5029

Register Number | | | | | | |

Part III — PHYSICS

(English Version)

Time Allowed : 3 Hours] [Maximum Marks : 150

PART – I

Note : i) Answer *all* the questions.

ii) Choose and write the correct answer. 30 × 1 = 30

1. Which of the following equations represents Biot-Savart law ?

a) $dB = \frac{\mu_0}{4\pi} \frac{I\,dl}{r^2}$

b) $\vec{dB} = \frac{\mu_0}{4\pi} \frac{I\,dl \sin\theta}{r^2}$

c) $\vec{dB} = \frac{\mu_0}{4\pi} \frac{I\,\vec{dl} \times \vec{r}}{r^2}$

d) $\vec{dB} = \frac{\mu_0}{4\pi} \frac{I\,\vec{dl} \times \vec{r}}{r^3}$

2. In a thermocouple, the temperature of the cold junction is 20°C, the neutral temperature is 270°C, the temperature of inversion is

a) 520°C

b) 540°C

c) 500°C

d) 510°C.

3. A coil of area of cross-section 0·5 m^2 with 10 turns is in a plane which is parallel to a uniform magnetic field of 0·2 Wb/m^2. The flux through the coil is

a) 100 Wb

b) 10 Wb

c) 1 Wb

d) zero.

4. Which of the following devices does not allow d.c. to pass through ?

a) Resistor

b) Capacitor

c) Inductor

d) All of these.

5. The part of the A.C. generator that passes the current from the coil to the external circuit is

a) field magnet
b) split rings
c) slip-rings
d) brushes.

6. In hydrogen atom the ratio of the radii of the first three Bohr orbits is

a) $1 : \frac{1}{2} : \frac{1}{3}$
b) 1 : 2 : 3
c) 1 : 4 : 9
d) 1 : 8 : 27.

7. In Sommerfeld atom model, for principal quantum number $n = 3$, which of the following subshells represents circular orbit ?

a) $3s$
b) $3p$
c) $3d$
d) None of these.

8. *X*-ray is

a) phenomenon of conversion of kinetic energy into radiation
b) conversion of momentum
c) conversion of energy into mass
d) principle of conservation of charge.

9. The chromium ions doped in the ruby rod

a) absorbs red light
b) absorbs green light
c) absorbs blue light
d) emits green light.

10. The photoelectric effect can be explained on the basis of

a) Corpuscular theory of light
b) Wave theory of light
c) Electromagnetic theory of light
d) Quantum theory of light.

11. The following arrangement performs the logic function of ..... gate.

a) AND
b) OR
c) NAND
d) EXOR.

12. In the pin configuration of IC 741, pin 3 represents

a) inverting input
b) non-inverting input
c) $-V_{cc}$
d) output.

13. The forbidden energy gap for conductors is

a) 0·7 eV
b) 1·1 eV
c) zero
d) 3 eV.

14. The principle used for the transmission of light signals through the optical fibre is

a) total internal reflection
b) refraction
c) diffraction
d) polarisation.

15. The RF channel in a radio transmitter produces

a) audio signals
b) high frequency carrier waves
c) both audio signal and high frequency carrier waves
d) low frequency carrier waves.

16. A hollow metal ball carrying an electric charge produces no electric field at points

a) outside the sphere
b) on its surface
c) inside the sphere
d) at a distance more than twice its radius.

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.

18. Three capacitors of capacitances 1 μF, 2 μF and 3 μF are connected in series. The effective capacitance of the capacitors is

a) 6 μF
b) $\frac{11}{6}$ μF
c) $\frac{6}{11}$ μF
d) $\frac{1}{6}$ μF.

19. An electric dipole of moment $\vec{p}$ is placed in a uniform electric field of intensity $\vec{E}$ at an angle θ with respect to the field. The direction of the torque is

a) along the direction of $\vec{p}$
b) opposite to the direction of $\vec{p}$
c) along the direction of $\vec{E}$
d) perpendicular to the plane containing $\vec{p}$ and $\vec{E}$.

20. If the length of a copper wire has a certain resistance R, then on doubling the length its specific resistance

a) will be doubled
b) will become $\frac{1}{4}$ th
c) will become four times
d) will remain the same.

21. The r.m.s. value of the alternating current (AC) flowing through a resistor is 5 A. Its peak value is

a) 3·536 A
b) 70·7 A
c) 7·07 A
d) 7 A.

22. If the wavelength of the light is reduced to one fourth, then the amount of scattering is

a) increased by 16 times
b) decreased by 16 times
c) increased by 256 times
d) decreased by 256 times.

23. The refractive index of the medium for the polarising angle 60° is

a) 1·732
b) 1·414
c) 1·5
d) 1·468.

24. In Raman effect, the incident photon makes collision with an excited molecule of the substance. The scattered photon gives rise to

a) Stokes' line b) anti-Stokes' line

c) Rayleigh line d) Zeeman line.

