SECTION *

- (●) A
- ( ) B
- ( ) C
- ( ) D
- ( ) E
- ( ) F
- ( ) G
- ( ) H
- ( ) I
- ( ) J
- ( ) K

Answer ALL Questions

Each question carries ONE mark.

1. *

Cauchy – Riemann equation in Cartesian co-ordinates are

(A) $u_x = v_y, u_y = -v_x$ (B) $u_x = -v_y, u_y = v_x$

(C) $u_x = v_y, u_y = v_x$ (D) $u_x = -v_y, u_y = -v_x$

- (●) A
- ( ) B
- ( ) C

- [ ] D

2. *

The transformation $w = a\,z$, where a is a real constant represents	
(A) magnification	(B) rotation
(C) reflection	(D) inversion

- [x] A
- [ ] B
- [ ] C
- [ ] D

3. *

The real part of $f\,(z) = e^{2\,z}$ is	
(A) $e^x \cos y$	(B) $e^x \sin y$
(C) $e^{2x} \cos 2y$	(D) $e^{2x} \sin 2y$

- [ ] A
- [ ] B
- [x] C
- [ ] D

4. *

An analytic function with constant real part is

(A) zero	(B) analytic
(C) harmonic	(D) constant

- [ ] A
- [ ] B
- [ ] C
- [x] D

5. *

A mapping that preserves angles between every pair of curves through a point, both in magnitude and direction is called a _______________ mapping.

(A) isogonal	(B) conformal
(C) regular	(D) formal

- [ ] A
- [x] B
- [ ] C
- [ ] D

6. *

If $w = f(z) = u + iv$ is an analytic function with constant imaginary part, then $f(z)$ is

(A) zero	(B) analytic
(C) harmonic	(D) constant

- A
- B
- C
- (selected) D

7. *

The points at which the function $f(z) = \frac{1}{z^2 - 1}$ fails to be analytic are	
(A) $z = \pm i$	(B) $z = \pm 1$
(C) $z = \pm 2$	(D) $z = \pm 3$

- A
- (selected) B
- C
- D

8. *

The fixed points of the transformation $w = \frac{z-1}{z+1}$ are	
(A) $\pm i$	(B) ± 1
(C) ± 2	(D) ± 3

- (selected) A
- B
- C
- D

9. *

The harmonic conjugate of $u = e^x \cos y$ is	
(A) $e^x \sin y$	(B) $e^{2x} \sin y$
(C) $e^{2x} \cos 2y$	(D) $e^{2x} \sin 2y$

- (●) A
- ( ) B
- ( ) C
- ( ) D

10. *

The critical point of the transformation $w = z^2$ is	
(A) $z = 0$	(B) $z = -i$
(C) $z = 1$	(D) $z = -1$

- (●) A
- ( ) B
- ( ) C
- ( ) D

11. *

The function $f(z) = \bar{z}$ is	
(A) not analytic	(B) analytic
(C) constant	(D) equal to 1

- (●)

A

B

C

D

12. *

If $w = f(z) = u + iv$ is an analytic function, then

(A) $\nabla^2 \lvert f(z)\rvert^2 = 4\lvert f'(z)\rvert^2$	(B) $\nabla^2 \lvert f'(z)\rvert^2 = 4\lvert f(z)\rvert^2$
(C) $\nabla^2 \lvert f'(z)\rvert = 2\lvert f(z)\rvert$	(D) $\nabla^2 \lvert f(z)\rvert^2 = 2\lvert f'(z)\rvert^2$

- [x] A
- [ ] B
- [ ] C
- [ ] D

13. *

The transformation $w = f(z) = a\,z$, where a is a complex constant represents

(A) magnification	(B) rotation
(C) both magnification and rotation	(D) reflection

- [ ] A
- [ ] B
- [x] C
- [ ] D

14. *

If $w = f(z) = u + i\ v$ is an analytic function of z, then	
(A) u and v are not harmonic	(B) u is not harmonic
(C) both u and v are harmonic	(D) v is not harmonic

- ○ A
- ○ B
- ◉ C
- ○ D

15. *

If $w = f(z) = u + iv$ is analytic, then the family of curves $u = C_1$ and $v = C_2$ where C_1 and C_2 are constants	
(A) cut orthogonally	(B) intersect each other
(C) is parallel	(D) coincide

- ◉ A
- ○ B
- ○ C
- ○ D

16. *

If z_1, z_2, z_3 and z_4 are four points in the z-plane, then the cross-ratio of these points is	
(A) $\dfrac{(z_1-z_3)(z_4-z_2)}{(z_1-z_2)(z_3-z_4)}$	(B) $\dfrac{(z_1-z_2)(z_4-z_2)}{(z_1-z_2)(z_3-z_2)}$
(C) $\dfrac{(z_1-z_4)(z_3-z_2)}{(z_1-z_2)(z_3-z_4)}$	(D) $\dfrac{(z_1-z_2)(z_3-z_4)}{(z_1-z_4)(z_3-z_2)}$

- ○ A
- ○ B
- ○ C
- ◉ D

17. *

The invariant points of the transformation $w=\dfrac{6z-9}{z}$ are	
(A) 3, 3	(B) 6, 9
(C) 0, 6	(D) 3, −3

