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Mathematics 10th
New Book 2026

EXERCISE # 1.1

Question # 1

Simplify the following:

(i) i^5 $\boxed{i^2=-1}$

Sol. i^5

$= i^4 \cdot i$

$= (i^2)^2 \cdot i$

$= (-1)^2 \cdot i$

$= 1 \cdot i$

$= \boxed{i}$ Ans.

(ii) i^{16}

Sol. i^{16}

$= (i^2)^8$

$= (-1)^8$

$= \boxed{1}$ Ans.

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(iii) $(-i)^{-19}$

Sol. $(-i)^{-19}$

$$= \frac{1}{(-i)^{19}}$$

$$= \frac{1}{-i^{19}}$$

$$= \frac{1}{-i^{18}.i}$$

$$= \frac{1}{-(i^2)^9.i}$$

$$= \frac{1}{-(-1)^9.i}$$

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

$$= \frac{1}{+1.i}$$

$$= \boxed{\frac{1}{i}} \text{ Ans.}$$

OR

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

Ans

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(iv) $27 i^{-26}$

Sol. $27 i^{-26}$

$$= \frac{27}{i^{26}}$$

$$= \frac{27}{(i^2)^{13}}$$

$$= \frac{27}{(-1)^{13}}$$

$$= \frac{27}{-1}$$

$$= \boxed{-27}$$ Ans.

(v) $i^{11} + i^5$

Sol. $i^{11} + i^5$

$$= i^{10}.i + i^4.i$$

$$= (i^2)^5.i + (i^2)^2.i$$

$$= (-1)^5.i + (-1)^2.i$$

$$= (-1).i + (1)i$$

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$= \cancel{-i} + \cancel{i}$

$= \boxed{0}$ Ans.

(vi) $(i^4 + i^3 + i^2 + i)^2$

Sol. $(i^4 + i^3 + i^2 + i)^2$

$= ((i^2)^2 + i^2 . i + i^2 + i)^2$

$= ((-1)^2 + (-1) . i + i^2 + i)^2$

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

$= (1 - 1)^2$

$= (0)^2$

$= \boxed{0}$ Ans.

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(vii) $\left(\frac{i^8}{i^5}\right)^{-5}$

Sol. $\left(\frac{i^8}{i^5}\right)^{-5}$

$= \left(\frac{i^5}{i^8}\right)^{5}$

$= \left(\frac{i^4 \cdot i}{(i^2)^4}\right)^{5}$

$= \left(\frac{(i^2)^2 \cdot i}{(-1)^4}\right)^{5}$

$= \left(\frac{(-1)^2 \cdot i}{1}\right)^{5}$

$= \left(\frac{1 \cdot i}{1}\right)^{5}$

$= i^5 = i^4 \cdot i = (i^2)^2 \cdot i = (-1)^2 \cdot i$

$= 1 \cdot i$

$= \boxed{i}$ Ans.

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(vii) $\left(\frac{i^8}{i^5}\right)^{-5}$ $\boxed{\text{2nd Method}}$

Sol. $\left(\frac{i^8}{i^5}\right)^{-5}$

$= \left(i^{8-5}\right)^{-5}$

$= \left(i^3\right)^{-5}$

$= i^{-15}$

$= \frac{1}{i^{15}}$

$= \frac{1}{i^{14} \cdot i}$

$= \frac{1}{(i^2)^7 \cdot i}$

$= \frac{1}{(-1)^7 \cdot i}$

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

$= \frac{i}{-i^2} = \frac{i}{-(-1)} = \frac{i}{1}$

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(viii) $i^{13} \times i^{29}$

Sol. $i^{13} \times i^{29}$

$= i^{12} \cdot i \times i^{28} \cdot i$

$= (i^2)^6 \cdot i \times (i^2)^{14} \cdot i$

$= (-1)^6 \cdot i \times (-1)^{14} \cdot i$

$= (1) \cdot i \times (1) \cdot i$

$= i \times i$

$= i^2$

$= \boxed{-1}$ Ans.

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EXERCISE # 1.1

Question #2

Write in term of i.

(i) $2+\sqrt{-4}$

Sol.

$2+\sqrt{-4}$

$\boxed{\sqrt{-1}=i}$

$=2+\sqrt{(4)(-1)}$ $\quad -4=(4)(-1)$

$=2+\sqrt{4}\sqrt{-1}$

$=\boxed{2+2i}$ Ans. $\quad \sqrt{4}=2$

(ii) $3-\sqrt{-7}$

Sol.

$3-\sqrt{-7}$

$=3-\sqrt{(7)(-1)}$

$=3-\sqrt{7}\sqrt{-1}$

$=\boxed{3-\sqrt{7}\,i}$ Ans.

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(iii) $\frac{2}{5}+\frac{\sqrt{-16}}{5}$

Sol. $\frac{2}{5}+\frac{\sqrt{-16}}{5}$

$=\frac{2}{5}+\frac{\sqrt{(16)(-1)}}{5}$

$=\frac{2}{5}+\frac{\sqrt{16}\sqrt{-1}}{5}$

$=\boxed{\frac{2}{5}+\frac{4i}{5}}$ Ans $\because \sqrt{16}=4$, $\sqrt{-1}=i$

(iv) $\sqrt{2}-\sqrt{-3}$

Sol. $\sqrt{2}-\sqrt{-3}$

$=\sqrt{2}-\sqrt{(3)(-1)}$

$=\sqrt{2}-\sqrt{3}\sqrt{-1}$

$=\boxed{\sqrt{2}-\sqrt{3}\,i}$ Ans.

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Question # 3

Find the value of x and y.

(i) $(2x+5)+(y-3)i = 1+2i$

Sol.

$$(2x+5)+(y-3)i = 1+2i$$

$2x+5 = 1$

$2x = 1-5$

$2x = -4$

$x = \frac{-4}{2}$

$\boxed{x = -2}$ Ans.

$y-3 = 2$

$y = 2+3$

$\boxed{y = 5}$ Ans.

(ii) $(3x+2)-(4-y)i = 5+3i$

Sol.

$$(3x+2)-(4-y)i = 5+3i$$

$3x+2 = 5$

$3x = 5-2$

$3x = 3$

$x = \frac{3}{3} \Rightarrow \boxed{x=1}$ Ans.

$-(4-y) = 3$

$-4+y = 3$

$y = 3+4$

$\boxed{y=7}$ Ans.