25. The refractive index of glass is 1·5. The velocity of light in glass is

a) 2×10^8 ms^{-1} b) $4{\cdot}5 \times 10^8$ ms^{-1}

c) 3×10^8 ms^{-1} d) $1{\cdot}33 \times 10^8$ ms^{-1}.

26. Electron microscope works on the principle of

a) photoelectric effect b) particle nature of electron

c) wave nature of moving electron d) dual nature of matter.

27. The explosion of atom bomb is based on the principle of

a) uncontrolled nuclear fission reaction

b) controlled nuclear fission reaction

c) nuclear fusion reaction

d) thermonuclear reaction.

28. Anaemia can be diagnosed by

a) ${}_{15}P^{31}$ b) ${}_{15}P^{32}$

c) ${}_{26}Fe^{59}$ d) ${}_{11}Na^{24}$.

29. In the nuclear reaction ${}_4Be^9 + X \rightarrow {}_6C^{12} + {}_0n^1$, X stands for

a) Proton b) α-particle (Alpha particle)

c) Electron d) Deuteron.

30. Which of the following belongs to Baryon group ?

a) Photon b) Electron

c) Pion d) Proton.

PART – II

Note : Answer any *fifteen* questions. $15 \times 3 = 45$

31. State Coulomb's law in electrostatics.

32. Why is it safer to be inside a car than standing under a tree during lightning ?

33. Define drift velocity.

34. State Ohm's law.

35. If $6{\cdot}25 \times 10^{18}$ electrons flow through a given cross-section of a conductor in unit time, find the current.

    [Given : Charge of an electron is $1{\cdot}6 \times 10^{-19}$ C]

36. What are the characteristics of heating element used in electric heating device ?

37. An e.m.f. of 5 V is induced when the current in the coil changes at the rate of 100 As^{-1}. Find the coefficient of self-induction of the coil.

38. State Fleming's right hand rule.

39. Define specific rotation.

40. Distinguish between Fresnel and Fraunhofer diffractions.

41. What are the characteristics of LASER ?

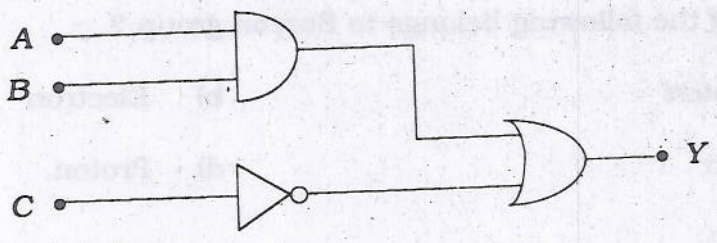
42. Find the minimum wavelength of *X*-rays produced by an *X*-ray tube operating at 1000 kV.

43. Write any three applications of photoelectric cells.

44. Tritium has a half-life of 12·5 years. What fraction of the sample will be left over after 25 years ?

45. Define Curie.

46. What is the Boolean expression for the logic diagram shown in figure. Evaluate its output if $A = 1$, $B = 1$ and $C = 1$.



47. When negative feedback is applied to an amplifier of gain 50, the gain after feedback falls to 25. Calculate the feedback ratio.

48. Draw energy band diagrams of *N*-type semiconductor and *P*-type semiconductor.

49. Give the Barkhausen condition for oscillations.

50. Define modulation factor.

PART – III

Note : i) Answer Question No. **56** 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 force.

52. Derive the condition for balancing of Wheatstone's bridge.

53. The effective resistances are 10 Ω and 2·4 Ω when two resistors are connected in series and in parallel. What are the resistances of individual resistors ?

54. Explain how you will convert a galvanometer into a voltmeter.

55. Explain any two applications of eddy current.

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

OR

In a Newton's rings experiment the diameter of the 20th dark ring was found to be 5·82 mm and that of the 10th ring 3·36 mm. If the radius of the plano-convex lens is 1 m, calculate the wavelength of light used.

57. Explain the spectral series of hydrogen atom. (Diagram not necessary)

58. Derive Einstein's photoelectric equation.

59. Explain length contraction on the basis of special theory of relativity.

60. The disintegration constant λ of a radioactive element is 0·00231 per day. Calculate its half-life and mean life.

61. State and prove De Morgan's theorems.

62. State the principle of Radar. What are the applications of Radar ?

PART – IV

Note : 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. Explain the special cases.

64. Obtain an expression for the magnetic induction at a point due to an infinitely long straight conductor carrying current.

65. Discuss with theory the method of inducing e.m.f. in a coil by changing its orientation with respect to the direction of the magnetic field.

66. Explain emission and absorption spectra.

67. Describe the J. J. Thomson method for determining the specific charge $\left(\frac{e}{m}\right)$ of an electron.

68. What are cosmic rays ?

Explain

i) latitude effect

ii) altitude effect

of cosmic rays.

69. What is rectification ? Explain the working of bridge rectifier with diagram. Draw input and output signals.

70. Explain the functional block diagram of a monochrome TV receiver.