

PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Complex analysis - CSIR NET Physics PYQs

Mathematical Physics . All PYQs (2015-2025) with answer key

26 questions . Answer key included

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Q1. [Dec 2015] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2015 Dec	3.5 M
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The function $\frac{Z}{\sin \pi Z^2}$ of a complex variable Z has

1. a simple pole at 0 and poles of order 2 at $\pm\sqrt{n}$ for $n = 1,2,3 \dots$
2. a simple pole at 0 and poles of order 2 at $\pm\sqrt{n}$ and $\pm i\sqrt{n}$ for $n = 1,2,3 \dots$
3. poles of order 2 at $\pm\sqrt{n}, n = 0,1,2,3 \dots$
4. poles of order 2 at $\pm n, n = 0,1,2,3 \dots$

Q2. [June 2015] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2015 June	3.5 M
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The value of the integral $\int_{-\infty}^{\infty} \frac{dx}{1+x^4}$ is

1. $\frac{\pi}{\sqrt{2}}$
2. $\frac{\pi}{2}$
3. $\sqrt{2}\pi$
4. 2π

Q3. [June 2016] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2016 June	3.5M
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The value of the contour integral

$$\frac{1}{2\pi i} \oint_C \frac{e^{4z} - 1}{\cosh(z) - 2\sinh(z)} dz$$

around the unit circle C traversed in the anti-clockwise direction, is

1. 0

2. 2

3. $-8/\sqrt{3}$ 4. $-\tanh\left(\frac{1}{2}\right)$

Q4. [June 2017] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2017 June	3.5M
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Let $u(x, y) = e^{ax} \cos(by)$ be the real part of a function $f(z) = u(x, y) + iv(x, y)$ of the complex variable $z = x + iy$, where a, b are real constants and $a \neq 0$. The function $f(z)$ is complex analytic everywhere in the complex plane if and only if

1. $b = 0$
2. $b = \pm a$
3. $b = \pm 2\pi a$
4. $b = a \pm 2\pi$

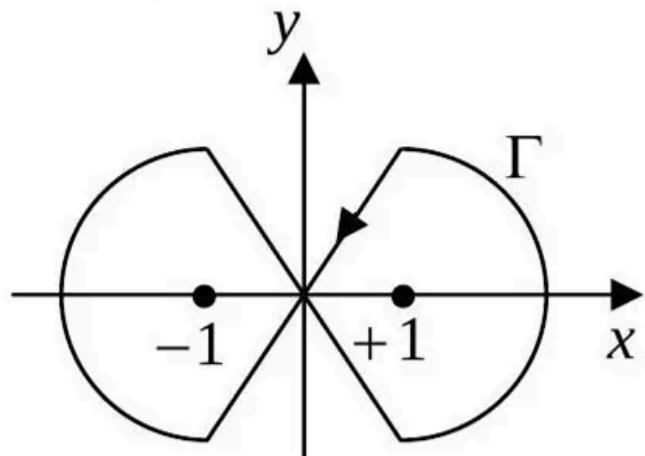
Q5. [June 2017] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2017 June	3.5M
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The integral $\oint_{\Gamma} \frac{ze^{i\pi z/2}}{z^2-1} dz$ along the closed contour Γ shown in the figure is

1. 0
2. 2π
3. -2π
4. $4\pi i$



Q6. [Dec 2018] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2018 Dec	3.5M
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The value of the integral $\oint_C \frac{dz \tanh 2z}{z \sin \pi z}$, where C is a circle of radius $\frac{\pi}{2}$, traversed counterclockwise, with center at $z = 0$, is

