W-115

Ph.D. Entrance Examination, 2024

PHYSICS

Maximum Marks : 50

Note : Each question carrying 2 marks.

Q. 1. 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 :

(a)   1

(b)   0

(c)   3

(d)   2

Q. 2. The matrix $\begin{bmatrix} \dfrac{1}{\sqrt{2}} & \dfrac{i}{\sqrt{2}} \\ -\dfrac{i}{\sqrt{2}} & -\dfrac{1}{\sqrt{2}} \end{bmatrix}$ is :

(a)   Only Hermitian

(b)   Only unitary

(c)   Hermitian and unitary

(d)   None of these

Q. 3. Cauchy Integral formula for any analytic function

z is :

(a) $f(a) = \dfrac{1}{2\pi i} \oint \dfrac{f(z)}{(z-a)}$

(b) $f(a) = \dfrac{1}{\pi i} \oint \dfrac{f(z)}{(z-a)}$

(3)

(c) $f(a) = \dfrac{1}{2\pi i} \oint \dfrac{f(z)}{(z-2a)}$

(d) $f(a) = \dfrac{1}{\pi i} \oint \dfrac{f(z)}{(z-2a)}$

Q. 4. The elements of a 3 × 3 matrix A are the products

of its rows and columns indices Aij = ij (where i,

j = 1, 2, 3). The eigen value of A are :

(a) (7, 7, 0)

(b) (7, 4, 3)

(c) (14, 0, 0)

(d) $\left(\dfrac{14}{3}, \dfrac{14}{3}, \dfrac{14}{3} \right)$

W-115

P.T.O.

(4)

Q. 5. The value of the definite integral $\displaystyle\int_0^\pi \dfrac{d\theta}{5+4\cos\theta}$

is :

(a) $\dfrac{4\pi}{3}$

(b) $\dfrac{2\pi}{3}$

(c) π

(d) $\dfrac{\pi}{3}$

Q. 6. Hamilton's equation of motion are :

(a) $q_i = \dfrac{\partial H}{\partial \dot{p}_i}, p_i = \dfrac{\partial H}{\partial q_i}$

(b) $\dot{q}_i = \dfrac{\partial H}{\partial p_i}, \dot{p}_i = -\dfrac{\partial H}{\partial q_i}$

W-115

(c) $p_i = \dfrac{\partial H}{\partial p_i}, \ \dot{q}_i = \dfrac{\partial H}{\partial q_i}$

(b) Zero

(d) None of these

(c) $\dfrac{\partial V}{\partial p}$

Q. 7. Lagrangian equation of motion for conservative

(d) $-\dfrac{\partial V}{\partial p}$

system is :

Q. 9. Which one of the following is Maxwell's third

equation :

(a) $\dfrac{d}{dt}\left(\dfrac{\partial L}{\partial \dot{q}_j}\right) - \dfrac{\partial L}{\partial q_j} = 0$

(b) $\dfrac{d}{dt}\left(\dfrac{\partial L}{\partial q_j}\right) - \dfrac{\partial L}{\partial \dot{q}_j} = 0$

(a) $\vec{\nabla}\cdot\vec{E} = -\dfrac{\partial \vec{B}}{\partial t}$

(c) $\dfrac{d}{dt}\left(\dfrac{\partial L}{\partial \dot{q}_j}\right) - \dfrac{\partial L}{\partial \dot{q}_j} = 0$

(b) $\vec{\nabla}\cdot\vec{B} = -\dfrac{\partial \vec{E}}{\partial t}$

(d) None of these

(c) $\vec{\nabla}\times\vec{E} = -\dfrac{\partial \vec{B}}{\partial t}$

Q. 8. Find the Poisson bracket of p with V(p) :

(d) None of these

(a) One

Q. 10. Skin depth for good conductor :

(a) $\delta = \sqrt{\dfrac{2}{\sigma\omega\mu}}$

(b) $\delta = \sqrt{\dfrac{\sigma\omega\mu}{2}}$

(c) $\delta = \sqrt{\dfrac{2\sigma}{\omega\mu}}$

(d) $\delta = \sqrt{\dfrac{\omega\mu}{2\sigma}}$

Q. 11. Density of plasma is _____ ions-electrons pair/
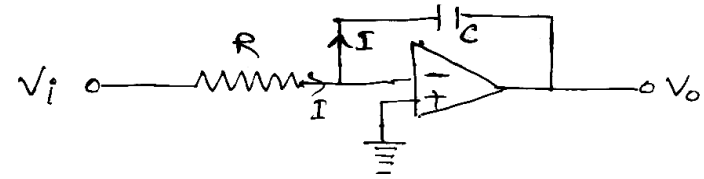
cm^3 :

(a) 10^{12}

(b) 10^{20}

(c) 10^{21}

(d) 10^2

Q. 12. The circuit given below works as :

(a) Differentiator

(b) Integrator

(c) Both (a) and (b)

(d) None of these

Q. 13. The simplified logic expression of $\overline{AB + \overline{A} + AB}$

is :

(a) 0

(b) 1

(c) $\overline{A}$

(d) $\overline{B}$

Q. 14. How many different instructions are possible in

an 8 bit microprocessor ?

(a) 32

(b) 64

(c) 128

(d) 256

Q. 15. Normalisation of a wave function (ψ) is :

(a) $\int_{-\infty}^{\infty} \psi^* \psi \, dx = 0$

(b) $\int_{-\infty}^{\infty} \psi^* \psi \, dx = 1$

(c) $\int_{-\infty}^{\infty} \psi^* \psi \, dx = \infty$

(d) None of these

Q. 16. Energy eigen values of harmonic oscillator is :

(a) $E_n = \dfrac{1}{2}\hbar w$

(b) $E_n = \left(n + \dfrac{1}{2}\right)\hbar w$

(c) $E_n = \left(n^2 + \dfrac{1}{2}\right)\hbar w$

(d) None of these

Q. 17. Boltzman relation between entropy and probability

is :

(a)   S = k log w

(b) $S = \dfrac{k}{\log w}$

(c)   S = k + log w

(d)   None of these

Q. 18. The Fermi energy of a free electron gas depends

upon the electron density ρ as :

(a) $\rho^{1/3}$

(b) $\rho^{2/3}$

(c) $\rho^{-1/3}$

(d) $\rho^{-2/3}$

Q. 19. JFET is also known as :

(a)   Linear device

(b)   Square law device

(c)   Logarithmic law device

(d)   None of the above

Q. 20. The UJT may be used as :

(a)   An Amplifier

(b)   Rectifier

(c)   Modulator

(d)   Saw tooth generator

Q. 21. When a force (or stress) is applied on the crystal,

the emission of light is called :

(a) Mechanoluminescence

(b) Thermo-luminescence

(c) Electro-luminescence

(d) Sono-luminescence

Q. 22. Splitting of energy levels in external magnetic field

is called :

(a) Stark effect

(b) Zeeman effect

(c) Both (a) and (b)

(d) None of the above

Q. 23. Expulsion of magnetic flux from the interior of

semiconductor is called :

(a) Stark effect

(b) Meissner effect

(c) Zeeman effect

(d) None of the above

Q. 24. The quark content of proton is :

(a) uuu

(b) uus

(c)   uud

(d)   udd

Q. 25. In LASER, relation between Einstein coefficients

$\left(\dfrac{A_{21}}{B_{21}}\right)$ is :

(a) $\dfrac{8\pi h\nu^3}{c^3}$

(b) $\dfrac{8\pi h\nu^2}{c^2}$

(c) $\dfrac{8\pi h\nu}{c}$

(d)   None of the above

——————