

FlexiPrep

NCERT Class 11 Mathematics Solutions: Chapter 5 – Complex Number and Quadratic Equations Miscellaneous Exercise Part 2 (For CBSE, ICSE, IAS, NET, NRA 2022)

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$$i^2 = -1$$

Complex numbers are numbers of the form $a + bi$, where a and b are real numbers. The real number a is called the real part of the number $a + bi$; the real number b is called the imaginary part of $a + bi$.

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1. Reduce $\left(\frac{1}{1-4i} - \frac{2}{1+i}\right) \left(\frac{3-4i}{5+i}\right)$ to the standard form.

Answer:

$$\begin{aligned}
& \left(\frac{1}{1-4i} - \frac{2}{1+i} \right) \left(\frac{3-4i}{5+i} \right) = \left[\frac{(1+i) - 2(1-4i)}{(1-4i)(1+i)} \right] \left[\frac{3-4i}{5+i} \right] \\
& = \left[\frac{1+i-2+8i}{1+i-4i-4i^2} \right] \left[\frac{3-4i}{5+i} \right] \\
& = \left[\frac{-1+9i}{5-3i} \right] \left[\frac{3-4i}{5+i} \right] \\
& = \left[\frac{-3+4i+27i-36i^2}{25+5i-15i-3i^2} \right] \\
& = \frac{33+31i}{28-10i} \\
& = \frac{33+31i}{2(14-5i)} \\
& = \frac{(33+31i)}{2(14-5i)} \times \frac{(14+5i)}{(14+5i)} \text{ [On multiplying numerator and denominator by } (14+5i) \text{]} \\
& = \frac{462+165i+434i+155i^2}{2[(14)^2-(5i)^2]} \\
& = \frac{307+599i}{2(196-25i^2)} \\
& = \frac{307+599i}{2(221)} = \frac{307+599i}{442} \\
& = \frac{307}{442} + \frac{599i}{442}
\end{aligned}$$

This is the required standard form.

2. If $x - iy = \sqrt{\frac{a-ib}{c-id}}$ prove that $(x^2 + y^2)^2 = \frac{a^2 + b^2}{c^2 + d^2}$

Answer:

$$\begin{aligned}
x - iy &= \sqrt{\frac{a-ib}{c-id}} \\
&= \sqrt{\frac{a-ib}{c-id} \times \frac{c+id}{c+id}} \text{ [On multiplying numerator and denominator by } (c+id) \text{]} \\
&= \sqrt{\frac{(ac+bd) + i(ad-bc)}{c^2+d^2}} \\
\therefore (x - iy)^2 &= \frac{(ac+bd) + i(ad-bc)}{c^2+d^2}
\end{aligned}$$

$$\Rightarrow x^2 - y^2 - 2ixy = \frac{(ac + bd) + i(ad - bc)}{c^2 + d^2}$$

On comparing real and imaginary parts

$$x^2 - y^2 = \frac{ac + bd}{c^2 + d^2}, -2xy = \frac{ad - bc}{c^2 + d^2} \dots \text{eq (1)}$$

$$\Rightarrow (x^2 + y^2)^2 = (x^2 - y^2)^2 + 4x^2y^2$$

$$\Rightarrow \left(\frac{ac + bd}{c^2 + d^2} \right)^2 + \left(\frac{ad - bc}{c^2 + d^2} \right)^2 \text{ [Using (1)]}$$

$$= \frac{a^2c^2 + b^2d^2 + 2acdb + a^2d^2 + b^2c^2 - 2adbc}{(c^2 + d^2)^2}$$

$$= \frac{a^2c^2 + b^2d^2 + a^2d^2 + b^2c^2}{(c^2 + d^2)^2}$$

$$= \frac{a^2(c^2 + d^2) + b^2(c^2 + d^2)}{(c^2 + d^2)^2}$$

$$= \frac{a^2 + b^2}{c^2 + d^2}$$

So, proved.