



Time: 3 Hours

Total Marks: 70

**General instructions:**

- The question paper is divided into four sections.
- Section A:** Q.No.1 contains Ten multiple choice type of questions carrying **One mark** each.  
Q. No.2 contains Eight very short answer type of questions carrying **One mark** each.
- Section B:** Q.No.3 to Q. No. 14 contains Twelve short answer type of questions carrying **Two marks** each. (Attempt any Eight).
- Section C:** Q.No.15 to Q. No. 26 contains Twelve short answer type of questions carrying **Three marks** each. (Attempt any Eight).
- Section D:** Q.No.27 to Q. No. 31 contains Five long answer type of questions carrying **Four marks** each. (Attempt any Three).
- Use of log table is allowed. Use of calculator is not allowed.
- Figures to the right indicate full marks.
- For each MCQ, correct answer must be written along with its alphabet.  
e.g., (a)...../ (b).... / (c).... / (d)..... Only first attempt will be considered for evaluation.
- Physical constants:
  - The quantity  $\left(\frac{1}{4\pi\epsilon_0}\right) = 9 \times 10^9$ ,
  - Permeability of free space  $(\mu_0) = 4\pi \times 10^{-7}$  H/m
  - Velocity of sound in air =  $340 \text{ ms}^{-1}$

**SECTION A****Q.1. Select and write the correct answer:****[10]**

- Sensitivity of a potentiometer is increased by
  - increasing the emf of the cell.
  - increasing the length of potentiometer wire.
  - decreasing the length of potentiometer wire.
  - none of these
- A thin ring has mass 0.25 kg and radius 0.5 m. Its M.I. about an axis passing through its centre and perpendicular to its plane is \_\_\_\_\_.
  - $0.0625 \text{ kg m}^2$
  - $0.625 \text{ kg m}^2$
  - $6.25 \text{ kg m}^2$
  - $62.5 \text{ kg m}^2$
- A wire of length 2 m is moving with a velocity of 1 m/s normal to a magnetic field of  $0.5 \text{ Wb/m}^2$ . The e.m.f induced in it will be
  - 0.5 V
  - 0.1 V
  - 2 V
  - 1 V
- The magnetic field inside a long solenoid is
  - non uniform
  - zero
  - uniform
  - infinity
- In a BJT, largest current flow occurs
  - in the emitter
  - in the collector
  - in the base
  - through CB junction
- Heat energy is incident on the surface at the rate of 500 J/min. If coefficient of absorption is 0.6 and coefficient of reflection is 0.2 then heat energy transmitted by the surface in 5 minutes is
  - 150 J
  - 500 J
  - 350 J
  - 100 J
- Which of the following is NOT the property of equipotential surfaces?
  - They do not intersect each other.
  - They are concentric spheres for uniform electric field.
  - Potential at all points on the surface has constant value.
  - Separation of equipotential surfaces increases with decrease in electric field.



- viii. In LCR series circuit, at resonance, the power factor is \_\_\_\_\_  
(A) Zero (B) 0.5 (C) 1 (D)  $\infty$
- ix. Chemical properties of an atom are decided by  
(A) number of nucleons. (B) number of neutrons.  
(C) number of electrons. (D) number of electrons, protons and neutrons.
- x. Which of the following statement is not related to photon?  
(A) Its energy does not depend on frequency. (B) Its energy depends on frequency.  
(C) It moves always with the velocity light. (D) Its wave is electromagnetic.

**Q.2. Answer the following:****[8]**

- i. What does the negative sign indicate in Lenz's law?
- ii. Define the beat frequency.
- iii. If the radius of third Bohr's orbit in Hydrogen atom is  $47.7 \times 10^{-11}$  m. What will be the radius of the first Bohr's orbit?
- iv. What will be the direction of angular displacement and angular velocity, if angular acceleration is constant and is along the axis of rotation?
- v. In a common-base connection, a certain transistor has an emitter current of 10 mA and collector current of 9.8 mA. Calculate the value of the base current.
- vi. A straight conductor 2 m long carrying a current of 15 A is kept at right angles to a uniform magnetic field of induction  $5 \times 10^{-3}$  Wb/m<sup>2</sup>. What is the force acting upon it?
- vii. Mention the conditions under which a real gas obeys ideal gas equation.
- viii. How can a galvanometer be converted into an ammeter?

