GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

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CHAPTERWISE MULTIPLE CHOICE QUESTIONS FOR COMPETATIVE EXAM

SUBJECT: MATHEMATICS – I PUC

NAME OF THE CHAPTER: COMPLEX NUMBERS AND QUADRATIC EQUATIONS

RECAP

Number system consists of real numbers $\left(\mathbf{-5, 7, \frac{1}{3}, \sqrt{3}.............etc}\right)$ and imaginary numbers $\left(\mathbf{\sqrt{-5}, \sqrt{-9}....etc.}\right)$

If we combine these two numbers by some mathematical operations, the resulting number is known as Complex Number *i.e.*,

"Complex Number is the combination of real and imaginary numbers".

Complex Numbers

A number of the form $x+iy$, where $x,y\in R$ and $i=\sqrt{-1}$ is called a complex number so the quantity $\sqrt{-1}$ is denoted by 'i' called iota thus $i=\sqrt{-1}$.

A complex number is usually denoted by z and the set of complex number is denoted by c

i.e., $c=\{x+i\,y : x\in R, y\in R, i=\sqrt{-1}\}$

For example, $5+3i, -1+i, 0+4i, 4+0i$ etc. are complex numbers.

- Euler was the first mathematician to introduce the symbol i (iota) for the square root of – 1 with property $i^2=-1$. He also called this symbol as the imaginary unit.
- Iota (i) is neither 0, nor greater than 0, nor less than 0.
- The square root of a negative real number is called an imaginary unit.
- For any positive real number a, we have $\mathbf{\sqrt{-a} = \sqrt{-1\times a} = \sqrt{-1}\sqrt{a} = i\sqrt{a}}$
- $\mathbf{i\sqrt{-a} = -\sqrt{a}}$.
- The property $\mathbf{\sqrt{a}\sqrt{b} = \sqrt{ab}}$ is valid only if at least one of a and b is non-negative. If a and b are both negative then $\mathbf{\sqrt{a}\sqrt{b} = -\sqrt{ab}}$.
- If $a<0$ then $\mathbf{\sqrt{a} = \sqrt{|a|}i}$.

Integral powers of iota (i):

Since $i=\sqrt{-1}$ hence we have $i^2=-1$, $i^3=-i$ and $i^4=1$.

To find the value of $i^n\ (n>4)$, first divide n by 4. Let q be the quotient and r be the remainder.

i.e., $n=4q+r$ where $0\le r\le 3$

$$i^n=i^{4q+r}=(i^4)^q.(i)^r=(1)^q.(i)^r=i^r$$

In general we have the following results $i^{4n}=1, i^{4n+1}=i, i^{4n+2}=-1, i^{4n+3}=-i$, where n is any integer.

In other words, $i^n=(-1)^{n/2}$ if n is even integer and $i^n=(-1)^{n-1/2}i$ if n is odd integer.

The value of the negative integral powers of i are found as given below:

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

Real and Imaginary Parts of a Complex Number.

If x and y are two real numbers, then a number of the form $z=x+iy$ is called a complex number.

Here 'x' is called the real part of z and 'y' is known as the imaginary part of z.

The real part of z is denoted by $Re(z)$ and the imaginary part by $\text{Im}(z)$.

If $z=3-4i$, then $\text{Re}(z)=3$ and $\text{Im}(z)=-4$.

- ✓ A complex number z is purely real if its imaginary part is zero *i.e.*, $\text{Im}(z)=0$ and purely imaginary if its real part is zero *i.e.*, $\text{Re}(z)=0$.
- ✓ i can be denoted by the ordered pair (0,1).
- ✓ The complex number (a, b) can also be split as $(a, 0)+(0, 1)\ (b, 0)$.

Algebraic Operations with Complex Numbers

Let two complex numbers $z_1=a+ib$ and $z_2=c+id$

Addition : $(a+ib)+(c+id)=(a+c)+i(b+d)$

Subtraction : $(a+ib)-(c+id)=(a-c)+i(b-d)$

Multiplication : $(a+ib)(c+id)=(ac-bd)+i(ad+bc)$

Division : $\dfrac{a+ib}{c+id}$ (when at least one of c and d is non-zero)

$$\frac{a+ib}{c+id}=\frac{(a+ib)}{(c+id)}.\frac{(c-id)}{(c-id)} \qquad \text{(Rationalization)}$$

$$\frac{a+ib}{c+id}=\frac{(ac+bd)}{c^2+d^2}+\frac{i(bc-ad)}{c^2+d^2}.$$

Properties of algebraic operations with complex numbers:

Let z_1, z_2 and z_3 are any complex numbers then their algebraic operation satisfy following operations:

(i) Addition of complex numbers satisfies the commutative and associative properties

i.e., $\mathbf{z_1 + z_2 = z_2 + z_1}$ and $\mathbf{(z_1 + z_2) + z_3 = z_1 + (z_2 + z_3)}$.

(ii) Multiplication of complex number satisfies the commutative and associative properties.

i.e., $\mathbf{z_1 z_2 = z_2 z_1}$ and $\mathbf{(z_1 z_2) z_3 = z_1 (z_2 z_3)}$.

(iii) Multiplication of complex numbers is distributive over addition

i.e., $\mathbf{z_1(z_2 + z_3) = z_1 z_2 + z_1 z_3}$ and $\mathbf{(z_2 + z_3) z_1 = z_2 z_1 + z_3 z_1}$.

Note :

- $0 = 0 + 0i$ is the identity element for addition.
- $1 = 1 + 0i$ is the identity element for multiplication.
- The additive inverse of a complex number $z = a + ib$ is $-z$ $(i.e. -a - ib)$.
- For every non-zero complex number z, the multiplicative inverse of z is $\frac{1}{z}$.

Equality of Two Complex Numbers

Two complex numbers $\mathbf{z_1 = x_1 + iy_1}$ and $\mathbf{z_2 = x_2 + iy_2}$ are said to be equal if and only if their real parts and imaginary parts are separately equal.

i.e., $z_1 = z_2 \Rightarrow x_1 + iy_1 = x_2 + iy_2 \Leftrightarrow x_1 = x_2$ and $y_1 = y_2$.

Thus, one complex equation is equivalent to two real equations.

✓ A complex number $z = x + iy = 0$ *iff* $x = 0, y = 0$.

✓ The complex number do not possess the property of order

i.e., $(a + ib) < (or) > (c + id)$ is not defined.

For example, the statement $9 + 6i > 3 + 2i$ makes no sense.

Conjugate of a Complex Number

If there exists a complex number $z = \mathbf{a + ib, (a, b)} \in R$, then its conjugate is defined as $\mathbf{\bar{z} = a - ib}$.

Hence, we have $\mathbf{Re(z) = \dfrac{z + \bar{z}}{2}}$ and $\mathbf{Im(z) = \dfrac{z - \bar{z}}{2i}}$.

Geometrically, the conjugate of z is the reflection or point image of z in the real axis.