1. 4
2. $4i$
3. $2i$
4. 0

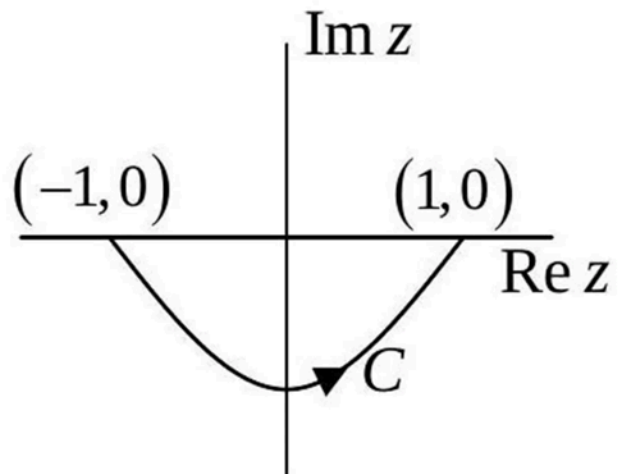
Q7. [Dec 2018] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2018 Dec	3.5M
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The integral $I = \int_C e^z dz$ is evaluated from the point $(-1,0)$ to $(1,0)$ along the contour C , which is an arc of the parabola $y = x^2 - 1$, as shown in the figure. The value of I is

1. 0
2. $2 \sinh 1$
3. $e^{2i} \sinh 1$
4. $e + e^{-1}$



Q8. [Dec 2018] . 5.0 marks

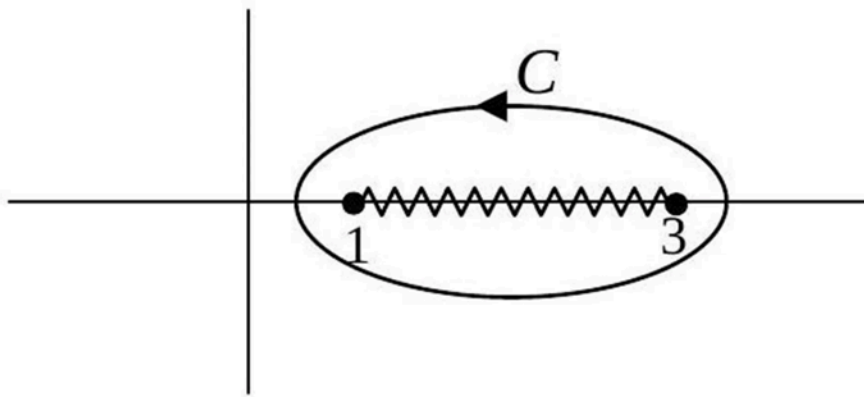
Mathematical Physics > Complex analysis

CSIR NET	2018 Dec	5M
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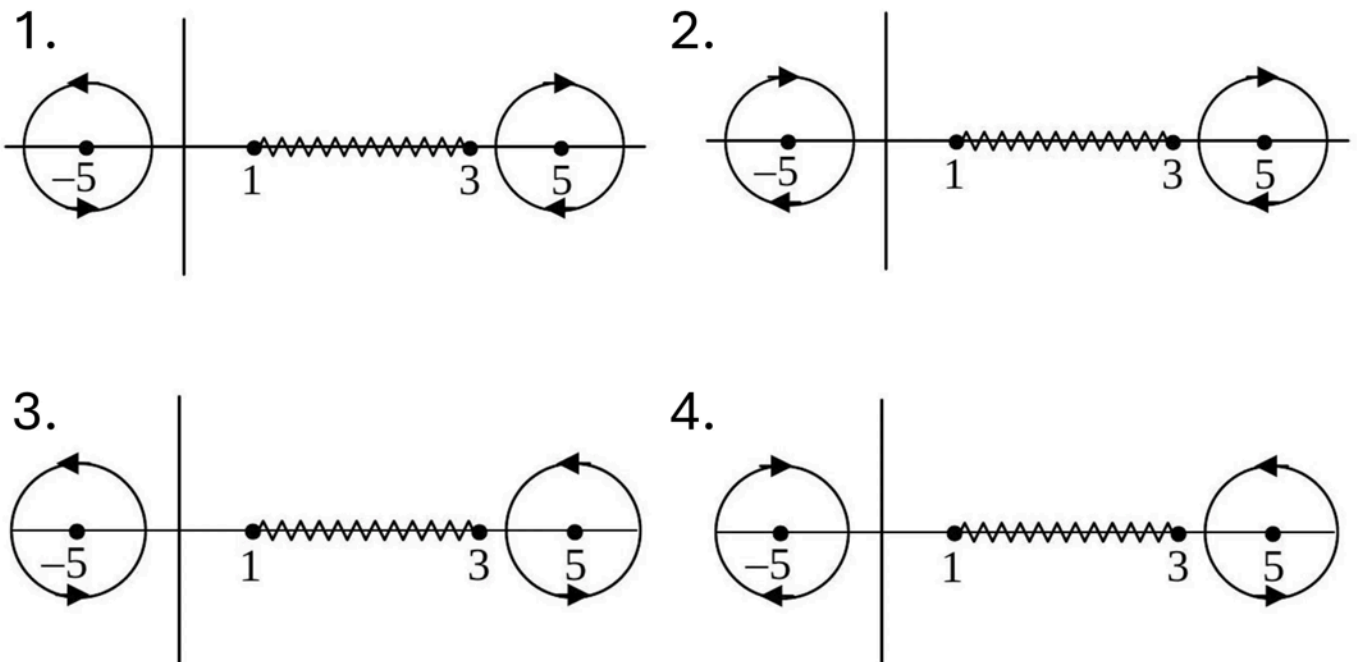
The contour C of the following integral

