20.5 Multiplicative Inverses

$\boxed{\text{Real \#'s}}$

$$\frac{2}{1} \cdot \frac{1}{2} = 1$$

$\boxed{\text{Complex \#'s}}$

$$\cancel{a + bi} \cdot \frac{1}{\cancel{a + bi}} = 1$$

We have to rationalize the denominator though!

ex) $\cancel{3 - i} \cdot \frac{1}{\cancel{3-i}} = 1$

To find the Multiplicative Inverse of a + b*i*:

Quick Trick = $\frac{a - bi}{a^2 + b^2}$ **OR Multiply by the Conjugate**

ex) Find the mult. inv of 3 - i and simplify if possible

$$3 - i \qquad \left(\frac{1}{3-i}\right) \longrightarrow \frac{3+i}{3^2+1^2} = \frac{3+i}{10}$$

$$\frac{1}{(3-i)}\frac{(3+i)}{(3+i)} = \frac{3+i}{9+\cancel{3i}-\cancel{3i}-i^2}$$

$$9+1$$

$$\frac{3+i}{10}$$

Find the multiplicative inverse of 2 + 4i and simplify if possible.

$$(2+4i)\left(\frac{1}{2+4i}\right)$$

$$\frac{2-4i}{2^2+4^2} = \frac{\overset{1}{\cancel{2}}-\overset{2}{\cancel{4}}i}{\cancel{20}\;10} = \frac{\cancel{2}(1-2i)}{\cancel{20}\;10}$$

$$(2+4i)\left(\frac{1-2i}{10}\right)$$

$$\frac{2\cancel{-4i}\cancel{+4i}-8i^2}{10}$$

$$\frac{2+8}{10} = \frac{10}{10} = 1$$

Find the multiplicative inverse of 8 - 4i and simplify if possible.

$$\frac{2+i}{20}$$

$7+3i$

$$\frac{7-3i}{49+9} = \frac{7-3i}{58}$$

Prove that 1 + i and $\frac{1}{2} - \frac{1i}{2}$ are multiplicative inverses

$$\frac{(1+i)}{1}\left(\frac{1-1i}{2}\right)$$

$$\frac{1+1}{2} = \frac{2}{2} = 1 \checkmark$$

Division of Complex Numbers:

Divide 8 + *i* by 2 - *i*

STEPS:

1. Put them on top of each other

2. Multiply by the conjugate

3. Simplify

$$\frac{(8+i)}{(2-i)}\frac{(2+i)}{(2+i)}$$

$$\frac{16+8i+2i+i^2}{4+1} = \frac{15+10i}{5} = \frac{\cancel{5}(3+2i)}{\cancel{5}}$$

Check

ans $\cdot$ den $=$ num

$(3+2i)(2-i) = 6 - 3i + 4i - 2i^2$

✓ $8+i$

Divide and Check:

$(3+12i) \div (4 - i)$

Homework: **pg 940 # 1,3,5,11,13,24,25,27,30,34**