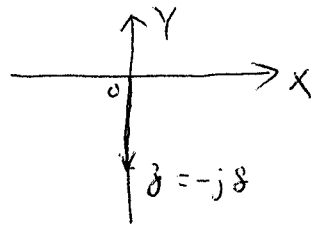
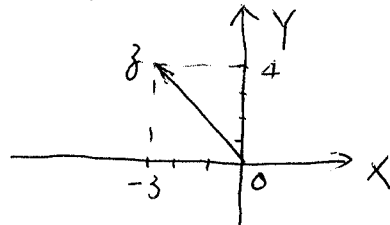
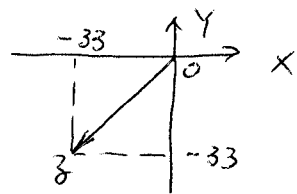
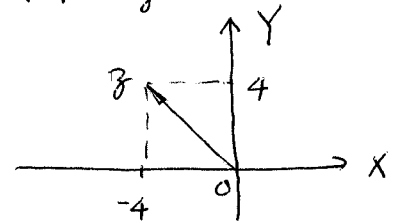
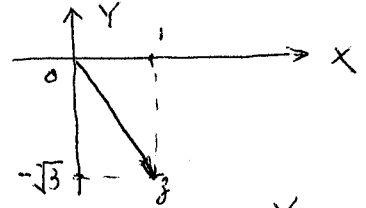
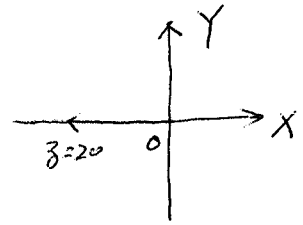


ECE2025 Problem Set#1 Solution

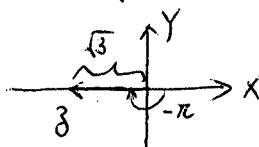
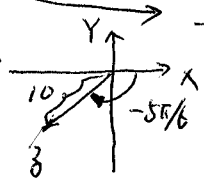
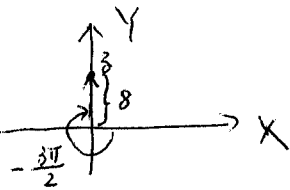
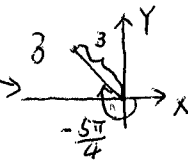
Problem 1.1

- (a) $r = \sqrt{x^2 + y^2} = \sqrt{(-20)^2 + 0^2} = 20,$
 $\theta = \arctan\left(\frac{y}{x}\right) = \arctan\left(\frac{0}{-20}\right) + \pi = \pi,$
 $z = 20 \angle \pi = 20e^{j\pi}.$
- (b) $r = \sqrt{x^2 + y^2} = \sqrt{(1)^2 + (-\sqrt{3})^2} = 2,$
 $\theta = \arctan\left(\frac{y}{x}\right) = \arctan\left(\frac{-\sqrt{3}}{1}\right) = -\pi/3,$
 $z = 2 \angle -\pi/3 = 2e^{-j\pi/3}.$
- (c) $r = \sqrt{x^2 + y^2} = \sqrt{(-4)^2 + 4^2} = 4\sqrt{2},$
 $\theta = \arctan\left(\frac{y}{x}\right) + \pi = \arctan\left(\frac{4}{-4}\right) + \pi = 3\pi/4,$
 $z = 4\sqrt{2} \angle 3\pi/4 = 4\sqrt{2}e^{j3\pi/4}.$
- (d) $r = \sqrt{x^2 + y^2} = \sqrt{(-33)^2 + (-33)^2} = 33\sqrt{2},$
 $\theta = \arctan\left(\frac{y}{x}\right) + \pi = \arctan\left(\frac{-33}{-33}\right) + \pi = 5\pi/4,$
 $z = 33\sqrt{2} \angle 5\pi/4 = 33\sqrt{2}e^{j5\pi/4}.$
- (e) $r = \sqrt{x^2 + y^2} = \sqrt{(-3)^2 + 4^2} = 5,$
 $\theta = \arctan\left(\frac{y}{x}\right) + \pi = \arctan\left(\frac{4}{-3}\right) + \pi \approx 2.21$
 $z = 5 \angle 2.21 = 5e^{j2.21}.$
- (f) $r = \sqrt{x^2 + y^2} = \sqrt{0^2 + (-8)^2} = 8,$
 $\theta = \arctan\left(\frac{y}{x}\right) = \arctan\left(\frac{-8}{0}\right) = -\pi/2,$
 $z = 8 \angle -\pi/2 = 8e^{-j\pi/2}.$