- ◉ A
- ○ B
- ○ C
- ○ D

18. *

If a function $v(x,y)$ satisfies the equation $\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}=0$, then v is said to be

(A) analytic function	(B) harmonic function
(C) differential function	(D) continuous function

- ○ A
- ◉ B
- ○ C
- ○ D

19. *

The condition for the function $f(z)=u+iv$ to be analytic in polar form is

(A) $u_r=\frac{1}{r}\,v_\theta,\ v_r=-\frac{1}{r}\,u_\theta$	(B) $u_r=-\frac{1}{r}\,v_\theta,\ v_r=\frac{1}{r}\,u_\theta$
(C) $u_r=-\frac{1}{r}\,v_\theta,\ v_r=-\frac{1}{r}\,u_\theta$	(D) $u_r=\frac{1}{r}\,v_\theta,\ v_r=\frac{1}{r}\,u_\theta$

- ◉ A
- ○ B
- ○ C
- ○ D

20. *

If $w = f(z) = u + iv$ is an analytic function with constant modulus, then $f(z)$ is

(A) zero	(B) analytic
(C) harmonic	(D) constant

- ○ A
- ○ B
- ○ C
- ◉ D

21. *

A point at which the mapping $w = f(z)$ is not conformal is called

(A) fixed point	(B) critical point
(C) singular point	(D) regular point

- ○ A
- ○ B
- ◉ C
- ○ D

22. *

The critical points of the transformation $w = z + \frac{1}{z}$ are

(A) $\pm i$	(B) ± 1
(C) ± 2	(D) ± 3

- ○ A

- ◉ B
- ○ C
- ○ D

23. *

The transformation $w = \dfrac{az+b}{cz+d}$ where a, b, c, d are complex constants is said to be bilinear, if

(A) $ad-bc=0$	(B) $ad-bc\neq 0$
(C) $ad-bc<0$	(D) $ad-bc>0$

- ○ A
- ◉ B
- ○ C
- ○ D

24. *

Any function which has continuous second order partial derivatives and which satisfies Laplace equation is called ______________

(A) Harmonic function	(B) Beta function
(C) Gamma function	(D) Alpha function

- ◉ A
- ○ B
- ○ C
- ○ D

25. *

The fixed points of the transformation $w = \frac{5z+4}{z+5}$ are

(A) $\pm i$	(B) ± 1
(C) ± 2	(D) ± 3

- ○ A
- ○ B
- ◉ C
- ○ D

26. *

The point z_0 at which a function $f(z)$ is not analytic is known as

(A) zeros	(B) critical point
(C) singular point	(D) fixed point

- ○ A
- ○ B
- ◉ C
- ○ D

27. *

The singular points of $f(z) = \frac{z+3}{(z-3)(z-2)}$ are

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

- [ ] A
- [ ] B
- [ ] C
- [x] D

28. *

The residue of $f(z) = \frac{z}{z-1}$ at its pole is

(A) 0	(B) 1
(C) -1	(D) $2\pi i$

- [ ] A
- [x] B
- [ ] C
- [ ] D

29. *

The function $f(z) = \frac{1}{(z+2)^4(z-3)^2(z-1)}$ has pole of order 2 at the point

(A) $z = 4$	(B) $z = -3$
(C) $z = 1$	(D) $z = 3$

- [ ] A
- [ ] B
- [ ] C
- [x] D

30. *

If $f(z) = \frac{\sin z}{z}$, then the singular point of $f(z)$ is

(A) $z = 0$	(B) $z = \pi$
(C) $z = 2\pi i$	(D) $z = -2\pi i$

- (selected) A
- B
- C
- D

31. *

If $C : |z - a| = r$ is a circle, then $f(z)$ can be expanded as a Taylor's series if

(A) $f(z)$ is an analytic function at all points within C
(B) $f(z)$ is not an analytic function
(C) $f(z)$ is an analytic function outside C
(D) $f(z)$ is not an analytic function outside C

- (selected) A
- B
- C
- D

32. *

The value of $\oint_C \frac{\cos z}{z-3}\,dz$ where C is a circle $|z| = 2$ is

(A) 0	(B) 1
(C) e	(D) $2\pi i$

- (●) A
- ( ) B
- ( ) C
- ( ) D

33. *

A singular point $z = z_0$ is called ________________ singular point of $f(z)$, if there is no other singular point in the neighbourhood of z_0 .

