Chapter wise Theoretical Important Questions in Physics for Class-XII

Electrostatics-

1. Derive an expression for the electric field at a point on the axial position of an electric dipole.
2. Derive an expression for the electric field at a point on the equatorial position of an electric dipole.
3. Derive an expression for the energy stored in a capacitor. Show that whenever two conductors share charges by bringing them into electrical contact, there is a loss of energy.
4. Derive an expression for the effective capacitance when capacitors are connected in (a) series and (b) parallel
5. Explain the principle of a capacitor and derive an expression for the capacitance of a parallel plate capacitor.
6. State Gauss theorem and apply it to find the electric field at a point due to (a) a line of charge (b) A plane sheet of charge (c) A Charged spherical conducting shell
7. State Coulomb's law and express it in vector form. Derive it using Gauss theorem.
8. Derive an expression for the torque on an electric dipole in a uniform electric field.
9. Derive an expression for the work done in rotating an electric dipole in a uniform electric field
10. Derive an expression for the energy stored (Potential Energy) in a dipole in a uniform electric field. Hence explain stable and unstable equilibrium.
11. Derive an expression for the electric potential at a point due to an electric dipole. Mention the contrasting feature of electric potential of a dipole at a point as compared to that due to a single charge.
12. Derive an expression for the electrostatic potential energy of a system of point charges
13. Derive an expression for the capacitance of a parallel plate capacitor with (a) a dielectric slab (b) a metallic plate in between the plates of the capacitor.
14. Define electric potential at a point. Derive an expression for the electric potential at a point due to (a) a point charge (b) a system of point charges (c) a dipole.
15. Show that the work done in an electric field is independent of path.
16. What are dielectrics? Distinguish polar and non polar dielectrics. Define the term Polarization vector.

Current Electricity-

1. Define drift velocity and derive an expression for it.
2. Derive the expression $I = nAev_{d.}$ (Symbols have their usual meaning)
3. Deduce Ohm's law from elementary ideas and hence write an expression for resistance and resistivity.
4. Derive an expression for conductivity in terms of mobility
5. Explain the color coding of carbon resistors.
6. Derive an expression for the current in a circuit with external resistance R when (a) n identical cells of emf E and internal resistance r are connected in series (b) m identical cells are connected in parallel
7. State and explain Kirchhoff's laws.

8. State and explain the principle of Wheat Stone's principle. Deduce it using Kirchhoff's laws.
9. Describe how you will determine the resistance of a given wire using Meter Bridge.
10. Explain the principle of a potentiometer. Describe how will you determine (a) the ratio of emfs of two primary cells using potentiometer. (b) The internal resistance of a primary cell using potentiometer.
11. Explain the variation of resistance and resistivity with temperature and hence define temperature coefficient of resistance and resistivity.

Magnetic Effect of Current and Magnetism

1. State Biot- Savart law and apply it to find the magnetic field due to a circular loop carrying current at a point (a) at its centre (b) on the axis
2. State Ampere's circuital law and apply it to find the magnetic field (a) inside a current carrying solenoid (b) inside a current carrying toroid
3. Apply Ampere's circuital law to determine the magnetic field at a point due to a long straight current carrying conductor.
4. Derive an expression for the force on a current carrying conductor in a uniform magnetic field
5. Derive an expression for the force between long straight conductors carrying current and hence define 1 ampere.
6. Derive an expression for the torque on a current carrying loop in a uniform magnetic field.
7. Describe the principle construction and working of a Moving coil galvanometer.
8. Describe the conversion of a moving coil galvanometer into (a) Ammeter (b) Voltmeter
9. What is radial magnetic field? What is its importance in a moving coil galvanometer? How is a radial magnetic field realized in moving coil galvanometers?
10. Describe the principle construction and working of a cyclotron. Explain why an electron cannot be accelerated using a cyclotron.
11. Describe the motion of a charged particle in a magnetic field when it enters the field (a) perpendicular to the field lines (b) obliquely making and angle Θ with the field lines
12. Derive an expression for the magnetic dipole moment of a revolving electron and hence define Bohr magneton.
13. Distinguish between diamagnetic, paramagnetic and ferromagnetic materials.
14. State Gauss's law of magnetism. How is it different from Gauss's law in electrostatic?
15. Name the three elements of earth magnet and define them.
16. What is the effect of temperature on diamagnetic, paramagnetic and ferromagnetic substances on their magnetic properties? Explain briefly.
17. Derive the expression for the magnetic field due to a solenoid of length ' 2l', radius 'a' having 'n' number of turns per unit length and carrying a steady current 'I' at appoint on the axial line, distant 'r' from the centre of the solenoid. How does this expression compare with the axial magnetic field due to a bar magnet of magnetic moment 'm'?

