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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.

$30 \times 1 = 30$

- In a thermocouple, the temperature of the cold junction is 20°C , the inversion temperature is 600°C , then the neutral temperature is
 - 310°C
 - 320°C
 - 300°C
 - 315°C .
- In a tangent galvanometer a current 1 A, produces a deflection of 30° . The current required to produce a deflection of 60° is
 - 3 A
 - 2 A
 - $\sqrt{3}$ A
 - $\frac{1}{\sqrt{3}}$ A.
- The generator rule is
 - Fleming's left hand rule
 - Fleming's right hand rule
 - Maxwell's right hand corkscrew rule
 - Right hand palm rule.

[Turn over

4. The power loss is less in transmission line when
- voltage is less but current is more
 - both voltage and current are more
 - voltage is more but current is less
 - both voltage and current are less.
5. In an a.c. circuit, the current $I = I_0 \sin \left(\omega t - \frac{\pi}{2} \right)$ lags behind the *e.m.f.*
- $e = E_0 \sin \left(\omega t + \frac{\pi}{2} \right)$ by
- 0
 - $\frac{\pi}{4}$
 - $\frac{\pi}{2}$
 - π .
6. In Sommerfeld atom model, for a given value of n , the number of values l can take is
- n
 - $n + 1$
 - $n - 1$
 - $2n + 1$.
7. The ratio of areas enclosed by first three Bohr orbits of hydrogen atom is
- 1 : 2 : 3
 - 1 : 8 : 27
 - 1 : 4 : 9
 - 1 : 16 : 81.
8. In hydrogen atom, which of the following transitions produces spectral line of maximum wavelength ?
- 2 → 1
 - 3 → 2
 - 4 → 3
 - 5 → 4.
9. In holography, which of the following is (are) recorded on the photographic film ?
- Frequency and amplitude
 - Phase and frequency
 - Phase and amplitude
 - Frequency only.

10. At the threshold frequency, the velocity of the photoelectrons is

- a) maximum
- b) minimum
- c) infinity
- d) zero.

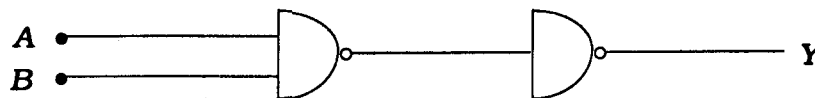
11. The forbidden energy gap for silicon is of the order of

- a) 0.7 eV
- b) 0.4 eV
- c) 1.1 eV
- d) 10 eV.

12. In CE single stage amplifier, the voltage gain at mid-frequency is 10. The voltage gain at upper cut-off frequency is

- a) 10
- b) 14.14
- c) 7.07
- d) 20.

13. The following arrangement performs the logic function of



- a) AND gate
- b) OR gate
- c) NAND gate
- d) EX-OR gate.

14. The radiowaves after refraction from different parts of ionosphere on reaching the earth are called as

- a) ground waves
- b) sky waves
- c) space waves
- d) microwaves.

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

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

16. The unit of electric field intensity is

- a) NC^{-2}
- b) NC
- c) Vm^{-1}
- d) Vm.

17. Four charges $+q, +q, -q$ and $-q$ respectively are placed at the corners A, B, C and D of a square of side a . The electric potential at the centre O of the square is
- a) $\frac{1}{4\pi\epsilon_0} \frac{q}{a}$ b) $\frac{1}{4\pi\epsilon_0} \frac{2q}{a}$
 c) $\frac{1}{4\pi\epsilon_0} \frac{4q}{a}$ d) zero.
18. The value of permittivity of free space is
- a) $8.854 \times 10^{12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ b) $9 \times 10^9 \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
 c) $\frac{1}{9 \times 10^9} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ d) $\frac{1}{4\pi \times 9 \times 10^9} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$.
19. The principle used in lightning conductors is
- a) corona discharge b) mutual induction
 c) self-induction d) electromagnetic induction.
20. A copper wire has a resistance R . On doubling its length, the specific resistance
- a) will be doubled b) will be halved
 c) will become four times d) will remain the same.
21. In a step-up transformer the input voltage is 220 V and the output voltage is 11 kV. The ratio of number of turns of primary to secondary is
- a) 50 : 1 b) 1 : 50
 c) 25 : 1 d) 1 : 25.
22. Which one of the following is not an electromagnetic wave ?
- a) X-rays b) γ -rays
 c) U - V rays d) β -rays.
23. If C is the velocity of light in vacuum, the velocity of light in a medium with refractive index μ is
- a) μC b) $\frac{C}{\mu}$
 c) $\frac{\mu}{C}$ d) $\frac{1}{\mu C}$.

