

Simplifying Complex Numbers

Complex Numbers are binomials (expressions with two terms) that look like: $a + bi$. They add and subtract just like any other variable expression—by combining like terms. But, remember: unlike x , the i term goes at the back.

EXAMPLE $(4 + 3i) - (2 - 4i)$ $4 + 3i - 2 + 4i$ Re-organized: $4 - 2 + 3i + 4i$ $\boxed{2 + 7i}$	1. $(9 - 2i) + (4 - i)$	2. $(2 + 4i) - (7 + 5i)$	3. $(3 - 8i) - (6 - 7i)$	4. $(7 + i) + (2 - 3i)$
EXAMPLE $-(5 - 2i) + (4 + 6i)$ $-5 + 2i + 4 + 6i$ Re-organized: $-5 + 4 + 2i + 6i$ $\boxed{-1 + 8i}$	5. $-(6 + 4i) + (1 - i)$	6. $(17 + 8i) + (2 + 9i)$	7. $(11 + 3i) - (5 - 3i)$	8. $-(8 + 7i) - (2 - 5i)$

To multiply complex numbers, you have two choices (just like with any variable expressions): you can FOIL or use the box method. I prefer the box method, because it keeps me organized. Either way, you multiply it just like you normally would. However, there are two things you cannot forget: if you can simplify, you must simplify; and $i^2 = -1$.

EXAMPLE $(-2 + 3i)(4 - 5i)$ $\begin{array}{r} -2 \quad +3i \\ 4 \begin{array}{ c c } \hline -8 & +12i \\ \hline \end{array} \\ -5i \begin{array}{ c c } \hline +10i & -15i^2 \\ \hline \end{array} \\ \hline -8 + 12i + 10i - 15i^2 \\ -8 + 22i - 15(-1) \\ -8 + 22i + 15 \\ \boxed{7 + 22i} \end{array}$	9. $(8 + 2i)(5 - 3i)$	10. $(-4 - i)(7 - 2i)$	11. $(3 + 6i)(-3 + 5i)$
EXAMPLE $(8 + 5i)(6 + 2i)$ $\begin{array}{r} 8 \quad +5i \\ 6 \begin{array}{ c c } \hline 48 & +30i \\ \hline \end{array} \\ +2i \begin{array}{ c c } \hline +16i & +10i^2 \\ \hline \end{array} \\ \hline 48 + 30i + 16i + 10i^2 \\ 48 + 46i + 10(-1) \\ 48 + 46i - 10 \\ \boxed{38 + 46i} \end{array}$	12. $(11 - 2i)(6 + 3i)$	13. $(-9 + 2i)(9 + 2i)$	14. $(5 - 4i)(2 + 4i)$
EXAMPLE $(-2 - 7i)(-2 + 7i)$ $\begin{array}{r} -2 \quad -7i \\ -2 \begin{array}{ c c } \hline 4 & +14i \\ \hline \end{array} \\ +7i \begin{array}{ c c } \hline -14i & -49i^2 \\ \hline \end{array} \\ \hline 4 + 14i - 14i - 49i^2 \\ 4 - 49(-1) \\ 4 + 49 \\ \boxed{53} \end{array}$	15. $(4 + 6i)(4 - 6i)$	16. $(-3 - 5i)(-3 + 5i)$	17. $(8 + 2i)(8 - 2i)$

To simplify a fraction with a complex number in the numerator (the top), simply reduce each term, as always.

EXAMPLE $\frac{9 - 6i}{12}$ EVERY term can be reduced by 3, so... $\frac{9 \div 3 - 6i \div 3}{12 \div 3} = \frac{3 - 2i}{4}$	18. $\frac{-2 + 8i}{-10}$	19. $\frac{14 + 21i}{14}$	20. $\frac{5 + 5i}{5}$	21. $\frac{-12 + 16i}{20}$
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