COMPLEX NUMBER

LEVEL-I

1. If z_1 , z_2 are two complex numbers such that $\arg(z_1+z_2) = 0$ and $\text{Im}(z_1z_2) = 0$, then
(A) $z_1 = - z_2$ (B) $z_1 = z_2$
(C) $z_1 = \overline{z}_2$ (D) none of these

2. Roots of the equation $x^n - 1 = 0$, $n \in I$,
(A) form a regular polygon of unit circum-radius . (B) lie on a circle.
(C) are non-collinear. (D) A & B

3. Which of the following is correct
(A) $6 + i > 8 - i$ (B) $6 + i > 4 - i$
(C) $6 + i > 4 + 2i$ (D) None of these

4. If $(1+i\sqrt{3})^{1999} = a+ib$, then
(A) $a = 2^{1998}$, $b = 2^{1998}\sqrt{3}$ (B) $a = 2^{1999}$, $b = 2^{1999}\sqrt{3}$
(C) $a=-2^{1998}$, $b = -2^{1998}\sqrt{3}$ (D) None of these

5. If $z = 1 + i\sqrt{3}$, then $|\arg(z)| + |\arg(\overline{z})|$ equals
(A) $\pi/3$ (B) $2\pi/3$
(C) 0 (D) $\pi/2$

6. The equation $z\left(\overline{z + i + i\sqrt{3}}\right) + \overline{z}\left(z + 1 + i\sqrt{3}\right) = 0$ represents a circle with
(A) centre $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and radius 1 (B) centre $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$ and radius 1
(C) centre $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and radius 2 (D) centre $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$ and radius 2

7. Number of solutions to the equation $(1 - i)^x = 2^x$ is
(A) 1 (B) 2
(C) 3 (D) no solution

8. If $\arg(z) < 0$, then $\arg(-z) - \arg(z) =$
(A) π (B) $\frac{-\pi}{4}$ (C) $-\frac{\pi}{2}$ (D) $-\frac{\pi}{2}$

9. The number of solutions of the equation $z^2 + |z|^2 = 0$, where $z \in C$ is
(A) one (B) two (C) three (D) infinitely many

10. If ω is an imaginary cube root of unity, then $(1 + \omega - \omega^2)^7$ equals
(A) $128\,\omega$ (B) $-128\,\omega$
(C) $128\,\omega^2$ (D) $-128\,\omega^2$

11. If z_1 and z_2 be the n^{th} roots of unity which subtend right angle at the origin. Then n must be of the form

(A) 4k + 1 (B) 4k + 2

(C) 4k + 3 (D) 4k

12. For any two complex numbers z_1 and z_2 $|\sqrt{7}\, z_1 + 3z_2|^2 + |3z_1 - \sqrt{7}\, z_2|^2$ is always equal to

(A) $16(|z_1|^2 + |z_2|^2)$ (B) $4(|z_1|^2 + |z_2|^2)$

(C) $8(|z_1|^2 + |z_2|^2)$ (D) none of these

13. If α is an nth root of unity other than unity itself, then the value of $1 + \alpha + \alpha^2 + \ldots\ldots\ldots + \alpha^{n-1}$ is ……………………………

14. Locus of 'z' in the Argand plane is $|z| = 2,$ then the locus of z + 1 is -

(A) a straight line (B) a circle with centre (1, 0)

(C) a circle with centre (0, 0) (D) a straight line passing through (0, 0)

15. Value of $\omega^{1999} + \omega^{299} + 1$ is

(A) 1 (B) 2

(C) 0 (D) -1

16. Square root(s) of '–1' is/ are -

(A) $\frac{1}{\sqrt{2}}(1-i)$ (B) $\frac{1}{\sqrt{3}}(i-1)$

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

17. The real value of 'θ' for which $\frac{3+2i\sin\theta}{1-2i\sin\theta}$ is real is

(A) $\theta = n\pi, \quad n \in I$ (B) $\theta = n\pi + \frac{\pi}{3}, \ n \in I$

