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3027

Register 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. The forbidden energy gap for silicon is of the order of

   a) 0·7 eV b) 1·1 eV

   c) 0·3 eV d) 10 eV.

2. According to the laws of Boolean algebra, the expression ($A + AB$) is equal to

   a) A b) AB

   c) B d) $\overline{A}$.

3. An example for non-sinusoidal oscillator is

   a) Multivibrator b) RC oscillator

   c) Colpitts oscillator d) Crystal oscillator.

4. 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.

[Turn over

5. An FM signal has a resting frequency of 105 MHz and highest frequency of 105·03 MHz, when modulated by a signal. Then the carrier swing is

a) 0·03 MHz b) 0·06 MHz

c) 0·03 kHz d) 60 MHz.

6. According to special theory of relativity the only constant in all frames is

a) mass b) length

c) velocity of light d) time.

7. In β-decay,

a) atomic number decreases by one

b) mass number decreases by one

c) proton number remains the same

d) neutron number decreases by one.

8. In the nuclear reaction

$$_{80}Hg^{198} + X \rightarrow {}_{79}Au^{198} + {}_{1}H^{1},$$

X stands for

a) proton b) electron

c) neutron d) deuteron.

9. The half-life of a radioactive element is 300 days. The disintegration constant of the radioactive element is

a) 0·00231 day b) 0·00231 / day

c) 0·0231/day d) 0·0231 day.

10. The nuclear force is due to the continuous exchange of particles called

a) leptons b) hyperons

c) mesons d) photons.

11. The chromium ions doped in the ruby rod

a) absorbs red light b) absorbs green light

c) absorbs blue light d) emits green light.

12. In a discharge tube, the source of positive rays (canal rays) is

a) cathode

b) anode

c) gas atoms present in the discharge tube

d) fluorescent screen.

13. The minimum wavelength of *X*-rays produced in an *X*-ray tube at 1000 kV is

a) 0·0124 Å b) 0·124 Å

c) 1·24 Å d) 0·00124 Å.

14. The ionisation potential of hydrogen atom is

a) 13·6 eV b) – 13·6 eV

c) 13·6 V d) – 13·6 V.

15. At the threshold frequency, the velocity of the electrons is

a) zero b) minimum

c) maximum d) infinite.

16. In an A.C. circuit

a) the average value of current is zero

b) the average value of square of current is zero

c) the average power dissipation is zero

d) the rms current is $\sqrt{2}$ times of peak current.

17. In an electromagnetic wave the phase difference between electric field $\vec{E}$ and magnetic field $\vec{B}$ is

a) $\frac{\pi}{4}$ b) $\frac{\pi}{2}$

c) π d) zero.

18. A ray of light is incident on a glass surface such that the reflected ray is completely plane polarised. The angle between the reflected ray and the refracted ray is

a) 57·5° b) 32·5°

c) 90° d) 115°.

19. Soap bubbles exhibit brilliant colours in sunlight due to

a) scattering of light
b) diffraction of light
c) polarisation of light
d) interference of light.

20. The radii of Newton's dark rings are in the ratio

a) 1 : 2 : 3 : .....
b) $\sqrt{1} : \sqrt{2} : \sqrt{3}$: .....
c) $\sqrt{1} : \sqrt{3} : \sqrt{5}$: .....
d) 1 : 4 : 9 : ..... .

21. Of the following devices, which has small resistance ?

a) Voltmeter
b) Moving coil galvanometer
c) Ammeter of range 0 – 1 A
d) Ammeter of range 0 – 10 A.

22. The resistance of the filament of a 110 W, 220 V electric bulb is

a) 440 Ω
b) 220 Ω
c) 484 Ω
d) 848 Ω .

23. The self-inductance of a straight conductor is

a) zero
b) infinity
c) very large
d) very small.

24. A D.C. (direct currrent) of 5 A produces the same heating effect as an A.C. (alternating current) of

a) 50 A rms current
b) 5 A peak current
c) 15 A rms current
d) none of these.

25. Q-factor of a series resonant circuit

a) $Q = \frac{1}{L}\sqrt{\frac{R}{C}}$
b) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$
c) $Q = \frac{1}{R}\sqrt{\frac{C}{L}}$
d) $Q = \frac{1}{C}\sqrt{\frac{L}{R}}$.

26. Which of the following quantities is scalar ?

a) Dipole moment b) Electric force

c) Electric field d) Electric potential.

27. The unit of electric field intensity is

a) NC b) NC^{-1}

c) Vm d) NC^{-2}.

28. The magnitude of the force acting on a charge of 2×10^{-10} C placed in a uniform electric field of 10 Vm^{-1} is

a) 2×10^{-9} N b) 4×10^{-9} N

c) 2×10^{-10} N d) 4×10^{-10} N.