$$\oint_C dz \frac{\sqrt{(z-1)(z-3)}}{(z^2-25)^3}$$

in the complex z plane is shown in the figure below.



This integral is equivalent to an integral along the contours



Q9. [June 2018] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2018 June	3.5M
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What is the value of a for which $f(x, y) = 2x + 3(x^2 - y^2) + 2i(3xy + ay)$ is an analytic function of complex variable $z = x + iy$

1. 1
2. 0
3. 3
4. 2

Q10. [Dec 2019] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2019 Dec	3.5M
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Let C be the circle of radius $\frac{\pi}{4}$ centered at $z = \frac{1}{4}$ in the complex z -plane that is traversed counter-clockwise. The value of the contour integral

$$\oint_C \frac{z^2}{\sin^2 4z} dz \text{ is}$$

1. 0
2. $\frac{i\pi^2}{4}$
3. $\frac{i\pi^2}{16}$
4. $\frac{i\pi}{4}$

Q11. [June 2019] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2019 June	3.5M
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The value of the definite integral $\int_0^\pi \frac{d\theta}{5+4\cos\theta}$ is

1. $\frac{4\pi}{3}$
2. $\frac{2\pi}{3}$
3. π
4. $\frac{\pi}{3}$

Q12. [June 2020] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2020 June	3.5M
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A function of a complex variable z is defined by the integral $f(z) = \oint_{\Gamma} \frac{w^2-2}{w-z} dw$, where Γ is a circular contour of radius 3, centred at origin, running counter-clockwise in the w - plane. The value of the function at $z = (2 - i)$ is

1. 0
2. $1 - 4i$
3. $8\pi + 2\pi i$
4. $-\frac{2}{\pi} - \frac{i}{2\pi}$

Q13. [June 2022] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2022 June	3.5M
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At $z = 0$, the function $\frac{1}{z - \sin z}$ of a complex variable z has

1. no singularity
2. a simple pole
3. a pole of order 2
4. a pole of order 3

Q14. [June 2022] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2022 June	3.5M
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If $z = i^{i^{i^{\dots}}}$ (note that the exponent continues indefinitely), then a possible value of $\frac{1}{z} \ln z$ is

1. $2i \ln i$
2. $\ln i$
3. $i \ln i$
4. $2 \ln i$

Q15. [June 2022] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2022 June	5M
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The value of the integral $\int_{-\infty}^{\infty} \frac{\cos \alpha x}{x^2+1} dx$, for $\alpha > 0$, is

