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

# 24-0010-E TEST BOOKLET

**Time Allowed: 3:00 hrs**

## MAIN PAPER- PHYSICS

**Maximum Marks: 300**

### INSTRUCTIONS TO CANDIDATES

*Read the instructions carefully before answering the questions: -*

1. This Test Booklet consists of 12(twelve) printed pages and has 75 (seventy five) **items (questions)**.
2. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
3. **Please note that it is the candidate's responsibility to fill in the Roll Number and other required details carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet and the Separate Answer Booklet. Any omission/discrepancy will render the OMR Answer Sheet and the Separate Answer Booklet liable for rejection.**
4. Do not write anything else on the OMR Answer Sheet except the required information. Before you proceed to mark in the OMR Answer Sheet, please ensure that you have filled in the required particulars as per given instructions.
5. Use **only Black Ball Point Pen** to fill the OMR Answer Sheet.
6. This Test Booklet is divided into 4 (four) parts – **Part – I, Part - II , Part – III** and **Part IV.**
7. All FOUR parts are **Compulsory**.
8. **Part-I consists of Multiple Choice-based Questions.** The answers to these questions have to be marked in the **OMR Answer Sheet** provided to you.
9. **Part - II , Part – III** and **Part IV consist of Conventional Questions.** The answers to these questions have to be written in the **Separate Answer Booklet** provided to you.
10. In Part-I, each item (question) comprises of 04 (four) responses (answers). You are required to select the response which you want to mark on the OMR Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
11. After you have completed filling in all your responses on the OMR Answer Sheet and the Answer Booklet(s) and the examination has concluded, you should hand over to the Invigilator ***only the OMR Answer Sheet and the Answer Booklet(s)***. You are permitted to take the Test Booklet with you.
12. **Penalty for wrong answers in Multiple Choice-based Questions:**

THERE WIL BE **PENALTY** FOR WRONG ANSWERS MARKED BY A CANDIDATE.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to the question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to the question.

(iii) If a question is left blank. i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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## PART – I

MULTIPLE CHOICE BASED QUESTIONS

Instructions for Questions 1 to 50:

- Choose the correct answer for the following questions
- Each question carries 3 marks (50 x 3 = 150 marks)

1. Four point charges $q_A = 5$ C, $q_B = -30\mu C$, $q_C = 5C$, and $q_D$ are placed at the corners of a square ABCD of side 50 cm. If the net force on a charge of 5 $\mu$C placed at the center of the square is zero. What will be the value of $q_D$ ?

   a) 5C
   b) 30$\mu$C
   c) -5C
   d) –30$\mu$C

2. $ML^3 T^{-3} A^{-1}$ is the dimension of

   a) Electric Field intensity
   b) Electric potential
   c) Electric force
   d) Electric flux

3. Which of the following molecule have permanent electric dipole moment

   a) $H_2O$
   b) $CO_2$
   c) $CH_4$
   d) All of the above

4. Which is not a basic property of a charge

   a) quantization,
   b) additivity
   c) neutrality
   d) conservation.

5. Electric field lines doesn't provide information about

   a) field strength
   b) direction
   c) Nature of medium
   d) nature of charge

6. Which among the following material exhibits strong dependence of resistivity with temperature

a) Nichrome
b) Copper
c) Manganin
d) constantan

7. Which of the following is not a ohmic resistance?

a) Lamp filament
b) Carbon resistor
c) Diode
d) Copper wire

8. Three resistors 1 Ω, 2 Ω, and 3 Ω are first connected in series with a cell of internal resistance 2 ohms. Then, they are connected in parallel to the same cell. Find the ratio of the respective currents in the two cases.

a) 22:7
b) 7:22
c) 6: (6/11)
d) 8: 11/28

9. ..... instrument is used as the null detector in the Wheatstone bridge?

a) Voltmeter
b) Ammeter
c) Galvanometer
d) Multimeter

10. Magnitude of the drift velocity per unit electric field is known as

a) Mobility
b) Conductivity
c) Resistivity
d) Acceleration

11. The power dissipated in a resistor is given by:

a) $I^2R$
b) $IR^2$
c) $I^2/R$
d) $I/R^2$

12. Drift velocity of electrons is due to

a) motion of conduction electrons due to random collisions
b) motion of conduction electrons due to Electric field
c) repulsion of conduction electrons due to inner electrons of ions
d) collision of conduction electrons with each other.

