

**COMMON P. G. ENTRANCE TEST – 2020**

Test Booklet No. :

**DEPT. OF HIGHER EDUCATION, GOVT. OF ODISHA  
TEST BOOKLET**

Subject Code **37**

Subject **PHYSICS**

Time Allowed : **90 Minutes**

Full Marks : **70**

**: INSTRUCTIONS TO CANDIDATES :**

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET **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 **Hall Ticket No.** on the Test Booklet in the Box provided alongside. **DO NOT** write *anything else* on the Test Booklet.
3. YOU ARE REQUIRED TO FILL UP & DARKEN HALL TICKET NO. & TEST BOOKLET NO. IN THE ANSWER SHEET AS WELL AS FILL UP TEST BOOKLET SERIAL NO. & ANSWER SHEET SERIAL NO. IN THE ATTENDANCE SHEET CAREFULLY. WRONGLY FILLED UP ANSWER SHEETS ARE LIABLE FOR REJECTION AT THE RISK OF THE CANDIDATE.
4. This Test Booklet contains 70 items (questions). Each item (question) comprises four responses (answers). You have to select the correct response (answer) which you want to mark (darken) on the Answer Sheet. In case, you feel that there is more than one correct response (answer), you should mark (darken) the response (answer) which you consider the best. In any case, choose **ONLY ONE** response (answer) for each item (question).
5. You have to mark (darken) all your responses (answers) **ONLY** on the **separate Answer Sheet** provided by using **BALL POINT PEN (BLUE OR BLACK)**. See instructions in the Answer Sheet.
6. All items (questions) carry equal marks. All items (questions) are compulsory. Your total marks will depend only on the number of correct responses (answers) marked by you in the Answer Sheet. **There is no negative marking.**
7. **After you have completed filling in all your responses (answers) on the Answer Sheet and after conclusion of the examination, you should hand over to the Invigilator the 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.**
8. Sheets for rough work are appended in the Test Booklet at the end.

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



1. The directional derivative of the scalar function  $\phi = x^2yz + 4xz^2$  at the point  $(1, -2, 1)$  in the direction  $2\hat{i} + \hat{j} + 2\hat{k}$ :

(A)  $\frac{3}{27}$

(B)  $\frac{27}{3}$

(C) 35

(D) 20

2. The value of  $\text{div} \left( \frac{\vec{r}}{r^3} \right)$ :

(A) 0

(B) 1

(C) 3

(D)  $\infty$

3. The value of  $\int_{-\infty}^{+\infty} f(x)\delta(x-2)dx$  is:

(A)  $f(0)$

(B)  $f(1)$

(C)  $f(2)$

(D)  $f(\infty)$

4. Moment of inertia of a sphere of mass  $M$  and radius  $R$  about one of its diameter is:

(A)  $\frac{2}{5} MR^2$

(B)  $\frac{2}{3} MR^2$

(C)  $\frac{1}{2} MR^2$

(D)  $MR^2$

5. Which of the following is true for the relation between modulus of rigidity ( $\eta$ ), Young's modulus ( $Y$ ) and Poisson's ratio ( $\sigma$ )?