1. πe^{α}
2. $\pi e^{-\alpha}$
3. $\pi e^{-\alpha/2}$
4. $\pi e^{\alpha/2}$

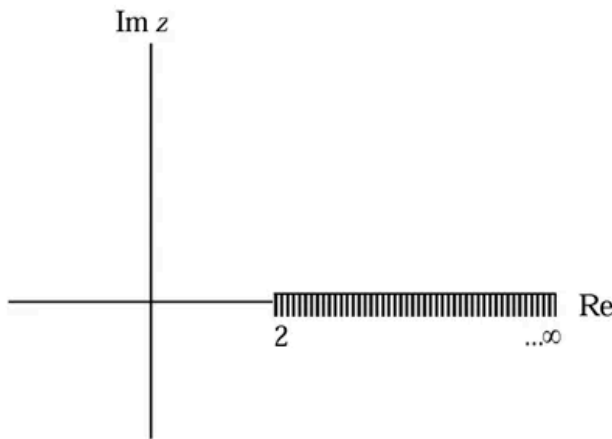
Q16. [Dec 2023] . 3.5 marks

Mathematical Physics > Complex analysis

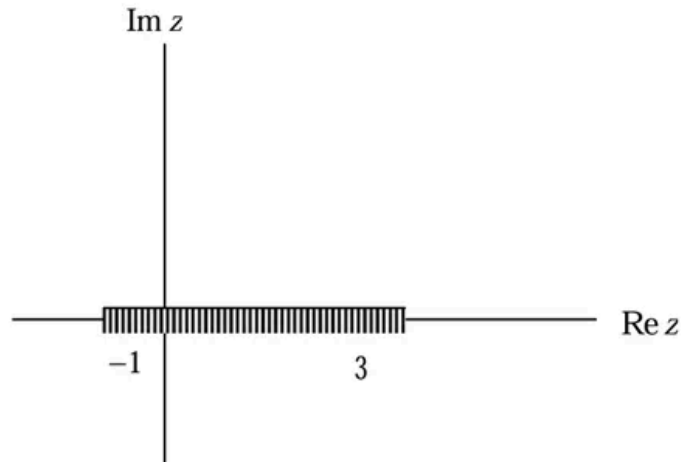
CSIR NET	2023 Dec	3.5 M
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The branch line for the function $f(z) = \sqrt{\frac{z^2 - 5z + 6}{z^2 + 2z + 1}}$ is

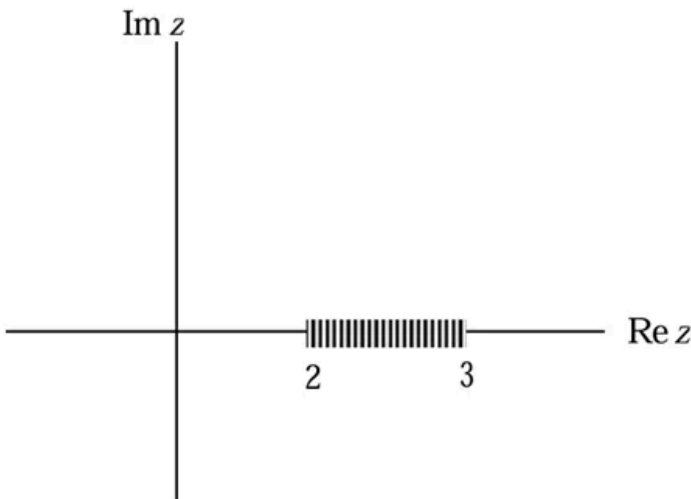
1.