13. Magnetic force by a current carrying conductor (I) on a stationary charge Q, place at a distance R from conductor at right angle is given by

a) $B = \mu I/2\pi R$
b) $B= \mu IR /2\pi$
c) $B= \mu R /2\pi I$
d) B= Zero

14. In Cyclotron which fields are used to increase the energy of particles

a) Electric Field
b) Magnetic field
c) Electric and magnetic field acting parallel to each other
d) Electric and magnetic field acting perpendicular to each other

15. There are 2 long parallel conductors $AA^*$ and $CC^*$. $AA^*$ carries 10A current and CC* carries 2A current. The magnetic field at the midpoint of these two conductors is B. If 2A current is switched off, then what is the magnetic field at the midpoint now?

a) B/5
b) 2B/5
c) 5B/4
d) 10B/4

16. The value of gyromagnetic ratio for a proton is

a) $4.790 \times 10^8$ C/kg
b) $4.790 \times 10^7$ C/kg
c) $4.790 \times 10^9$ C/kg
d) $4.790 \times 10^{10}$ C/kg

17. To convert a galvanometer into an ammeter we use a shunt resistance $r_s$ of very ..... value in .....

a) Small, Series
b) High, series
c) Small, parallel
d) high, parallel

18. The net magnetic flux through any closed surface is zero. This law is

a) Gauss's law for magnetism
b) Bio Savrt law for magnetism
c) Amperes law for magnetism
d) Amperes modified law for magnetism

19. Susceptibility is positive for (1) Ferromagnetic material (2) Paramagnetic material (3) Diamagnetic material

a) Option (1) and (2)
b) Option (1) and (3)
c) Option (3) and (2)
d) None of the above

20. What is the value of the angle of dip at the magnetic equator?

a) 45 degree
b) 0 degree
c) 90 degree
d) 60 degree

21. Find the true statement.

a) Magnetic intensity is not a vector quantity
b) Induced magnetization is a natural process by which a non-magnetic material magnetize
c) Magnetic intensity and intensity of magnetization are different.
d) Total intensity is the measurement from the magnetometer after a model of the earth's normal magnetic field is removed

22. The angle of dip at a certain place where the horizontal and vertical components of the earth's magnetic field are equal is

(a) 30°
(b) 45°
(c) 60°
(d) 75°

23. If a bar magnet is broken into two halves we get the two similar bar magnets with somewhat

a) Weaker properties
b) Same properties
c) Stronger properties
d) None

24. Which of the following waves have a minimum wavelength?

a) gamma rays
b) microwaves
c) radio waves
d) infrared waves

25. The ratio of contributions shared by the magnetic field and electric field components to the energy of an EM wave is

a) 1:2
b) 1:1
c) 1:3
d) 1:4

26. The dimension of E/B are same as that of

a) Charge
b) Velocity
c) Current
d) Acceleration

27. Electromagnetic wave have the speed of

a) $3x\ 10^3$ km/s
b) $3x\ 10^4$km/s
c) $3x\ 10^5$ km/s
d) $3x\ 10^6$ km/s

28. Which of the following statement is true for the properties of electromagnetic waves?

a) Both electric and magnetic field vectors attain the maxima and minima at the different place and time.

b) The energy in electromagnetic waves is divided unequally between electric and magnetic field vectors.

c) Both electric and magnetic field vectors are perpendicular to each other and perpendicular to the direction of propagation of wave.

d) These waves require any material medium for propagation.

29. Which of the following electromagnetic waves is used in medicine to destroy cancer cells?

(a) IR-rays
(b) Visible rays
(c) Gamma rays
(d) Ultraviolet rays

30. If a glass prism is dipped in water, what happens to its dispersive power?

a) No effect
b) Increases
c) Decreases
d) Cannot say

31. Which of the following wave doesn't show property of polarization

(a) Radio waves
(b) Transverse waves
(c) X-rays
d) Sound waves

32. In Cartesian sign convention, the distances are measured from the

a) object
b) pole of the mirror
c) focal point
d) image

33. An object is placed at 10 cm, in front of a concave mirror of radius of curvature 15 cm. What will be the position and magnification of the image.

a) -30cm, -3
b) -30, 3
c) 30, -3
d) 30, 3

34. The internal reflection occurs when

a) light travels from an optically denser medium to a rarer medium
b) light travels from an optically rarer medium to a denser medium
c) light travels from an optically denser medium to a denser medium
d) light travels from an optically rarer medium to a rarer medium

35. The SI unit for power of a lens is

a) diopter
b) meter
c) joule
d) no unit

36. Telescopes with mirror objectives are called ……..telescopes.

a) obstructing
b) chromatic
c) repulsive
d) reflecting

37. What is the cause of the blue color of the ocean?

a) Reflection
b) Refraction
c) Scattering of light by water molecules
d) Total internal reflection

38. Two Particles of different mass have the same momentum, what is the same for both particles,

a) Kinetic energy
b) De Broglie wavelength
c) Time period
d) Frequency

39. X-rays are deflected by

a) Magnetic field only
b) Electric field only
c) Electromagnetic field
d) None of the above

40. What is the de Broglie wavelength associated with an electron, accelerated through a potential difference of 100 volts?

a) 1.02nm
b) 1.22nm
c) 1.42nm
d) 1.30nm

41. In which of the following, emission of electrons does not take place?

(a) X-rays emission
(b) Photoelectric emission
(c) Secondary emission
d) Thermionic emission