(A)  $\eta = \frac{Y}{2(1+\sigma)}$

(B)  $\eta = \frac{Y}{3(1+\sigma)}$

(C)  $\eta = \frac{Y}{2(1-\sigma)}$

(D)  $\eta = \frac{Y}{3(1-\sigma)}$

6. At what speed will the mass of a body be 1.25 times its rest mass ?
- (A)  $0.1c$  (B)  $0.3c$   
(C)  $0.4c$  (D)  $0.6c$
7. The electric field intensity  $\vec{E}$  due to an infinite uniformly charged plane sheet at a point of distance  $r$  from the sheet is related as :
- (A)  $\vec{E} \propto r$  (B)  $\vec{E} \propto r^{-1}$   
(C)  $\vec{E} \propto r^2$  (D)  $\vec{E}$  is independent of  $r$
8. The magnetic field due to a long straight current carrying conductor of radius  $R$ , when  $r > R$  ( $r$  is the distance between the point and the axis of wire) proportional to :
- (A)  $r$  (B)  $r^{-1}$   
(C)  $r^2$  (D)  $r^{-2}$
9. The self-inductance of a coil with turns 50, flux 3 units and a current of 0.5A is :
- (A) 75 (B) 150  
(C) 300 (D) 450
10. The dielectric constant for a material with electric susceptibility of 5 is :
- (A) 6 (B) 4  
(C) 3 (D) 0
11. Two thin convex lenses having focal lengths 5cm and 2 cm are coaxial and separated by a distance of 3 cm. The equivalent focal length is :
- (A) 0.5 cm  
(B) 2.5 cm  
(C) 1.5 cm  
(D) 3.5 cm

12. In Young's double slit experiment, the separation of the slits is 1.9 mm and the fringe spacing is 0.31mm at a distance of 1 metre from the slits. The wavelength of the slit is :
- (A) 4890 Å (B) 5890 Å  
(C) 6890 Å (D) 7890 Å
13.  $f(t)$  is a periodic function with period  $T$ . The average value is :
- (A)  $\int_0^T f(t)dt$  (B)  $\frac{1}{T} \int_0^T f(t)dt$   
(C)  $\frac{2}{T} \int_0^T f(t)dt$  (D)  $\frac{1}{2T} \int_0^T f(t)dt$
14. If  $\int_{-1}^{+1} P_n(x)dx = 2$  : then  $n$  is,
- (A)  $-1$  (B) 1  
(C)  $-1$  (D) None of these
15. If  $\Gamma n = \frac{\Gamma(n+1)}{n}$ , then  $\Gamma(-n)$  is :
- (A) 0 (B) 1  
(C)  $\infty$  (D) None of these
16. The efficiency of Carnot's engine working between the steam point and the ice point is :
- (A) 24.31 % (B) 25.21 %  
(C) 23.52 % (D) 26.80 %
17. Two ends of the rod are kept at 127°C and 227°C. When 2000 Cal of heat flows in this rod, then the change in entropy is :
- (A) 1 Cal/K (B) 20 Cal/K  
(C) 6.9 Cal/K (D) 0.7 Cal/K

18. In a gas, the relative magnitude of the most probable speed ( $V_p$ ), the average speed  $\bar{V}$  and root mean square speed ( $V_{rms}$ ) of the molecule are :

- (A)  $V_{rms} > \bar{V} > V_p$  (B)  $\bar{V} > V_{rms} > V_p$   
 (C)  $V_p > \bar{V} > V_{rms}$  (D)  $V_p > V_{rms} > \bar{V}$

19. The residue of  $\frac{z}{(z-a)(z-b)}$  at infinity is :

- (A) 1 (B)  $-\perp$   
 (C) 0 (D)  $\infty$

20. The Fourier transform of the function  $f(x)$  is  $F(k) = \int e^{iks} f(x) dx$ . The Fourier transform of  $\frac{df(x)}{dx}$  is :

- (A)  $\frac{dF(k)}{dk}$  (B)  $\int F(k) dk$   
 (C)  $-ik F(k)$  (D)  $ikF(k)$

21. If  $f(s) = \int_0^{\infty} e^{-st} F(t) dt$  is the Laplace transform of a function  $F(t)$ , the Laplace transform of  $kt$  is :

- (A)  $\frac{1}{s^2}$  (B)  $\frac{k}{s^2}$   
 (C)  $\frac{k}{s}$  (D)  $\frac{s^2}{k}$

22. When an electron jump from the fourth orbit to the second orbit, one can get :

- (A) First line of Pfund series (B) Second line of Lyman series  
 (C) Second line of Paschen series (D) Second line of Balmer series

23. Davisson and Germer experiments relates to :

- (A) Interference (B) Polarization  
 (C) Electron diffraction (D) Phosphorescence