(C) $\theta = n\pi + \frac{\pi}{2}, \quad n \in I$ (D) $\theta = \frac{n\pi}{2}, \ n \in I$

18. Principal argument of $z = -\sqrt{3} + i$ is

(A) $\frac{5\pi}{6}$ (B) $\frac{\pi}{6}$

(C) $-\frac{5\pi}{6}$ (D) None

19. Which one is not a root of the fourth root of unity

(A) i (B) 1

(C) $\frac{i}{\sqrt{2}}$ (D) –i

20. If $z^3 - 2z^2 + 4z - 8 = 0$ then

(A) $|z| = 1$

(B) $|z| = 2$

(C) $|z| = 3$

(D) None

LEVEL-II

1. If a,b, c are three complex numbers such that $c = (1-\lambda)a + \lambda b$, for some non-zero real number λ, then points corresponding to a,b, c are
(A) vertices of a triangle (B) collinear
(C) lying on a circle (D) none of these

2. If z be any complex number such that $|3z-2| + |3z+2| = 4$, then locus of z is
(A) an ellipse (B) a circle
(C) a line-segment (D) None of these

3. If $\arg(\bar{z}_1) = \arg(z_2)$, then
(A) $z_2 = k z_1^{-1}$ $(k > 0)$ (B) $z_2 = kz_1$ $(k > 0)$
(C) $|z_2| = |\bar{z}_1|$ (D) None of these.

4. The value of the expression $2\left(1+\frac{1}{\omega}\right)\left(1+\frac{1}{\omega^2}\right)+3\left(2+\frac{1}{\omega}\right)\left(2+\frac{1}{\omega^2}\right)+4\left(3+\frac{1}{\omega}\right)\left(3+\frac{1}{\omega^2}\right) + \ldots + (n+1)\left(n+\frac{1}{\omega}\right)\left(n+\frac{1}{\omega^2}\right)$, where ω is an imaginary cube root of unity, is
(A) $\frac{n(n^2+2)}{3}$ (B) $\frac{n(n^2-2)}{3}$ (C) $\frac{n^2(n+1)^2+4n}{4}$ (D) none of these

5. For a complex number z, $|z-1| + |z+1| = 2$. Then z lies on a
(A) parabola (B) line segment
(C) circle (D) none of these

6. If z_1 and z_2 are two complex numbers such that $|z_1| = |z_2| + |z_1 - z_2|$, then
(A) $\mathrm{Im}\left(\frac{z_1}{z_2}\right) = 0$ (B) $\mathrm{Re}\left(\frac{z_1}{z_2}\right) = 0$
(C) $\mathrm{Re}\left(\frac{z_1}{z_2}\right) = \mathrm{Im}\left(\frac{z_1}{z_2}\right)$ (D) none of these.

7. If $\left|\frac{z_1}{z_2}\right| = 1$ and $\arg(z_1 z_2) = 0$, then
(A) $z_1 = z_2$ (B) $|z_2|^2 = z_1 z_2$
(C) $z_1 z_2 = 1$ (D) none of these.

8. Number of non-zero integral solutions to $(3+4i)^n = 25^n$ is
(A) 1 (B) 2
(C) finitely many (D) none of these.

9. If $|z| < 4$, then $|iz + 3 - 4i|$ is less than
(A) 4 (B) 5
(C) 6 (D) 9

10. If z is a complex number, then $z^2 + \bar{z}^2 = 2$ represents

(A) a circle (B) a straight line
(C) a hyperbola (D) an ellipse

11. If $\frac{1-i\alpha}{1+i\alpha}$ = A + iB, then $A^2 + B^2$ equals to
(A) 1 (B) α^2
(B) -1 (D) - α^2

12. A,B and C are points represented by complex numbers z_1, z_2 and z_3. If the circumcentre of the triangle ABC is at the origin and the altitude AD of the triangle meets the circumcircle again at P, then P represents the complex number
(A) $-\frac{z_1z_2}{z_3}$ (B) $-\frac{z_2z_3}{z_1}$
(C) $-\frac{z_3z_1}{z_2}$ (D) $\frac{z_1z_2}{z_3}$

13. If $|z_1| = |z_2|$ and $\arg(z_1) + \arg(z_2) = \pi/2$, then
(A) $\arg(z_1^{-1}) + \arg(z_2^{-1}) = -\pi/2$ (B) z_1z_2 is purely imaginary
(C) $(z_1+z_2)^2$ is purely imaginary (D) All the above.

