

Home Work - Complex numbers - Solution:

Prob #1

$$r = \text{abs}(z) \quad \theta = \text{atan2}(\text{imag}(z), \text{real}(z)) * 180 / \pi$$

(a)	$z = 1.0000 + 2.0000i$	$r = 2.2361$	$\theta = 63.4349$
(b)	$z = 2.7000 + 3.1000i$	$r = 4.1110$	$\theta = 48.9452$
(c)	$z = -6.4000 + 6.4000i$	$r = 9.0510$	$\theta = 135$
(d)	$z = 3.1000 - 8.4000i$	$r = 8.9538$	$\theta = -69.7435$
(e)	$z = -17.7000 + 42.3000i$	$r = 45.8539$	$\theta = 112.7064$
(f)	$z = -3$	$r = 3$	$\theta = 180$
(g)	$z = 5.0000 - 5.0000i$	$r = 7.0711$	$\theta = -45$

Prob #2

$$x = r * \exp(i * \theta); \theta \text{ in degrees}$$

$$z = r * (\cos(\theta * \pi / 180) + \sin(\theta * \pi / 180) * i)$$

(a)	$z = 16.3135 + 7.6071i$	(b)	$z = -0.0000 - 32.0000i$
(c)	$z = -8.0000 + 0.0000i$	(d)	$z = 141.81 - 25.005i$
(e)	$z = 5.0488 + 7.7745i$		

Prob #3

Product:

$$z = s1 * s2; \quad r = \text{abs}(z); \quad \theta = \text{atan2}(\text{imag}(z), \text{real}(z)) * 180 / \pi$$

(a)	$z = 32.0000 + 4.0000i$	$r = 32.2490$	$\theta = 172.8750$
(b)	$z = -1.9799 + 11.8794i$	$r = 12.0433$	$\theta = 99.4623$
(c)	$z = 8.5331e+02 + 1.0922e+03i$	$r = 1.3860e+03$	$\theta = 52.0000$
(d)	$z = 0 + 54.0000i$	$r = 54$	$\theta = 90$
(e)	$z = -43.0000 - 18.0000i$	$r = 46.6154$	$\theta = -157.2856$

Quotient:

$$z = s1 / s2; \quad r = \text{abs}(z); \quad \theta = \text{atan2}(\text{imag}(z), \text{real}(z)) * 180 / \pi$$

(a)	$z = 2.0000e-01 - 3.5000e-01i$	$r = 4.0311e-01$	$\theta = -6.0255e+01$
(b)	$z = 6.0609e-02 + 1.0102e-02i$	$r = 6.1445e-02$	$\theta = 9.4623e+00$
(c)	$z = 1.5942e+00 + 1.1343e+01i$	$r = 1.1455e+01$	$\theta = 82$
(d)	$z = 0 - 6.0000e+00i$	$r = 6$	$\theta = -90$
(e)	$z = 5.0943e-01 + 7.1698e-01i$	$r = 8.7954e-01$	$\theta = 5.4605e+01$

Prob #4

$x = rx \cdot \exp(i \cdot \text{thetax}) = rx \cdot \exp(i \cdot (\text{thetax} + 2 \cdot k \cdot \pi))$; k is an integer

$rx = \text{abs}(x)$; $\text{thetax}(\text{degrees}) = \text{atan2}(\text{imag}(z), \text{real}(z)) \cdot 180/\pi$

$z = (x)^{1/n} = rz \cdot \exp(i \cdot \text{thetaz})$ - for n th root

$rz = (rx)^{1/n}$; $\text{thetaz} = (\text{thetax} + 360 \cdot k)/n$, $k = +1, +2, \dots$ *n* *nth* roots

- (a) $x = 2 + 0i$; $n = 3$;
 $rx = 2$ $\text{thetax} = 0$
 $rz = 1.2599e+00$
 $\text{thetaz1} = 0$ $\text{thetaz2} = 120$ $\text{thetaz3} = -120$
- (b) $x = -1 + i \cdot (3)^{.5}$; $n = 2$;
 $rx = 2$ $\text{thetax} = 1.2000e+02$
 $rz = 1.4142e+00$ $\text{thetaz1} = 60$ $\text{thetaz2} = 240$
- (c) $x = -1 + 0i$; $n = 3$;
 $rx = 1$ $\text{thetax} = 180$
 $rz = 1$ $\text{thetaz1} = 60$ $\text{thetaz2} = 180$ $\text{thetaz3} = -60$
- (d) $x = -1 - i$; $n = 5$;
 $rx = 1.4142e+00$ $\text{thetax} = -135$
 $rz = 1.0718e+00$
 $\text{thetaz1} = -27$ $\text{thetaz2} = 45$ $\text{thetaz3} = -99$ $\text{thetaz4} = 117$ $\text{thetaz5} = -171$
- (e) $x = 0 + 16i$; $n = 4$;
 $rx = 16$ $\text{thetax} = 90$
 $rz = 2$
 $\text{thetaz1} = 2.2500e+01$ $\text{thetaz2} = 1.1250e+02$
 $\text{thetaz3} = -6.7500e+01$ $\text{thetaz4} = 2.0250e+02$
- (f) $x = 6 \cdot \exp(i \cdot 40 \cdot \pi/180)$; $n = 3$;
 $rx = 6$ $\text{thetax} = 40$
 $rz = 1.8171e+00$
 $\text{thetaz1} = 1.3333e+01$ $\text{thetaz2} = 1.3333e+02$ $\text{thetaz3} = -1.0667e+02$