



a : 1 .

b : 3 .

$\mathbf{A} = \mathbf{X} + \mathbf{Y}$

Find $d = |\mathbf{A}|^2$

$$X = \sqrt{3}\, e^{j\frac{2\pi}{3}} = \sqrt{3}\left(-\frac{1}{2} + \frac{\sqrt{3}}{2} j\right) = -\frac{\sqrt{3}}{2} + \frac{3}{2} j$$

$$Y = 3\, e^{j\frac{\pi}{6}} = 3\left(\frac{\sqrt{3}}{2} + \frac{j}{2}\right) = \frac{3\sqrt{3}}{2} + \frac{3}{2} j$$

$$A = X + Y = \frac{2\sqrt{3}}{2} + \frac{6}{2} j = \sqrt{3} + 3j$$

$$|A|^2 = (\sqrt{3})^2 + (3)^2 = 3 + 9 = 12$$

$$\boxed{d = 12}$$

Complex numbers 004

Problem has been graded.

$$\frac{\mathbf{V_1} + 4j}{j} - \frac{\mathbf{V_1} + 4j}{cj} + \frac{\mathbf{V_1}}{-4j} + \frac{\mathbf{V_1}}{4} = 0$$

Find $\mathbf{V_1}$ in cartesian coordinates, i.e., find a and b:

$$\mathbf{V_1} = a + bj$$

Solve without a calculator

Given Variables:

c : 2 .

Calculate the following:

a (.) :

-4 ✓

b (.) :

-4 ✓

Hint: Solve in cartesian coordinates.

$$\frac{\mathbf{V_1} + 4j}{j} - \frac{\mathbf{V_1} + 4j}{cj} + \frac{\mathbf{V_1}}{-4j} + \frac{\mathbf{V_1}}{4} = 0$$

c : 2 .

Find $\mathbf{V_1}$ in cartesian coordinates, i.e., find a and b:

$\mathbf{V_1} = a + bj$

$$\frac{V_1 + 4j}{j} - \frac{V_1 + 4j}{2j} + \frac{V_1}{-4j} + \frac{V_1}{4} = 0$$

$$\frac{4V_1 + 16j}{4j} + \frac{(-2V_1 - 8j)}{4j} + \frac{(-V_1)}{4j} + \frac{(V_1 j)}{4j} = 0$$

$$V_1 + jV_1 + 8j = 0$$

$$V_1 = \frac{-8j}{1+j} \cdot \left(\frac{1-j}{1-j}\right)$$

$$V_1 = \frac{-8j - 8}{1+1} = -4 - 4j$$

$$\boxed{a = -4}$$

$$\boxed{b = -4}$$

Complex numbers 005

Problem has been graded.

Hint: Solve this symbolically as much as you can and only plug in numbers at the very end.

Find P and Q.

Note: We've used bold capital letters to denote complex variables. The * operator stands for complex conjugate. The Re[] and Im[] operators stand for taking the real part and imaginary part respectively.

Solve without a calculator

$$\mathbf{V_1} = be^{j\frac{\pi}{3}} \qquad \mathbf{Z_1} = a - aj \qquad \mathbf{I_1} = \frac{\mathbf{V_1}}{\mathbf{Z_1}}$$

$$\mathbf{S} = \frac{1}{2} \cdot \mathbf{V_1} \cdot \mathbf{I_1^*} \qquad P = \mathrm{Re}[\mathbf{S}] \qquad Q = \mathrm{Im}[\mathbf{S}]$$

Given Variables:

a : 1 .

b : 2 .

Calculate the following:

P (.) :

1 ✓

Q (.) :

-1 ✓

Hint: Work this out symbolically first and only plug in numbers later.

Find P and Q.

a : 2 .

b : 4 .

Note: We've used bold capital letters to denote complex variables. The * operator stands for complex conjugate. The Re[] and Im[] operators stand for taking the real part and imaginary part respectively.

$$\mathbf{V_1} = be^{j\frac{\pi}{3}} \qquad \mathbf{Z_1} = a - aj \qquad \mathbf{I_1} = \frac{\mathbf{V_1}}{\mathbf{Z_1}}$$

$$\mathbf{S} = \frac{1}{2} \cdot \mathbf{V_1} \cdot \mathbf{I_1^*} \qquad P = \mathrm{Re}[\mathbf{S}] \qquad Q = \mathrm{Im}[\mathbf{S}]$$

$$S = \frac{1}{2} V_1 I_1^* = \frac{1}{2} \frac{V_1 V_1^*}{Z_1^*} = \frac{1}{2} \frac{|V_1|^2}{Z_1^*}$$

$$S = \frac{1}{2} \cdot \frac{4^2}{2+2j} = \frac{4^2}{2 \cdot 2} \frac{1}{1+j} \frac{1-j}{1-j} = 4 \frac{(1-j)}{1+1} = 2(1-j)$$

$$\boxed{P = 2}$$

$$\boxed{Q = -2}$$

Complex numbers 006

Problem has been graded.

Hint: Solve this symbolically as much as you can and only plug in numbers at the very end.

Find P and Q.

Note: We've used bold capital letters to denote complex variables. The * operator stands for complex conjugate. The Re[] and Im[] operators stand for taking the real part and imaginary part respectively.

Solve without a calculator

$$\mathbf{V_0} = ae^{j\frac{\pi}{6}} \qquad \mathbf{Z_1} = 2 + j \qquad \mathbf{Z_2} = bj$$

$$\mathbf{I_1} = \frac{\mathbf{V_0}}{\mathbf{Z_1}} \qquad \mathbf{V_1} = \mathbf{Z_2} \cdot \mathbf{I_1} \qquad \mathbf{S} = \frac{1}{2} \cdot \mathbf{V_1} \cdot \mathbf{I_1^*}$$

$$P = \mathrm{Re}[\mathbf{S}] \qquad Q = \mathrm{Im}[\mathbf{S}]$$

Given Variables:

a : 2 .

b : 1 .

Calculate the following:

P (.) :

0 ✓

Q (.) :

0.4 ✓

Hint: Work this out symbolically first and only plug in numbers later.

Find P and Q.

a : 2 .

b : 1 .

Note: We've used bold capital letters to denote complex variables. The * operator stands for complex conjugate. The Re[] and Im[] operators stand for taking the real part and imaginary part respectively.

$$\mathbf{V}_0 = ae^{j\frac{\pi}{6}} \qquad \mathbf{Z}_1 = 2 + j \qquad \mathbf{Z}_2 = bj$$

$$\mathbf{I}_1 = \frac{\mathbf{V}_0}{\mathbf{Z}_1} \qquad \mathbf{V}_1 = \mathbf{Z}_2 \cdot \mathbf{I}_1 \qquad \mathbf{S} = \frac{1}{2} \cdot \mathbf{V}_1 \cdot \mathbf{I}_1^*$$

$$P = \mathrm{Re}[\mathbf{S}] \qquad Q = \mathrm{Im}[\mathbf{S}]$$

$$S = \frac{1}{2} V_1 I_1^* = \frac{1}{2} Z_2 I_1 \cdot I_1^* = \frac{1}{2} \cdot j \, |I_1|^2$$

$$I_1 = \frac{V_0}{Z_1} \Rightarrow |I_1|^2 = \frac{|V_0|^2}{|Z_1|^2} = \frac{a^2}{4+1} = \frac{4}{5}$$

$$\Rightarrow S = \frac{1}{2} \cdot j \cdot \frac{4}{5} = j \cdot \frac{4}{10}$$

$$\boxed{P = 0}$$

$$\boxed{Q = 0.4}$$