Properties of conjugate:

If z, z_1 and z_2 are existing complex numbers, then we have the following results:

(i) $\overline{(\bar{z})} = z$

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

(iii) $\overline{z_1 - z_2} = \bar{z}_1 - \bar{z}_2$

(iv) $\overline{z_1 z_2} = \bar{z}_1 \bar{z}_2$, In general $\overline{z_1.z_2.z_3.....z_n} = \bar{z}_1.\bar{z}_2.\bar{z}_3.....\bar{z}_n$

(v) $\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$, $z_2 \neq 0$

(vi) $(\bar{z})^n = \overline{(z^n)}$

(vii) $z + \bar{z} = 2\text{Re}(z) = 2\text{Re}(\bar{z}) =$ purely real

(viii) $z - \bar{z} = 2i\text{Im}(z) =$ purely imaginary

(ix) $z\bar{z} =$ purely real

(x) $z_1\bar{z}_2 + \bar{z}_1 z_2 = 2\text{Re}(z_1\bar{z}_2) = 2\text{Re}(\bar{z}_1 z_2)$

(xi) $z - \bar{z} = 0$ *i.e.*, $z = \bar{z} \Leftrightarrow z$ is purely real *i.e.*, $\text{Im}(z) = 0$

(xii) $z + \bar{z} = 0$ *i.e.*, $z = -\bar{z} \Leftrightarrow$ either $z = 0$ or z is purely imaginary *i.e.*, $\text{Re}(z) = 0$

(xiii) $z_1 = z_2 \Leftrightarrow \bar{z}_1 = \bar{z}_2$

(xiv) $z = 0 \Leftrightarrow \bar{z} = 0$

(xv) $z\bar{z} = 0 \Leftrightarrow z = 0$

(xvi) If $w = f(z)$ then $\bar{w} = f(\bar{z})$

(xvii) $\overline{re^{i\theta}} = re^{-i\theta}$

Reciprocal of a complex number:

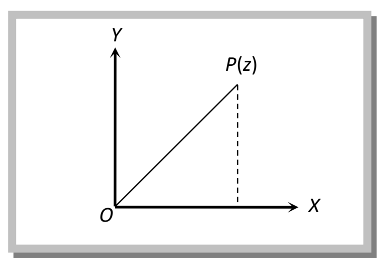
For an existing non-zero complex number $z = a + ib$,

the reciprocal is given by $z^{-1} = \frac{1}{z} = \frac{\bar{z}}{|z|^2}$ *i.e.*, $z^{-1} = \frac{1}{a+ib} \Rightarrow \frac{a-ib}{a^2+b^2} = \frac{\text{Re}(z)}{|z|^2} + \frac{i[-\text{Im}(z)]}{|z|^2} = \frac{\bar{z}}{|z|^2}$.

Modulus of a Complex Number

Modulus of a complex number $z = a + ib$ is defined by a positive real number given by $|z| = \sqrt{a^2 + b^2}$, where *a, b* real numbers. Geometrically $|z|$ represents the distance of point *P* (represented by *z*) from the origin,

i.e. $|z| = OP$.



If $|z| = 0$, then z is known as zero modular complex number and is used to represent the origin of reference plane.

If $|z| = 1$ the corresponding complex number is known as unimodular complex number.

Clearly z lies on a circle of unit radius having centre (0, 0).

- ✓ In the set C of all complex numbers, the order relation is not defined. As such $z_1 > z_2 >$ or $z_1 < z_2$ has no meaning. But $|z_1| > |z_2|$ or $|z_1| < |z_2|$ has got its meaning since $|z_1|$ and $|z_2|$ are real numbers.

Properties of modulus

(i) $|z| \geq 0 \Rightarrow |z| = 0$ *iff* $z = 0$ and $|z| > 0$ *iff* $z \neq 0$

(ii) $-|z| \leq \text{Re}(z) \leq |z|$ and $-|z| \leq \text{Im}(z) \leq |z|$

(iii) $|z| = |\bar{z}| = |-z| = |-\bar{z}| = |zi|$

(iv) $z\bar{z} = |z|^2 = |\bar{z}|^2$

(v) $|z_1 z_2| = |z_1||z_2|$. In general $|z_1 z_2 z_3 ......z_n| = |z_1||z_2||z_3|....|z_n|$

(vi) $\left|\frac{z_1}{z_2}\right| = \frac{|z_1|}{|z_2|}$, $(z_2 \neq 0)$

(vii) $|z^n| = |z|^n, n \in N$

(viii) $|z_1 \pm z_2|^2 = (z_1 \pm z_2)(\bar{z}_1 \pm \bar{z}_2) = |z_1|^2 + |z_2|^2 \pm (z_1\bar{z}_2 + \bar{z}_1 z_2)$ or $|z_1|^2 + |z_2|^2 \pm 2\text{Re}(z_1\bar{z}_2)$

(ix) $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 \Leftrightarrow \frac{z_1}{z_2}$ is purely imaginary or $\text{Re}\left(\frac{z_1}{z_2}\right) = 0$

(x) $|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2\left\{|z_1|^2 + |z_2|^2\right\}$ (Law of parallelogram)

(xi) $|az_1 - bz_2|^2 + |bz_1 + az_2|^2 = (a^2 + b^2)\left(|z_1|^2 + |z_2|^2\right)$, where $a, b \in R$.

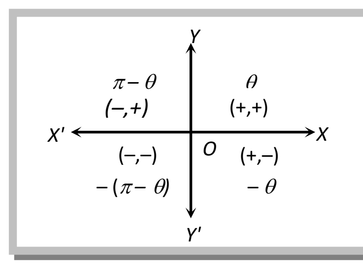
Argument of a Complex Number.

Let $z = a + ib$ be any complex number. If this complex number is represented geometrically by a point P, then the angle made by the line OP with real axis is known as argument or amplitude of z and is expressed as

arg $(z) = \theta = \tan^{-1}\left(\frac{b}{a}\right)$, $\theta = \angle POM$. Also, argument of a complex number is not unique, since if θ be a value of the argument, so also is $2n\pi + \theta$, where $n \in I$.

Principal value of arg (z):

The value θ of the argument, which satisfies the inequality $-\pi < \theta \leq \pi$ is called the principal value of argument. Principal values of argument z will be $\theta, \pi - \theta, -\pi + \theta$ and $-\theta$ according as the point z lies in the 1st, 2nd, 3rd and 4th quadrants respectively, where $\theta = \tan^{-1}\left|\frac{b}{a}\right| = \alpha$ (acute angle).



Principal value of argument of any complex number lies between $-\pi < \theta \leq \pi$.

ARGUMENT OF A COMPLEX NUMBER

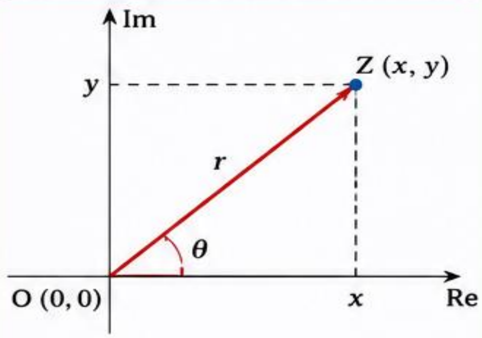
The argument of a complex number is the angle that the vector representing the complex number makes with the positive real axis, measured in the counter–clockwise direction.

1. DEFINITION

Let $z = x + iy$ be a complex number where $x,\ y \in \mathbb{R}$, not both zero.