29. Electric potential energy (U) of two point charges is

a) $\frac{q_1 q_2}{4\pi \varepsilon_0 r^2}$ b) $\frac{q_1 q_2}{4\pi \varepsilon_0 r}$

c) $PE \cos \theta$ d) $PE \sin \theta$.

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

a) decreases b) increases

c) remains constant d) becomes zero.

PART – II

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

31. State Gauss' law.

32. What is a capacitor ? Define its capacitance.

33. Two wires of same material and length have resistances 5 Ω and 10 Ω respectively. Find the ratio of radii of the two wires.

34. State Kirchhoff's second law for electrical network.

35. Define mobility of electrons. Give its unit.

36. State Ampere's circuital law.

37. Calculate the mutual inductance between two coils when a current of 4 A changing to 8 A in 0·5 s in one coil, induces an *e.m.f.* of 50 mV in the other coil.

38. State Fleming's right hand rule.

39. A 300 mm long tube containing 60 c.c. of sugar solution produces a rotation of 9° when placed in a polarimeter. If the specific rotation is 60°, calculate the quantity of sugar contained in the solution.

40. Why is the centre of the Newton's ring dark ?

41. Calculate the longest wavelength of *X*-rays that can be analysed by a rock salt crystal of spacing $d = 2{\cdot}82$ Å in the first order.

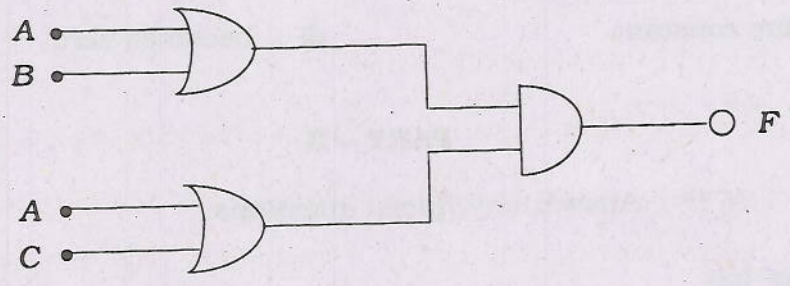
42. State Moseley's law.

43. What are the limitations of electron microscope ?

44. What is meant by breeder reactor ?

45. Mention any three properties of nuclear force.

46. Give the Boolean equation for the given logic diagram :



47. Draw the circuit for summing amplifier.

48. What is rectification ?

49. State de Morgan's theorems.

50. Mention the advantages of frequency modulation.

PART – III

N. B. : i) Answer Question No. **54** compulsorily.

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

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

51. Define electric potential at a point. Obtain an expression for electric potential due to a point charge.

52. A copper wire of 10^{-6} m^2 area of cross-section, carries a current of 2 A. If the number of electrons per cubic metre is 8×10^{28}, calculate the current density and average drift velocity.

(Given $e = 1{\cdot}6 \times 10^{-19}$ C).

53. Mention any five applications of superconductors.

54. A moving coil galvanometer of resistance 20 Ω produces full scale deflection for a current of 50 mA. How will you convert the galvanometer into (i) an ammeter of range 20 A and (ii) a voltmeter of range 120 V ?

OR

A circular coil of radius 20 cm has 100 turns of wire and it carries a current of 5 A. Find the magnetic induction at a point along its axis at a distance of 20 cm from the centre of the coil.

55. Explain how an e.m.f. can be induced by changing the area enclosed by the coil in a uniform magnetic field.

56. State and prove Brewster's law.

57. Explain the origin of characteristic *X*-rays.

58. What is photoelectric effect ? State the laws of photoelectric emission.

59. Derive an expression for the de Broglie wavelength of matter waves.

60. The binding energy per nucleon for ${}_6C^{12}$ nucleus is 7·68 MeV and that for ${}_6C^{13}$ is 7·47 MeV. Calculate the energy required to remove a neutron from ${}_6C^{13}$ nucleus.

61. Explain the working of a half wave diode rectifier.

62. With the help of block diagram, explain the operation of an FM superheterodyne receiver.

PART – IV

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

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

63. What is an electric dipole ? Derive an expression for the electric field due to an electric dipole at a point on its axial line.

64. Deduce an expression for the force on a current carrying conductor placed in a magnetic field. Find the magnitude of the force.

65. What are eddy currents ? Explain their applications. How are they minimised ?

66. Derive an expression for bandwidth of interference fringes in Young's double slit experiment.

67. Draw a neat sketch of Ruby Laser. Explain its working with the help of energy level diagram.

68. Discuss the principle and action of a Bainbridge mass spectrometer to determine the isotopic masses.

69. What is meant by feedback ? Derive an expression for voltage gain of an amplifier with negative feedback.

70. Make an analysis of amplitude modulated wave. Plot the frequency spectrum.