24. Which is incorrect according to the shell model of the nucleus ?

- (A) Magic number exist
- (B) Nucleons interact with their nearest neighbours only
- (C) Nucleons in a nucleus interact with a general force field
- (D) Large electronic quadruple moment exists for certain nuclei

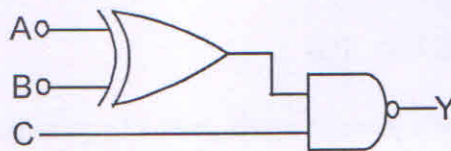
25. Which of the following is not used as a moderator in a nuclear reactor ?

- (A)  $H_2O$
- (B)  $D_2O$
- (C) C
- (D) Al

26. Which of the following is used in VLSI technology to form integrated circuit ?

- (A) Transistors
- (B) Switches
- (C) Diodes
- (D) Buffers

27. The Boolean expression for the output of the logic circuit shown in the Figure is :



- (A)  $Y = AB + A\bar{B} + C$
- (B)  $Y = \bar{A}\bar{B} + A\bar{B} + \bar{C}$
- (C)  $Y = A\bar{B} + \bar{A}B + C$
- (D)  $Y = AB + \bar{A}B + C$

28. Digital circuit can be made by repetitive use of :

- (A) NOT gates
- (B) OR gates
- (C) NAND gates
- (D) AND gates

29. Asynchronous counter are known as :

- (A) Ripple counters
- (B) Modulus counters
- (C) Decade counters
- (D) Multiple check counters

30. According to Schrödinger, a particle is equivalent to a :
- (A) Single wave (B) Sound wave  
(C) Light wave (D) Wave packet
31. Position and momentum operators satisfy  $[\hat{x}, \hat{p}] = i\hbar$ , the value of  $[\hat{p}, [\hat{x}, \hat{p}]]$  is :
- (A) 1 (B) 0  
(C)  $\hbar$  (D)  $i\hbar$
32. The normal Zeeman effect is :
- (A) Observed only in atoms with an even number of electrons  
(B) Observed only in atoms with an odd number of electrons  
(C) Confirmation of space quantization  
(D) Not a confirmation of space quantization
33. For Bragg's reflection by a crystal to occur, the X-ray wavelength  $\lambda$  and interatomic distance  $d$  must be :
- (A)  $\lambda > 2d$  (B)  $\lambda = 2d$   
(C)  $\lambda \leq 2d$  (D)  $\lambda < 2d$
34. According to the band theory of solids, the potential energy of two types of standing waves inside the crystal differ by an amount of :
- (A) Energy gap (B) 6 eV  
(C) 2 eV (D) None of these
35. The magnetic lines of force cannot penetrate the body of a superconductor. This phenomenon is known as :
- (A) Isotopic effect (B) BCS theory  
(C) Meissner effect (D) London theory
36. The Poynting vector  $S$  of an electromagnetic wave is :
- (A)  $\vec{S} = \vec{E} \times \vec{H}$  (B)  $\vec{S} = \vec{E} \times \vec{B}$   
(C)  $\vec{S} = \frac{\vec{E}}{\vec{B}}$  (D)  $\vec{S} = \frac{\vec{E}}{\vec{H}}$



37. For good conductors, skin depth ( $\delta$ ) varies with frequency ( $\omega$ ) as :

(A)  $\frac{1}{\omega}$

(B)  $\frac{1}{\sqrt{\omega}}$

(C)  $\omega$

(D)  $\sqrt{\omega}$

38. The thickness of half wave plate of quartz for a wavelength of  $5000 \text{ \AA}$  (given refractive index  $\mu_{\text{Extraordinary}} = 1.553$  and refractive index  $\mu_{\text{ordinary}} = 1.544$ ) is :