The **argument of z** is denoted by $\boxed{\arg z}$ and is defined as the angle θ that the line (vector) from the **origin** to the point $Z(x,\ y)$ makes with the **positive real axis**, measured in the **counter–clockwise direction**.

2. GEOMETRIC REPRESENTATION



$$r = |z| = \sqrt{x^2 + y^2} \quad \text{(Modulus)}$$
$$\theta = \arg(z)$$

3. PRINCIPAL ARGUMENT

The **principal value** of the argument of z is denoted by Arg z and is defined to be the unique value of arg z in the interval $(-\pi,\ \pi]$.

$$\boxed{\text{Arg } z \in (-\pi,\ \pi]}$$

Note :

- When $y > 0,\ \ 0 < \arg z < \pi$
- When $y < 0,\ \ -\pi < \arg z < 0$
- When $x < 0,\ y = 0,\ \arg z = \pi$
- When $x > 0,\ y = 0,\ \arg z = 0$
- arg 0 is undefined.

4. arg z IN TERMS OF x AND y

Case	Condition	arg z
1	$x > 0,\ y > 0$ (Quadrant I)	$\tan^{-1}\left(\frac{y}{x}\right)$
2	$x < 0,\ y > 0$ (Quadrant II)	$\pi - \tan^{-1}\left(\frac{\lvert y\rvert}{\lvert x\rvert}\right)$
3	$x < 0,\ y < 0$ (Quadrant III)	$-\pi + \tan^{-1}\left(\frac{\lvert y\rvert}{\lvert x\rvert}\right)$
4	$x > 0,\ y < 0$ (Quadrant IV)	$-\tan^{-1}\left(\frac{\lvert y\rvert}{\lvert x\rvert}\right)$
5	$x = 0,\ y > 0$	$\frac{\pi}{2}$
6	$x = 0,\ y < 0$	$-\frac{\pi}{2}$
7	$y = 0,\ x > 0$	0
8	$y = 0,\ x < 0$	π

5. ALL POSSIBLE VALUES OF ARGUMENT

The set of all values (arguments) of z is given by

$$\boxed{\arg z = \text{Arg } z + 2n\pi,\ n \in \mathbb{Z}}$$

This means the arguments of z differ from one another by integral multiples of 2π.

Example :

If Arg $z = \frac{\pi}{6}$, then

$$\arg z = \frac{\pi}{6} + 2n\pi,\ n \in \mathbb{Z}$$
$$= \ldots, -\frac{11\pi}{6}, \frac{\pi}{6}, \frac{13\pi}{6}, \frac{25\pi}{6}, \ldots$$

6. SPECIAL CASES ON AXES

- **For $z = x + 0i$ (Real axis)**

  If $x > 0$, $\arg z = 0$

  If $x < 0$, $\arg z = \pi$

- **For $z = 0 + iy$ (Imaginary axis)**

  If $y > 0$, $\arg z = \frac{\pi}{2}$

  If $y < 0$, $\arg z = -\frac{\pi}{2}$

- **For $z = 0$**

  arg 0 is not defined.

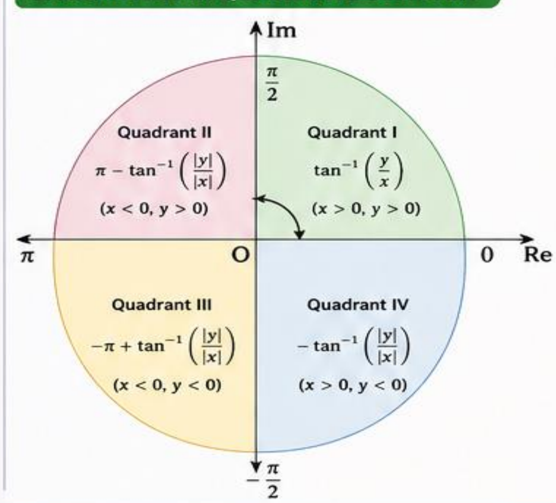
7. EXAMPLES

1. $z = 3 + 4i$ (Quadrant I)
   $\arg z = \tan^{-1}\left(\frac{4}{3}\right)$
2. $z = -2 + 2i$ (Quadrant II)
   $\arg z = \pi - \tan^{-1}\left(\frac{2}{2}\right) = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$
3. $z = -1 - 1$ (Quadrant III)
   $\arg z = -\pi + \tan^{-1}\left(\frac{1}{1}\right) = -\frac{3\pi}{4}$
4. $z = 2 - 2i$ (Quadrant IV)
   $\arg z = -\tan^{-1}\left(\frac{2}{2}\right) = -\frac{\pi}{4}$
5. $z = -5 \ \rightarrow\ \arg z = \pi$
6. $z = 7i \ \rightarrow\ \arg z = \frac{\pi}{2}$
7. $z = -7i \ \rightarrow\ \arg z = -\frac{\pi}{2}$

8. PROPERTIES OF ARGUMENT

- $\arg(\overline{z}) = -\arg z \quad (z \neq 0)$
  (Conjugate rule)
- $\arg(-z) = \arg z + \pi \pmod{2\pi}$
  (Negative rule)
- $\arg(z_1 z_2) = \arg z_1 + \arg z_2 \pmod{2\pi}$
  (Product rule)
- $\arg\left(\frac{z_1}{z_2}\right) = \arg z_1 - \arg z_2 \pmod{2\pi}$
  (Quotient rule)
- $\arg(z^n) = n \arg z \quad \pmod{2\pi}$
  for any integer n
- For $r > 0$, $\arg(rz) = \arg z$.

9. ARGUMENT IN QUADRANTS SUMMARY



IMPORTANT POINT Always determine the quadrant of the complex number first, then use the correct formula to find arg z. Finally, take the principal value in $(-\pi,\ \pi]$ for Arg z.

Remember:
Arguments repeat every 2π radians.
Principal Argument is unique in $(-\pi,\ \pi]$.

Complex Numbers

1. **If 4x+i(3x-y)=3+i(-6), where x and y are real numbers, then the values of x and y are** *(Easy)*

   (a) x=3/5 and y=33/4 (b) x=3/4 and y=22/3

   (c) x=3/4 and y=33/4 (d) x=3/4 and y=33/5

2. **For a complex number $z=-4i+7$, what is the $\mathrm{Re}(z)$ and Im (z) respectively?** *(Easy)*

   (a) -4,7 (b) 7,-4 (c) 4,-7 (d) -7,4

3. **If $(x+iy)(2-3i)=4+i$, then** *(Average)*

   (a) $x=-14/13, y=5/13$ (b) $x=5/13, y=14/13$

   (c) $x=14/13, y=5/13$ (d) $x=5/13, y=-14/13$

4. **If $x, y \in R$, then $x+$ iy is a non-real complex number, if** *(Average)*

   (a) x=0 (b) y=0 (c) x≠0 (d) y≠0

5. **If $a+ib=c+id$, then** *(Easy)*

   (a) $a^2+c^2=0$ (b) $b^2+c^2=0$ (c) $b^2+d^2=0$ (d) $a^2+b^2=c^2+d^2$

Complex Numbers									
1	2	3	4	5					
C	B	B	D	D					

Algebra Of Complex Numbers

1. **If $z=5i\left(\frac{-3}{5}i\right)$, then z is equal to $3+$ bi. The value of ' b ' is** *(Easy)*