14. If z_1 and z_2 are two complex numbers satisfying the equation $\left|\frac{z_1+iz_2}{z_1-iz_2}\right| = 1$, then $\frac{z_1}{z_2}$ is a
(A) purely real (B) of unit modulus
(C) purely imaginary (D) none of these

15. If the complex numbers z_1, z_2, z_3, z_4, taken in that order, represent the vertices of a rhombus, then
(A) $z_1 + z_3 = z_2 + z_4$ (B) $|z_1 - z_2| = |z_2 - z_3|$
(C) $\frac{z_1-z_3}{z_2-z_4}$ is purely imaginary (D) none of these

16. If $\left|\frac{z_1z-z_2}{z_1z+z_2}\right| = k, (z_1, z_2 \neq 0)$ then
(A) for k = 1 locus of z is a straight line
(B) for k $\notin$ {1, 0} z lies on a circle
(C) for k = 0 z represents a point
(D) for k = 1,z lies on the perpendicular bisector of the line segment joining $\frac{z_2}{z_1}$ and $-\frac{z_2}{z_1}$

17. If the equation $|z - z_1|^2 + |z - z_2|^2 = k$ represents the equation of a circle, where $z_1 \equiv 2 + 3i$, $z_2 \equiv 4 + 3i$ are the extremities of a diameter, then the value of k is
(A) $\frac{1}{4}$ (B) 4
(C) 2 (D) None of these

18. If z be a complex number and a_i , b_i , (i= 1,2,3) are real numbers, then the value of the determinant $\begin{vmatrix} a_1z+b_1\bar{z} & a_2z+b_2\bar{z} & a_3z+b_3\bar{z} \\ b_1z+a_1\bar{z} & b_2z+a_2\bar{z} & b_3z+a_3\bar{z} \\ b_1z+a_1 & b_2z+a_2 & b_3z+a_3 \end{vmatrix}$ is equal to

(A) $(a_1 a_2 a_3 + b_1 b_2 b_3)\,|z|^2$
(B) $|z|^2$
(C) 0
(D) None of these

19. If z = x + iy satisfies the equation arg (z-2) = arg(2z+3i), then 3x-4y is equal to
(A) 5
(B) -3
(C) 7
(D) 6

20. If a complex number x satisfies $\log_{1/\sqrt{2}}\left(\frac{|z|^2+2|z|+6}{2|z|^2-2|z|+1}\right)<0$, then locus / region of the point represented by z is
(A) $|z| = 5$
(B) $|z| <5$
(C) $|z|> 1$
(D) $2<|z|<3$

21. If for a complex number z= x + iy, $\sec^{-1}\left(\frac{z-2}{i}\right)$ is an acute angle, then
(A) x = 2, y = 1
(B) x< 2, y < –1
(C) xy <0
(D) x = 2, y > 1

22. Number of solutions of Re $(z^2) = 0$ and $|Z| = a\sqrt{2}$, where z is a complex number and a > 0, is
(A) 1
(B) 2
(C) 4
(D) 8

23. If the area of the triangle formed by the points represented by, Z, Z + iZ and iZ is 200, then |Z| is ____________

24. Let z is a variable complex number and a is a real constant. Then the solution set for z, satisfying the equation, |z-a| + |z + a| = |a| is _____________

25. If Z_1, Z_2 be two non zero complex numbers satisfying the equation $\left|\frac{Z_1+Z_2}{Z_1-Z_2}\right|=1$ then $\frac{Z_1}{Z_2}+\overline{\left(\frac{Z_1}{Z_2}\right)}$ is _________.