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(iii) $(2+i)x+(1-2i)y=3+4i$

Sol. $(2+i)x+(1-2i)y=3+4i$

$2x+ix+1y-2yi=3+4i$

$2x+1y+ix-2yi=3+4i$

$(2x+1y)+(x-2y)i=3+4i$

$2x+1y=3 \longrightarrow (1)$ | $x-2y=4 \longrightarrow (2)$

Multiply by 2

$2(x-2y)=2(4)$

$2x-4y=8 \longrightarrow (3)$

Subtract eq (1) from eq (3)

$$\begin{array}{r} \cancel{2x}-4y=8 \\ -\cancel{2x}\mp 1y=\mp 3 \\ \hline -5y=5 \end{array}$$

$y=\frac{5}{-5}$

$\boxed{y=-1}$ Ans.

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put $y = -1$ in equation (1)

$$2x + 1y = 3$$

$$2x + 1(-1) = 3$$

$$2x - 1 = 3$$

$$2x = 3 + 1$$

$$2x = 4$$

$$x = \frac{4}{2}$$

$\boxed{x = 2}$ Ans.

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(iv) $(1-i)x+(2+i)y=4-i$

Sol

$$(1-i)x+(2+i)y=4-i$$

$$x-xi+2y+yi=4-i$$

$$x+2y-xi+yi=4-i$$

$$(x+2y)-i(x-y)=4-i \quad (1)$$

$x+2y=4 \rightarrow (1)$ | $x-y=1 \rightarrow (2)$

Subtract eq (2) from eq (1)

$$\begin{array}{r} x+2y=4 \\ \underline{\pm x \mp 1y = \pm 1} \\ 3y=3 \end{array}$$

$$y=\frac{3}{3} \Rightarrow \boxed{y=1} \text{ Ans.}$$

put $y=1$ in equation (2)

$$x-y=1$$

$$x-1=1$$

$$x=1+1$$

$$\boxed{x=2} \text{ Ans.}$$

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(v) $(3x-1)+(2y-3)i = 8+7i$

Sol.

$$(3x-1)+(2y-3)i = 8+7i$$

$3x-1 = 8$	$2y-3 = 7$
$3x = 8+1$	$2y = 7+3$
$3x = 9$	$2y = 10$
$x = \frac{9}{3}$	$y = \frac{10}{2}$
$\boxed{x=3}$ Ans.	$\boxed{y=5}$ Ans.

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EXERCISE # 1.2

(Question # 2)

Write additive Inverse جمعی معکوس for each complex number.

(i) $3+2i$

Sol. Additive inverse $= -(3+2i)$

$= \boxed{-3-2i}$ Ans.

(ii) $4-3i$

Sol. Additive inverse $= -(4-3i)$

$= \boxed{-4+3i}$ Ans.

(iii) $5-7i$

Sol. Additive inverse $= -(5-7i)$

$= \boxed{-5+7i}$ Ans.

(iv) $-\frac{2}{3}+\frac{5}{4}i$

Sol Additive inverse $= -\left(-\frac{2}{3}+\frac{5}{4}i\right)$

$= \boxed{\frac{2}{3}-\frac{5}{4}i}$ Ans.

EXERCISE # 1.2

(Question # 3)

Find multiplicative inverse for each complex number:

(i)

$4+5i$

Sol.

$4+5i$

$$\text{Inverse} = \frac{1}{4+5i}$$

$$= \frac{1}{(4+5i)} \times \frac{(4-5i)}{(4-5i)}$$

$$= \frac{1(4-5i)}{(4)^2-(5i)^2}$$

$$= \frac{4-5i}{16-25i^2}$$

$$= \frac{4-5i}{16-25(-1)} \qquad \because i^2=-1$$

$$= \frac{4-5i}{16+25} = \frac{4-5i}{41} = \boxed{\frac{4}{41}-\frac{5}{41}i}$$

Ans.

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(ii)

$6+2i$

Sol. $6+2i$

$$\text{Inverse} = \frac{1}{6+2i}$$

$$= \frac{1}{(6+2i)} \times \frac{(6-2i)}{(6-2i)}$$

$$= \frac{1(6-2i)}{(6)^2-(2i)^2}$$

$$= \frac{6-2i}{36-4i^2}$$

$$= \frac{6-2i}{36-4(-1)} \quad \because i^2=-1$$

$$= \frac{6-2i}{36+4}$$

$$= \frac{6-2i}{40}$$

$$= \frac{6}{40} - \frac{2}{40}i$$

$$= \boxed{\frac{3}{20} - \frac{1}{20}i}$$ Ans.

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(iii)

$7-3i$

Sol. $7-3i$

$$\text{Inverse} = \frac{1}{7-3i}$$

$$= \frac{1}{(7-3i)} \times \frac{(7+3i)}{(7+3i)}$$

$$= \frac{1(7+3i)}{(7)^2-(3i)^2}$$

$$= \frac{7+3i}{49-9i^2}$$

$$= \frac{7+3i}{49-9(-1)} \qquad \because i^2=-1$$

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

$$= \frac{7+3i}{58}$$

$$= \boxed{\frac{7}{58}+\frac{3}{58}i} \text{ Ans.}$$

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(iv)

$\sqrt{5} - 4i$

Sol.

$\sqrt{5} - 4i$

$$\text{Inverse} = \frac{1}{\sqrt{5}-4i}$$

$$= \frac{1}{(\sqrt{5}-4i)} \times \frac{(\sqrt{5}+4i)}{(\sqrt{5}+4i)}$$

$$= \frac{1(\sqrt{5}+4i)}{(\sqrt{5})^2 - (4i)^2}$$

$$= \frac{\sqrt{5}+4i}{5-16i^2}$$

$$= \frac{\sqrt{5}+4i}{5-16(-1)} \qquad \because i^2 = -1$$

$$= \frac{\sqrt{5}+4i}{5+16}$$

$$= \frac{\sqrt{5}+4i}{21}$$

$$= \boxed{\frac{\sqrt{5}}{21} + \frac{4}{21}i} \text{ Ans.}$$

Question # 4

If $z_1 = 2+5i$, $z_2 = 1-3i$ and $z_3 = 2+i$, then verify that

(i) $\boxed{Z_1 + Z_2 = Z_2 + Z_1}$

Sol.

$$L.H.S = Z_1 + Z_2$$
$$= (2+5i) + (1-3i)$$
$$= 2 + 5i + 1 - 3i$$
$$= 2 + 1 + 5i - 3i$$
$$= 3 + 2i \longrightarrow (1)$$

$$R.H.S = Z_2 + Z_1$$
$$= (1-3i) + (2+5i)$$
$$= 1 - 3i + 2 + 5i$$
$$= 1 + 2 - 3i + 5i$$
$$= 3 + 2i \longrightarrow (2)$$

$+5i$
$-3i$
$+2i$

From equation (1) and (2)

$$L.H.S = R.H.S$$
$$Z_1 + Z_2 = Z_2 + Z_1$$

Hence proved.

