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Number

Part III — PHYSICS

(English Version)

Time Allowed : 3 Hours]

[Maximum Marks : 150

PART – I

N. B. : i)   Answer *all* the questions.

     ii)   Choose and write the correct answer.

     iii)   Each question carries *one* mark. $30 \times 1 = 30$

1. Joule's law of heating is

     a) $H = \dfrac{I^2}{R} t$ b) $H = V^2 Rt$

     c) $H = IR^2 t$ d) $H = VIt$.

2. Fuse wire is an alloy of

     a)   Lead and Tin   b)   Tin and Copper

     c)   Lead and Copper   d)   Lead and Iron.

3. Electromagnetic Induction is not used in

     a)   transformer   b)   room heater

     c)   AC generator   d)   choke coil.

4. Lenz's law is in accordance with the law of

     a)   conservation of charges   b)   conservation of flux

     c)   conservation of momentum   d)   conservation of energy.

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5. In a transformer, eddy current loss is minimised by using

   a) laminated core made of Mumetal

   b) laminated core made of stelloy

   c) shell type core

   d) thick copper wires.

6. The ratio of the radii of the first three Bohr orbits is

   a) $1 : \dfrac{1}{2} : \dfrac{1}{3}$ b) $1 : 2 : 3$

   c) $1 : 4 : 9$ d) $1 : 8 : 27$.

7. The first excitation potential energy or the minimum energy required to excite the atom from ground state of hydrogen atom is

   a) 13·6 eV   b) 10·2 eV

   c) 3·4 eV   d) 1·89 eV.

8. In hydrogen atom, which of the following transitions produces a spectral line of maximum wavelength ?

   a) $2 \rightarrow 1$ b) $4 \rightarrow 1$

   c) $6 \rightarrow 5$ d) $5 \rightarrow 2$.

9. If the minimum wavelength of X-rays produced from a Coolidge tube is 0·062 nm, then the potential difference between the cathode and target material is

   a) 2000 V   b) 20,000 V

   c) 2×10^5 V   d) 6.2×10^3 V.

10. The work function of a photo-electric material is 3·3 eV. The threshold frequency will be equal to

   a) 8×10^{14} Hz   b) 8×10^{10} Hz

   c) 5×10^{20} Hz   d) 4×10^{14} Hz.

11. The forbidden energy gap of silicon is of the order of

    a)   0·1 eV
    b)   0·3 eV
    c)   0·7 eV
    d)   1·1 eV.

12. An oscillator is

    a)   an amplifier with feedback

    b)   a converter of a.c. to d.c. energy

    c)   nothing but an amplifier

    d)   an amplifier without feedback.

13. Of the following, the donor atoms are

    a)   silicon and germanium
    b)   aluminium and gallium

    c)   bismuth and arsenic
    d)   boron and indium.

14. The audio frequency range is

    a)   20 Hz to 200000 Hz
    b)   20 Hz to 2000 Hz

    c)   20 Hz to 2000000 Hz
    d)   20 Hz to 20000 Hz.

15. Printed documents to be transmitted by fax are converted into electrical signals by the process of

    a)   reflection
    b)   scanning

    c)   modulation
    d)   light variation.

16. The unit of permittivity is

    a) $C^2 N^{-1} m^{-2}$
    b) $Nm^2 C^{-2}$

    c) Hm^{-1}
    d) $NC^{-2} m^{-2}$.

17. The work done in moving 500 μC charge between two points on equipotential surface is

    a)   zero
    b)   finite positive

    c)   finite negative
    d)   infinite.

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18. An electric dipole placed at an angle θ in a non-uniform electric field experience

   a) neither a force nor a torque

   b) torque only

   c) both force and torque

   d) force only.

19. A capacitor of capacitance 6 μF is connected to a 100 V battery. The energy stored in the capacitor is

   a) 30 J   b) 3 J

   c) 0·03 J   d) 0·06 J.

20. In the case of insulators, as the temperature decreases, the resistivity

   a) decreases   b) increases

   c) remains constant   d) becomes zero.

21. A power of 11,000 W is transmitted at 220 V. The current through line wires is

   a) 50 A   b) 5 A

   c) 500 A   d) 0·5 A.

22. Which of the following gives rise to continuous emission spectrum ?

   a) Electric filament lamp   b) Sodium vapour lamp

   c) Gases in the discharge tube   d) Calcium salt in bunsen flame.

23. When a drop of water is introduced between the glass plate and plano-convex lens in Newton's rings system, the ring system

   a) contracts

   b) expands

   c) remains same

   d) first expands, then contracts.

24. A light of wavelength 6000 Å is incident normally on a grating 0·005 m wide with 2500 lines. Then the maximum order is

 a) 3

 b) 2

 c) 1

 d) 4.

25. The transverse nature of light waves is demonstrated only by the phenomenon of

 a) interference

 b) diffraction

 c) polarisation

 d) reflection.

26. The particle which has zero mass but has energy, is

 a) electron

 b) photon

 c) proton

 d) neutron.