26. If $(x – iy)^{1/3} = a – ib$, then $\frac{x}{a}+\frac{y}{b}$ equals
(A) $–2 (a^2 + b^2)$
(B) 4 (a + b)
(C) 4 (a – b)
(D) 4 ab

27. If $\left(\sqrt{3}+i\right)^n = 2^n$, where n is an integer, then

(A) n is a multiple of 5
(B) n is a multiple of 6
(C) n is a multiple of 10
(D) none of these

28. If points corresponding to the complex numbers z_1, z_2 and z_3 in the Argand plane are A,B and C respectively and if ΔABC is isosceles, and right angled at B then a possible value of $\frac{z_1 - z_2}{z_3 - z_2}$ is

(A) 1
(B) -1
(C) i
(D) none of these

29. If z_1 and z_2 are two complex numbers satisfying the equation $\left|\frac{z_1 + z_2}{z_1 - z_2}\right| = 1$, then $\frac{z_1}{z_2}$ is a number which is

(A) Real
(B) Imaginary
(C) Zero
(D) None of these

30. If |z| = 1, then |z-1| is

(A) < |arg z|
(B) >|arg z|
(C) = |arg z|
(D) None of these

31. If z_1, z_2 and z_3, z_4 are two pairs of conjugate complex numbers then $\arg\left(\frac{z_1}{z_4}\right) + \arg\left(\frac{z_2}{z_3}\right)$ equals

(A) $\frac{\pi}{2}$
(B) π
(C) $\frac{3\pi}{2}$
(D) 0

32. If $||z + 2| - |z - 2|| = a^2$, $z \in C$ is representing a hyperbola for $a \in S$, then S contains

(A) $[-1, 0]$
(B) $(-\infty, 0]$
(C) $(0, \infty)$
(D) none of these

33. If |z| = 1 and $z \neq \pm i$, then $\frac{z+i}{z-i}$ is

(A) purely real
(B) purely imaginary
(C) a complex number with equal real and imaginary parts
(D) none of these

34. The locus of z which satisfied the inequality $\log_{0.5}|z - 2| > \log_{0.5}|z - i|$ is given by

(A) $x + 2y > 1$
(B) $x - y < 0$
(C) $4x - 2y > 3$
(D) none of these

35. Let Z_1 and Z_2 be the complex roots of $ax^2 + bx + c = 0$, where $a \geq b \geq c > 0$. Then

(A) $|Z_1 + Z_2| \le 1$ (B) $|Z_1 + Z_2| > 2$
(C) $|Z_1| = |Z_2| = 1$ (D) none of these

36. If the roots of $z^3 + az^2 + bz + c = 0$, a, b, c $\in$C(set of complex numbers) acts as the vertices of a equilateral triangle in the argand plane, then
(A) $a^2 + b = c$ (B) $a^2 = b$
(C) $a^2 + b = 0$ (D) none of these

37. If $|z_1| = 4$, $|z_2| = 4$, then $|z_1 + z_2 + 3 + 4i|$ is less than
(A) 2 (B) 5
(C) 10 (D) 13

38. If z = x + iy satisfies Re{z -|z –1| + 2i} = 0, then locus of z is
(A) parabola with focus $\left(-\frac{1}{2}, \frac{1}{2}\right)$ and directrix $x + y = \frac{1}{2}$
(B) parabola with focus $\left(-\frac{1}{2}, \frac{1}{2}\right)$ and directrix $x + y = -\frac{1}{2}$
(C) parabola with focus $\left(0, \frac{1}{2}\right)$ and directrix $y = -\frac{1}{2}$
(D) parabola with focus $\left(\frac{1}{2}, 0\right)$ and directrix $x = -\frac{1}{2}$

39. If $|z + 1| = z + 1$, where z is a complex number, then the locus of z is
(A) a straight line (B) a ray
(C) a circle (D) an arc of a circle

40. Length of the curved line traced by the point represented by z, when $\arg\frac{z-1}{z+1} = \frac{\pi}{4}$, is
(A) $2\sqrt{2}\pi$ (B) $\sqrt{2}\,\pi$
(C) $\frac{\pi}{\sqrt{2}}$ (D) none of these