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(ii) $\boxed{z_1 z_2 = z_2 z_1}$

Sol.

$$L.H.S = z_1 z_2$$
$$= (2+5i)(1-3i)$$
$$= (2)(1)-(2)(3i)+(5i)(1)-(5i)(3i)$$
$$= 2 \underbrace{-6i+5i}-15i^2$$
$$= 2-1i-15(-1)$$
$$= 2-1i+15$$
$$= 17-1i \longrightarrow (1)$$

$$R.H.S = z_2 z_1$$
$$= (1-3i)(2+5i)$$
$$= (1)(2)+(1)(5i)-(3i)(2)-(3i)(5i)$$
$$= 2 \underbrace{+5i-6i}-15i^2$$
$$= 2-1i-15(-1)$$
$$= 2-1i+15$$
$$= 17-1i \longrightarrow (2)$$

From equation # (1) and (2)

$$L.H.S = R.H.S$$
$$z_1 z_2 = z_2 z_1$$

Hence proved.

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(iii) $\boxed{(z_1+z_2)+z_3 = z_1+(z_2+z_3)}$

Sol.

$$L.H.S = (z_1+z_2)+z_3$$

$$= \big((2+5i)+(1-3i)\big)+(2+i)$$

$$= (2+5i+1-3i)+(2+i)$$

$$= (3+2i)+(2+i)$$

$$= 3+2i+2+i$$

$$= 5+3i \longrightarrow (1)$$

$$\begin{array}{r} +2i \\ +1i \\ \hline +3i \end{array}$$

$$R.H.S = z_1+(z_2+z_3)$$

$$= (2+5i)+\big((1-3i)+(2+i)\big)$$

$$= (2+5i)+(1-3i+2+i)$$

$$= (2+5i)+(3-2i)$$

$$\begin{array}{r} -3i \\ +1i \\ \hline -2i \end{array}$$

$$= 2+5i+3-2i$$

$$= 5+3i \longrightarrow (2)$$

$$\begin{array}{r} +5i \\ -2i \\ \hline +3i \end{array}$$

From equation (1) and (2)

$$L.H.S = R.H.S$$

$$(z_1+z_2)+z_3 = z_1+(z_2+z_3)$$

Hence proved.

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(iv) $\boxed{(Z_1 Z_2) Z_3 = Z_1 (Z_2 Z_3)}$

Sol. $L.H.S = (Z_1 Z_2) Z_3$

$= \left((2+5i)(1-3i)\right)(2+i)$

$= \left((2)(1) - (2)(3i) + (5i)(1) - (5i)(3i)\right)(2+i)$

$= (2 - \underbrace{6i + 5i} - 15i^2)(2+i)$

$= (2 - 1i - 15(-1))(2+i)$

$= (2 - 1i + 15)(2+i)$

$= (17 - 1i)(2+i)$

$= (17)(2) + (17)(i) - (1i)(2) - (1i)(i)$

$= 34 + \underbrace{17i - 2i} - 1i^2$

$= 34 + 15i - 1(-1)$

$= 34 + 15i + 1$

$= 35 + 15i \longrightarrow (1)$

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$$R.H.S = Z_1(Z_2 Z_3)$$

$$= (2+5i)\big((1-3i)(2+i)\big)$$

$$= (2+5i)\big((1)(2)+(1)(i)-(3i)(2)-(3i)(i)\big)$$

$$= (2+5i)(2+\underbrace{1i-6i}-3i^2)$$

$$= (2+5i)(2-5i-3(-1))$$

$$= (2+5i)(2-5i+3)$$

$$= (2+5i)(5-5i)$$

$$= (2)(5)-(2)(5i)+(5i)(5)-(5i)(5i)$$

$$= 10-\underbrace{10i+25i}-25i^2$$

$$= 10+15i-25(-1)$$

$$= 10+15i+25$$

$$= 35+15i \longrightarrow (2)$$

From equation (1) and (2)

$$L.H.S = R.H.S$$

$$(Z_1 Z_2)Z_3 = Z_1(Z_2 Z_3)$$

Hence proved.

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(v) $\boxed{z_1 + (-z_1) = (-z_1) + z_1 = 0}$

Sol. $z_1 = 2 + 5i$ ← given in Question

$-z_1 = -2 - 5i$

$L.H.S = z_1 + (-z_1)$

$= (2 + 5i) + (-2 - 5i)$

$= \cancel{2} + \cancel{5}i - \cancel{2} - \cancel{5}i$

$= 0 \longrightarrow (1)$

$R.H.S = (-z_1) + z_1$

$= (-2 - 5i) + (2 + 5i)$

$= -\cancel{2} - \cancel{5}i + \cancel{2} + \cancel{5}i$

$= 0 \longrightarrow (2)$

From equation (1) and (2)

$L.H.S = R.H.S = 0$

$z_1 + (-z_1) = (-z_1) + z_1 = 0$

Hence proved.

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Question # 5

EXERCISE # 1.2

If $\frac{(1+i)^2}{2-i} = x+iy$, the find the values of x and y.

Sol.

$$\frac{(1+i)^2}{2-i} = x+iy$$

Apply formula $(a+b)^2 = (a)^2+(b)^2+2(a)(b)$

$$\frac{(1)^2+(i)^2+2(1)(i)}{2-i} = x+iy$$

$$\frac{1+i^2+2i}{2-i} = x+iy$$

$$\frac{1+(-1)+2i}{2-i} = x+iy$$

$$\frac{\cancel{1}-\cancel{1}+2i}{2-i} = x+iy$$

$$\frac{2i}{2-i} = x+iy$$

$$\frac{2i}{(2-i)} \times \frac{(2+i)}{(2+i)} = x+iy$$

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$$\frac{2i(2+i)}{(2)^2-(i)^2} = x+iy$$

$$\frac{4i+2i^2}{4-i^2} = x+iy$$

$$\frac{4i+2(-1)}{4-(-1)} = x+iy$$

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

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

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

Rearrange

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

Compare Real and imaginary part

$$\boxed{x=-\frac{2}{5}} \quad \text{and} \quad \boxed{y=\frac{4}{5}}$$

Ans. Ans.

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Question # 6

EXERCISE # 1.2

If $(2x+iy)(1-i) = 4+2i$, then find the values of x and y.

