DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

TEST BOOKLET

Sl. No. 02544

Subject Code : 20 | **Subject : Physics**

LECTURERS FOR NON-GOVT. AIDED COLLEGES OF ODISHA

Time Allowed : 3 Hours | *Maximum Marks : 165*

: INSTRUCTIONS TO CANDIDATES :

1. **IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET CONTAINS 31 PAGES AND DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.**

2. You have to enter your **Roll No.** on the Test Booklet in the Box provided alongside. **DO NOT** write anything else on the Test Booklet.

3. The Test Booklet contains **165** questions. Each question comprises four answers. You have to select the correct answer which you want to mark (darken) on the Answer Sheet. In case, you feel that there is more than one correct answer, you should mark (darken) the answer which you consider the best. In any case choose ONLY ONE answer for each question. If more than one answer is darkened it will be considered as wrong.

4. You have to mark (darken) all your answers **ONLY** on the **separate OMR Answer Sheet** provided, by **using BLACK BALL POINT PEN**. You have to do rough work on the space provided in the Test Booklet only. See instruction in the Answer Sheet.

5. All questions carry equal marks, i.e. of one mark for each correct answer and each wrong answer will result in negative marking of **0.25** mark.

6. Before you proceed to mark (darken) in the Answer Sheet the answers to various questions in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per the instructions in your Admit Card.

7. After you have completed filling in all your answers on the Answer Sheet and after completion of the examination, you should hand over to the Invigilator the **Original Answer Sheet (OMR Answer Sheet)** issued to you. You are allowed to take with you the candidate's copy/second page of the Answer Sheet along with the Test Booklet after completion of the examination for your reference.

Candidate's full signature | **Invigilator's signature**

2018

1. Let $f(x, y, z) = \frac{1}{\sqrt{x^2 + y^2 + z^2}}$, which is defined everywhere except at the origin. Compute $\int \nabla f \cdot dr$ where c is any curve from (1, 2, 2) to (3, 4, 0) :

(A) $-\frac{3}{15}$

(B) $-\frac{2}{15}$

(C) $-\frac{6}{15}$

(D) $-\frac{15}{4}$

2. If F is the conservative vector field, then $\nabla \times F = ?$

(A) π

(B) 2π

(C) 4π

(D) 0

3. Calculate the divergence of F, if $F = -x^2 i + 2xyj$:

(A) 6

(B) 1

(C) 0

(D) 5

4. Estimate the flux of F across a small circle C of a radius a if div F at the center of the circle is 3 :

(A) $6\pi a^2$

(B) $6\pi a$

(C) $3\pi a^2$

(D) 0

5. Let F be defined on a simple connected region in space. If crul F = 0, then F is :

(A) Conservative

(B) Non-conservative

(C) Rotational

(D) Irrotational

6. Which one of the following functions satisfies the functional equation $f(f(x)) = x$ for every real number x :

(A) $f(x) = 2x$

(B) $f(x) = x^2$

(C) $f(x) = 2 - x$

(D) $f(x) = 2\sqrt{x}$

7. What is the value of $\arg z + \arg |\bar{z}|$?

(A) 2π

(B) $2n\pi$

(C) 3π

(D) 0

8. If u is a Harmonic function, the value of $\nabla^2 u$ is :

(A) $\frac{2\pi}{3}$

(B) $\frac{\pi}{2}$

(C) $\frac{\pi}{4}$

(D) $\frac{3\pi}{2}$

9. The modulus of the product of any number of complex quantities is equal to the :

(A) Product of their moduli

(B) Complex conjugate of their moduli

(C) Sum of their moduli

(D) Divsion of their moduli

10. The recursion relation of gamma function can be written as :

(A) $\Gamma(m+n) = \Gamma(m) \times \Gamma(n)$

(B) $\Gamma(n+1) = n\,\Gamma(n)$

(C) $\Gamma(m+n) = \Gamma(m) + \Gamma(n)$

(D) $\Gamma(n+1) = n\,\Gamma(1)$

11. The beta function value of the integral $I = \int_0^\infty \frac{x^3}{(1+x)^5} dx$ is :

(A) 4

(B) 1/4

(C) 0

(D) 3/5

12. A Fourier series is defined as an expansion of a function in a series of :

(A) Sines function only

(B) Cosines function only

(C) Both (A) and (B)