41. If $8iz^3 + 12z^2 - 18z + 27i = 0$ then
(A) $|z| = 3/2$ (B) $|z| = 1$ (C) $|z| = 2/3$ (D) $|z| = 3/4$

42. If $|z - i| \le 2$ and $z_1 = 5 + 3i$ then the maximum value of $|iz + z_1|$ is
(A) $2 + \sqrt{31}$ (B) $\sqrt{31} - 2$ (C) $\sqrt{31} + 2$ (D) 7

43. $\sin^{-1}\left\{\frac{1}{i}(z-1)\right\}$, where z is not real, can be the angle of the triangle if
(A) $\text{Re}(z) = 1, I_m(z) = 2$ (B) $\text{Re}(z) = 1, -1 \le I_m(z) \le 1$
(C) $\text{Re}(z) + I_m(z) = 0$ (C) None of these

44. The value of $\ln(-1)$

(A) does not exist (B) $2\ln i$ (C) $i\pi$ (D) 0

45. If n_1, n_2 are positive integers then $(1+i)^{n_1}+(1+i^3)^{n_2}+(1+i^5)^{n_1}+(1+i^7)^{n_2}$ is a real Number if and only if

(A) $n_1 = n_2 + 1$ (B) $n_1 + 1 = n_2$ (C) $n_1 = n_2$ (D) n_1, n_2 be +ve integers

46. Let z_1, z_2 be two nonreal complex cube roots of unity and $|z-z_1|^2+|z-z_1|^2=\lambda$ be the equation of a circle with z_1, z_2 as ends of a diameter then the value of λ is

(A) 4 (B) 3 (C) 2 (D) $\sqrt{2}$

47. The center of the arc $\arg\left(\dfrac{3z-6-3i}{2z-8-6i}\right)=\dfrac{\pi}{4}$ is

(A) (4,1) (B) (1,4) (C) (2,5) (D) (3,1)

48. The value of $\displaystyle\sum_{k=1}^{6}\left(\sin\frac{2\pi k}{7}-i\cos\frac{2\pi k}{7}\right)$

(A) i (B) $-i$ (C) 1 (D) –1

49. The complex numbers z_1, z_2 and z_3 satisfying $\dfrac{z_1-z_3}{z_2-z_3}=\dfrac{1-i\sqrt{3}}{2}$ are the vertices of a triangle which is

(A) of area zero (B) right angled isosceles

(C) equilateral (D) obtuse angled isosceles

50. If |z| = 3 then the number $\dfrac{z-3}{z+3}$ is

(A) purely real (B) purely imaginary

(C) a mixed number (D) none of these

51. If $iz^3 + z^2 - z + i = 0$, then |z| is equal to ……………………………………

52. If α and β are different complex numbers with $|\beta| = 1$, then $\left|\dfrac{\beta-\alpha}{1-\bar{\alpha}\beta}\right|$ is equal to

53. If the complex numbers z_1, z_2, z_3 are in A.P., then they lie on a

(A) circle (B) parabola

(C) line (D) ellipse

54. If z_1 and z_2 are two nth roots of unity, then $\arg\left(\dfrac{z_1}{z_2}\right)$ is a multiple of ………………….

55. The maximum value of $|z|$ when z satisfies the condition $\left|z+\dfrac{2}{z}\right| = 2$ is ……………….

56. All non-zero complex numbers z satisfying $\bar{z} = iz^2$ are…………………………………….

57. Common roots of the equation $z^3 + 2z^2 + 2z + 1 = 0$ and $z^{1985} + z^{100} + 1 = 0$ is ………..

LEVEL-III

1. If points corresponding to the complex numbers z_1, z_2, z_3 and z_4 are the vertices of a rhombus, taken in order, then for a non-zero real number k