Sol.

$$(2x+iy)(1-i) = 4+2i$$

$$(2x)(1)-(2x)(i)+(iy)(1)-(iy)(i) = 4+2i$$

$$2x-2xi+yi-yi^2 = 4+2i$$

$$2x-2xi+yi-y(-1) = 4+2i$$

$$2x-2xi+yi+y = 4+2i$$

$$2x+y+yi-2xi = 4+2i$$

$$\underline{2x+y}+i(\underline{y-2x}) = 4+2i$$

Compare Real and Imaginary part

$$2x+y = 4 \rightarrow (1)$$

$$y-2x = 2$$

Rearrange

$$-2x+y = 2 \rightarrow (2)$$

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Add equation # 1 and 2

$$
\begin{aligned}
\cancel{2x} + y &= 4 \\
-\cancel{2x} + y &= 2 \\
\hline
2y &= 6
\end{aligned}
$$

$$2y = 6$$

$$y = \frac{6}{2}$$

$$\boxed{y = 3} \text{ Ans}$$

Now put the value of "y" in equation 1

$$2x + y = 4$$

$$2x + 3 = 4$$

$$2x = 4 - 3$$

$$2x = 1$$

$$\boxed{x = \frac{1}{2}} \text{ Ans.}$$

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Question # 7

EXERCISE # 1.2

Find the values of a and b, if $(a+bi)(1+3i) = -8+11i$

Sol.

$$(a+bi)(1+3i) = -8+11i$$

$$(a)(1)+(a)(3i)+(bi)(1)+(bi)(3i) = -8+11i$$

$$a+3ai+bi+3bi^2 = -8+11i$$

$$a+3ai+bi+3b(-1) = -8+11i$$

$$a+3ai+bi-3b = -8+11i$$

$$a-3b+3ai+bi = -8+11i$$

$$a-3b+i(3a+b) = -8+11i$$

Compare Real and Imaginary part

$a-3b=-8 \longrightarrow (1)$ | $3a+b=11 \longrightarrow (2)$

Multiply by 3

$$3(a-3b) = 3(-8)$$

$$3a-9b=-24 \longrightarrow (3)$$

Subtract equation (2) from eq (3)

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$$\cancel{3a} - 9b = -24$$
$$\underset{-}{\cancel{3a}} \underset{-}{+} b = \underset{-}{11}$$

$$-10b = -35$$

$$\cancel{+}10b = \cancel{+}35$$

$$b = \frac{35}{10}$$

Divided by 5

$$\boxed{b = \frac{7}{2}}$$ Ans.

put the value of "b" in equation (1)

$$a - 3b = -8$$

$$a - 3\left(\frac{7}{2}\right) = -8$$

$$a - \frac{21}{2} = -8$$

$$a = -\frac{8}{1} + \frac{21}{2}$$

$$a = \frac{-16+21}{2}$$

$$\boxed{a = \frac{5}{2}}$$ Ans.

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EXERCISE # 1.3

(Question # 1)

Find the modulus of the following complex numbers:

(i) $4+3i$

Sol.

If $z = x+iy$

then $|z| = \sqrt{(x)^2+(y)^2}$

Let $z = 4+3i$

$|z| = \sqrt{(4)^2+(3)^2}$

$|z| = \sqrt{16+9}$

$|z| = \sqrt{25}$

$\boxed{|z| = 5}$

Ans.

Solved by:

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(ii) $-5-4i$

Sol

Let $z=-5-4i$

$z=-5+(-4)i$

$$|z|=\sqrt{(-5)^2+(-4)^2}$$

$$|z|=\sqrt{25+16}$$

$$\boxed{|z|=\sqrt{41}}$$ Ans

(iii) $\frac{3}{5}-\frac{4}{5}i$

Sol.

Let $z=\frac{3}{5}-\frac{4}{5}i$

$$z=\frac{3}{5}+\left(\frac{-4}{5}\right)i$$

$$|z|=\sqrt{\left(\frac{3}{5}\right)^2+\left(\frac{-4}{5}\right)^2}$$

$$|z|=\sqrt{\frac{9}{25}+\frac{16}{25}}$$

$$|z|=\sqrt{\frac{9+16}{25}}$$

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$$|z| = \sqrt{\frac{25}{25}}$$

$$|z| = \sqrt{1}$$

$$\boxed{|z| = 1}$$ Ans.

(iv) $-\sqrt{2} - \sqrt{3}i$

Sol. Let $z = -\sqrt{2} - \sqrt{3}i$

$$z = -\sqrt{2} + (-\sqrt{3})i$$

$$|z| = \sqrt{(-\sqrt{2})^2 + (-\sqrt{3})^2}$$

$$|z| = \sqrt{(+2) + (+3)}$$

$$|z| = \sqrt{2+3}$$

$$\boxed{|z| = \sqrt{5}}$$ Ans.

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Question #2

EXERCISE # 1.3

If $z_1 = 2+7i$ and $z_2 = 4-3i$, then verify that

(i) $\boxed{\overline{z_1+z_2} = \bar{z}_1 + \bar{z}_2}$

Sol. L.H.S $= \overline{z_1+z_2} = ?$

$$z_1+z_2 = (2+7i)+(4-3i)$$

$$z_1+z_2 = 2+7i+4-3i$$

$$z_1+z_2 = 6+4i \qquad \begin{array}{r} +7i \\ -3i \\ \hline +4i \end{array}$$

$$\overline{z_1+z_2} = \overline{6+4i}$$

$$\overline{z_1+z_2} = 6-4i \longrightarrow (1)$$

$$\text{R.H.S} = \bar{z}_1 + \bar{z}_2 = ?$$

$$z_1 = 2+7i$$

$$\bar{z}_1 = \overline{2+7i}$$

$$\bar{z}_1 = 2-7i \longrightarrow (2)$$

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$$z_2 = 4 - 3i$$

$$\overline{z}_2 = \overline{4 - 3i}$$

$$\overline{z}_2 = 4 + 3i \longrightarrow (3)$$

Add equation (2) and (3)

$$\overline{z}_1 + \overline{z}_2 = (2 - 7i) + (4 + 3i)$$

$$\overline{z}_1 + \overline{z}_2 = 2 - 7i + 4 + 3i$$

$$\overline{z}_1 + \overline{z}_2 = 6 - 4i \longrightarrow (4)$$

$$\begin{array}{r} -7i \\ +3i \\ \hline -4i \end{array}$$

From equation (2) and (4)

L.H.S = R.H.S

$$\overline{z_1 + z_2} = \overline{z}_1 + \overline{z}_2$$

Hence proved.