42. Which of the following metals is not sensitive to visible light?

(a) Caesium
(b) Sodium
(c) Rubidium
(d) Cadmium

43. Balmer series lies in which spectrum?

a) Ultraviolet
b) Partially Visible
c) Infrared
d) Visible

44. The first model of the atom was proposed by

a) J.J Thompson
b) Neils Bohr
c) Albert Einstein
d) Ernest Rutherford

45. The ratio between bohr radii is

a) 1:2:3
b) 1:4:9
c) 2:4:6
d) 1:9:16

46. To explain the fine structure of the spectrum of hydrogen atom, we must consider:

a) A finite size of nucleus
b) The presence of neutrons in the nucleus
c) Spin angular momentum
d) Orbital angular momentum

47. Television signals are

a) Amplitude modulated
b) Frequency modulated
c) Phase modulated
d) Both frequency and amplitude modulated

48. The space waves that are seriously affected by the atmospheric conditions are known as:

a) VHF
b) HUF
c) MF
d) UHF

49. Which of the following is the purpose of the transmitter?

a) Converts signals to electric form
b) Operating the received signal
c) Converting the signal into a suitable form
d) Reduces noise from signals

50. Find the odd one out.

a) Radio
b) Telephone
c) Television
d) Computer networking

## PART – II

## SHORT ANSWER TYPE QUESTIONS

(Answer any 10 out of 13 questions) 10 x 5 marks each = 50 marks

51. Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field.

52. What are ohmic and non-ohmic resistors? Give two example of each?

53. A closely wound solenoid 180 cm long has 3 layers of windings of 200 turns each. The diameter of the solenoid is 3.8 cm. If the current carried is 10.0 A, estimate the magnitude of B inside the solenoid near its centre.

54. Write two characteristics of a material used for making permanent magnets.

55. What is the ratio of speed of gamma rays and radio waves in vacuum?

56. In a telescope the focal length of the objective and the eye piece are 160 cm and 15 cm respectively. What is its magnification power?

57. The stopping potential in an experiment on photoelectric effect is 0.5 V. What is the maximum kinetic energy of the photoelectrons emitted?

58. Write two characteristics of photons.

59. Why is photoelectric emission not possible at all frequencies?

60. Define the term LASER.

61. What are the limitations of Bohr's Atomic Model?

62. Explain the term 'attenuation' used in communication system.

63. Why does FM give noiseless reception.

## PART- III

## LONG ANSWER TYPE QUESTIONS

(Answer any 5 out of 8 questions) 5 x 10 marks each = 50 marks

64. State 'Gauss law' in electrostatics. Use this law to derive an expression for the electric field due to an infinitely long straight wire of linear charge density $\lambda$ /cm.

65. What is drift velocity? Derive expression for drift velocity of electrons in a good conductor in terms of relaxation time of electrons?

66. Using Ampere's circuital law, obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.

67. From a molecular viewpoint, discuss the temperature dependence of susceptibility for diamagnetism, paramagnetism and ferromagnetism.

68. A radio can tune in to any station in the 7.5 MHz to 12 MHz band. What is the corresponding wavelength band?

69. What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? Is the system a converging or a diverging lens? Ignore thickness of the lenses

70. What is the de Broglie wavelength of:

(a) a bullet of mass 0.040 kg travelling at the speed of 1.0 km/s,
(b) a ball of mass 0.060 kg moving at a speed of 1.0 m/s, and
(c) a dust particle of mass $1.0 \times 10^{-9}$ kg drifting with a speed of 2.2 m/s

71. Draw a block diagram of a simple amplitude modulation. Explain briefly how amplitude modulation is achieved.

## PART – IV

## ESSAY TYPE QUESTIONS

( Answer any 2 out of 4 questions ) 2 x 25 marks each = 50 marks

72. (a) Define electric dipole and dipole moment. An electric dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$?. Obtain the expression for the torque $\vec{\tau}$ experienced by the dipole.

(b) The intensity of a light pulse travelling along a communication channel decreases exponentially with distance x according to the relation $I=I_0e^{-\alpha x}$, where $I_0$ is the intensity at $x = 0$ and $\alpha$ is the attenuation constant. Show that the intensity reduces by 75 per cent after a distance of $(\log 4/\alpha)$

73. (a) Using Bohr's postulates of the atomic model, derive the expression for radius of $n^{th}$ electron orbit. Also obtain the expression for Bohr's radius.

b) The storage battery of a car has an emf of 12V. If the internal resistance of the battery is 0.4Ω, what is the maximum current that can be drawn from the battery?

74. (a) How is the generalized form of Ampere's circuital law obtained to include the term due to displacement current?

b) Name the following parts of the electromagnetic spectrums.

a. used in radar systems for aircraft navigation
b. used to treat muscular strain
c. used in hospitals for diagnosing diseases

Also, briefly describe how these waves can be produced.

75. (a) What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? Is the system a converging or a diverging lens? Ignore thickness of the lenses

b) Why photoelectric effect can not be explained on the basis of wave nature of light? Give reasons.

.....X.....