(D) None of these

13. The expansion of $e^{\sin(x)}$ is :

(A) $1 + x + x^2/2 + x^4/8 + \cdots$

(B) $1 + x + x^2/2 - x^4/8 + \cdots$

(C) $1 + x - x^2/2 + x^4/8 + \cdots$

(D) $1 + x + x^3/6 - x^5/10 + \cdots$

14. The value of $(1+i)^{10}$ is ..... ?

(A) 16i

(B) 2i

(C) 0

(D) 32i

15. Who discovered Fourier series ?

(A) Jean Baptiste de Fourier

(B) Fourier Joseph

(C) Jean Baptiste Joseph Fourier

(D) Jean Fourier

16. What is the fundamental period of the signal : e^{jwt} ?

(A) $2\prod/w$

(B) $2\prod/w^2$

(C) $2\prod/w^3$

(D) $4\prod/w$

17. What is unit of Dirac function ?

(A) x

(B) x^{-1}

(C) t

(D) t^{-1}

18. The function $g(z) = \frac{\cos(z)-1}{z^2}$ has an isolated singularity at the point ?

(A) z = 0

(B) z = 1/2

(C) z = – 1/2

(D) z = 1

19. A system for which the potential V is purely a function of co-ordinates is called as :

(A) Non-conservative system

(B) Non-dimensional system

(C) Conservative system

(D) Multi-dimensional system

20. For a system with N dimension and 3 holonomic constraints, how many generalised co-ordinates are needed to describe the system ?

(A) N + 6

(B) N – 3

(C) N – 6

(D) N + 3

21. For a Lagrangian L(q, $\dot{q}$, t), write an expression for the variation δL corresponding to a free particle :

(A) $\delta L = m\dot{q} + \delta\dot{q}$

(B) $\delta L = m\dot{q}$

(C) $\delta L = m\dot{q} / \delta\dot{q}$

(D) $\delta L = m\dot{q}\,\delta\dot{q}$

22. Consider a free particle in 2D space. Obtain Lagrangian in (r, θ) spherical coordinate system ?

(A) $L = \frac{1}{2}m(\dot{r} + r^2\dot{\theta}^2)$

(B) $L = \frac{1}{2}m(\dot{r} - r\dot{\theta})$

(C) $L = \frac{1}{2}m(\dot{r} + r\dot{\theta}^2)$

(D) $L = \frac{1}{2}m(\dot{r} + r\dot{\theta})$

23. What is the Lagendre transformation of the function $f(x) = e^x$?

(A) $\ell np(p-1)$

(B) $\ell np - 1$

(C) $p(\ell np - 1)$

(D) $\ell n(\ell np - 1)$

24. A particle with position x and momentum p has angular momentum $L = x \times p$. Evlauate the Poission bracket $\{p_i, L_k\}$. The indices I, j and k correspond to Cartesian components :

(A) p_{jk}

(B) x_j

(C) p_j

(D) x_{jk}

25. The Lagrange's equation of motion $\frac{d}{dt}\left[\frac{dL}{d\dot{q}}\right] - \frac{dL}{dq} = 0$ can be used for :

(A) Conservative and non-holonomic systems

(B) Conservative and holonomic systems

(C) Non-conservative and non-holonomic systems

(D) Non-conservative and holonomic systems

26. If the Lagrangian, L, is unchanged under the translation of the system along the time t leads conservation of :

(A) Linear momentum

(B) Energy

(C) Angular momentum

(D) Parity

27. If $\{p_l, q_i\}$, $\{q_l, q_i\}$ are the Lagrangian brackets and $[p_l, p_j]$, $[q_l, p_j]$ are Poisson brackets then which below equation is correct :

(A) $\sum_{l=1}^{n}\{p_l, q_i\}[p_l, p_j] + \sum_{l=1}^{n}\{q_l, q_i\}$ $[q_l, p_j] = \delta_{ij}$

(B) $\sum_{l=1}^{n}\{p_l, q_i\}[p_l, p_j] + \sum_{l=1}^{n}\{q_l, q_i\}$ $[q_l, p_j] = \delta_{lj}$

(C) $\sum_{l=1}^{n}\{p_l, q_i\}[p_l, p_j] + \sum_{l=1}^{n}\{q_l, q_i\}$ $[q_l, p_j] = 0$

(D) $\sum_{l=1}^{n}\{p_l, q_i\}[p_l, p_j] + \sum_{l=1}^{n}\{q_l, q_i\}$ $[q_l, p_j] = \delta_{li}$