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Question # 2(ii)

EXERCISE # 1.3

If $z_1 = 2+7i$ and $z_2 = 4-3i$

then verify that

$$\overline{z_1 z_2} = \bar{z}_1 \bar{z}_2$$

Sol.

$$L.H.S = \overline{z_1 z_2} = ?$$

$$z_1 z_2 = (2+7i)(4-3i)$$

$$z_1 z_2 = (2)(4) - (2)(3i) + (7i)(4) - (7i)(3i)$$

$$z_1 z_2 = 8 \underbrace{-6i + 28i} - 21i^2$$

$$z_1 z_2 = 8 + 6i - 21(-1)$$

$$z_1 z_2 = 8 + 6i + 21$$

$$z_1 z_2 = 29 + 6i$$

$$\overline{z_1 z_2} = \overline{29 + 6i}$$

$$\overline{z_1 z_2} = 29 - 6i \longrightarrow ①$$

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$$R.H.S = \bar{z}_1 \, \bar{z}_2 = ?$$

$$z_1 = 2 + 7i$$

$$\bar{z}_1 = \overline{2 + 7i}$$

$$\bar{z}_1 = 2 - 7i \longrightarrow (2)$$

$$z_2 = 4 - 3i$$

$$\bar{z}_2 = \overline{4 - 3i}$$

$$\bar{z}_2 = 4 + 3i \longrightarrow (3)$$

Multiply equation (2) and (3)

$$\bar{z}_1 \, \bar{z}_2 = (2 - 7i)(4 + 3i)$$

$$\bar{z}_1 \, \bar{z}_2 = (2)(4) + (2)(3i) - (7i)(4) - (7i)(3i)$$

$$\bar{z}_1 \, \bar{z}_2 = 8 + \underbrace{6i - 28i} - 21i^2$$

$$\bar{z}_1 \, \bar{z}_2 = 8 - 6i - 21(-1)$$

$$\bar{z}_1 \, \bar{z}_2 = 8 - 6i + 21$$

$$\bar{z}_1 \, \bar{z}_2 = 29 - 6i \longrightarrow (4)$$

From equation (1) and (4)

$$L.H.S = R.H.S$$

$$\overline{z_1 z_2} = \bar{z}_1 \, \bar{z}_2$$ Hence proved.

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Question # 2 (iii)

EXERCISE # 1.3

If $z_1 = 2+7i$ and $z_2 = 4-3i$, then verify that

$$\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$$

Sol.

$$L.H.S = \overline{\left(\frac{z_1}{z_2}\right)}$$

$$\frac{z_1}{z_2} = \frac{2+7i}{4-3i}$$

$$\frac{z_1}{z_2} = \frac{(2+7i)}{(4-3i)} \times \frac{(4+3i)}{(4+3i)}$$

$$\frac{z_1}{z_2} = \frac{(2)(4)+(2)(3i)+(7i)(4)+(7i)(3i)}{(4)^2-(3i)^2}$$

$$\frac{z_1}{z_2} = \frac{8+6i+28i+21i^2}{16-9i^2}$$

$$\frac{z_1}{z_2} = \frac{8+34i+21(-1)}{16-9(-1)}$$

$$\frac{z_1}{z_2} = \frac{8+34i-21}{16+9}$$

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$$\frac{z_1}{z_2} = \frac{-13+34i}{25}$$

$$\frac{z_1}{z_2} = \frac{-13}{25} + \frac{34}{25}i$$

$$\overline{\left(\frac{z_1}{z_2}\right)} = \overline{\frac{-13}{25} + \frac{34}{25}i}$$

$$\overline{\left(\frac{z_1}{z_2}\right)} = -\frac{13}{25} - \frac{34}{25}i \longrightarrow (1)$$

$$R.H.S = \frac{\overline{z_1}}{\overline{z_2}}$$

$$z_1 = 2+7i$$

$$\overline{z_1} = \overline{2+7i}$$

$$\overline{z_1} = 2-7i \longrightarrow (2)$$

$$z_2 = 4-3i$$

$$\overline{z_2} = \overline{4-3i}$$

$$\overline{z_2} = 4+3i \longrightarrow (3)$$

Divide equation (2) by eq (3)

$$\frac{\overline{z_1}}{\overline{z_2}} = \frac{2-7i}{4+3i}$$

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$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{(2-7i)}{(4+3i)} \times \frac{(4-3i)}{(4-3i)}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{(2)(4)-(2)(3i)-(7i)(4)+(7i)(3i)}{(4)^2-(3i)^2}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{8-6i-28i+21i^2}{16-9i^2}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{8-34i+21(-1)}{16-9(-1)}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{8-34i-21}{16+9}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{-13-34i}{25}$$

$$\frac{\bar{z}_1}{\bar{z}_2} = \frac{-13}{25} - \frac{34}{25}i \longrightarrow (4)$$

From equation (1) and (4)

L.H.S = R.H.S

$$\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$$ Hence proved.

Question # 3(i)

EXERCISE # 1.3

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If $z = 5-2i$, then verify that $\bar{\bar{z}} = z$

Sol.

$$L.H.S = \bar{\bar{z}}$$

$$z = 5-2i$$

$$\bar{z} = \overline{5-2i}$$

$$\bar{z} = 5+2i$$

$$\bar{\bar{z}} = \overline{5+2i}$$

$$\bar{\bar{z}} = 5-2i \longrightarrow (1)$$

$$R.H.S = z$$

$$z = 5-2i \longrightarrow (2)$$

From equation (1) & (2)

$$L.H.S = R.H.S$$

$$\bar{\bar{z}} = z$$

Hence proved.

Question # 3(ii)

Day: ________ EXERCISE # 1.3 Date: __/__/20

If $z = 5-2i$, then verify that $|z| = |\bar{z}|$

Sol.

$$L.H.S = |z|$$

$$z = 5-2i$$

$$z = 5+(-2)i$$

$$|z| = \sqrt{(5)^2+(-2)^2}$$

$$|z| = \sqrt{25+4}$$

$$|z| = \sqrt{29} \longrightarrow (1)$$

$$R.H.S = |\bar{z}|$$

$$z = 5-2i$$

$$\bar{z} = \overline{5-2i}$$

$$\bar{z} = 5+2i$$

$$|\bar{z}| = \sqrt{(5)^2+(2)^2}$$

$$|\bar{z}| = \sqrt{25+4}$$

$$|\bar{z}| = \sqrt{29} \longrightarrow (2)$$

From equation (1) and (2)

$$L.H.S = R.H.S$$

$$|z| = |\bar{z}| \quad \text{Hence proved.}$$

Question # 3 (iii)

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EXERCISE # 1.3

If $z = 5 - 2i$, then verify that $|z| = |-z|$

Sol.

$$L.H.S = |z|$$

$$z = 5 - 2i$$

$$z = 5 + (-2)i$$

$$|z| = \sqrt{(5)^2 + (-2)^2}$$

$$|z| = \sqrt{25 + 4}$$

$$|z| = \sqrt{29} \longrightarrow (1)$$

$$R.H.S = |-z|$$

$$z = 5 - 2i$$

$$-z = -(5 - 2i)$$

$$-z = -5 + 2i$$

$$|-z| = \sqrt{(-5)^2 + (2)^2}$$

$$|-z| = \sqrt{25 + 4}$$

$$|-z| = \sqrt{29} \longrightarrow (2)$$

From equation (1) and (2)

$$L.H.S = R.H.S$$

$$|z| = |-z|$$

Hence proved.