24. A ray of light passes from a denser medium into a rarer medium. For an angle of incidence of 45° , the refracted ray grazes the surface of separation of the two media. The refractive index of the denser medium is
- a) $\frac{3}{2}$ b) $\frac{1}{\sqrt{2}}$
c) $\sqrt{2}$ d) 2.
25. Of the following, which one is a uniaxial crystal ?
- a) Mica b) Aragonite
c) Topaz d) Quartz.
26. According to special theory of relativity the only constant in all frames is
- a) mass b) length
c) time d) velocity of light.
27. The value of 1 amu is
- a) 931 eV b) mass of carbon atom
c) mass of one proton d) 1.66×10^{-27} kg.
28. The penetrating power is maximum for
- a) α -particles b) β -particles
c) gamma rays d) protons.
29. In the following nuclear reaction,
$${}_{13}\text{Al}^{27} + {}_2\text{He}^4 \rightarrow X + {}_0\text{n}^1$$

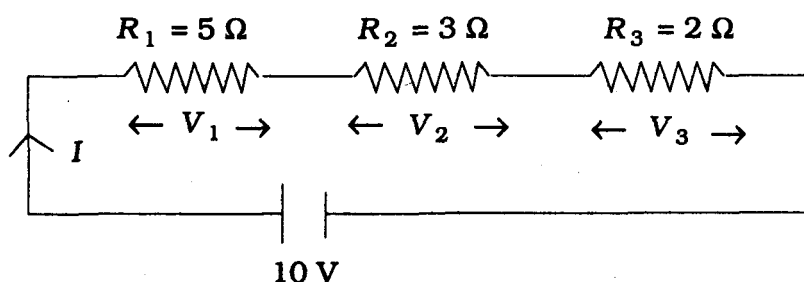
the element X is
- a) ${}_{15}\text{Si}^{30}$ b) ${}_{15}\text{P}^{30}$
c) ${}_{15}\text{S}^{30}$ d) ${}_{15}\text{Si}^{29}$.
30. Based on quark model, a neutron is represented as
- a) uud b) udd
c) udd' d) u' du.

PART - II

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

15 × 3 = 45

31. State Gauss' law in electrostatics.
32. What is meant by electric polarisation ?
33. Define mobility of electrons. Give its unit.
34. Write any three applications of superconductors.
35. Three resistors are connected in series with 10 V supply as shown in the figure. Find the voltage drop across each resistor.



36. Mention the limitations of cyclotron.
37. Define quality factor.
38. The wings of an aeroplane are 10 m apart. The plane is moving horizontally towards the north at a place where the vertical component of earth's magnetic field is 3×10^{-5} T. Calculate the induced e.m.f. set up between the tips of the wings if the velocity of the aeroplane is 720 km/hr.
39. What is band emission spectrum ? Give an example.
40. A light of wavelength 6000 Å falls normally on a thin air film. 6 dark fringes are seen between two points. Calculate the thickness of the air film.
41. What are the characteristics of Laser ?
42. Rydberg constant for hydrogen atom is $1.097 \times 10^7 \text{ m}^{-1}$. Calculate the shortest wavelength of the spectral line of its Lyman series.
43. What are inertial and non-inertial frames of reference ?
44. Write any three conclusions obtained from Binding energy curve.
45. Define curie.
46. Draw the circuit diagram for NPN transistor at Common Emitter (CE) mode.

47. What is Zener breakdown ?
48. The voltage gain of an amplifier without feedback is 100. If negative feedback is applied with a feedback fraction $\beta = 0.1$, calculate the voltage gain after feedback.
49. Mention any three advantages of Integrated Circuit (IC).
50. What is Fax ? Mention its use.

PART - III

- N. B. : i) Answer the Question No. 60 compulsorily.
 ii) Answer any six of the remaining 11 questions,
 iii) Draw diagrams wherever necessary.

7 × 5 = 35

51. Three capacitors each of capacitance 9 pf are connected in series. (i) What is the total capacitance of the combination ? (ii) What is the potential difference across each capacitor, if the combination is connected to 120 V supply ?
52. If two or more resistors are connected in parallel, derive an expression for the effective resistance.
53. Obtain the condition for bridge balance in Wheatstone's bridge.
54. 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. What are the different energy losses in a transformer ? How can they be minimised ?
56. State and prove Brewster's law.
57. Describe Laue experiment. What are the facts established by it ?
58. Write any five applications of photoelectric cells.
59. Derive an expression for de Broglie wavelength of matter waves.
60. Show that the mass of radium (${}_{88}\text{Ra}^{226}$) with an activity of 1 curie is almost a gram.
 (Given $T_{1/2} = 1600$ yrs, 1 curie = 3.7×10^{10} disintegrations per second)

OR

B

[Turn over

Calculate the mass of coal required to produce the same energy as that produced by the fission of 1 kg of U^{235} .

(Given : heat of combustion of coal = $33.6 \times 10^6 \text{ Jkg}^{-1}$.

Energy per fission of $U^{235} = 200 \text{ MeV}$.

1 eV = $1.6 \times 10^{-19} \text{ J}$. Avogadro number $N = 6.023 \times 10^{23}$)

61. State and prove De Morgan's theorems.
62. Explain space wave propagation of radiowaves.

PART - IV

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

ii) Draw diagrams wherever necessary.

4 × 10 = 40

63. Derive an expression for the electric potential at a point due to an electric dipole. Discuss the special cases.
64. Define Ampere's circuital law. Applying it, find the magnetic induction due to a long solenoid carrying current.
65. In an a.c. circuit containing a capacitor, the instantaneous *e.m.f.* is $e = E_0 \sin \omega t$. Obtain the expression for instantaneous current. Explain the phase relation between *e.m.f.* and current by graph.
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. Explain the principle and action of a Bainbridge Mass spectrometer in determining the isotopic masses.
69. With the circuit diagram explain the construction and working of a Colpitts oscillator.
70. Make an analysis of amplitude modulated wave. Plot the frequency spectrum,