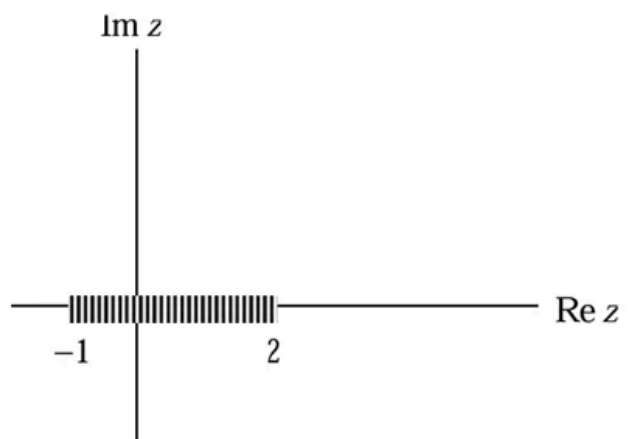
2.



3.



4.



Q17. [Dec 2023] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2023 Dec	3.5 M
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If z is a complex number, which among the following sets is neither open nor closed?

1. $\{z \mid 0 \leq |z - 1| \leq 2\}$
2. $\{z \mid |z| \leq 1\}$
3. $\{z \mid z \in (\mathbf{C} - \{3\}) \text{ and } |z| \leq 100\}$
4. $\left\{z \mid z = re^{i\theta}, 0 \leq \theta \leq \frac{\pi}{4}\right\}$

Q18. [Dec 2023] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2023 Dec	5 M
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The function $f(z) = \frac{1}{(z+1)(z+3)}$ is defined on the complex plane. The coefficient of the $(z - z_0)^2$ term of the Laurent series of $f(z)$ about $z_0 = 1$ is

1. $\frac{7}{64}$
2. $\frac{7}{128}$
3. $\frac{9}{64}$
4. $\frac{9}{128}$

Q19. [June 2023] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2023 June	3.5M
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The locus of the curve $\text{Im} \left(\frac{\pi(z-1)-1}{z-1} \right) = 1$ in the complex z -plane is a circle centred at (x_0, y_0) and radius R . The values of (x_0, y_0) and R , respectively, are

1. $\left(1, \frac{1}{2}\right)$ and $\frac{1}{2}$
2. $\left(1, -\frac{1}{2}\right)$ and $\frac{1}{2}$
3. $(1, 1)$ and 1
4. $(1, -1)$ and 1

Q20. [Dec 2024] . 3.5 marks

Mathematical Physics > Complex analysis

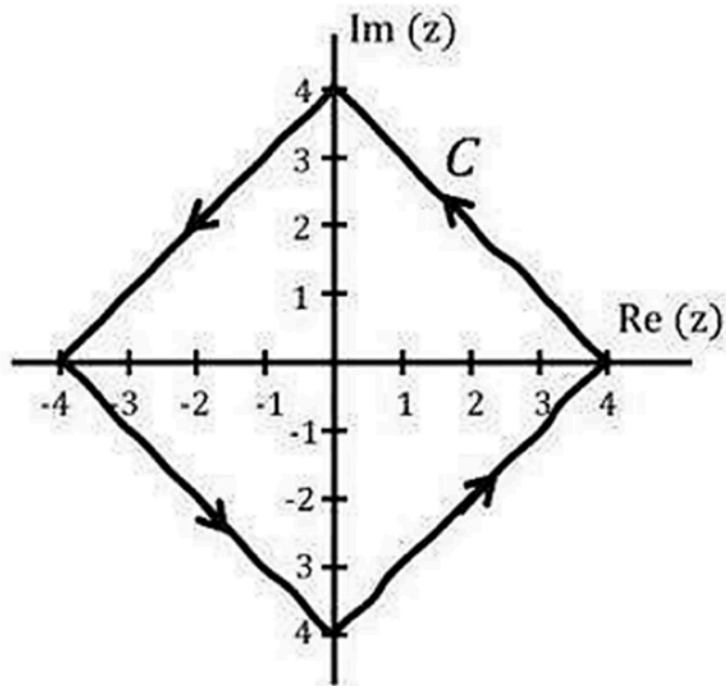
CSIR NET	2024 Dec	3.5M
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The value of the integral (where k is a constant),

$$\frac{1}{2\pi i} \oint_C \frac{5}{(z - 2)^2} \sin(kz) dz$$

over the closed contour C as shown below, is

1. $5k \cos(2k)$
2. $5k \sin(2k)$
3. $5 \cos(2k)$
4. $-5k^2 \sin(2k)$



Q21. [Dec 2024] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2024 Dec	5M
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The complex integral $\int_C z^4 \exp\left(\frac{1}{2z}\right) dz$, where C is the unit circle centered around the origin traversed counter-clock-wise, equals