Solved by: Bashir Ahmad Mubashar (M.Phil, M.Ed)

If $z = 5-2i$, then verify that $z\bar{z} = |z|^2$

Sol.

$$L.H.S = z\bar{z}$$

$$z\bar{z} = (5-2i)(\overline{5-2i})$$

$$z\bar{z} = (5-2i)(5+2i)$$

$$z\bar{z} = (5)^2-(2i)^2$$

$$z\bar{z} = 25-4i^2$$

$$z\bar{z} = 25-4(-1)$$

$$z\bar{z} = 25+4$$

$$z\bar{z} = 29 \longrightarrow (1)$$

$$R.H.S = |z|^2$$

$$z = 5-2i$$

$$z = 5+(-2)i$$

$$|z| = \sqrt{(5)^2+(-2)^2}$$

$$|z| = \sqrt{25+4}$$

$$|z| = \sqrt{29}$$

Taking square on both side

$$|z|^2 = (\sqrt{29})^2$$

$$|z|^2 = 29 \longrightarrow (2)$$

From equation (1) and (2)

$$L.H.S = R.H.S$$

$$z\bar{z} = |z|^2$$

Question # 3(v)

EXERCISE # 1.3

Day: ______ Date: __/__/20

If $z = 5-2i$, then verify that $|z| = |-\bar{z}|$

Sol. L.H.S $= |z|$

$$z = 5-2i$$
$$z = 5+(-2)i$$
$$|z| = \sqrt{(5)^2+(-2)^2}$$
$$|z| = \sqrt{25+4}$$
$$|z| = \sqrt{29} \longrightarrow (1)$$

R.H.S $= |-\bar{z}|$

$$z = 5-2i$$
$$-z = -(5-2i)$$
$$-z = -5+2i$$
$$-\bar{z} = \overline{-5+2i}$$
$$-\bar{z} = -5-2i$$
$$-\bar{z} = -5+(-2)i$$
$$|-\bar{z}| = \sqrt{(-5)^2+(-2)^2}$$
$$|-\bar{z}| = \sqrt{25+4}$$
$$|-\bar{z}| = \sqrt{29} \longrightarrow (2)$$

From equation (1) and (2)

L.H.S = R.H.S

$$|z| = |-\bar{z}|$$ Hence proved.

Question # 4

EXERCISE # 1.3

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If $z = 4-3i$, then verify that

$|z| = |-z| = |\bar{\bar{z}}| = |-\bar{z}|$

Sol. $z = 4-3i$

$z = 4+(-3)i$

$|z| = \sqrt{(4)^2+(-3)^2}$

$|z| = \sqrt{16+9}$

$|z| = \sqrt{25}$

$\boxed{|z| = 5} \longrightarrow (1)$

$z = 4-3i$

$-z = -(4-3i)$

$-z = -4+3i$

$|-z| = \sqrt{(-4)^2+(3)^2}$

$|-z| = \sqrt{16+9}$

$|-z| = \sqrt{25}$

$\boxed{|-z| = 5} \longrightarrow (2)$

$z = 4-3i$

$\bar{z} = \overline{4-3i}$

$\bar{z} = 4+3i$

$\bar{\bar{z}} = \overline{4+3i}$

$\bar{\bar{z}} = 4-3i$

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$$\bar{\bar{z}} = 4 + (-3)i$$

$$|\bar{\bar{z}}| = \sqrt{(4)^2 + (-3)^2}$$

$$|\bar{\bar{z}}| = \sqrt{16+9}$$

$$|\bar{\bar{z}}| = \sqrt{25}$$

$$\boxed{|\bar{\bar{z}}| = 5} \longrightarrow (3)$$

$$z = 4 - 3i$$

$$-z = -(4-3i)$$

$$-z = -4 + 3i$$

$$-\bar{z} = \overline{-4+3i}$$

$$-\bar{z} = -4 - 3i$$

$$-\bar{z} = -4 + (-3)i$$

$$|-\bar{z}| = \sqrt{(-4)^2 + (-3)^2}$$

$$|-\bar{z}| = \sqrt{16+9}$$

$$|-\bar{z}| = \sqrt{25}$$

$$\boxed{|-\bar{z}| = 5} \longrightarrow (4)$$

From equation (1), (2), (3) and (4)

$$|z| = |-z| = |\bar{\bar{z}}| = |-\bar{z}|$$

Hence proved.

Question # 5(ii)

EXERCISE # 1.3

If $z_1 = 2+3i$, $z_2 = -1+i$,
then evaluate:
(i) $Re(z_1z_2)$ (ii) $Im(z_1z_2)$

Sol.
(i) $Re(z_1z_2) = ?$ (ii) $Im(z_1z_2) = ?$

$$z_1z_2 = (2+3i)(-1+i)$$
$$z_1z_2 = -(2)(1) + (2)(i) - (3i)(1) + (3i)(i)$$
$$z_1z_2 = -2 \underbrace{+2i - 3i} + 3i^2$$
$$z_1z_2 = -2 - 1i + 3(-1)$$
$$z_1z_2 = -2 - 1i - 3$$
$$z_1z_2 = -5 - 1i$$
$$z_1z_2 = -5 + (-1)i \longrightarrow (1)$$
$$z_1 \cdot z_2 = Re(z_1z_2) + Im(z_1z_2) \longrightarrow (2)$$

Compare equation (1) and (2)

$\boxed{Re(z_1z_2) = -5}$ Ans.

$\boxed{Im(z_1z_2) = -1}$ Ans.

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Exercise # 1.4

Question # 1(i)

Find the real and imaginary parts of the following complex numbers:

$$(8-3i)^2$$

Sol.

Apply formula $(a-b)^2=(a)^2+(b)^2-2(a)(b)$

$(8-3i)^2$

$= (8)^2+(3i)^2-2(8)(3i)$

$= 64+9i^2-48i$

$= 64+9(-1)-48i \quad \because i^2=-1$

$= 64-9-48i$

$= 55-48i$

$= 55+(-48)i$

Real part $= \boxed{55}$

Imaginary part $= \boxed{-48}$ Ans.

Written by:

Bashir Ahmad Mubashar

M.Phil, M.Ed

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Question #1 (ii)

EXERCISE # 1.4

Find real and imaginary parts

$$(5+3i)^{-1}$$

Sol.

$$(5+3i)^{-1}$$

$$= \frac{1}{(5+3i)^{1}}$$

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

$$= \frac{1(5-3i)}{(5)^2-(3i)^2}$$

$$= \frac{5-3i}{25-9i^2} \qquad \because i^2=-1$$

$$= \frac{5-3i}{25-9(-1)}$$

$$= \frac{5-3i}{25+9}$$

Real part $= \frac{5}{34}$

Imaginary part $= -\frac{3}{34}$

$$= \frac{5-3i}{34} = \boxed{\frac{5}{34} - \frac{3}{34}i}$$ Ans.

