CBSE Class–11 Mathematics
NCERT Solutions
Chapter - 5 Complex Numbers and Quadratic Equations
Exercise 5.1

Express each of the complex numbers given in the exercises 1 to 10 in the form a+ib:

1. $(5i)\left(\frac{-3}{5}i\right)$

Ans. Here $(5i)\left(\frac{-3}{5}i\right) = -3i^2$

$= -3\times -1$

$=3$

2. $i^9 + i^{19}$

Ans. Here $i^9 + i^{19}$

$= \left(i^2\right)^4 .i + \left(i^2\right)^9 .i = (-1)^4 .i + (-1)^9 .i = i - i = 0$

3. i^{-39}

Ans. $i^{-39} = \frac{1}{i^{39}} = \frac{1}{\left(i^2\right)^{19}.i} = \frac{1}{(-1)^{19}.i} = \frac{1}{-i}$

$= \frac{-1}{i}\times\frac{i}{i} = \frac{-i}{i^2} = \frac{-i}{-1} = i$

4. $3(7+i7)+i(7+i7)$

Ans. Here $3(7+i7)+i(7+i7)$

= $21+21i+7i+7i^2 = 21+28i-7 = 14+28i$

5. $(1-i)-(-1+i6)$

Ans. Here $(1-i)-(-1+i6)$

= $1-i+1-i6 = 2-7i$

6. $\left(\frac{1}{5}+\frac{2}{5}i\right)-\left(4+\frac{5}{2}i\right)$

Ans. Here $\left(\frac{1}{5}+\frac{2}{5}i\right)-\left(4+\frac{5}{2}i\right)$

= $\frac{1}{5}+\frac{2}{5}i-4-\frac{5}{2}i$

= $\left(\frac{1}{5}-4\right)+\left(\frac{2}{5}-\frac{5}{2}\right)i = \frac{-19}{5}-\frac{21}{10}i$

7. $\left[\left(\frac{1}{3}+\frac{7}{3}i\right)+\left(4+\frac{1}{3}i\right)\right]-\left[\frac{-4}{3}+i\right]$

Ans. Here $\left[\left(\frac{1}{3}+\frac{7}{3}i\right)+\left(4+\frac{1}{3}i\right)\right]-\left[\frac{-4}{3}+i\right]$

= $\left[\left(\frac{1}{3}+4\right)+\left(\frac{7}{3}+\frac{1}{3}i\right)\right]-\left[\frac{-4}{3}+i\right]$

= $\frac{13}{3}+\frac{8}{3}i+\frac{4}{3}-i = \left(\frac{13}{3}+\frac{4}{3}\right)+\left(\frac{8}{3}-1\right)i = \frac{17}{3}+\frac{5}{3}i$

8. $(1-i)^4$

Ans. Here $(1-i)^4 = \left[(1-i)^2\right]^2$

$= \left[1+i^2-2i\right]^2 = (1-1-2i)^2 = (-2i)^2$

$= 4i^2 = -4$

9. $\left(\frac{1}{3}+3i\right)^3$

Ans. Here $\left(\frac{1}{3}+3i\right)^3$

$= \left(\frac{1}{3}\right)^3 + (3i)^3 + 3\times\left(\frac{1}{3}\right)^2 \times 3i + 3\times\frac{1}{3}\times(3i)^2$

$= \frac{1}{27} + 27i^3 + i + 9i^2$

$= \frac{1}{27} - 27i + i - 9$

$= \frac{1}{27} - 9 - 26i$

$= \frac{-242}{27} - 26i$

10. $\left(-2-\frac{1}{3}i\right)^3$

Ans. Here $\left(-2-\frac{1}{3}i\right)^3 = -\left(2+\frac{1}{3}i\right)^3$

$= -\left[(2)^3 + \left(\frac{1}{3}i\right)^3 + 3\times(2)^2 \times\frac{1}{3}i + 3\times 2\times\left(\frac{1}{3}i\right)^2\right]$

$= -\left[8 + \frac{1}{27}i^3 + 4i + \frac{2}{3}i^2\right]$

$= -\left[8-\frac{1}{27}i+4i-\frac{2}{3}\right]$

$= -\left[8-\frac{2}{3}-\frac{1}{27}i+4i\right] = \frac{-22}{3}-\frac{107}{27}i$

Find the multiplicative inverse of each of the complex numbers given in the exercises 11 to 13.

11. $4-3i$

Ans. Multiplicative Inverse of $4-3i$

$= \frac{1}{4-3i}\times\frac{4+3i}{4+3i}$

$= \frac{4+3i}{(4)^2-(3i)^2}$

$= \frac{4+3i}{16-9i^2}$

$= \frac{4+3i}{16+9} = \frac{1}{25}(4+3i)$

$= \frac{4}{25}+i\frac{3}{25}$

12. $\sqrt{5}+3i$

Ans. Multiplicative Inverse of $\sqrt{5}+3i$

$= \frac{1}{\sqrt{5}+3i}\times\frac{\sqrt{5}-3i}{\sqrt{5}-3i}$

$= \frac{\sqrt{5}-3i}{(\sqrt{5})^2-(3i)^2}$

$= \frac{\sqrt{5}-3i}{5-9i^2}$

$= \frac{\sqrt{5}-3i}{5+9} = \frac{1}{14}\left(\sqrt{5}-3i\right)$

$= \frac{\sqrt{5}}{14} - i\frac{3}{14}$

13. $-i$

Ans. Multiplicative Inverse of $-i$

$= \frac{1}{-i} \times \frac{i}{i}$

$= \frac{i}{-i^2}$

$= \frac{i}{-(-1)} = i$

14. Express the following expression in the form of $a+ib$: $\frac{\left(3+\sqrt{5}i\right)\left(3-\sqrt{5}i\right)}{\left(3+\sqrt{2}i\right)-\left(3-\sqrt{2}i\right)}$

Ans. Here $\frac{\left(3+\sqrt{5}i\right)\left(3-\sqrt{5}i\right)}{\left(3+\sqrt{2}i\right)-\left(3-\sqrt{2}i\right)}$

$= \frac{(3)^2-\left(\sqrt{5}i\right)^2}{\sqrt{3}+\sqrt{2}i-\sqrt{3}+\sqrt{2}i}$

$= \frac{9-5i^2}{2\sqrt{2}i}$

$= \frac{9+5}{2\sqrt{2}i} = \frac{14}{2\sqrt{2}i}$

$= \frac{7}{\sqrt{2}i} = \frac{7}{\sqrt{2}i} \times \frac{i}{i} = \frac{7i}{\sqrt{2}i^2} = \frac{-7i}{\sqrt{2}} = \frac{-7\sqrt{2}i}{2}$