Problem 1.2

- (a) $z = 3 \cos(-5\pi/4) + j3 \sin(-5\pi/4) = -\frac{3}{2}\sqrt{2} + j\frac{3}{2}\sqrt{2}.$
- (b) $z = 8 \cos(-3\pi/2) + j8 \sin(-3\pi/2) = j8.$
- (c) $z = 10 \cos(-5\pi/6) + j10 \sin(-5\pi/6) = -5\sqrt{3} - j5.$
- (d) $z = \sqrt{3} \cos(31\pi) + j\sqrt{3} \sin(31\pi) = -\sqrt{3}.$



Problem 1.3 $z_1 = -5 + j5 = 5\sqrt{2}e^{j3\pi/4}$, $z_2 = 5\sqrt{2}e^{-j(7\pi/2)} = 5\sqrt{2}e^{j(\pi/2)} = j5\sqrt{2}$

(a) $z_1^* = (-5 + j5)^* = -5 - j5 = 5\sqrt{2}\angle -3\pi/4$.

(b) $jz_2 = j(5\sqrt{2}e^{-j(7\pi/2)}) = e^{j\pi/2} 5\sqrt{2}e^{-j(7\pi/2)} = 5\sqrt{2}e^{-j(6\pi/2)} = 5\sqrt{2}\angle \pi = -5\sqrt{2}$.

(c) $z_2 / z_1 = 5\sqrt{2}e^{j\pi/2} / (5\sqrt{2}e^{j3\pi/4}) = 1\angle -\pi/4 = \frac{\sqrt{2}}{2} - j\frac{\sqrt{2}}{2}$.

(d) $z_2^2 = (5\sqrt{2}e^{j(\pi/2)})^2 = 50\angle \pi = -50$.

(e) $1/z_1 = 1/(5\sqrt{2}e^{j3\pi/4}) = \frac{\sqrt{2}}{10}\angle -3\pi/4 = -\frac{1}{10} - j\frac{1}{10}$.

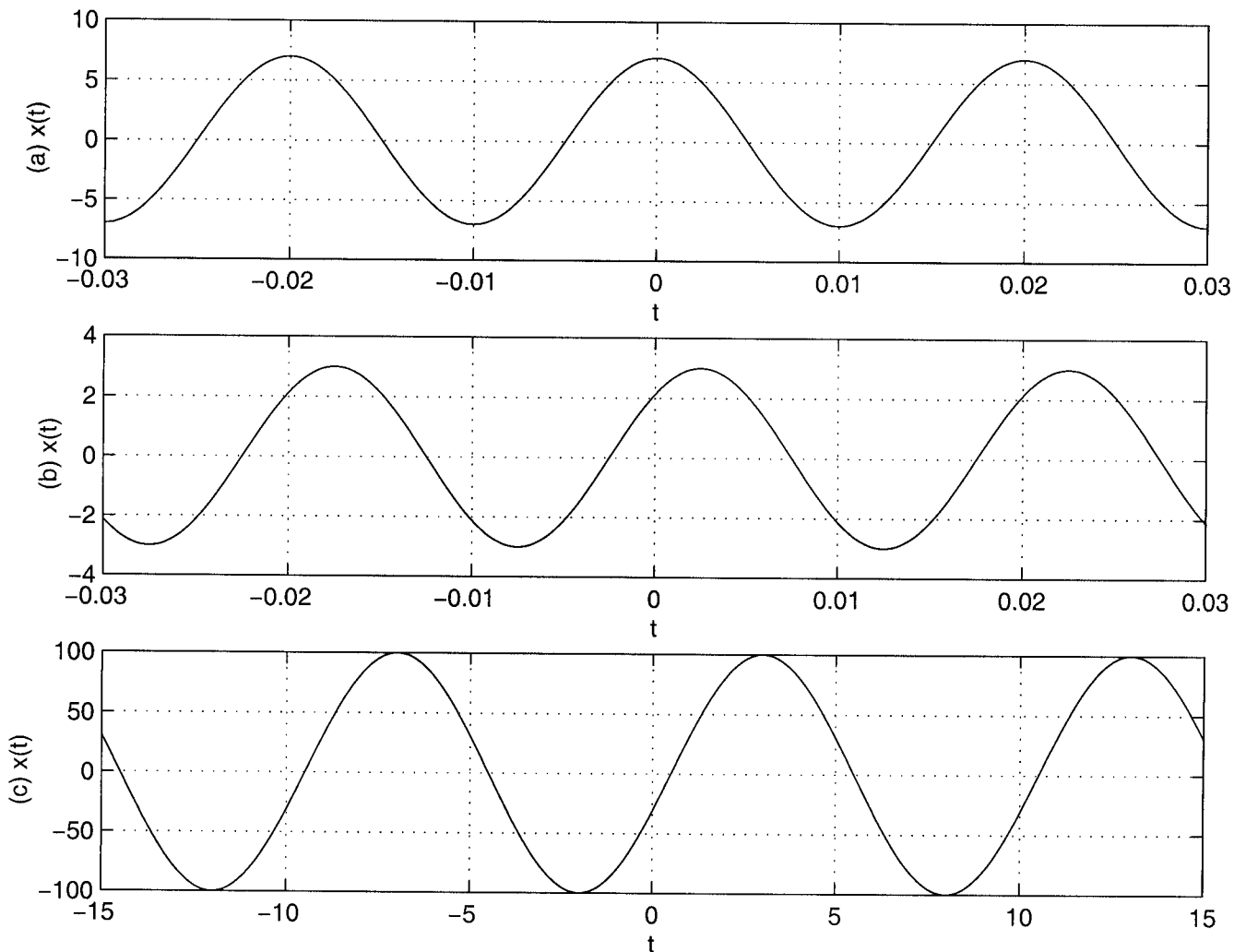
(f) $z_1 z_2 = (5\sqrt{2}e^{j3\pi/4}) \cdot 5\sqrt{2}e^{j\pi/2} = 50\angle 5\pi/4 = -25\sqrt{2} - j25\sqrt{2}$.