Question # 1 (iii)

EXERCISE # 1.4

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Find real and imaginary parts

$$(4-5i)^{-1}$$

Sol.

$$(4-5i)^{-1}$$

$$= \frac{1}{(4-5i)^1}$$

$$= \frac{1}{(4-5i)} \times \frac{(4+5i)}{(4+5i)}$$

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

$$= \frac{4+5i}{16-25i^2}$$

$$= \frac{4+5i}{16-25(-1)} \qquad \because i^2=-1$$

$$= \frac{4+5i}{16+25}$$

$$= \frac{4+5i}{41}$$

$$= \boxed{\frac{4}{41}+\frac{5}{41}i}$$

Real part $= \frac{4}{41}$

Imaginary part $= \frac{5}{41}$

Ans.

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Question # 1(iv)

EXERCISE # 1.4

Find real and imaginary part

$$(4-3i)^{-2}$$

Sol-

$$(4-3i)^{-2}$$

$$= \frac{1}{(4-3i)^2}$$

$$= \frac{1}{(4)^2+(3i)^2-2(4)(3i)}$$

$$= \frac{1}{16+9i^2-24i}$$

$$= \frac{1}{16+9(-1)-24i} \quad \because i^2=-1$$

$$= \frac{1}{16-9-24i}$$

$$= \frac{1}{7-24i}$$

$$= \frac{1}{(7-24i)} \times \frac{(7+24i)}{(7+24i)}$$

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$$= \frac{1(7+24i)}{(7)^2-(24i)^2}$$

$$= \frac{7+24i}{49-576i^2}$$

$$= \frac{7+24i}{49-576(-1)} \quad \because i^2=-1$$

$$= \frac{7+24i}{49+576}$$

$$= \frac{7+24i}{625}$$

$$= \boxed{\frac{7}{625} + \frac{24}{625}i}$$

Real part $= \frac{7}{625}$

Imaginary part $= \frac{24}{625}$ Ans.

Question # 1.(v)

EXERCISE # 1.4

Find real and imaginary part $\left(\frac{3+2i}{4+3i}\right)^{-1}$

Sol.

$$\left(\frac{3+2i}{4+3i}\right)^{-1}$$

$$= \left(\frac{4+3i}{3+2i}\right)^{1}$$

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

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

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

$$= \frac{12-8i+9i-6i^2}{9-4i^2}$$

$$= \frac{12+1i-6(-1)}{9-4(-1)} \qquad \because i^2=-1$$

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$$= \frac{12 + 1i + 6}{9+4}$$

$$= \frac{18 + 1i}{13}$$

$$= \boxed{\frac{18}{13} + \frac{1}{13} i}$$

Real part $= \frac{18}{13}$

Imaginary part $= \frac{1}{13}$ Ans.

Question # 1 (vi)

EXERCISE # 1.4

Find real and imaginary part $\left(\frac{2-i}{2+i}\right)^{-2}$

Sol. $\left(\frac{2-i}{2+i}\right)^{-2}$

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

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

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

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

$$= \frac{4+(-1)+4i}{4+(-1)-4i}$$

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

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

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

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

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$$= \frac{9 + 12i + 12i + 16i^2}{9 - 16i^2}$$

$$= \frac{9 + 24i + 16(-1)}{9 - 16(-1)} \qquad \because i^2 = -1$$

$$= \frac{9 + 24i - 16}{9 + 16}$$

$$= \frac{7 + 24i}{25}$$

$$= \boxed{\frac{7}{25} + \frac{24}{25}i}$$

Real part $= \frac{7}{25}$

Imaginary part $= \frac{24}{25}$ Ans.

Question # 1(vii)

EXERCISE # 1.4

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Find real and imaginary part $\left(\frac{1-2i}{1+i}\right)^2$

Sol.

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

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

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

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

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

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

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$$= \frac{-3-4i}{2i}$$

$$= \frac{(-3-4i)}{(2i)} \times \frac{i}{i} \quad \star$$

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

$$= \frac{-3i-4i^2}{2(-1)} \quad \because i^2 = -1$$

$$= \frac{-3i-4(-1)}{-2}$$

$$= \frac{-3i+4}{-2} \quad \text{Rearrange}$$

$$= \frac{4-3i}{-2}$$

$$= \frac{4}{-2} - \frac{3}{-2} i$$

$$= -2 + \frac{3}{2} i$$

Real part $= -2$, Imaginary part $= \frac{3}{2}$ Ans.

EXERCISE # 1.4

Solve the following simultaneous linear equations with complex coefficients for w and z:

$$3z + (2+i)w = 11 - i$$
$$(2-i)z - w = -1 + i$$

Sol.

$$3z + (2+i)w = 11 - i \longrightarrow (1)$$

$$(2-i)z - w = -1 + i$$

$$2z - zi - w = -1 + i$$

$$2z + 1 - zi - i = w$$

OR

$$w = 2z + 1 - zi - i \longrightarrow (2)$$

put the value of "w" in equation # (1)

$$3z + (2+i)[2z + 1 - zi - i] = 11 - i$$

$$3z + 4z + 2 - \cancel{2zi} - 2i + \cancel{2zi} + i - zi^2 - i^2 = 11 - i$$

$$7z - 1i + 2 - z(-1) - (-1) = 11 - i$$

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$$7z - 1i + 2 + z + 1 = 11 - i$$

$$8z + 3 - 1i = 11 - i$$

$$8z = 11 - \cancel{i} - 3 + \cancel{1i}$$

$$8z = 11 - 3$$

$$8z = 8$$

$$z = \frac{8}{8}$$

$$\boxed{z = 1} \text{ Ans.}$$

put the value of "z" in equation #2

$$w = 2z + 1 - zi - i$$

$$w = 2(1) + 1 - (1)i - i$$

$$w = 2 + 1 - i - i$$

$$\boxed{w = 3 - 2i} \text{ Ans.}$$

Question # 2(ii)
EXERCISE # 1.4

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Solve the following simultaneous linear equation with complex coefficients for w and z.

$$2z+(3+i)w = 9-i$$
$$-iz-iw = -1+i$$

Sol.

