**Instructions :**

1. There are **4** Sections and total **60** questions in this question paper.
2. Symbols used in this question paper have their usual meanings.
3. Log table or simple electronic calculator can be used.
4. Write new Section on a new page.

$$\boxed{\textbf{S E C T I O N A}}$$

● **Questions 1 to 16 are multi - choice questions. Choose the correct option. Each question is of ONE mark.**   **16**

1. What is electric force of repulsion in newton between two electrons kept 1 cm apart ?
   (a) 2.3×10^{-19} (b) 2.3×10^{-24} (c) 2.3×10^{-20} (d) 2.3×10^{-9}

2. The electric potential inside a hollow charged sphere is
   (a) constant.
   (b) directly proportional to the distance from the centre of the sphere.
   (c) inversely proportional to the distance from the centre of the sphere.
   (d) inversely proportional to the square of the distance from the centre of the sphere.

3. The S I unit of electric flux is
   (a) $V\,m^{-1}$ (b) $\dfrac{N\,m}{C^2}$ (c) $\dfrac{N\,m^2}{C}$ (d) $V\,m^2$

4. A wire of resistance R is cut into n equal parts. These parts are then connected in parallel. The equivalent resistance of the combination is
   (a) $n\,R$ (b) $\dfrac{R}{n}$ (c) $\dfrac{n}{R}$ (d) $\dfrac{R}{n^2}$

5. To send 10 % of the main current through a moving coil galvanometer of resistance 99 ohm, the shunt required is
   (a) 10 ohm   (b) 9.9 ohm   (c) 9 ohm   (d) 11 ohm

6. Relative permeability of one substance is 0.075. Its magnetic susceptibility is
   (a) 0.925   (b) - 0.925   (c) 1.075   (d) - 1.075

7. For a L, C, R connected in series with an A. C. source, L = 1 H, C = 20 μF and R = 6 Ω, calculate Q factor.
   (a) 3.72   (b) 0.372   (c) 37.2   (d) 2.37

8. The self induced emf produced in a coil for a unit rate of change of current is equal to
   (a) the thickness of the coil.   (b) number of turns of the coil.
   (c) self inductance of the coil.   (d) magnetic flux linked with the coil.

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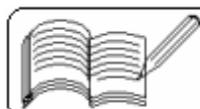
9. In case of electro - magnetic waves, which one of the following has average value zero over one period ?
(a) electric energy   (b) magnetic energy   (c) electric field   (d) magnetic field

10. The angle of a prism is 60° and refractive index of its material is 1.5. There will be no emergent light, if the angle of incidence on the first face is
(a) equal to 30°   (b) equal to 60°   (c) less than 27°   (d) more than 30°

11. Waves which cannot be polarized are
(a) electro - magnetic waves   (b) light waves
(c) longitudinal waves   (d) transverse waves.

12. Cathode - rays are
(a) atoms moving towards cathode   (b) electro - magnetic waves
(c) negative ions moving from anode to cathode
(d) electrons emitted from cathode to anode

13. What will be the area covered by the transmitter, if height of the T. V. transmitter is doubled ?
(a) will be doubled   (b) will become four times
(c) will become three times   (d) will not change

14. Which kind of communication is there by a Modem ?
(a) simplex   (b) full duplex   (c) half duplex   (d) double duplex

15. Which semi - conductor device is to be forward biased in order to operate it ?
(a) Photo diode   (b) Zenner diode
(c) Varactor diode   (d) Light Emitting Diode (LED)

16. Which of the following is conserved in nuclear processes ?
(a) only mass   (b) only energy
(c) only momentum   (d) mass, energy and momentum

S E C T I O N B

● **Questions 17 to 32 are very short questions, each carrying ONE mark. 16**

17. What is the net force on an electric dipole placed in a uniform electric field ?

18. If 50 μJ of work is required to carry a 2 μC charge from point R to S, what is the potential difference between these points ? Which point is at a higher potential ?   **OR**

We know that electric field is discontinuous across the surface of a charged conductor. Is electric potential also discontinuous there ?
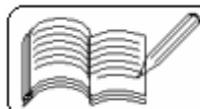
19. Define chemical equivalent.

20. Which of the three has lowest resistance - Ammeter, Voltmeter, Galvanometer ?

21. What is Magnetic Dip Angle ?   **OR**
    What is the value of dip angle at the magnetic poles of earth ?

22. A transformer has 50 turns in the primary and 100 in the secondary. If the primary is connected to a 220 V D. C. supply, what will be the voltage across the secondary ?

23. What is the value of power factor at resonance in LCR series circuit ?

24. A wire kept along north - south is allowed to fall freely. Will an induced emf be set up ? Why ?

25. Which part of the electromagnetic spectrum has the largest penetrating power ? **OR**
    If the earth did not have an atmosphere, would its average surface temperature be higher or lower than what it is now ? Why ?

26. A glass convex lens is held in water. What would be the change in the focal length ?

27. How can you increase magnifying power of a telescope ?

28. Write Huygen's Principle.   **OR**
    What is called unpolarized light ?

29. What is threshold frequency in photo - electric effect ?   **OR**
    Write de - Broglie's hypothesis.

30. In which region in hydrogen spectra, Balmer series lies ?

31. Give circuit symbol of P - N junction diode.

32. What is called modulation ?
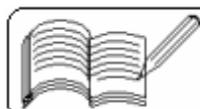
S E C T I O N   C

- **Questions 33 to 48 are short answer type questions, each carrying TWO marks.**   **32**

33. **Write Coulomb's law for stationary charges and explain its vector form.**

34. **Obtain formula for capacitance of a parallel plate capacitor**   **OR**
    Obtain formula for equivalent capacitance in parallel combination of capacitors.