   (a) 1 (b) 2 (c) 0 (d) 3

2. **If $z=i^9+i^{19}$, then z is equal to $a+a$. The value of ' a ' is** *(Easy)*

   (a) 0 (b) 1 (c) 2 (d) 3

3. **Find the Value of $\left(\frac{2i}{1+i}\right)^2$** *(Easy)*

   (a) i (b) 2i (c) 1-i (d) 1-2i

4. **If $\left(\frac{1+i}{1-i}\right)^x=1$, then** *(Average)*

   (a) $x=2n+1,\ n \in N$ (b) $x=4n,\ n \in N$

   (c) $x=2n\ ,\ n \in N$ (d) $x=4n+1\ ,\ n \in N$

5. **If $\left(\frac{1-i}{1+i}\right)^{100}=a+ib$ then** *(Average)*

   (a) a=2,b=-1 (b) a=1,b=0 (c) a=0,b=1 (d) a=-1,b=2

6. **$i^{57}+\frac{1}{i^{25}}$, when simplified has the value** *(Average)*

   (a) 0 (b) $2i$ (c) $-2i$ (d) 2

7. **$1+i^2+i^4+i^6+\cdots+i^{2n}$** *(Average)*

   (a) positive (b) negative (c) 0 (d) cannot be determined

8. **Find the Value of** $\frac{i^{592}+i^{590}+i^{588}+i^{586}+i^{584}}{i^{582}+i^{580}+i^{578}+i^{576}+i^{574}}-1$ *(Average)*

(a) -2 (b) 0 (c) -1 (d) 1

9. **If** $z=x-iy$ **and** $z^{\frac{1}{3}}=p+iq$**, then** $\left(\frac{x}{p}+\frac{y}{q}\right)/(p^2+q^2)$ **is equal to** *(Difficult)*

(a) -2 (b) -1 (c) 2 (d) 1

10. **If** $z=1+i$**, then the multiplicative inverse of** z^2 **is (where,** $i=\sqrt{-1}$ **)** *(Average)*

(a) 2i (b) 1-i (c) $-\frac{i}{2}$ (d) $\frac{i}{2}$

11. **The multiplicative inverse of** $\frac{3+4i}{4-5i}$ **is** *(Average)*

(a) $\frac{8}{25}-\frac{31}{25}i$ (b) $-\frac{8}{25}-\frac{31}{25}i$ (c) $-\frac{8}{25}+\frac{31}{25}i$ (d)) $\frac{8}{25}+\frac{31}{25}i$

12. **If** $z(2-i)=(3+i)$**, then** z^{20} **is equal to** *(Average)*

(a) 2^{10} (b) -2^{10} (c) 2^{20} (d) -2^{20}

13. **If** $(x+iy)^{\frac{1}{3}}=a+ib$**, where** $x,y,a,b\in R$**, then** $\frac{x}{a}-\frac{y}{b}=$ *(Difficult)*

(a) a^2-b^2 (b) $-2(a^2+b^2)$ (c) $2(a^2-b^2)$ (d) a^2+b^2

14. **If** $z=2-3i$**, then value of** $z^2-4z+13$ **is** *(Difficult)*

(a) 0 (b) 1 (c) 2 (d) 3

15. **If** $\mathrm{z}=\mathrm{i}^{-39}$**, then simplest form of** z **is equal to** $a+i$**. The value of '** a **' is** *(Average)*

(a) 0 (b) 1 (c) 2 (d) 3

16. **If** $z_1=2+3i$ **and** $z_2=3+2i$**, then** z_1+z_2 **equals to a+ai then value of 'a' is equal to**

(Average)

(a) 3 (b) 4 (c) 5 (d) 2

17. **If** $z_1=2+3i$ **and** $z_2=3-2i$**, then** z_1-z_2 **equals to** $-1+bi$**. The value of '** b **' is**

(Average)

(a) 1 (b) 2 (c) 3 (d) 5

18. **The value of** $(1+\mathrm{i})^4\left(1+\frac{1}{\mathrm{i}}\right)^4$ **is** *(Average)*

(a) 12 (b) 2 (c) 8 (d) 16

19. **Evaluate:** $(1+\mathrm{i})^6+(1-\mathrm{i})^3$ *(Average)*

(a) $-2-10\mathrm{i}$ (b) $2-10\mathrm{i}$ (c) $-2+10\mathrm{i}$ (d) $2+10\mathrm{i}$

20. **The value of** $\frac{\mathrm{i}^{4n+1}-\mathrm{i}^{4n-1}}{2}$ **is** *(Average)*

(a) i (b) 2i (c) $-\mathrm{i}$ (d) $-2\mathrm{i}$

21. **Value of** $\mathrm{i}^{4k}+\mathrm{i}^{4k+1}+\mathrm{i}^{4k+2}+\mathrm{i}^{4k+3}$ **is** *(Average)*

(a) 0 (b) 1 (c) 2 (d) 3

22. The value of $(1+i)^5 \times (1-i)^5$ is *(Average)*

(a) -8 (b) 8i (c) 8 (d) 32

23. $\left(\frac{1}{1-2i}+\frac{3}{1+i}\right)\left(\frac{3+4i}{2-4i}\right)$ is equal to: *(Average)*

(a) $\frac{1}{2}+\frac{9}{2}i$ (b) $\frac{1}{2}-\frac{9}{2}i$ (c) $\frac{1}{4}-\frac{9}{4}i$ (d) $\frac{1}{4}+\frac{9}{4}i$

24. The real part of $\frac{(1+i)^2}{(3-i)}$ is *(Average)*

(a) $\frac{1}{3}$ (b) $\frac{1}{5}$ (c) $-\frac{1}{3}$ (d) $-\frac{1}{5}$

Algebra Of Complex Numbers									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
c	a	b	b	b	a	d	a	a	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	b	b	a	a	c	d	d	a	a
21	**22**	**23**	**24**						
a	d	d	d						

Modulus And Conjugate Of A Complex Number

1. What is the conjugate of $\frac{\sqrt{5+12i}+\sqrt{5-12i}}{\sqrt{5+12i}-\sqrt{5-12i}}$ *(Average)*

(a) $-3i$ (b) $3i$ (c) $\frac{3}{2}i$ (d) $-\frac{3}{2}i$

2. The modulus of $\frac{(1+i\sqrt{3})(2+2i)}{(\sqrt{3}-i)}$ is *(Average)*

(a) 2 (b) 4 (c) $3\sqrt{2}$ (d) $2\sqrt{2}$

3. If $z_1 = 6+3i$ and $z_2 = 2-i$, then $\frac{z_1}{z_2}$ is equal to $\frac{1}{a}(9+12i)$. The value of ' a ' is *(Difficult)*