1. $\frac{\pi i}{120}$
2. $\frac{\pi i}{960}$
3. 0
4. $\frac{\pi i}{1920}$

Q22. [Dec 2024] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2024 Dec	5M
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Gamma function with argument z is defined as

$$\Gamma[z] = \int_0^{\infty} dt t^{z-1} e^{-t}$$

where z is a complex variable and $\text{Re}z \geq 0$. $\Gamma[z]$ has

1. a branch point at $z = 0$
2. a simple pole at $z = 0$
3. a removable singularity at $z = 0$
4. an essential singularity at $z = 0$

Q23. [Dec 2025] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 Dec	3.5M	MMP
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If C be the unit circle traversed clockwise, then the integral $\oint_C dz |1 + 2z|^2$ equals

1. $-4\pi i$
2. $-\pi i$
3. 0
4. $-2\pi i$

Q24. [Dec 2025] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 Dec	3.5M	MMP
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The residue of $f(z) = \frac{\cos(\pi z)}{(1-z^2)^3}$ at $z = 1$ is

1. $\frac{\pi^2}{16}$
2. $\frac{3}{16}$
3. $\frac{3+\pi^2}{16}$
4. $\frac{3-\pi^2}{16}$

Q25. [June 2025] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 June	3.5M	MMP
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For the function $f(z) = \exp\left[z - 1 + \frac{1}{z-1}\right]$

1. $z = 1$ is a pole of order one.
2. $z = 1$ is an essential singularity.
3. $z = 1$ is a pole of order two.
4. $z = 1$ is a removable singular point.

Q26. [June 2025] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 June	5M	MMP
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The value of the integral $\int_0^{\infty} \frac{\cos(\alpha x)}{1+x^2} dx$, where α is a positive real number, is

1. $\frac{\pi}{2} e^{-\alpha}$
2. $\pi e^{-\alpha}$
3. $\frac{\pi}{2} e^{-(\alpha/2)}$
4. $\pi e^{-(\alpha/2)}$

Answer Key

26 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Mathematical Physics	Complex analysis	2
Q2	Mathematical Physics	Complex analysis	1
Q3	Mathematical Physics	Complex analysis	3
Q4	Mathematical Physics	Complex analysis	2
Q5	Mathematical Physics	Complex analysis	3
Q6	Mathematical Physics	Complex analysis	None
Q7	Mathematical Physics	Complex analysis	2
Q8	Mathematical Physics	Complex analysis	2
Q9	Mathematical Physics	Complex analysis	1
Q10	Mathematical Physics	Complex analysis	3
Q11	Mathematical Physics	Complex analysis	4
Q12	Mathematical Physics	Complex analysis	3
Q13	Mathematical Physics	Complex analysis	4
Q14	Mathematical Physics	Complex analysis	2
Q15	Mathematical Physics	Complex analysis	2
Q16	Mathematical Physics	Complex analysis	3
Q17	Mathematical Physics	Complex analysis	3
Q18	Mathematical Physics	Complex analysis	2
Q19	Mathematical Physics	Complex analysis	1
Q20	Mathematical Physics	Complex analysis	1
Q21	Mathematical Physics	Complex analysis	4
Q22	Mathematical Physics	Complex analysis	2
Q23	Mathematical Physics	Complex analysis	1
Q24	Mathematical Physics	Complex analysis	4
Q25	Mathematical Physics	Complex analysis	2
Q26	Mathematical Physics	Complex analysis	1

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