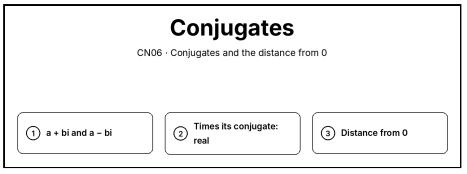
Conjugates: teacher script

CN06-V1 · CN06 Conjugates and the distance from 0 · teachers only. Without a screen, read each Say line and draw each Draw step on the board. About 110 seconds as a video.

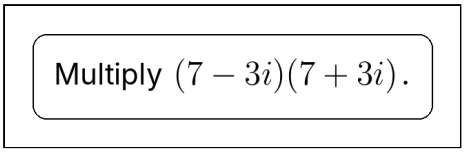
01



Say. Conjugates. The conjugate of a plus b i is a minus b i: change the sign of the imaginary part only. A number times its conjugate is always real. And on the complex plane, it gives the distance from 0.

Draw. Write the title “Conjugates” and the steps: 1. a + bi and a − bi; 2. Times its conjugate: real; 3. Distance from 0.

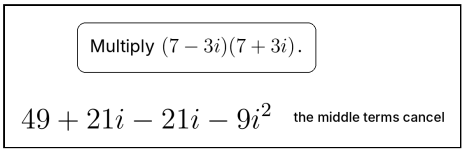
02



Say. Multiply 7 minus 3 i, times its conjugate, 7 plus 3 i.

Draw. Clear the board. Write “Multiply (7 − 3i)(7 + 3i).” in a box at the top.

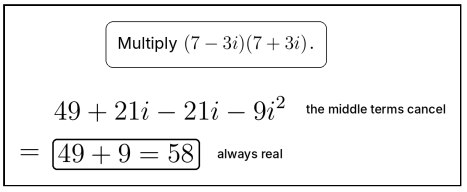
03



Say. Four products. The two middle terms, 21 i and negative 21 i, cancel.

Draw. Write 49 + 21i − 21i − 9i² on the next line. Beside it, write “the middle terms cancel”.

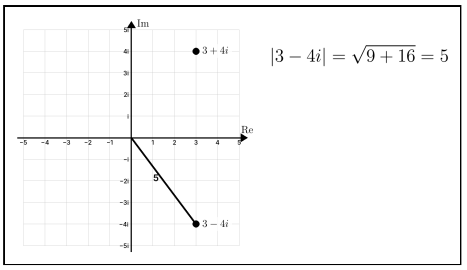
04



Say. And negative 9 i squared is plus 9. So the product is 49 plus 9, which is 58: a real number. In general, a plus b i, times a minus b i, is a squared plus b squared.

Draw. Write = 49 + 9 = 58 and box it on the next line. Beside it, write “always real”.

05



Say. On the complex plane, 3 minus 4 i is 3 right and 4 down, and its conjugate, 3 plus 4 i, is its reflection in the real axis. The distance from 0 is the root of 9 plus 16, which is 5: the root of the number times its conjugate.

Draw. Clear the board and draw the complex plane, the real axis across and the imaginary axis up, from -5 to 5. Mark 3 − 4i at 3 across and -4 up or down. Mark 3 + 4i at 3 across and 4 up or down. Draw a segment from (0, 0) to (3, -4), labelled “5”. Beside the grid, write “|3 - 4i| = \sqrt{9 + 16} = 5”.

06

$(-3+8i)(-3+Ai)$ is real. Find A.

Say. Negative 3 plus 8 i, times negative 3 plus A i, is a real number. Find A.

Draw. Clear the board. Write “(−3 + 8i)(−3 + Ai) is real. Find A.” in a box at the top.

07

$(-3+8i)(-3+Ai)$ is real. Find A.

$(9-8A)+(-3A-24)i$ collect the parts

Say. Expand and collect the parts: 9 minus 8 A, plus, negative 3 A minus 24, times i.

Draw. Write (9 − 8A) + (−3A − 24)i on the next line. Beside it, write “collect the parts”.

08

$(-3+8i)(-3+Ai)$ is real. Find A.

$(9-8A)+(-3A-24)i$ collect the parts

$\boxed{-3A-24=0, \quad A=-8}$ the imaginary part is 0

Say. The imaginary part must be 0: negative 3 A minus 24 equals 0, so A is negative 8. The conjugate again.

Draw. Write −3A − 24 = 0, A = −8 and box it on the next line. Beside it, write “the imaginary part is 0”.

09

Trap $\overline{3-2i}$

$\times \quad -3+2i$

$\checkmark \quad 3+2i$

Say. Watch for the trap: the conjugate of 3 minus 2 i is not negative 3 plus 2 i. Only the imaginary part changes sign: 3 plus 2 i.

Draw. Clear the board. Write “Trap” and $\overline{3-2i}$. Below, write −3 + 2i and cross it out ×. Then write 3 + 2i with a tick ✓.

10

Your turn

Change the sign of the imaginary part.

$z \cdot \bar{z} = a^2 + b^2$, real.

Say. Now it is your turn. The conjugate changes the sign of the imaginary part only. A number times its conjugate is a squared plus b squared, and its root is the distance from 0.

Draw. Point to today's activity: Change the sign of the imaginary part. $z \cdot \bar{z} = a^2 + b^2$, real.