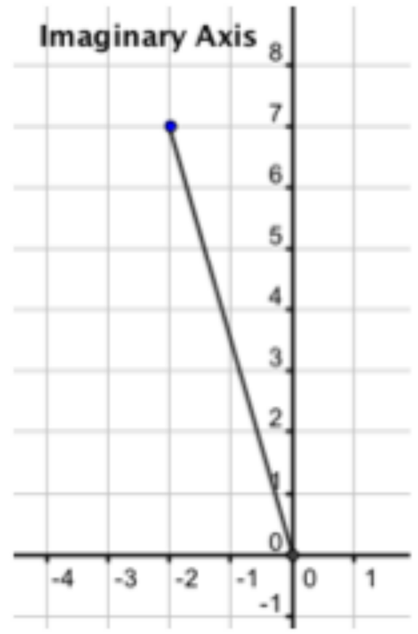
Precalc Honor | 11-2a Graphing Complex Numbers | Name: _____________

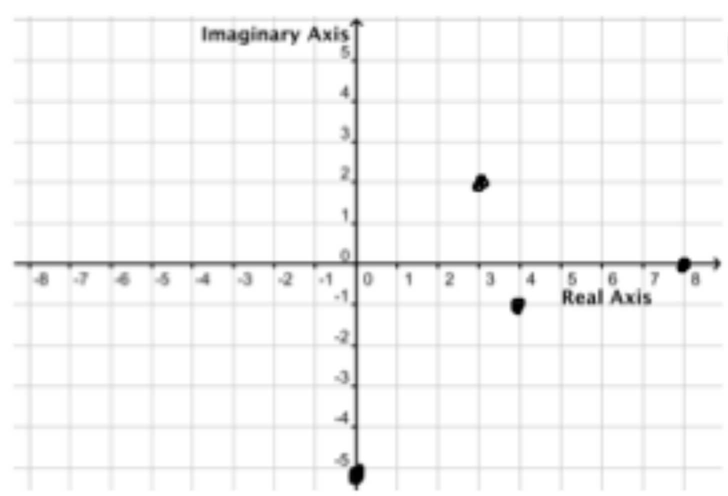
The x-y coordinate plane can be used to represent complex numbers, $a+bi$. The real part of the complex number, a, is represented by the x coordinate, and the imaginary part of the complex number, b, is represented by the y coordinate.



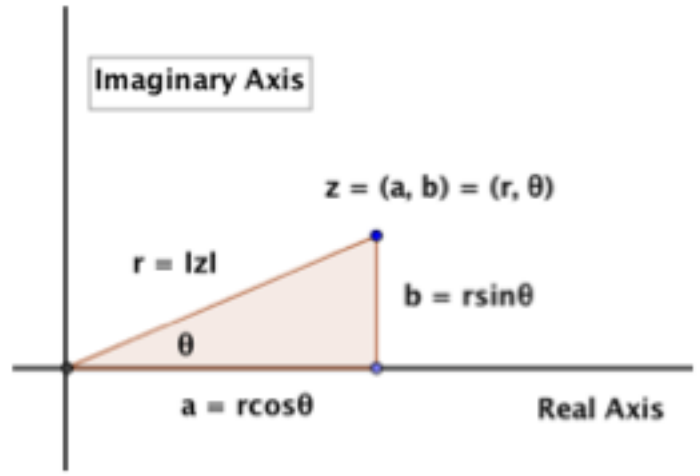
So the complex number $-2+7i$ can be represented by the ordered pair (-2, 7). Its graph is shown here:

Rectangular Coordinates	Rectangular Form
(-2, 7)	$-2+7i$

Graph the following complex numbers on the complex number plane given:



Rectangular Form ~~Coordinates~~	Rectangular coordinates
1. Plot 3+2i	(3, 2)
2. Plot 4-i	(4, -1)
3. Plot -5i	(0, -5)
4. Plot 8	(8, 0)
a+bi	(x, y)



The point representing the complex number can also be expressed in polar coordinates, (r,θ).

Polar Coordinates	Polar Form
(r,θ)	$r\cos\theta+(r\sin\theta)i$
$x = r\cos\theta$	$a+bi$
$y = r\sin\theta$	

Polar form of a complex number is long, so it is often abbreviated in the following way:

$r\cos\theta+(r\sin\theta)i$

$r(\cos\theta+i\sin\theta)$

$r cis\theta$ (r,θ)

For example the polar form $\sqrt{2}cis45^{\circ}$ is an abbreviation for $\sqrt{2}(\cos 45^{\circ}+i\sin 45^{\circ})$. The corresponding polar coordinates would be $(\sqrt{2},45^{\circ})$.

The length of the arrow representing the complex number z is called the **absolute value of z.** Using the Pythagorean Theorem $|z|=\sqrt{a^2+b^2}$. Although points can be represented using both positive and negative r values, we will only use positive values of r in polar coordinates and polar form since $|z|$ is defined to be positive.

$$z = a+bi$$
$$= r cis\theta$$
$$|z| = \sqrt{a^2+b^2}$$

Converting between polar and rectangular form:

5. Convert $1+i\sqrt{3}$ to polar form.

$x = 1$

$y = \sqrt{3}$

$r^2 = x^2 + y^2$

$r = \sqrt{1+3} = \boxed{2}$

$\tan\theta = \frac{y}{x} = \sqrt{3}$

$\theta = 60^\circ$

$(2, 60^\circ)$

$r\,cis\,\theta$

$2\,cis\,60^\circ$

6. Convert $9cis\frac{4\pi}{3}$ to rectangular form.

$r = 9$

$\theta = \frac{4\pi}{3}$

$x = r\cos\theta$

$= 9\cos\frac{4\pi}{3}$

$= 9\left(-\frac{1}{2}\right) = -4.5$

$y = r\sin\theta$

$= 9\sin\frac{4\pi}{3}$

$= 9\left(-\frac{\sqrt{3}}{2}\right) = -\frac{9\sqrt{3}}{2}$

$\left(-4.5, -\frac{9\sqrt{3}}{2}\right)$

$a+bi$

$-4.5 - \frac{9\sqrt{3}}{2}i$