(a) 1 (b) 2 (c) 4 (d) 5

4. If $z=\frac{7-i}{3-4i}$, then $|z|^{14}=$ *(Average)*

(a) 2^7 (b) 2^7i (c) -2^7 (d) $-2^7\mathbf{i}$

5. If $z_1 = 6+3i$ and $z_2 = 2-i$, then $\frac{z_1}{z_2}$ is equal to *(Average)*

(a) $\frac{1}{5}(9+12i)$ (b) $9+12i$ (c) $3+2i$ (d) $\frac{1}{5}(12+9i)$

6. If $(1-i)^n = 2^n$, then the value of n is *(Average)*

(a) 1 (b) 2 (c) 0 (d) -1

7. If $|z-4|<|z-2|$, its solution is given by *(Difficult)*

(a). $\mathrm{Re}(z)>0$ (b) $\mathrm{Re}(z)<0$ (c) $\mathrm{Re}(z)>3$ (d) $\mathrm{Re}(z)>2$

8. Modulus of $z=\frac{(1+i\sqrt{3})(\cos\theta+i\sin\theta)}{2(1-i)(\cos\theta-i\sin\theta)}$ is *(Average)*

(a) $\frac{1}{\sqrt{3}}$ (b) $-\frac{1}{\sqrt{2}}$ (c) $\frac{1}{\sqrt{2}}$ (d) 1

9. If $z_1 = 2 - i$ and $z_2 = 1 + i$, then value of $\left|\frac{z_1+z_2+1}{z_1-z_2+1}\right|$ is *(Difficult)*

(a) 2 (b) 2i (c) $\sqrt{2}$ (d) $\sqrt{2}$i

10. If $\frac{(1+i)^3}{(1-i)^3} - \frac{(1-i)^3}{(1+i)^3} = x + iy$ *(Average)*

(a) $x = 0, y = -2$ (b) x = 1, y = 1 (c) $x = -2, y = 0$ (d) $x = -1, y = 1$

11. Additive inverse of $1 - i$ is *(Average)*

(a) 0 + 0i (b) $-1 - i$ (c) $-1 + i$ (d) 1+i

12. If z is a complex number such that $z^2 = (\bar{z})^2$, then *(Average)*

(a) z is purely real (b) z is purely imaginary

(c) either z is purely real or purely imaginary (d) None of these

13. If $x + iy = \sqrt{\frac{a+ib}{c+id}}$, then $(x^2 + y^2)^2 =$ *(Average)*

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

14. If $x + iy = \frac{a+ib}{a-ib}$, then $x^2 + y^2 =$ *(Average)*

(a) 1 (b) 2 (c) 0 (d) 4

15. The conjugate of the complex number $\frac{2+5i}{4-3i}$ is equal to : *(Average)*

(a) $\frac{7-26i}{25}$ (b) $\frac{-7-26i}{25}$ (c) $\frac{-7+26i}{25}$ (d) $\frac{7+26i}{25}$

16. A real value of x satisfies the equation $\left(\frac{3-4ix}{3+4ix}\right) = \alpha - i\beta (\alpha, \beta \in R)$, if $\alpha^2 + \beta^2$ is equal to *(Difficult)*

(a) 1 (b) -1 (c) 2 (d) -2

17. If z = 2 + i, then $(z - 1)(\bar{z} - 5) + (\bar{z} - 1)(z - 5)$ is equal to *(Difficult)*

(a) 2 (b) 7 (c) -1 (d) -4

18. If $|z| = 1, (z \neq -1)$ and $z = x + iy$, then $\left(\frac{z-1}{z+1}\right)$ is *(Difficult)*

(a) purely real (b) purely imaginary

(c) zero (d) undefined

19. If $\bar{z}$ be the conjugate of the complex number z, then which of the following relations is false? *(Difficult)*

(a) $|z| = |\bar{z}|$ (b) $z \cdot \bar{z} = |\bar{z}|^2$ (c) $\overline{z_1 + z_2} = \bar{z}_1 + \bar{z}_2$ (d) $\arg z = \arg \bar{z}$

20. $(x - iy)(3 + 5i)$ is the conjugate of $(-6 - 24i)$, then x and y are *(Average)*

(a) $x = 3, y = -3$ (b) $x = -3, y = 3$

(c) $x = -3, y = -3$ (d) $x = 3, y = 3$

21. If z is a complex number such that $\frac{z-1}{z+1}$ is purely imaginary, then *(Average)*

(a) $|z| = 0$ (b) $|z| = 1$ (c) $|z| > 1$ (d) $|z| < 1$

22. The complex number z which satisfies the condition $\left|\frac{i+z}{i-z}\right| = 1$ lies on *(Average)*

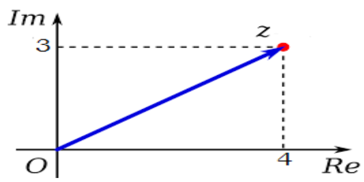
(a) circle $x^2 + y^2 = 1$ (b) the x-axis

(c) the y-axis (d) the line $x + y = 1$

Modulus And Conjugate Of A Complex Number									
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
c	d	d	a	a	c	c	c	c	a
11	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***
c	c	a	a	b	a	d	b	d	a
21	***22***								
b	b								

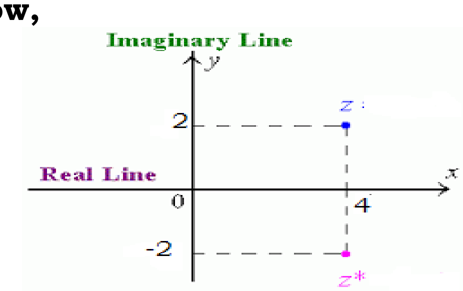
Diagram-Based, Matching & Statement-Type Questions

1. The graph drawn below depicts *(Easy)*



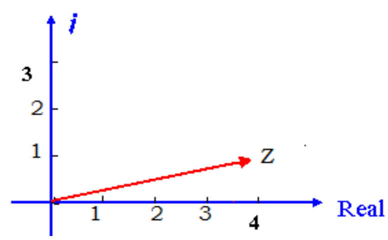
(A) $Z = 3 + 4i$ (B) $Z = 3 - 4i$ (C) $Z = 4 + 3i$ (D) $Z = 4 - 3i$

2. For the figure given below, *(Easy)*



(A) $Z^* = Z$ (B) $Z^* = -Z$ (C) $Z^* = \bar{Z}$ (D) $Z^* = \frac{1}{Z}$

3. For the figure given below, $|z|$ *is* *(Average)*



(A) 4 (B) 1 (C) $\sqrt{17}$ (D) 17

4. Match List I with List II *(Average)*

List I	**List II**
a) Additive inverse of 1+ i	i) $\frac{1}{1+i}$
b) conjugate of 1+ i	ii) $1 - i$
c) multiplicative inverse of 1+ i	iii) $-1 - i$

Choose the correct answer from the options given below:

A) a-i, b-ii, c-iii B) a-iii, b-ii, c-i C) a-ii, b-i, c-iii D) a-iii, b-i, c-ii

5. **If z = x+iy, then match List I with List II** ***(Easy)***

List I	**List II**
a) $z\,\bar{z}$	i) x^2+y^2
b) $z-\bar{z}$	ii) 2x
c) $z+\bar{z}$	iii) $i2y$

Choose the correct answer from the options given below:

A) a-i, b-ii, c-iii B) a-iii, b-ii, c-i C) a-ii, b-i, c-iii D) a-i, b-iii, c-ii.