Electromagnetic Induction (EMI)-

1. State and Explain Faraday's laws of electromagnetic induction.
2. State Lenz' Law and show that it is in accordance with the law of conservation of energy.
3. Use Lenz' law to find the direction of induced emf in a coil when (a) a north pole is brought towards the coil (b) north pole taken away from the coil (c) A south pole is brought towards the coil and (d) a south pole is taken away from the coil. Draw illustrations in each case.
4. What is motional emf. Deduce an expression for it. State Fleming's right hand rule to find the direction of induced emf.
5. What are eddy currents? Describe the applications of eddy currents.
6. Explain the working of (a) Electromagnetic Brakes (b) Induction Furnace
7. Which physical quantity is called the INERTIA OF ELECTRICITY? Why is it called so?
8. Define self induction and self inductance. What is its unit? Write its dimensions.
9. Derive an expression for the self inductance of a long solenoid.
10. Explain the phenomenon of mutual induction and define mutual inductance. Write the unit and dimensions of mutual inductance.
11. What are the factors affecting mutual inductance of a pair of coils? Define coefficient of coupling.
12. Describe the various methods of producing induced emf. Derive an expression for the instantaneous emf induced in a coil rotated in a magnetic field.
13. What is displacement current? Explain its need.

Alternative Current-

1. Describe the principle construction and working of an AC generator. Draw neat labeled diagram
2. Define mean value of AC (over a half cycle) and derive an expression for it.
3. Define RMS value of AC and derive an expression for it.
4. Show that the average value of AC over a complete cycle is zero.
5. Show that the current and voltage are in phase in an ac circuit containing resistance only.
6. Deduce the phase relationship between current and voltage in an ac circuit containing inductor only.
7. Deduce the phase relationship between current and voltage in an ac circuit containing capacitor only.
8. Draw the phasor diagram showing voltage and current in LCR series circuit and derive an expression for the impedance
9. What do you mean by resonance in Series LCR circuit? Derive an expression for the frequency of resonance in LCR circuit.
10. Distinguish between resistance, reactance and impedance.
11. Define quality factor (Q factor) of resonance and derive an expression for it.
12. Describe the mechanism of electromagnetic oscillations in LC circuit and write expression for the frequency of oscillations produced.

13. Derive an expression for the average power in an ac circuit.
14. Define power factor. Deduce expression for it and explain wattles current?

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15. Describe the principle construction theory and working of a transformer.
16. Describe the various losses in a transformer and explain how the losses can be minimized.

Electromagnetic Waves-

1. Explain the inadequacy of Ampere's circuital law
2. Describe Hertz experiment to demonstrate the production of electromagnetic waves
3. Write the properties of electromagnetic waves.
4. Write any five electromagnetic waves in the order of decreasing frequency and write any two properties and uses of each
5. Deduce an expression for velocity of em waves in vacuum
6. Establish the transverse nature of electromagnetic waves.
7. Compare the properties of electromagnetic waves and mechanical waves

Ray-Optics-

1. Derive mirror formula for a concave mirror and convex mirror.
2. Derive an expression for lateral shift and normal shift. On what factors these depend.
3. Define TIR and write the conditions for TIR. Derive a relation between critical angle and the refractive index of the medium. Also explain the working of isosceles prism and optical fiber.
4. Derive the following relation for a real image formed by a convex refracting surface when the object is placed in rarer medium. Also write the assumptions and sign convention used.

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

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5. Derive the lens maker's formula. Also write the assumptions and sign convention used.
6. Derive the lens formula for convex lend and concave lens.
7. Derive the relation for equivalent focal length or power when two thin lenses are placed in contact to each other. In which condition the lens combination will act as a plane glass sheet.

8. Derive the following relations for a prism-

(i) $i + e = A + \delta$ (ii) $\delta = (\mu - 1)A$

(iii) $$\mu = \frac{\sin \frac{(A+\delta_m)}{2}}{\sin A/2}$$

10. Where the symbols have their usual meanings.
11. Draw a ray diagram to show the image formation in refracting type astronomical telescope in the near point adjustment (when image is formed at LDDV i.e. D=25cm). Derive an expression for its magnifying power. Why the diameter of objective of telescope should be large.

12. Draw a ray diagram to show the image formation in refracting type astronomical telescope in the normal adjustment (when image is formed at infinity). Derive an expression for its magnifying power. How does the magnifying power get affected on increasing the aperture of the objective lens and why?
13. Draw a ray diagram to show the image formation a compound microscope. Explain briefly the working. Derive an expression for its magnifying power. Why the diameter of objective of microscope should be small.
14. Draw a labeled diagram of a reflecting type telescope. State two advantages of this telescope over refracting type telescope.
15. Define resolving power of compound microscope. How does the resolving power of a compound microscope change when-(a) Refractive index of medium between the object and objective lens increases (b) Wavelength of the light used is increased (c) decreasing the diameter of objective (iv) increasing the focal length of its objective.
16. Define the resolving power of astronomical telescope. Write the expression for it and state, on what factors it depends.