**SECTION B (Attempt any Eight)****[16]**

- Q.3. A needle of a sewing machine moves along a path of amplitude 4 cm with frequency 5 Hz. Find its acceleration  $\frac{1}{30}$  s after it has crossed the mean position.
- Q.4. Distinguish between conductors and insulators.
- Q.5. Explain the term gauge pressure.
- Q.6. Determine the adiabatic ratio in terms of degrees of freedom for a polyatomic gas.
- Q.7. Find the reactance of a coil of inductance 100 mH at a frequency 50 Hz and 1000 Hz.
- Q.8. A uniform disc and a hollow right circular cone have the same formula for their M.I., when rotating about their central axes. Why is it so?
- Q.9. The number of waves in 6 cm of vacuum is same as the number of waves in x cm of a medium. If the refractive index of the medium is  $\frac{3}{2}$ , find x.
- Q.10. Derive an expression for the total emf induced in a conducting rotating rod.
- Q.11. State Merits of Rutherford's model.
- Q.12. Two sound waves travel at a speed of 330 m/s. If their frequencies are also identical and are equal to 540 Hz, what will be the phase difference between the waves at points 3.5 m from one source and 3 m from the other if the sources are in phase?
- Q.13. Derive an expression for magnitude of magnetic dipole moment of a revolving electron.
- Q.14. Draw a neat diagram of a full wave rectifier



**SECTION C (Attempt any Eight)**

**[24]**

- Q.15. An air column is of length 17 cm long. Calculate the frequency of 5<sup>th</sup> overtone if the air column is
- closed at one end and
  - open at both ends.
- Q.16. Derive an expression for maximum possible speed for a vehicle to move on horizontal unbanked road.
- Q.17. Obtain an expression for power consumed in a LCR series circuit.
- Q.18. Derive the relation between surface tension and surface energy per unit area.
- Q.19. Prove that under certain conditions a magnet vibrating in uniform magnetic field performs angular S.H.M.
- Q.20. State Curie law for paramagnetic material. Using the law, derive relation between magnetic susceptibility and temperature.
- Q.21. State and explain law of equipartition of energy.
- Q.22. Derive Malus' law.
- Q.23. What are the conditions for system to be in:
- Mechanical equilibrium
  - Chemical equilibrium
  - Thermal equilibrium
- Q.24.
- Prove that nuclear density for all the nuclei is same.
  - Why is it necessary to connect a high resistance in series with a LED?
- Q.25. Find the potential midway between two point charges  $2 \times 10^{-9}$  C and  $5 \times 10^{-9}$  C, 0.2 m apart. How much work must be done in placing a third charge  $4 \times 10^{-9}$  C at that point?
- Q.26. State and explain Faraday's laws of electromagnetic induction.

**SECTION D (Attempt any Three)**

**[12]**

- Q.27.
- Why does the speed of a liquid increase and its pressure decrease when a liquid passes through constriction in a horizontal pipe?
  - State the merits of Huygens' wave theory of light.
- Q.28.
- Explain: Kirchhoff's voltage law is based on the law of conservation of energy.
  - The current of 1 A is flowing through an external resistance of  $10 \Omega$  when it is connected to the terminals of a cell. This current reduces to 0.5 A when the external resistance is  $25 \Omega$ . Find the internal resistance of the cell.
- Q.29. Describe Davisson and Germer experiment
- Q.30.
- Explain how 1 ampere is defined using concept of force between two long parallel current carrying wires.
  - Two parallel wires are 2 cm apart and carry currents of 30 A and 40 A in the same direction. Find the approximate total force they exert on each other, if the length of each is 10 cm.
- Q.31. Draw a p-V diagram and explain the concept of positive and negative work. Give one example each.

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