(A) $z_1 - z_3 = i\,k(z_2 - z_4)$ (B) $z_1 - z_2 = i\,k(z_3 - z_4)$

(C) $z_1 + z_3 = k(z_2 + z_4)$ (D) $z_1 + z_2 = k(z_3 + z_4)$

2. If z_1 and z_2 are two complex numbers such that $|z_1 - z_2| = ||z_1| - |z_2||$, then $\arg z_1 - \arg z_2$ is equal to

(A) $-\pi/4$ (B) $-\pi/2$

(C) $\pi/2$ (D) 0

3. If f(x) and g(x) are two polynomials such that the polynomial $h(x) = x\,f(x^3) + x^2\,g(x^6)$ is divisible by $x^2 + x + 1$, then

(A) $f(1) = g(1)$ (B) $f(1) \neq -g(1)$

(C) $f(1) = g(1) \neq 0$ (D) $f(1) = -g(1) \neq 0$

4. Consider a square OABC in the argand plane, where 'O' is origin and $A \equiv A(z_0)$. Then the equation of the circle that can be inscribed in this square is; (vertices of square are given in anticlockwise order)

(A) $|z - z_0(1+i)| = |z_0|$ (B) $2\left|z - \frac{z_0(1+i)}{2}\right| = |z_0|$

(C) $\left|z - \frac{z_0(1+i)}{2}\right| = |z_0|$ (D) none of these .

5. For a complex number z, the minimum value of $|z| + |z - \cos\alpha - i\sin\alpha|$ is

(A) 0 (B) 1

(C) 2 (D) none of these

6. The roots of equation $z^n = (z+1)^n$

(A) are vertices of regular polygon (B) lie on a circle

(C) are collinear (D) none of these

7. The vertices of a triangle in the argand plane are $3 + 4i$, $4 + 3i$ and $2\sqrt{6} + i$, then distance between orthocentre and circumcentre of the triangle is equal to,

(A) $\sqrt{137 - 28\sqrt{6}}$ (B) $\sqrt{137 + 28\sqrt{6}}$

(C) $\frac{1}{2}\sqrt{137 + 28\sqrt{6}}$ (D) $\frac{1}{3}\sqrt{137 + 28\sqrt{6}}$.

8. One vertex of the triangle of maximum area that can be inscribed in the curve $|z - 2i| = 2$, is $2 + 2i$, remaining vertices is / are

(A) $-1 + i(2 + \sqrt{3})$ (B) $-1 - i(2 + \sqrt{3})$

(C) $1 + i(2 - \sqrt{3})$ (D) $-1 - i(2 - \sqrt{3})$

9. If $\left(\frac{3-z_1}{2-z_1}\right)\left(\frac{2-z_2}{3-z_2}\right)$ = k, then points A(z_1) , B(z_2), C(3, 0) and D(2, 0) (taken in clockwise sense) will
(A) lie on a circle only for $k > 0$
(B) lie on a circle only for $k < 0$
(C) lie on a circle $\forall\ k \in R$
(D) be vertices of a square $\forall\ k \in (0, 1)$

10. Let 'z' be a complex number and 'a' be a real parameter such that $z^2 + az + a^2 = 0$, then
(A) locus of z is a pair of straight lines
(B) $\arg(z) = \pm\frac{2\pi}{3}$
(C) $|z| = |a|$.
(D) All

11. If $z_1, z_2, z_3 \ldots z_{n-1}$ are the roots of the equation $z^{n-1} + z^{n-2} + z^{n-3} + \ldots + z + 1 = 0$, where $n \in N$, $n > 2$, then
(A) ω^n, ω^{2n} are also the roots of the same equation.
(B) $\omega^{1/n}, \omega^{2/n}$ are also the roots of the same equation.
(C) $z_1, z_2, \ldots, z_{n-1}$ form a geometric series.
(D) none of these.
Where ω is the complex cube root of unity.