(A)  $2.78 \times 10^{-3} \text{ cm}$

(B)  $2.78 \times 10^{-5} \text{ cm}$

(C)  $2.78 \times 10^{-7} \text{ cm}$

(D)  $3.78 \times 10^{-5} \text{ cm}$

39. In a micro-canonical ensemble, a system A of fixed volume is in contact with a large reservoir B. Then :

(A) A can exchange only energy with B

(B) A can exchange only particles with B

(C) A can exchange neither energy nor particles with B

(D) A can exchange both energy and particles with B

40. The Fermi-Dirac distribution function is given as  $f_{F-D}(\epsilon_F) = \frac{1}{\exp\left(\frac{\epsilon - \epsilon_F}{kT}\right) + 1}$  where

$\epsilon_F$  is the Fermi energy. The value of  $f_{F-D}(\epsilon_F)$  at the absolute zero temperature is :

(A) 0

(B) 1

(C)  $\frac{1}{2}$

(D) infinity

41. Two bodies have their moments of inertia  $I$  and  $2I$  respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio of :

(A) 1 : 2

(B) 2 : 1

(C)  $1 : \sqrt{2}$

(D)  $\sqrt{2} : 1$

42. A particle executing simple harmonic motion of amplitude 5 cm has a maximum speed of 31.4 cm/s. The frequency of its oscillation is :
- (A) 4 Hz (B) 3 Hz  
(C) 2 Hz (D) 1 Hz
43. In a reversible cycle, the value of the integral  $\oint \frac{dQ}{T}$  is :
- (A)  $\oint \frac{dQ}{T} > 0$  (B)  $\oint \frac{dQ}{T} < 0$   
(C)  $\oint \frac{dQ}{T} = 0$  (D)  $\oint \frac{dQ}{T} = \text{constant}$
44. What is the correct expression for the phase angle in an RLC series circuit ?
- (A)  $\phi = \tan^{-1}(X_L - X_C)/R$  (B)  $\phi = \tan^{-1}(X_L + X_C)/R$   
(C)  $\phi = \tan(X_L - X_C)/R$  (D)  $\phi = \tan^{-1}(X_L - X_C)$
45. The time constant of an R-C circuit is :
- (A) RC (B) R/C  
(C) R (D) C
46. The value of the time constant in the R-L circuit is :
- (A) L/R (B) R/L  
(C) R (D) L
47. In Newton's rings experiment, the diameter of the 15th ring was found to be 0.590 cm and that of the 5th ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, the wavelength of light used :
- (A) 4880 Å (B) 5880 Å  
(C) 6680 Å (D) 7680 Å

48. If a charged particle of mass  $m$  is accelerated through a potential difference  $V$  volts, the de-Broglie wavelength is proportional to :
- (A)  $V$  (B)  $V^{-1/2}$   
 (C)  $V^2$  (D)  $V^{1/2}$
49. The lowest energy possible for a particle in a potential box is 2 eV. The next highest energy of the particle is :
- (A) 4 eV (B) 16 eV  
 (C) 32 eV (D) 8 eV
50. A rod has length of 1 metre. If the rod is placed inside a satellite moving with a velocity of  $0.8c$  relative to the laboratory, the length of the rod by the observer in the laboratory is :
- (A) 0.5 metre (B) 0.6 metre  
 (C) 0.7 metre (D) 0.8 metre
51. As an object approaches the speed of light, its mass becomes :
- (A) Zero (B) Double  
 (C) Remains Same (D) Infinite
52. Nuclear forces are :
- (A) Gravitational attractive (B) Electrostatic repulsive  
 (C) Long range and strong attractive (D) Short range and strong attractive
53. The binding energy per nucleon is maximum for the nucleus :
- (A)  $^{56}\text{Fe}$  (B)  $^4\text{He}$   
 (C)  $^{208}\text{Pb}$  (D)  $^{101}\text{Mp}$
54. The mean life time of one of the atoms of a radioactive sample with disintegration constant  $\lambda$  is :
- (A)  $1/\lambda$  (B)  $\ln 2/\lambda$   
 (C)  $\lambda \ln 2$  (D)  $\ln \lambda/2$

