

EENG 281 Homework #10 Solutions

Fall 2013

Problem 1

$$a) 6+j8 = \sqrt{6^2+8^2} \angle \tan^{-1} \frac{8}{6} = \underline{10.0 \angle 53.13^\circ} = \underline{10 e^{j53.13^\circ}}$$

$$b) 6-j8 = \underline{10 \angle -53.13^\circ} = \underline{10 e^{-j53.13^\circ}}$$

$$c) -6+j8 = \underline{10 \angle 126.87^\circ} = \underline{10 e^{j126.87^\circ}}$$

$$d) -6-j8 = \underline{10 \angle -126.87^\circ} = \underline{10 e^{-j126.87^\circ}}$$

$$e) 3-j4 = \underline{5 \angle -53.13^\circ} = \underline{5 e^{-j53.13^\circ}}$$

$$f) 5+j12 = \underline{13 \angle 67.38^\circ} = \underline{13 e^{j67.38^\circ}}$$

$$g) -3-j9 = \underline{9.49 \angle -108.43^\circ} = \underline{9.49 e^{-j108.43^\circ}}$$

$$h) -7+j = \underline{7.07 \angle 171.87^\circ} = \underline{7.07 e^{j171.87^\circ}}$$

Problem 2

$$a) 12 \angle -60^\circ = 12 \cos(-60) + j 12 \sin(-60) = \underline{6 - j10.39}$$

$$b) -50 \angle 285^\circ = \underline{-12.94 + j48.3}$$

$$c) 8e^{j10^\circ} = \underline{7.88 + j1.39}$$

$$d) 20e^{-j\pi/3} = 20e^{-j60^\circ} = \underline{10 - j17.32}$$

$$e) -8 \angle 210^\circ = \underline{6.93 + j4}$$

$$f) 40 \angle 305^\circ = \underline{22.94 - j32.77}$$

$$g) 10e^{-j30^\circ} = \underline{8.66 - j5}$$

$$h) 50e^{j\pi/2} = 50e^{j90^\circ} = \underline{0 + j50}$$

Problem 3.

$$A = 2 + j5 \quad B = 4 - j6$$

$$\begin{aligned} \text{a) } A^*(A+B) &= (2-j5)((2+j5) + (4-j6)) \\ &= 5.39 \angle -68.20^\circ (6-j) = 5.39 \angle -68.2^\circ (6.08 \angle \\ &= \underline{32.76 \angle -77.66^\circ} = 7 - j32 \end{aligned}$$

$$\begin{aligned} \text{b) } (A+B)/(A-B) &= \frac{6-j}{-2+j11} = \frac{6.08 \angle -9.46^\circ}{11.18 \angle 100.3^\circ} = \\ &= \underline{0.54 \angle -109.77^\circ} = -0.18 - j0.51 \end{aligned}$$

$$C = -3 + j7 \quad D = 8 + j$$

$$\begin{aligned} \text{c) } (C-D^*)(C+D) &= [(-3+j7) - (8-j)] [(-3+j7) + (8+j)] \\ &= (-11+j8)(5+j8) = \\ &= \underline{128.32 \angle -158.03^\circ} = -119 - j48 \end{aligned}$$

$$\begin{aligned} \text{d) } D^2/C^* &= (8+j)^2 / -3-j7 = 63+j16 / -3-j7 \\ &= \underline{8.53 \angle 127.45^\circ} = -5.19 + j6.78 \end{aligned}$$

$$\begin{aligned} \text{e) } 2CD/(C+D) &= \frac{2(-3+j7)(8+j)}{(-3+j7) + (8+j)} = \frac{122.8 \angle 120.32^\circ}{9.43 \angle 57.99^\circ} \\ &= \underline{13.02 \angle 62.33^\circ} = 6.04 + j11.53 \end{aligned}$$

Problem 4.

$$\begin{aligned} A &= \frac{(2+j5)(8e^{j10^\circ})}{2+j4 + 2 \angle -40^\circ} = \frac{5.39 \angle 68.2^\circ (8 \angle 10^\circ)}{2+j4 + 1.53 - j1.29} \\ &= \frac{43.08 \angle 78.2^\circ}{3.53 + j2.71} = \frac{43.08 \angle 78.2^\circ}{4.45 \angle 37.54^\circ} = 9.67 \angle 40.66^\circ \\ &= \underline{7.34 + j6.30} \end{aligned}$$

$$\begin{aligned} B &= \frac{j(3-j4)^*}{(-1+j6)(2+j)^2} = \frac{j(3+j4)}{(-1+j6)(2+j)^2} \\ &= \frac{-4+j3}{-27+j14} = \frac{5 \angle 143.13^\circ}{30.41 \angle 152.59^\circ} = 0.16 \angle -9.46^\circ \\ &= \underline{0.16 - j0.03} \end{aligned}$$

Problem 5.

$$\begin{aligned} C &= \frac{6 \angle 30^\circ + j5 - 3}{-1+j + 2e^{j45^\circ}} = \frac{2.20 + j8}{0.41 + j2.41} = \frac{8.30 \angle 74.65^\circ}{2.45 \angle 80.26^\circ} \\ &= \underline{3.39 \angle -5.62^\circ} = 3.37 - j0.33 = \underline{3.39e^{-j5.62^\circ}} \end{aligned}$$

$$\begin{aligned} D &= \left[\frac{(15-j7)(3+j2)^*}{(4+j6)^*(3 \angle 70^\circ)} \right]^* = \frac{0.83 - j2.63}{2.76 \angle -72.4^\circ} \\ &= \underline{2.76e^{-j72.4^\circ}} \end{aligned}$$

Problem 6. $A = 6 + j8 = 10 \angle 53.13^\circ$

a) $\sqrt{A} = \sqrt{10} \angle \frac{53.13^\circ}{2} = 3.16 \angle 26.57^\circ = 2.83 + j1.41$

b) $A^4 = 10^4 \angle 4(53.13^\circ) = 10,000 \angle 212.52^\circ = \underline{-8432 - j5376}$