12. The value of $i \log(x - i) + i^2\pi + i^3 \log(x + i) + i^4(2\tan^{-1}x)$, $x > 0$ (where $i = \sqrt{-1}$) is
(A) 0 (B) 1
(C) 2 (D) 3

13. If $z = -2 + 2\sqrt{3}i$, then $z^{2n} + 2^{2n} z^n + 2^{4n}$ may be equal to
(A) 2^{2n} (B) 0
(C) $3.\ 2^{4n}$ (D) none of these

14. The value of $169e^{i\left(\pi+\sin^{-1}\frac{12}{13}+\cos^{-1}\frac{5}{13}\right)}$ is
(A) 119 –120i (B) -i(120 +119i)
(C) 119 + 120i (D) none of these

15. Let z_1 and z_2 be the complex roots of the equation $3z^2 + 3z + b = 0$. If the origin, together with the points represented by z_1 and z_2 form an equilateral triangle then the value of b is
(A) 1 (B) 2
(C) 3 (D) None of these

16. If $|z-2| = \min\{|z-1|, |z-3|\}$, where z is a complex number, then
(A) $Re(z) = \frac{3}{2}$ (B) $Re(z) = \frac{5}{2}$

(C) Re (z) $\in \left\{\frac{3}{2}, \frac{5}{2}\right\}$ (D) None of these

17. If x = 1 + i, then the value of the expression $x^4 - 4x^3 + 7x^2 - 6x + 3$ is
(A) -1 (B) 1
(C) 2 (D) None of these

18. If z lies on the circle centred at origin. If area of the triangle whose vertices are z, ωz and $z + \omega z$, where ω is the cube root of unity, is $4\sqrt{3}$ sq. unit. Then radius of the circle is
(A) 1 unit (B) 2 units
(C) 3 units (D) 4 units

19. If $\theta_i \in [0, \pi/6]$, i = 1, 2, 3, 4, 5 and $\sin \theta_1 z^4 + \sin\theta_2 z^3 + \sin\theta_3 z^2 + \sin \theta_4 z + \sin\theta_5 = 2$, then z satisfies.
(A) $|z| > \frac{3}{4}$ (B) $|z| < \frac{1}{2}$
(C) $\frac{1}{2} < |z| < \frac{3}{4}$ (D) None of these

20. If α is the angle which each side of a regular polygon of n sides subtends at its centre, then $1 + \cos\alpha + \cos2\alpha + \cos3\alpha \ldots + \cos(n-1)\alpha$ is equal to
(A) n (B) 0
(C)1 (D) None of these

21. Triangle ABC, $A(z_1)$, $B(z_2)$, $C(z_3)$ is inscribed in the circle $|z| = 2$. If internal bisector of the angle A meets its circumcircle again at $D(z_d)$ then
(A) $z_d^2 = z_2z_3$ (B) $z_d^2 = z_1z_3$
(C) $z_d^2 = z_2z_1$ (D) none of these

ANSWERS

LEVEL −I

1.	C	2.	D	3.	D	4.	A
5.	B	6.	B	7.	A	8.	A
9.	D	10.	D	11.	D	12.	A
13.	0	14.	B	15.	C	16.	A
17.	A	18.	A	19.	C	20.	B

LEVEL −II

1.	B	2.	C	3.	A	4.	C
5.	B	6.	A	7.	B	8.	D
9.	D	10.	C	11.	A	12.	B
13.	D	14.	A	15.	A, B, C	16.	A, B, C, D
17.	B	18.	C	19.	D	20.	B
21.	D	22.	A	23.	20	24.	ϕ
25.	0	26.	A	27.	D	28.	C
29.	B	30.	A	31.	D	32.	A
33.	B	34.	C	35.	A	36.	D
37.	D	38.	D	39.	B	40.	D
41.	A	42.	D	43.	B	44.	C
45.	C	46.	B	47.	A	48.	A
49.	C	50.	B	51.	1		
52.	1	53.	C	54.	$\frac{2\pi}{n}$	55.	$1 + \sqrt{3}$
56.	$\left(\pm\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$	57.	ω, ω^2				

LEVEL −III

1.	A	2.	D	3.	A	4.	B
5.	B	6.	C	7.	B	8.	A
9.	C	10.	D	11.	C	12.	A
13.	B, C	14.	A, B	15.	A	16.	C
17.	B	18.	D	19.	A	20.	B
21.	A						