55. If a generalized coordinate has the dimensions of momentum, the generalized velocity will have the dimension of :
- (A) Velocity (B) Acceleration  
(C) Force (D) Torque
56. Hamilton's canonical equations of motion are :
- (A)  $\dot{q}_i = \frac{\partial H}{\partial p_i}$  and  $\dot{p}_i = \frac{\partial H}{\partial q_i}$  (B)  $\dot{q}_i = \frac{\partial H}{\partial p_i}$  and  $\dot{p}_i = -\frac{\partial H}{\partial q_i}$   
(C)  $\dot{q}_i = \frac{\partial H}{\partial \dot{p}_i}$  and  $\dot{p}_i = \frac{\partial H}{\partial \dot{q}_i}$  (D)  $\dot{q}_i = \frac{\partial H}{\partial \dot{p}_i}$  and  $\dot{p}_i = -\frac{\partial H}{\partial \dot{q}_i}$
57. The generalized velocity co-ordinate  $q_k$  of a classical system with Lagrangian 'L' is said to be cyclic if :
- (A)  $\frac{\partial L}{\partial q_k} = \dot{q}_k$  (B)  $\frac{\partial L}{\partial q_k} = 0$   
(C)  $\frac{\partial L}{\partial \dot{q}_k} = 0$  (D) None of these
58. A particle moves in a circular orbit about the origin under the action of a central force  $\vec{F} = -\frac{k\hat{r}}{r^3}$ . If the potential energy is zero at infinity, the total energy of the particle is :
- (A)  $-\frac{k}{r^2}$  (B)  $-\frac{k}{2r^2}$   
(C) 0 (D)  $\frac{k}{r^2}$
59. The law at given temperature, the ratio of spectral emissive and absorptive powers of a body is called :
- (A) Wien's law (B) Kirchoff's law  
(C) Stefan's law (D) Displacement law

60. A permanent memory, which helps to start-up the computer and does not erase data after power off :
- (A) Network interface card (B) CPU  
(C) RAM (D) ROM
61. Which of the following is non-volatile storage?
- (A) Backup (B) Secondary  
(C) Primary (D) Cache
62. A half adder is a logic circuit with :
- (A) Two inputs and two outputs  
(B) Three inputs and one output  
(C) Three inputs and two outputs  
(D) Two inputs and one output
63. An oscillator differs from an amplifier because :
- (A) It has more gain  
(B) It has less gain  
(C) It requires no input signals  
(D) It requires no dc supply
64. In a ferromagnetic material, as the applied field is gradually reduced to zero, the polarization still left is known as :
- (A) Coercive polarization (B) Spontaneous polarization  
(C) Space charge polarization (D) Remanent polarization
65. The splitting of spectral line in the presence of an electric field is called as :
- (A) Stark effect (B) Zeeman effect  
(C) Paschen-Back effect (D) Raman effect

66. Weak nuclear forces act on :
- (A) Both hadrons and leptons
  - (B) Hadrons only
  - (C) All the charged particles
  - (D) None of these
67. Which of the following elementary particle is a lepton :
- (A) Photon
  - (B)  $\mu$ -meson
  - (C) Neutron
  - (D) proton
68. Biot-Savarts law in magnetic field is analogous to law in electric field :
- (A) Gauss law
  - (B) Faraday law
  - (C) Coulombs law
  - (D) Ampere law
69. The Ampere law is based on
- (A) Stoke's theorem
  - (B) Green's theorem
  - (C) Gauss divergence theorem
  - (D) Maxwell theorem
70. The magnetic flux density of a finite length conductor of radius 12 cm and current 3 A in air is :
- (A)  $5 \times 10^{-6}$
  - (B)  $4 \times 10^{-6}$
  - (C)  $6 \times 10^{-6}$
  - (D)  $7 \times 10^{-6}$



# SPACE FOR ROUGH WORK