6. **If z_i = x_i+iy_i,then match List I with List II** ***(Easy)***

List I	**List II**
a) z_1z_2	i) $(x_1-x_2)+i(y_1-y_2)$
b) $z_{1+}z_2$	ii) $(x_1x_2-y_1y_2)+i(x_1y_2+y_1x_2)$
c) $z_{1-}z_2$	iii) $(x_1+x_2)+i(y_1+y_2)$

Choose the correct answer from the options given below:

A) a-ii, b-iii, c-i B) a-iii, b-ii, c-i C) a-ii, b-i, c-iii D) a-i, b-iii, c-ii

7. **Assertion (A):** The multiplicative inverse of $2+\ 2i$ is $\frac{2+\ 2i}{\sqrt{8}}$

Reason (R): The multiplicative inverse of Z is $\frac{\bar{Z}}{|Z|^2}$ ***(Average)***

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion A)

(C) Assertion (A) is true and Reason (R) is false

(D) Assertion (A) is false and Reason (R) is true

8. **STATEMENT 1:** The modulus of $3-4i$ is 5 ***(Easy)***

STATEMENT 2: The modulus of $a+bi$ is $\sqrt{\mathrm{a}^2+\mathrm{b}^2}$

(A) Both STATEMENT 1 and 2 are true and STATEMENT 2 is the correct explanation of the STATEMENT 1

(B) Both STATEMENT 1 and 2 are true and STATEMENT 2 is not the correct explanation of the STATEMENT 1

(C) STATEMENT 1 is true and STATEMENT 2 is false

(D) STATEMENT 1 is false and STATEMENT 1 is true

9. **STATEMENT 1:** *The value of* i *(iota) is* $(-1)^{1/2}$ ***(Easy)***

STATEMENT 2: $\boldsymbol{i}\,.\,\boldsymbol{i} = \sqrt{-1}\sqrt{-1} = 1$.

(A) Both STATEMENT 1 and 2 are true

(B) Both STATEMENT 1 and 2 are false.

(C) STATEMENT 1 is true and STATEMENT 2 is false.

(D) STATEMENT 1 is false and STATEMENT 1 is true.

10. **STATEMENT 1:** If $z=3+i$,then the real part of $\frac{1}{z}$ $is\,\frac{3}{10}$

STATEMENT 2: If $z=x+iy$, then $\frac{1}{z}=\frac{x-iy}{x^2+y^2}$. ***(Average)***

(A) Both STATEMENT 1 and 2 are true and STATEMENT 2 is the correct explanation of the STATEMENT 1

(B) Both STATEMENT 1 and 2 are true and STATEMENT 2 is not the correct explanation of the STATEMENT 1

(C) STATEMENT 1 is true and STATEMENT 2 is false.

(D) STATEMENT 1 is false and STATEMENT 1 is true.

11. **Assertion (A): The value of $1 + i^2 + i^4 + i^6 + \ldots + i^{20}$ is 0** *(Easy)*
Reason (R): If n is multiple of 4, then $i^n = -1$ and n is not a multiple of 4 then $i^n = 1$
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion A)
(C) Assertion (A) is false and Reason (R) is false
(D) Assertion (A) is false and Reason (R) is true

Diagram-Based, Matching & Statement-Type Questions									
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
C	C	C	B	D	A	D	A	C	A
11									

Practice Questions

1. **Let $z = 1 + i$, where $i = \sqrt{-1}$. If $z - \frac{24\bar{z}}{z^2} = \lambda z$, then the value of λ is equal to** *(Average)*

A) 12 B) 13 C) 18 D) 23

2. **The complex number z satisfying the equation $\frac{\text{Re}(z)}{2+i} + \frac{\text{Im}(z)}{1+2i} = \frac{3}{1-2i}$, is** *(Average)*

A) $6 - 5i$ B) $-4 + 5i$ C) $5 - 4i$ D) $4 - 5i$

3. **If α is a real number satisfying $\alpha^2 - \frac{1}{\alpha^2} = 2$, then the value of $\left(\alpha + \frac{i}{\alpha}\right)^{16}$ is equal to**

(Difficult)

A) 2048 B) 4096 C) 2024 D) 4048

4. **Let $z = \frac{a - \frac{i}{2}}{i-2}$, where a is a real number and $i = \sqrt{-1}$. If $\text{Im}(z) = 0$, then the value of a is equal to** *(Difficult)*

A) 1 B) 2 C) 3 D) 4

5. **In a complex plane, if two vertices of an equilateral triangle are at $-3(1 + i)$ and $3(1 - i)$, then the area of the triangle (in sq.units) is equal to** *(Difficult)*

A) 18 B) $9\sqrt{3}$ C) $6\sqrt{3}$ D) $3\sqrt{3}$

6. **The value of $\left[\frac{5i}{(3+i)(3-i)}\right]^{2026}$ is equal to** *(Average)*

A) $\frac{1}{2^{2026}}$ B) $\frac{1}{2^{1013}}$ C) $\frac{-1}{2^{1013}}$ D) $\frac{-1}{2^{2026}}$

7. **If $Z|Z| = 24 + 7i$, where Z is a complex number, then the value of $|z|$ is equal to**

(Average)

A) 5 B) 7 C) 12 D) 15

8. **Given that $i^2 = -1$. Then $i^{13} + i^{14} + i^{15} + \cdots + i^{2026}$ is equal to** *(Easy)*

A) $i - 2$ B) $i + 2$ C) $2i + 1$ D) $i - 1$

9. **Let x and y be real numbers. If $(3+i)x+y+(1-i)y+3i-4=(2x+1)i+(x-y+2)i$, where $i=\sqrt{-1}$, then the pair x,y is equal to** *(Average)*

A) $(1,2)$ B) $(0,2)$ C) $(0,-2)$ D) $(3,2)$

10. **Let $z_1=\frac{5+7i}{7-5i}, z_2=\frac{3+2i}{3-2i}$ and $z_3=\frac{1+11i}{11-i}$. Then $z_1\overline{z_1}+z_2\overline{z_2}+z_3\overline{z_3}$ is equal to** *(Difficult)*

A) 2 B) $1+2i$ C) 1 D) 3

11. **The value of $\frac{(1+i)^n}{(1-i)^{n-4}}$, where $i=\sqrt{-1}$ and n is an integer,** *(Average)*

A) $\frac{i^n}{4}$ B) $4i^n$ C) $-4i^n$ D) -1

12. **Given that $i^2=-1$. Then $(i^1)(i^2)(i^3)\dots(i^{2026})$ is equal to** *(Average)*

A) -1 B) 1 C) $2i$ D) $-i$

13. **Given that $i^2=-1$. If $z_1=(7+i\sqrt{5})^2+(7-i\sqrt{5})^2$ and $z_2=(3+2i)^3-(3-2i)^3$, then** *(Average)*

A) Z_1 is a purely imaginary number and Z_2 is a purely real number

B) Z_1 is a purely real number and Z_2 is a purely imaginary number

C) both Z_1 and Z_2 are purely imaginary numbers

D) both z_1 and z_2 are purely real numbers

14. **If $z_1=1+3i, z_2=-3i+5$, then $(z_1\overline{z_2}+z_2\overline{z_1})+\left(\overline{(z_1\overline{z_2}+z_2\overline{z_1})}\right.$ is equal to** *(Difficult)*