(A) removable	(B) isolated
(C) essential	(D) non-removable

- ( ) A
- (●) B
- ( ) C
- ( ) D

34. *

The singular points of the function $f(z) = \frac{1}{z\,(z-2)}$ are

(A) $z = 0, 2$ (B) $z = 1, 2$

(C) $z = -1$ (D) $z = 2\pi i$

- (selected) A
- B
- C
- D

35. *

If $z = z_0$ is a pole of order n, then the residue of $f(z)$ is

(A) $\mathrm{Res}\left[f(z), z_0\right] = \frac{1}{(n-1)!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} (z - z_0)^n \; f(z)$

(B) $\mathrm{Res}\left[f(z), z_0\right] = \frac{1}{n\,!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} (z - z_0)^n \; f(z)$

(C) $\mathrm{Res}\left[f(z), z_0\right] = \frac{1}{(n-1)!} \lim_{z \to z_0} \frac{d^{n-1}}{dz^{n-1}} \; f(z)$

(D) $\mathrm{Res}\left[f(z), z_0\right] = \frac{1}{(n+1)!} \lim_{z \to z_0} \frac{d}{dz} (z - z_0) f(z)$

- (selected) A
- B
- C
- D

36, *

The residue of $f(z) = \frac{1}{z-1}$ at its pole $z = 1$ is

(A) 0	(B) 1
(C) -1	(D) $2\pi i$

- ○ A
- ◉ B
- ○ C
- ○ D

37. *

The value of $\oint_C \frac{e^z}{(z-1)^3}\, dz$, where $C : |z| = \frac{1}{2}$ is

(A) 0	(B) $\frac{1}{4}$
(C) $\frac{1}{2}$	(D) $\frac{1}{3}$

- ◉ A
- ○ B
- ○ C
- ○ D

38. *

The singularity of $f(z) = \frac{z}{(z-2)^3}$ is

(A) $z = 2$ is a pole of order 2 (B) $z = 2$ is a pole of order 3

(C) $z = 2$ is a simple pole (D) $z = 2$ is pole of order 1

- ○ A
- ◉ B
- ○ C
- ○ D

39. *

The value of $\oint_C \frac{3z^2+7z+1}{z+1} dz$ where C is $|z| = \frac{1}{2}$ using Cauchy's residue theorem is

(A) 0 (B) $2\pi i$

(C) $-2\pi i$ (D) 1

- ◉ A
- ○ B
- ○ C
- ○ D

40. *

The value of $\oint_C \frac{dz}{z-1}$ where C is the circle $|z-1| = 1$ is

(A) 0	(B) $2\pi i$
(C) $-2\pi i$	(D) πi

- ○ A
- ◉ B
- ○ C
- ○ D

41. *

The annular region for the function $f(z) = \frac{1}{z(z-1)}$ is

(A) $0 < \|z\| < 1$	(B) $1 < \|z\| < 2$
(C) $2 < \|z\| < 3$	(D) $\|z\| > 1$

- ◉ A
- ○ B
- ○ C
- ○ D

42. *

The value of $\oint_C \frac{1}{z-4}\,dz$ where C is $|z-2| = 1$ by Cauchy's integral formula is __________.

(A) πi	(B) $4\pi i$
(C) 0	(D) $2\pi i$

- ( ) A
- ( ) B
- (•) C
- ( ) D

43. *

If $f(z)$ is analytic inside and on C, then the value of $\oint_C \frac{f(z)}{(z-a)^2}\,dz$, where C is a simple closed curve and 'a' is any point within C is

(A) 0	(B) $2\pi i\, f'(a)$
(C) $-2\pi i\, f(a)$	(D) 1

- ( ) A
- (•) B
- ( ) C
- ( ) D

44. *

The value of $\oint_C \frac{z}{z-2} dz$ where C is the circle $|z| = 3$ is

(A) 0	(B) $4\pi i$
(C) $-2\pi i$	(D) 1

- ○ A
- ◉ B
- ○ C
- ○ D

45. *

The residue of $f(z) = \frac{z-2}{z(z-1)}$ at $z = 1$ is

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

- ○ A
- ○ B
- ○ C
- ◉ D

46. *

If $f(z)$ is analytic inside and on C, then the value of $\oint_C \frac{f(z)}{(z-a)^n} dz$, where C is a simple closed curve and 'a' is any point within C is

(A) 0	(B) $\frac{2\pi i}{n!} f^n(a)$
(C) $-\frac{2\pi i}{n!} f^{n+1}(a)$	(D) $\frac{2\pi i}{(n-1)!} f^{n-1}(a)$

- [ ] A
- [ ] B
- [ ] C
- [x] D

47. *

If $f(z)$ is analytic and $f'(z)$ is continuous at all points inside and on a simple closed curve C, then $\oint_C f(z)\,dz =$

(A) 0	(B) $2\pi i$
(C) $-2\pi i$	(D) 1

- [x] A
- [ ] B
- [ ] C
- [ ] D

48. *

The value of $\oint_C \frac{2z}{z-1} dz$ where C is $|z| = 1$ by Cauchy's integral formula is

(A) 1	(B) $4\pi i$
(C) 0	(D) $2\pi i$

- A
- B
- C
- D

49. *

The value of $\oint_C \frac{z^2}{(z-1)^2(z+1)} dz$, where $C: |z| = \frac{1}{2}$ is

(A) 0	(B) $\frac{1}{4}$
(C) $\frac{1}{2}$	(D) $\frac{1}{3}$

- A
- B
- C
- D

50. *

The function $f(z) = \frac{z+1}{(z-1)(z+2)}$ has a zero at

(A) $z = 1$	(B) $z = 2$
(C) $z = -2$	(D) $z = -1$

- A
- B
- C
- D