35. **Explain Meissner's effect with necessary diagram.**   **OR**
    What is a potentiometer ? Discuss its principle with necessary circuit.

36. **Explain Peltier effect.**

37. **Write and explain Ampere's Circuital law.**

38. **Draw LCR series A. C. circuit and derive differential equation for charge in it.**   **OR**
    A. C. voltage is given as $V = V_m \cos \omega t$. Obtain formula for rms value of voltage.

39. **What is self - inductance ? Define self - inductance and write its unit.**

40. **Explain inductive and radiated components of electro - magnetic waves.**   **OR**
    Write any four characteristics of electro - magnetic waves.

41. **Explain total internal reflection and derive formula showing relation between refractive index and critical angle.**

42. **Explain magnification due to a mirror with ray diagram and derive formula for it.**

43. **Explain polarization by reflection. Also explain σ components and π components.**

44. **Write Einstein's explanation of photoelectric effect.**

45. **Using $\dfrac{dN}{dt} = -\lambda n$, obtain the exponential law of radioactive decay and draw the decay curve.**

46. **Write a note on emission and absorption spectra.**
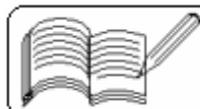
47. Write a note on simplex and full duplex communication.

48. Explain half - wave rectifier with necessary circuit.

$$\boxed{\textbf{S E C T I O N D}}$$

- **Answer the questions 49 to 60 as directed, each carrying THREE marks.**

36

49. A circle having radius a has linear charge distribution over its circumference having linear charge density $\lambda = \lambda_0 \cos^2 \theta$. Calculate the total electric charge residing on the circumference of the circle.

$$\left[\text{Hint :} \int_0^{2\pi} \cos^2\theta \, d\theta = \pi \right].$$

50. An electron is moving on a circular path of radius 5.3×10^{-11} m with a constant speed 2.2×10^6 m/s. Calculate its frequency and the electric current formed due to it.

OR

The tungsten filament of a bulb has resistance equal to 18 Ω at 20° C temperature. Current equal to 0.185 A flows when 30 V supply is connected to it. If $\alpha = 4.5 \times 10^{-3}$ K^{-1} for tungsten, then find the temperature of the filament.

51. A current of 0.3 A is passed through an electro - chemical cell containing $AgNO_3$ solution for 15 minutes. 3.02×10^{-4} Kg of silver is deposited on the cathode. Find the atomic mass of silver. Faraday constant = 96500 C / mole. Valency of silver = 1.

52. A 3 C charge passes with a velocity of 50 $\hat{j}$ m/s through a region having a uniform magnetic field 2 $\hat{k}$ T and some uniform electric field. If the Lorentz force acting on it is 330 $\hat{i}$ N, find the electric field in this region.

OR

Write the equation of magnetic force acting on a particle moving through a magnetic field. Using it, obtain Newton's equation of motion and show that the kinetic energy of the particle remains constant with time.
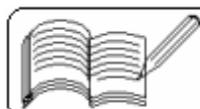
53. The work for rotating a magnet with dipole moment M, by 90° from its magnetic meridian is n times the work to rotate it by 60°. Find the value of n.

54. A coil having 200 turns has a surface area 0.12 m^2. A magnetic field of strength 0.10 Wb / m^2 linked perpendicular to this area changes to 0.5 Wb / m^2 in 0.2 sec. Find the average emf induced in the coil.

55. A real image formed by a concave mirror is four times the object size. If object is taken 3 cm away, the image is 3 times enlarged. Calculate the focal length of the mirror.

OR

When a ray enters from air to another medium, it is partially refracted and partially reflected if the refracted and reflected rays are perpendicular to each other and angle of incidence is 60°. Calculate refractive index of the medium.

56. An electric bulb of 100 W converts 3 % of electrical energy into light energy. If the wave - length of light emitted is 6625 A°, find the number of photons emitted in 1 sec. [h = 6.625 x 10^{-34} Js.].

57. Half - life of a radioactive element is 0.693 s. How much time will it take for the decay of 80 % of this substance ?

OR

Mass of a $_{17}Cl^{35}$ nucleus is 34.9800 u. If mass of a proton is 1.00783 u and neutron is 1.00866 u, then find the binding energy of $_{17}Cl^{35}$ nucleus. Take 1 u = 931 MeV.

58. Calculate the wave - length and energy in eV of a photon emitted when in a hydrogen atom an electron makes a transition from the third excited state to the ground state. Rydberg constant = 1.097 x 10^7 m^{-1}. c = 3 x 10^8 m/s, h = 6.62 x 10^{-34} Js.

59. There are 6 x 10^{19} electrons per cubic metre of pure semi - conductor. What will be the number of holes for this semi - conductor of dimensions 1 cm x 1 cm x 2 cm.

60. The A. C. current gain of a PNP common emitter circuit is equal to 100. The value of the input resistance is equal to 1 kΩ. . What should be the value of the load resistance R$_L$ in order to obtain power gain of 2000 ?