28. Which value of the bracket form transformation is called canonical ?

(A) $[Q, P] = 0$

(B) $[P, P] = 1$

(C) $\{Q, P\} = 1$

(D) $[Q, P] = 1$

29. Identify the Jacobi identity :

(A) $[A, [B, C]] + [B, [C, A]] + [C, [A, B]] = 0$

(B) $[A, [B, C]] + [B, [A, C]] + [C, [A, B]] = 0$

(C) $[A, \{B, C\}] + [B, \{A, C\}] + [C, \{A, B\}] = 0$

(D) $[A, \{B, C\}] + [B, \{C, A\}] + [C, \{A, B\}] = 0$

30. The mathematical representation of spherical wave travelling outwards from a point source is :

(A) Are^{ikr}

(B) $Ae^{-ikr/r}$

(C) Ae^{ikr}

(D) Are^{-ikr}

31. In a simple harmonic oscillator, when the particle is at the mean position $y = 0$ then, what is the value of kinetic and potential energy ?

(A) Kinetic energy is maximum and potential energy is zero

(B) Kinetic energy is zero and potential energy is zero

(C) Kinetic energy is zero and potential energy is maximum

(D) Kinetic energy is maximum and potential energy is maximum

32. The rigid spheres are connected by a light flexible rods with relative masses $m_1 : m_2 : m_3 = 1 : 2 : 1$. What are the normal modes of the system in the x direction :

(A) $x_1 + x_3$, and $x_1 + 2x_2 + x_3$

(B) $x_1 - x_3$, and $x_1 + 2x_2 + x_3$

(C) $x_1 + x_3$, and $x_1 - 2x_2 + x_3$

(D) $x_1 - x_3$, and $x_1 - 2x_2 + x_3$

33. Consider the problem of two particles of similar mass M connected by a spring of constant K_{12} and further each particle connected to fixed points with springs of constant K. If the motion of particles is restricted to direction along the x-axis only, so the system has two degrees of freedom x_1 and x_2 that give the displacement of the masses from their respective equilibrium position, what is the kinetic energy of the system ?

(A) $T = \frac{1}{2}K(\dot{x}_1^2 + \dot{x}_2^2)$

(B) $T = \frac{1}{2}M(\dot{x}_2^2 - \dot{x}_1^2)$

(C) $T = \frac{1}{2}M(\dot{x}_1^2 + \dot{x}_2^2)$

(D) $T = \frac{1}{2}K(\dot{x}_1^2 - \dot{x}_2^2)$

34. The ratio of intensity of magnetisation to the magnetisation force is known as :

(A) Flux density

(B) Susceptibility

(C) Relative permeability

(D) None of these

35. A conductor of length L has current I passing through it, when it is placed parallel to a magnetic field. The force experienced by the conductor will be :

(A) Zero

(B) BLI

(C) B2LI

(D) BLI2

36. The force between two long parallel conductors is inversely proportional to :

(A) Radius of conductors

(B) Current in one conductors

(C) Product of current in two conductors

(D) Distance between the conductors

37. A square cross-sectional magnet has a pole strength of 1 × 10 Wb and cross sectional area of 20 mm × 20 mm. What is the strength at a distance of 100 mm from the unitpole in air :

(A) 63.38 N/Wb

(B) 633.8 N/Wb

(C) 6338 N/Wb

(D) 63380 N/Wb

38. Magnetic field inside a solenoid is :

(A) Zero

(B) Infinite

(C) Strong

(D) Uniform

39. When a charged particle moves at right angle to a magnetic field quantity that changes is :

(A) Momentum

(B) Energy

(C) Speed

(D) Moment of Inertia

40. Value of magnetic field that will cause a max force of 7×10^{-3}N on a 20 cm wire carrying current of 10 A will be :

(A) 1.5×10^{-3}T

(B) 3.5×10^{-3}T

(C) 4.5×10^{-3}T

(D) 2.5×10^{-3}T

41. If a current carrying conductor is placed in uniform magnetic field parallel to direction of field then force experienced by conductor will be :

(A) $ILB \times \cos\theta$

(B) IBL

(C) Zero

(D) $ILB \times \sin\theta$

42. Consider a long coaxial cable of radius b and length l, with a center conductor of radius a. The outer shield is a perfect conductor and is shorted to the linear conductor at the right end. At t = 0, a voltage V_0 is suddenly applied at the left end and remains constant thereafter. Assuming the current is uniform along the length of the cable $1 >> b$, what is the current as a function of time (I(t)) :

(A) $\frac{V_0}{R}(1+e^{\frac{r}{l}t})$

(B) $\frac{V_0}{R}(e^{\frac{r}{l}t})$

(C) $\frac{V_0}{R}(e^{-\frac{r}{l}t})$

(D) $\frac{V_0}{R}(1-e^{-\frac{r}{l}t})$