$$2z+(3+i)w = 9-i \longrightarrow ①$$

$$-iz-iw = -1+i$$

★ Multiply by -1

$$-1(-iz-iw) = -1(-1+i)$$

$$iz+iw = 1-i$$

$$i(z+w) = 1-i$$

$$z+w = \frac{1-i}{i}$$

$$z+w = \frac{1-i}{i}\times\frac{i}{i}$$ ★

$$z+w = \frac{(1-i)i}{i^2}$$

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$$Z+w = \frac{i-i^2}{-1}$$

$$Z+w = \frac{i-(-1)}{-1}$$

$$Z+w = \frac{i+1}{-1}$$

$$Z+w = \frac{i}{-1} + \frac{1}{-1}$$

$$Z+w = -i-1$$

$$Z = -i-1-w \longrightarrow (2)$$

put the value of "Z" in equation

$$2Z+(3+i)w = 9-i$$

$$2(-i-1-w)+(3+i)w = 9-i$$

$$-2i-2-2w+3w+wi = 9-i$$

$$-2w+3w+wi = 9-i+2i+2$$

$$1w+wi = 11+1i$$

$$w(1+i) = 11+i$$

$$w = \frac{11+i}{1+i}$$

$$w = \frac{(11+i)}{(1+i)} \times \frac{(1-i)}{(1-i)}$$

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$$w = \frac{(11+i)(1-i)}{(1+i)(1-i)}$$

$$w = \frac{(11)(1)-(11)(i)+(i)(1)-(i)(i)}{(1)^2-(i)^2}$$

$$w = \frac{11 - 11i + 1i - i^2}{1 - i^2}$$

$$w = \frac{11 - 10i - (-1)}{1-(-1)} \quad \because i^2 = -1$$

$$w = \frac{11 - 10i + 1}{1+1}$$

$$w = \frac{12 - 10i}{2}$$

$$w = \frac{12}{2} - \frac{10}{2} i$$

$$\boxed{w = 6 - 5i}$$

put the value of "w" in equation #2

$$Z = -i - 1 - w$$

$$Z = -i - 1 - (6 - 5i)$$

$$Z = -i - 1 - 6 + 5i$$

$$\boxed{Z = -7 + 4i} \text{ Ans.}$$

Question # 2(iii)
EXERCISE # 1.4

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Solve the following simultaneous linear equation with complex coefficients for w and z.

$$z - 4w = 3i$$
$$2z + 3w = 11 - 5i$$

Sol.

$$z - 4w = 3i \longrightarrow (1)$$

Multiply equation # (1) by 2

$$2(z - 4w) = 2(3i)$$
$$2z - 8w = 6i \longrightarrow (2)$$

given

$$2z + 3w = 11 - 5i \longrightarrow (3)$$

Subtract equation (3) from equation (2)

$$\cancel{2z} - 8w = 6i$$
$$\underline{\cancel{2z} + 3w = 11 - 5i}$$
$$- \quad - \quad\quad - \quad +$$
$$-11w = -11 + 11i$$

$$w = \frac{-11 + 11i}{-11}$$

$$w = \frac{-11}{-11} + \frac{11i}{-11}$$

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$\boxed{w = 1 - 1i}$ Ans

put the value of w in equation (1)

$$z - 4w = 3i$$
$$z - 4(1-1i) = 3i$$
$$z - 4 + 4i = 3i$$
$$z = 4 + 3i - 4i$$
$$z = 4 - 1i$$
$$\boxed{z = 4 - i}$$ Ans

Question # 2(iv)
EXERCISE # 1.4

Solve for w and z.

$$z + w = 3i \quad , \quad 2z + 3w = 2$$

Sol.

$$z + w = 3i \longrightarrow (1)$$

Multiply equation # (1) by 2

$$2(z+w) = 2(3i)$$
$$2z + 2w = 6i \longrightarrow (2)$$

given

$$2z + 3w = 2 \longrightarrow (3)$$

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Subtract equation (3) from equation (2)

$$2\cancel{z} + 2w = 6i$$

$$\underline{-\cancel{2z} \pm 3w = -2}$$

$$-1w = -2 + 6i$$

$$w = \frac{-2 + 6i}{-1}$$

$$w = \frac{-2}{-1} + \frac{6}{-1}i$$

$$\boxed{w = 2 - 6i}$$

put the value of "w" in equation (1)

$$z + w = 3i$$

$$z + (2 - 6i) = 3i$$

$$z + 2 - 6i = 3i$$

$$z = -2 + 3i + 6i$$

$$\boxed{z = -2 + 9i}$$ Ans.

Question # 2(v)

EXERCISE # 1.4

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Solve the following simultaneous linear equations with complex coefficients for w and z.

$2z + (3+i)w = 1$

$-z - (1-i)w = 2$

Sol.

$$2z + (3+i)w = 1$$

$$2z + 3w + wi = 1 \longrightarrow (1)$$

$$-z - (1-i)w = 2$$

$$-z - 1w + wi = 2$$

Multiply by 2 on both side

$$2(-z - 1w + wi) = 2(2)$$

$$-2z - 2w + 2wi = 4 \longrightarrow (2)$$

Add equation (1) and (2)

$$\cancel{2z} + 3w + wi = 1$$

$$-\cancel{2z} - 2w + 2wi = 4$$

$$1w + 3wi = 5$$

$$w(1+3i) = 5$$

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$$w = \frac{5}{(1+3i)}$$

$$w = \frac{5}{(1+3i)} \times \frac{(1-3i)}{(1-3i)}$$

$$w = \frac{5(1-3i)}{(1)^2-(3i)^2}$$

$$w = \frac{5-15i}{1-9i^2}$$

$$w = \frac{5-15i}{1-9(-1)} \qquad \because i^2=-1$$

$$w = \frac{5-15i}{1+9}$$

$$w = \frac{5-15i}{10}$$

$$w = \frac{5}{10} - \frac{15}{10}i$$

$$\boxed{w = \frac{1}{2} - \frac{3}{2}i} \quad \text{Ans.}$$

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put the value of "ω" in

$$2z + (3+i)\omega = 1$$

$$2z + (3+i)\left(\frac{1}{2} - \frac{3}{2}i\right) = 1$$

$$2z + (3)\left(\frac{1}{2}\right) - (3)\left(\frac{3}{2}i\right) + (i)\left(\frac{1}{2}\right) - (i)\left(\frac{3}{2}i\right) = 1$$

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

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

$$2z + \frac{3}{2} + \left(\frac{+1i - 9i}{2}\right) + \frac{3}{2} = 1$$

$$2z + \frac{3}{2} + \frac{3}{2} + \left(\frac{-8i}{2}\right) = 1$$

$$2z + \left(\frac{3+3}{2}\right) - \frac{\overset{4}{\cancel{8}}}{\underset{1}{\cancel{2}}}i = 1$$

$$2z + \frac{6}{2} - 4i = 1$$

$$2z + 3 - 4i = 1$$

$$2z = 1 - 3 + 4i$$

$$2z = -2 + 4i$$

$$z = \frac{-2+4i}{2} \Rightarrow z = \frac{-2}{2} + \frac{4i}{2} \Rightarrow \boxed{z = -1 + 2i}$$

Ans.

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