Wave-Optics-

1. Define wave front. State Huygens principle and verify Snell's law.
2. State Huygens principle and prove the laws of reflection on the basis of wave theory.
3. What do you mean by interference of light? Explain in brief the Young's double slit experiment.
4. What are the coherent sources? Write the conditions for the sustained interference pattern. Also draw the intensity v/s path difference curve.
5. Find the conditions for constructive and destructive interference. How does the intensity depend on the width of slit?
6. Find the expression for the fringe width. What is the effect on the fringe width if the whole apparatus (YDSE) is completely immersed in a liquid of refractive index μ?
7. What do you mean by diffraction of light and state the condition for the diffraction? Obtain the conditions for secondary maxima and minima. Also draw the intensity distribution curve.
8. Prove that the width of central maxima is twice the width of the secondary maxima. How does the width of central maxima depend on the width of the slit?

9. State Brewster's law and prove that the reflected and refracted rays are mutually perpendicular at the angle of polarization.
10. State law of Malus and draw an intensity V/s angle between the plane of transmission of polarizer and analyzer.
11. What is a Polaroid? How are they constructed? Mention their important applications.
12. Explain Polarization of light. Give any one method to produce plane polarized light.

Dual Nature of Radiation-

1. Describe the experiment to study photoelectric effect and explain the laws of photoelectric effect and the significance of each.
2. Describe Hertz and Lenard's experiment to demonstrate photoelectric effect.
3. Explain Einstein's photoelectric equation and explain the laws of photoelectric effect using it.
4. State and explain de Broglie relation for matter waves.
5. Describe Davisson- Germer experiment which provided experimental evidence for wave nature of matter.
6. Write the characteristics of Photon.

Atom and Nuclei

1. Describe Geiger-Marsden experiment. What are its observations and conclusions?
2. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?
3. Using Bohr's postulate of the atomic model, derive the expression for radius of n^{th} electron orbit. Hence obtain the expression for Bohr's radius.
4. Using Bohr's postulate of the atomic model, derive the expression for the frequency of radiation emitted when electron hydrogen atom undergoes transition from higher energy state to lower energy state.
5. Derive the expression for the law of radioactive decay of given sample having initially N_0 nuclei decaying to the number N present in any subsequent time t. Plot a graph showing the variation of the number of nuclei versus the time t lapsed.
6. Define the term half life period and decay constant of radioactive sample. Derive the relation between these terms.
7. Derive an expression for average life of radio nuclei. Give its relationship with half life.
8. Draw a graph showing the variation of binding energy per nucleons with the mass number for a large number of nuclei $2 < A < 240$. What are the main inferences from the graph?
9. Distinguish between nuclear fission and fusion nuclear reaction.
10. Explain alpha, beta, and gamma emission of radioactive elements.

Semiconductor Devices-

1. Distinguish between conductors, insulators and semiconductors on the basis of energy bands.
2. What are extrinsic semiconductors? Mention its types and explain the mechanism of conduction in each.
3. Explain the conduction in N Type and P Type semiconductor on the basis of band theory.
4. Explain the formation of depletion layer and potential barrier in a PN junction diode.
5. Draw the circuit diagram used to determine the VI characteristics of a diode and draw the forward and reverse bias characteristics of a diode. Explain the conclusions drawn from the graph.
6. With the help of a labeled circuit diagram explain the working of half wave rectifier and draw the input and output waveforms.
7. With the help of a labeled circuit diagram explain the working of full wave rectifier and draw the input and output waveforms.
8. Write notes on LED, photodiode and solar cell.
9. What is a Zener diode? Draw the V- I characteristics of zener diode. Explain Zener breakdown and describe the use of a zener diode as a voltage regulator.
10. Explain the action of a PNP transistor and an NPN transistor.(Explain how conduction takes place in NPN and PNP transistor.)
11. Draw the circuit diagram for determining transistor characteristics and describe the input and output characteristics of transistor in CE configuration with relevant graphs.
12. Explain the working of Transistor amplifier in CE configuration with necessary circuit diagram.

14. Explain the working of transistor as a switch.
15. Draw the symbol, truth table and Boolean expression for Or, AND and NOT gate.
16. Draw the symbol and truth table of NOR gate and NAND gate.
17. Explain, how the fundamental logic gates can be realized using NOR gates alone.
18. Explain how the fundamental logic gates can be realized using NAND gates alone.

Principles of Communication-

1. Derive an expression for the **range of transmission** via space wave from a transmitting antenna of height h.
2. Describe radio wave propagation via (a) **Ground Wave** (b) **Space Wave** and (c) **Sky Wave**.
3. What is the need for **satellite communication**? Elaborate.
4. Explain the need for modulation for long distance transmission.
5. Define **amplitude modulation** and illustrate it using diagrams (graphs)
6. Define **modulation index** and write its expression.
7. What are the advantages and disadvantages of FM over AM?
8. Explain the role of repeater in communication
9. Describe the mechanism of **demodulation** (detection) of AM Wave using block diagram, circuit diagram and graphical representation.

10. What is **LOS** communication?
11. What are the basic elements of a **communication system**? Explain the function of each.
12. Draw the block diagram of a communication system **.**