A) -16 B) $1+i$ C) 1 D) $1-i$

15. $\left|\frac{\cos\alpha+i\sin\alpha}{\sin\alpha-i\cos\alpha}\right|^{1000}+\left|\frac{\sin\alpha+i\cos\alpha}{\cos\alpha-i\sin\alpha}\right|^{2000}$ **is equal to** *(Average)*

A) 2 B) 5 C) 4 D) 16

16. **If $|z+4|=2|z+1|$, where z is a complex number, then $|z|$ is equal to** *(Average)*

A) 0 B) 2 C) 4 D) 8

17. **If $z(3-i)=2+i$, then $z^2=$** *(Average)*

A) $\frac{i}{2}$ B) $\frac{-i}{2}$ C) $\frac{1}{2}$ D) $\frac{-1}{2}$

18. **The imaginary part of $\frac{1-i\sqrt{3}}{1+i\sqrt{3}}$ is** *(Average)*

A) $\frac{-1}{2}$ B) $\frac{1}{2}$ C) $\frac{\sqrt{3}}{2}$ D) $\frac{-\sqrt{3}}{2}$

19. **The sum of $i^2+i^4+\cdots$ upto 25 terms is equal to** *(Easy)*

A) 0 B) i C) $-i$ D) -1

20. **The equation $\text{Im}(1-i)z=1$ represents the line** *(Average)*

A) $y=x+1$ B) $y=1-x$ C) $y=x-1$ D) $y=x+2$

21. **The imaginary part of $\frac{\cos 50^\circ + i\sin 50^\circ}{\cos 50^\circ - i\sin 50^\circ}$ is equal to** ***(Average)***

A) $\cos 10^\circ$ B) $\sin 80^\circ$ C) $\cos 50^\circ$ D) $\sin 40^\circ$

22. **The value of $\left(\frac{\sqrt{3}}{2}+\frac{i}{2}\right)^3 + \left(\frac{\sqrt{3}}{2}-\frac{i}{2}\right)^3$ is equal to** ***(Easy)***

A) $3\sqrt{3}$ B) $2\sqrt{3}$ C) 2 D) 0

23. **If the complex numbers $(2+i)x+(1-i)y+2i-3$ and $x+(-1+2i)y+1+i$ are equal, then (x,y) is** ***(Average)***

A) $(1,-2)$ B) $(-1,2)$ C) $(2,-1)$ D) $(2,1)$

24. **If $x+iy=\frac{3+4i}{5-12i}$, then $x+y$ is equal to** ***(Easy)***

A) $\frac{23}{169}$ B) $\frac{56}{169}$ C) $-\frac{15}{169}$ D) $\frac{15}{169}$

25. **If $\left|\frac{z-5i}{z+5i}\right|=1$, then** ***(Average)***

A) $\text{Re}(z)=0$ B) $|z|=10$ C) $|z|=25$ D) $\text{Im}(z)=0$

26. **If the complex number $\frac{2+i}{\lambda+i}$ lies on the line $y=x$ of the first quadrant, then the value of λ is equal to** ***(Difficult)***

A) 3 B) -3 C) 2 D) -2

27. **Let $z=x+iy$, where $y>0$. If $z+\bar{z}=6$ and $|z|+|\bar{z}|=10$, then $z=$** ***(Difficult)***

A) $3+2i$ B) $3+5i$ C) $3+3i$ D) $3+4i$

28. **If the complex number $2+i$ is rotated through an angle 90° in the anti-clockwise direction about the origin in the complex plane, then the resulting complex number is** ***(Difficult)***

A) $2-i$ B) $1+2i$ C) $-1+2i$ D) $-2+i$

29. **The value of $\left(\frac{10i}{(2-i)(3-i)}\right)^{2024}$ is equal to** ***(Average)***

A) 2^{2024} B) 2^{1012} C) 4^{2024} D) $\left(\frac{1}{2}\right)^{2024}$

30. **The value of α for which the complex number $\frac{2-\alpha i}{\alpha - i}$ is purely imaginary, is** ***(Easy)***

A) 2 B) -2 C) 1 D) 0

31. **The centre of a square is at the origin of the complex plane. If one of the vertices is at $-3i$, then the area of the square is** ***(Difficult)***

A) 9 B) 12 C) 18 D) 24

32. **The modulus of the complex number $\frac{(1+i)^{10}(2-i)^6}{(2i-4)^4}$ is equal to** ***(Average)***

A) 8 B) 10 C) 16 D) 30

33. Real part of $\left(\frac{1+i}{1-i}\right)\left(\frac{2+i}{2-i}\right)$ is ***(Easy)***

A) $\frac{3}{5}$ B) $-\frac{3}{5}$ C) $\frac{4}{5}$ D) $-\frac{4}{5}$

34. Let z be a non-zero complex number such that $z = \frac{16}{\bar{z}}$. Then the locus of z is ***(Average)***

A) a straight line B) a parabola

C) an ellipse D) a circle with centre at the origin

35. If $a^2 + b^2 = 1$, then $\frac{1+(a-ib)}{1+(a+ib)} =$ is equal to ***(Average)***

A) $a - ib$ B) $a + ib$ C) $-a + ib$ D) $-a - ib$

36. $\left|\left(\frac{1+i}{\sqrt{2}}\right)^{2024}\right| =$ ***(Easy)***

A) 4 B) 2^{1012} C) 1 D) $\sqrt{2}$

37. $\sum_{n=1}^{24}\left(i^n + i^{n+1}\right) =$ ***(Easy)***

A) $1 + i$ B) i C) $1 - i$ D) 0

38. If z is a complex number of unit modulus, then $\left|\frac{1+z}{1+\bar{z}}\right|$ equals ***(Average)***

A) 2 B) 1 C) $\frac{1}{2}$ D) 4

39. Let z be a complex number satisfying $|z + 16| = 4|z + 1|$. Then ***(Average)***

A) $|z| = 2$ B) $|z| = 4$ C) $|z| = 8$ D) $|z| = 10$

40. If $2z = 7 + i\sqrt{3}$, then the value of $z^2 - 7z + 4$ is ***(Average)***

A) $-\frac{39}{4}$ B) $\frac{39}{4}$ C) -9 D) 17

41. If $\left(\frac{1-i}{1+i}\right)^{10} = a + ib$, then the values of a and b are, respectively, ***(Easy)***

A) 1 and 0 B) 0 and 1 C) -1 and 0 D) 0 and - 1

42. If z_1 and z_2 are two complex numbers with $|z_1| = 1$, then $\left|\frac{z_1 - z_2}{1 - z_1\bar{z}_2}\right|$ is equal to ***(Average)***

A) 0 B) $\frac{1}{4}$ C) $\frac{1}{2}$ D) 1

43. $\sum_{n=1}^{4}\left(\sqrt{-1}\right)^{2n} =$ ______ ***(Easy)***

A) 2 B) $-i$ C) 0 D) 1

44. If Z_1 and Z_2 are two non-zero complex numbers, then which of the following is not true? ***(Average)***

A) $\overline{Z_1 + Z_2} = \overline{Z_1} + \overline{Z_2}$ B) $|Z_1 Z_2| = |Z_1||Z_2|$

