

Model Questions in Mathematical Physics according to CBCS pattern

1. Physical interpretation of scalar triple product is?
2. What is the value of $\vec{A} \cdot (\vec{A} \times \vec{B})$?
3. Write expression for Line element in spherical polar coordinate ?
4. What is the divergence of position vector \vec{r} ?
5. What is the value of $\int_{-\infty}^{\infty} \sin(x)\delta(x - \frac{\pi}{4})dx$?
6. What is the directional derivative along unit vector \hat{n} of a scalar field ϕ ?
7. Legendre polynomial $P_2(x) = \frac{1}{2}(3x^2 - 1)$, $P_3(x) = \frac{1}{2}(5x^3 - 3x)$. What is the value of $\int_{-1}^1 P_2(x)P_3(x)dx$?
8. What is the coefficient of $\sin(3x)$ in the Fourier series expansion of the function $f(x) = x^2$ within the interval $-\pi \leq x \leq +\pi$?
9. Given $\Gamma(\frac{1}{2}) = \sqrt{\pi}$, What is the value of $\Gamma(-\frac{1}{2})$?
10. Is complex function $f(z) = |z|^2$ is an analytic function?
11. What is the value of counter integral $\oint_C z^{-1}dz$ on a circular counter?
12. Find residue of $1/\sin(z)$ at $z = 0$?
13. What is the Fourier transform of the Dirac delta function centered at origin?
14. Write gradient operator $\vec{\nabla}$ in cylindrical polar coordinates.
15. What is the Jacobian when we transform from Cartesian coordinates (x, y) to polar coordinates (r, θ) ?
16. What is Laplace transform of $f(t) = e^{kt}$?
17. If Laplace transform of $f(t)$ is $L\{f(t)\} = F(s)$ then what is Laplace transform $L\{f(at)\}$?
18. What is the condition that the equation $P(x, y)dx + Q(x, y)dy = 0$ is exact?
19. What is the value of Gaussian integral $\int_0^{\infty} e^{-x^2} dx$?
20. What is the order of pole at $z = 1$ for

$$\frac{z + 3}{z^2(z - 1)^3(z + 1)}$$

21. Using the relation connecting beta to gamma function, what is the value of beta function $\beta(2, 3)$?
22. What is the value of $(\cos(\pi/12) + i \sin(\pi/6))^3$?
23. What is the sum of three cube roots of unity?
24. Using Shifting theorem, what is the Laplace transform of $L\{f(t - b)\}$?
25. What is Laplace transformation of unity $L\{1\}$?
26. What is the value of Fourier series at point of discontinuity?
27. What is the degree of the differential equation?

$$\frac{dy}{dx} = \frac{x^4 - y^4}{(x^2 + y^2)xy}$$

28. The Jacobian of (p, q, r) with respect to (x, y, z) given $p = x + y + z, q = y + z, r = z$ is?
29. The temperature of a point in space is given by $T = x^2 + y^2 - z$. An insect located at a point $(1, 1, 2)$ desire to fly in such a direction such that it will get warm as soon as possible. In what direction it should move?
30. What are the singular points of the differential equation?

$$(4 - x^2) \frac{d^2y}{dx^2} + x^3 \frac{dy}{dx} + (1 + x)y = 0.$$