27. The nuclei $_{13}Al^{27}$ and $_{14}Si^{28}$ are example of

 a) isotopes

 b) isobars

 c) isotones

 d) isomers.

28. The mean life (τ) and half-life ($T_{1/2}$) of a radioactive element are related as

 a) $\tau = 2\, T_{1/2}$

 b) $\tau = \dfrac{T_{1/2}}{0.6931}$

 c) $\tau = 0.6931\, T_{1/2}$

 d) $\tau = \dfrac{T_{1/2}}{2}$.

29. A radioactive element $_{Z}X^{A}$ after emitting three α–particles and four β-particles is converted into an element Y represented as

 a) $_{Z-6}Y^{A-12}$

 b) $_{Z+2}Y^{A-12}$

 c) $_{Z-2}Y^{A-12}$

 d) $_{Z-10}Y^{A-12}$.

30. Which of the following is used to detect the presence of blocks in blood vessels ?

 a) $_{15}P^{31}$

 b) $_{15}P^{32}$

 c) $_{26}Fe^{59}$

 d) $_{11}Na^{24}$.

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PART – II

N. B. : Answer any *fifteen* questions.

$15 \times 3 = 45$

31. Three capacitors each of capacitance 9 pF are connected in series. What is the total capacitance of the combination ?

32. What is electrostatic shielding ?

33. The resistance of a nichrome wire at 0°C is 10 Ω. If its temperature of coefficient of resistance is 0·004/°C, find its resistance at boiling point of water.

34. Define Mobility. Write its unit.

35. State Kirchhoff's (i) current law, (ii) voltage law.

36. Define ampere in terms of force between two long parallel current carrying conductors.

37. An aircraft having a wingspan of 20·48 m flies due north at a speed of 40 ms^{-1}. If the vertical component of earth's magnetic field at the place is 2×10^{-5} T, calculate the e.m.f. induced between the ends of the wings.

38. What is electromagnetic induction ?

39. Two slits 0·3 mm apart are illuminated by light of wavelength 4500 Å. The screen is placed at 1 m distance from the slits. Find the separation between the second bright fringe on both sides of the central maximum.

40. Define specific rotation.

41. State Moseley's law. Write its equation.

42. Write any three medical applications of laser.

43. What are inertial and non-inertial frames ?

44. Define curie.

45. Write any three properties of neutron.

46. Draw the circuit configuration of *NPN* transistor in common collector (C.C.) mode.

47. What is Zener breakdown ?

48. A transistor is connected in *CE* configuration. The voltage drop across the load resistance (R_C) 3 kΩ is 6 V. Find the base current. The current gain α of the transistor is 0·97.

49. State de Morgan's theorems.

50. What is meant by skip distance ?

PART – III

N. B. :   i)   Answer Question No. **60** compulsorily.

        ii)   Answer any *six* of the remaining 11 questions.

        iii)   Draw diagrams wherever necessary. $7 \times 5 = 35$

51. Write the properties of electric lines of forces.

52. In Wheatstone bridge obtain the condition for bridge balance.

53. State Faraday's second law of electrolysis. How is it verified experimentally ?

54. Explain the conversion of a galvanometer into an ammeter.

55. Find the phase relation between current and voltage in an a.c. circuit containing a pure inductor. (Graph is not necessary)

56. A parallel beam of monochromatic light is allowed to incident normally on a plane transmission grating having 5000 lines per cm. A second order spectral line is found to be diffracted at an angle 30°. Calculate the wavelength of the light.

57. An α-particle is projected with an energy of 4 MeV directly towards a gold nucleus. Calculate the distance of its closest approach.

    Given :   Atomic number of gold = 79

                  Atomic number of α-particle = 2.

58. Write any 5 applications of photoelectric cells.

59. Explain Lorentz-FitzGerald contraction with an example.

60. Calculate the time required for 60% of a sample of radon to undergo decay.

    (Given $T_{1/2}$ of radon = 3·8 days)

OR

Show that the mass of radium $_{88}Ra^{226}$ with an activity of 1 curie is almost a gram. (Given $T_{1/2}$ = 1600 years)

(1 curie = $3·7 \times 10^{10}$ disintegrations per second).

61. Draw the frequency response curve of single stage *CE* amplifier and discuss the results.

62. What is an optical fibre ? Mention the advantages of fibre optical communication system.

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PART – IV

N. B. :   i)   Answer any *four* questions in detail.

      ii)   Draw diagrams wherever necessary. $4 \times 10 = 40$

63. Derive an expression for electric potential at a point due to an electric dipole. Discuss the special cases.

64. Deduce the relation for the Magnetic Induction at a point along the axis of a circular coil carrying current.

65. Explain in detail the principle, construction and working of a single phase a.c. generator.

66. What is Raman effect ? Explain Raman spectrum with diagram.

67. Obtain the expression for the radius of nth orbit of an electron based on Bohr's theory.

68. What are cosmic rays ? Explain the latitude effect of cosmic rays.

69. Draw the circuit diagram of Colpitts oscillator and explain its working.

70. Explain the analysis of amplitude modulated wave. Draw the plot of frequency spectrum.

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