C) $\overline{Z_1 Z_2} = \overline{Z_1}.\overline{Z_2}$ D) $\overline{Z_1 + Z_2} \geq \overline{Z_1} + \overline{Z_2}$

45. Let $z = 1 + \frac{1}{i}$. Then the value of z^4 is equal to *(Average)*

A) 4 B) -4 C) $1 - i$ D) $1 + i$

46. The modulus of the complex number $(2\sqrt{2} + i2\sqrt{2})^2$ is equal to *(Average)*

A) 16 B) 4 C) 32 D) 8

47. If $z + \bar{z} = 6$ and $z - \bar{z} = 4i$, then $|z|^2 =$ *(Average)*

A) 36 B) 16 C) 15 D) 13

48. Let $z = \frac{2-i}{\alpha+i}$, where α is a real number. If $4\text{Re}(z) = 3\text{Im}(\bar{z})$ then the value of α is *(Difficult)*

A) 5 B) -5 C) 3 D) 2

49. Let s, t, r be non-zero distinct positive real numbers. If the complex number $z = x + iy$ satisfies $sz + t\bar{z} + r = 0$, then z lies on *(Difficult)*

A) imaginary axis B) real axis C) $y = x$ D) $y = 2x$

50. Let $z = x + iy$ be a complex number, where $i = \sqrt{-1}$ is the complex unit. Then $|\, z - 1 + i \,| = 5$ is a circle with *(Difficult)*

A) centre at (-1,1) and radius 5 B) centre at (1,1) and radius $\sqrt{5}$

C) centre at $(-1, -1)$ and radius $\sqrt{5}$ D) centre at $(1, -1)$ and radius 5

51. Let z be a complex number such that $z^3 + iz^2 - iz + 1 = 0$ where $i^2 = -1$. Then $|z| =$ *(Average)*

A) 2 B) $\frac{1}{2}$ C) 1 D) $\frac{1}{4}$

52. Real part of $\frac{1+\sin\frac{2\pi}{27} - i\cos\frac{2\pi}{27}}{1+\sin\frac{2\pi}{27} + i\cos\frac{2\pi}{27}}$ is equal to *(Average)*

A) $\cos\frac{2\pi}{27}$ B) $\sin\frac{2\pi}{27}$ C) $1 + \sin\frac{2\pi}{27}$ D) $1 + \cos\frac{2\pi}{27}$

53. If $z = 1 + i\tan\theta$, where $\pi < \theta < \frac{3\pi}{2}$, then $|z|$ is equal to *(Difficult)*

A) $1 + \tan\theta$ B) $2\tan\theta$ C) $\sec\theta$ D) $-\sec\theta$

54. If $Z = \frac{3+i}{2-i}$ then Z^{-1} is equal to *(Average)*

A) $1 + i$ B) $\frac{1+i}{2}$ C) $\frac{1-i}{2}$ D) $2(1 - i)$

55. If z is a complex number, then the minimum value of $|z - 2| + |z - 4|$ is *(Average)*

A) $\sqrt{20}$ B) 2 C) 6 D) $\sqrt{6}$

56. The point $z = \frac{1}{\sqrt{2}}(1 + i)$ in the complex plane is rotated about the origin through an angle $\frac{\pi}{4}$ in the clockwise direction, then the new position of Z is *(Difficult)*

A) 2 B) 1 C) $\frac{1}{\sqrt{2}}(1 - i)$ D) $\frac{1}{2}(1 - i)$

57. **If $z = 2 + i, i^2 = -1$, then the value of $z^2 - 4z + 15$** *(Difficult)*

A) 2 B) 6 C) 10 D) 12

58. **The modulus of the complex number $\left(\frac{i}{2} - \frac{2}{i}\right)$ is equal to** *(Average)*

A) $\frac{2}{5}$ B) $\frac{5}{2}$ C) $\frac{2}{3}$ D) $\frac{3}{2}$

59. **If the complex number z varies so that the real and imaginary parts of $z - 2 - 3i$ are equal, then the locus of Z is** *(Difficult)*

A) a circle B) a straight line C) a parabola D) an ellipse

60. **If $k = 4n + 3$, where n is an integer and $i^2 = -1$ then i^k is equal to** *(Average)*

A) 0 B) 1 C) -1 D) $-i$

61. **The value of $(1 + i)^{10}$ is equal to** *(Average)*

A) 16 B) $16i$ C) 32 D) $32i$

62. **The value of $i^3 + i^4 + i^5 + \cdots i^{93}$, where $i = \sqrt{-1}$, is equal to** *(Average)*

A) i B) 1 C) $-i$ D) -1

63. **Imaginary parts of $\left(\frac{3-2i}{2i}\right)^2$ is equal to** *(Easy)*

A) $\frac{5}{4}$ B) $\frac{-5}{4}$ C) 3 D) -3

64. **Let $z_1 = \frac{1}{2} + i\frac{\sqrt{3}}{2}$ and $z_2 = -\frac{1}{2} - i\frac{\sqrt{3}}{2}$. If $w = z_1 + \overline{z_2}$, then $\bar{w} =$** *(Average)*

A) 1 B) $\sqrt{3}$ C) $i\sqrt{3}$ D) $-i\sqrt{3}$

65. **All the points in $A = \left\{\frac{\lambda+i}{\lambda-i}; \lambda \in \mathbb{R}\right\}$ lie on** *(Difficult)*

A) a circle with radius $\sqrt{2}$ B) a circle with radius 2

C) a circle with radius $\frac{1}{2}$ D) a circle with radius 1

66. $\sum_{n=1}^{2027} i^n (1+i)$, $i^2 = -1$, **is equal to** *(Easy)*

A) $i + 1$ B) $i - 1$ **C)** $-i - 1$ D) $-i + 1$

67. **If $x, y \in \mathbb{R}$ and $x + iy = -(6 + i)^3, i^2 = -1$, then $x - y$ is equal to** *(Easy)*

A) 93 B) -93 C) 91 D) -91

68. **Let $z = x + iy$, where $x, y \in \mathbb{R}$ and $i^2 = -1$. If $|z - i| = |z - 1|$, then $y =$** *(Easy)*

A) x B) $x + 1$ C) $-x - 1$ D) $x + 2$

Practice Questions									
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
B	D	B	A	B	D	A	D	B	D
11	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***
C	D	B	A	A	B	A	D	D	A
21	***22***	***23***	***24***	***25***	***26***	***27***	***28***	***29***	***30***
B	D	D	A	D	B	D	C	B	D
31	***32***	***33***	***34***	***35***	***36***	***37***	***38***	***39***	***40***
C	B	D	D	A	C	D	B	B	C
41	***42***	***43***	***44***	***45***	***46***	***47***	***48***	***49***	***50***
C	D	C	D	B	A	D	D	B	D
51	***52***	***53***	***54***	***55***	***56***	***57***	***58***	***59***	***60***
C	B	D	C	B	B	C	B	B	D
61	***62***	***63***	***64***	***65***	***66***	***67***	***68***		
D	B	C	D	D	C	D	A		