(g) $z_1 + z_2^* = (-5 + j5) + (-j5\sqrt{2}) = -5 - j5(\sqrt{2} - 1) \approx -5 - j2.07 = 202.5^\circ$.

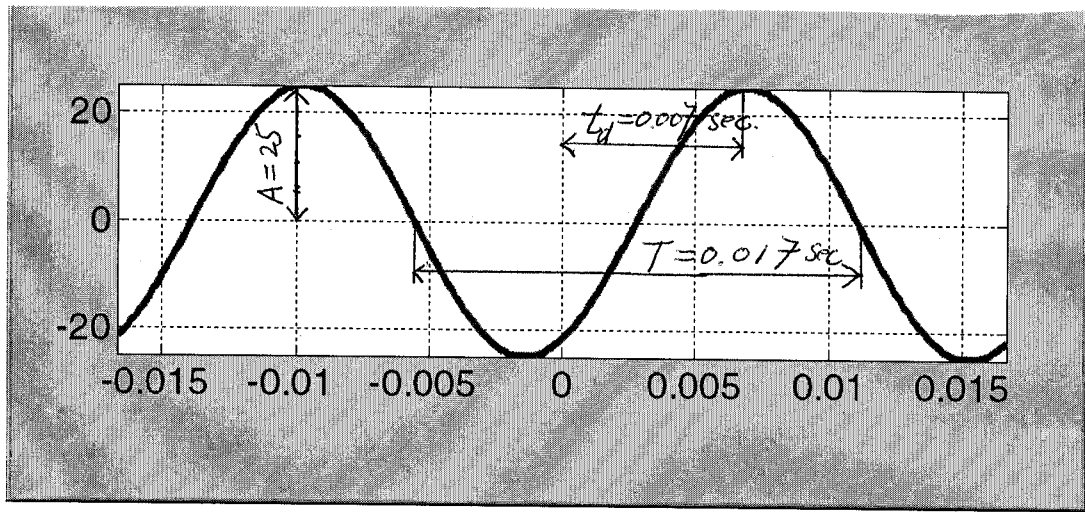
(h) $|z_2|^2 = (5\sqrt{2}e^{j\pi/2}) \cdot (5\sqrt{2}e^{j\pi/2}) = 50 = 50\angle 0$.

(i) $z_2 + z_2^* = j5\sqrt{2} + (j5\sqrt{2})^* = 0$.

Problem 1.4



Problem 1.5



From the above figure,

$$A = 25,$$

$$T = 0.017 \text{ sec}, f_o = \frac{1}{T} = 58.8 \text{ Hz}, \omega_o = 2\pi f_o = 369.6 \text{ rad/sec},$$

$$t_d = 0.007 \text{ sec}, \phi = -2\pi f_o t_d = -2\pi \frac{t_d}{T} = -0.824\pi = -2.59 \text{ rad or } -148^\circ.$$