* Complex numbers :

A number which can be written in the form $a+bi$, where a, b are real numbers and $i = \sqrt{-1}$ is called a complex number.

If $z = a+bi$ is the complex number, then (a) and (b i) are called real and imaginary parts; then

$z = \underbrace{a}_{\text{Real number}} + \underbrace{bi}_{\text{imaginary number}}$

Ex

$z = 2+3i$	$a=2$	$b=3$
$z = -3+6i$	$a=-3$	$b=6$
$z = -i$	$a=0$	$b=-1$
$z = 5$	$a=5$	$b=0$
$z = -3-6i$	$a=-3$	$b=-6$

* Operation of complex numbers :

(1) Addition of complex numbers :

Let $z_1 = a+bi$ and $z_2 = c+di$ be two complex numbers, then

$$z_1 + z_2 = (a+bi) + (c+di)$$
$$= \underbrace{(a+c)}_{\text{Real}} + \underbrace{(bi+di)}_{\text{imaginary}}$$

(3-) Multiplying Complex Numbers

Let $z_1 = a+bi$ and $z_2 = c+di$, be two Complex numbers. Then

$$z_1 \cdot z_2 = (a+bi)(c+di)$$
$$= a(c+di) + bi(c+di)$$
$$= ac + adi + bci + bdi^2$$
$$= ac + adi + bci - bd$$
$$(ac-bd) + (ad+bc)i$$

real — imaginary

Remark :-

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

2- $i^2 = \sqrt{-1} \cdot \sqrt{-1} = -1$

3- $i^3 = i^2 i = -1 \cdot i = -i$

4- $i^4 = (i^2)^2 = (-1)^2 = 1$

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

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

Ex: Find Multiply the following Complex numbers.

1- $(2+8i)(3+7i)$

$= 2(3+7i) + 8i(3+7i)$

$= 6 + 14i + 24i + 56i^2$

$= 6 + 38i - 56 = -50 + 38i$