VSA Type Important Questions

1. What is the electric flux through a cube of side 1 cm which encloses an electric dipole?

2. Plot a graph showing the variation of resistivity of a conductor with temperature.

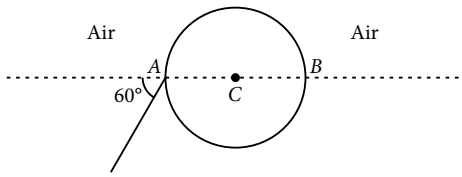
3. A long straight wire carries a steady current I along the positive y-axis in a coordinate system. A particle of charge + Q is moving with a velocity $\vec{v}$ along the x-axis. In which direction will the particle experience a force?

4. At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of the earth's magnetic field at equator?

5. State Lenz's law.

6. In which directions do the electric and magnetic field vectors oscillate in an electromagnetic wave propagating along the x-axis?

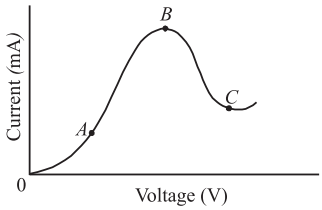
7. A ray of light falls on a transparent sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line AB. Find the angle of refraction at A if refractive index of the material of the sphere is $\sqrt{3}$.



8. Define ionisation energy. What is its value for a hydrogen atom?

9. What is the relationship between the half-life and mean life of a radioactive nucleus?

10. The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance.

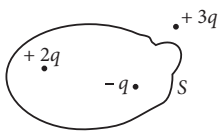


11. Draw a block diagram of a generalized communication system.

12. What is sky wave propagation?

SA I Type Important Questions

13. Figure shows three point charges, +2q, −q, +3q. Two charges +2q and −q are enclosed within a surface 'S'. What is the electric flux due to this configuration through the surface 'S' ?



14. Two point charges q and −2q are kept 'd' distance apart. Find the location of point relative to charge 'q' at which potential due to this system of charges is zero.

15. A battery of emf E and internal resistance r when connected across an external resistance of 12 Ω, produces a current of 0.5 A. When connected across a resistance of 25 Ω, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell.

16. A short bar magnet of magnetic moment 0.9 J/T is placed with its axis at 30° to a uniform magnetic field. It experiences a torque of 0.063 J.

(i) Calculate the magnitude of the magnetic field.

(ii) In which orientation will the bar magnet be in stable equilibrium in the magnetic field?

17. (a) How does a diamagnetic material behave when it is cooled to very low temperatures?

(b) Why does a paramagnetic sample display greater magnetisation when cooled? Explain.

18. Identify the electromagnetic waves whose wavelengths vary as

(a) 10^{-11} m < λ < 10^{-14} m

(b) 10^{-4} m < λ < 10^{-6} m

Write one use of each.

19. State Brewster's law.

The value of Brewster angle for a transparent medium is different for light of different colours. Give reason.

20. Draw a plot showing the variation of de Broglie wavelength of electron as a function of its K.E.

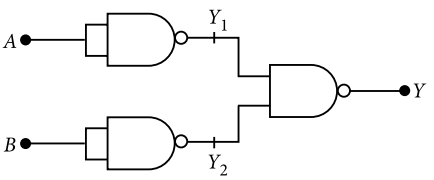
21. The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 Å. Calculate the short wavelength limit for Balmer series of the hydrogen spectrum.

22. When four hydrogen nuclei combine to form a helium nucleus estimate the amount of energy in MeV released in this process of fusion (Neglect the masses of electrons and neutrons). Given:

(i) Mass of ^1_1H = 1.007825 u

(ii) mass of helium nucleus = 4.002603 u, 1u = 931 MeV/c^2

23. Identify the equivalent gate represented by the circuit shown in the figure. Draw its logic symbol and write the truth table.

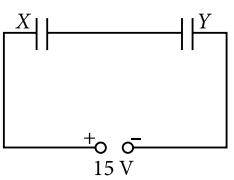


24. By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21%?

SA II Type Important Questions

25. An electric dipole is kept in a uniform electric field. Derive an expression for the net torque acting on it and write its direction. State the conditions under which the dipole is in (i) stable equilibrium and (ii) unstable equilibrium.

26. Two parallel plate capacitors *X* and *Y* have the same area of plates and same separation between them. *X* has air between the plates while *Y* contains a dielectric of $\varepsilon_r = 4$.



(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 μF.

(ii) Calculate the potential difference between the plates of *X* and *Y*.

(iii) Estimate the ratio of electrostatic energy stored in *X* and *Y*.

27. Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons? Use this relation to deduce the expression for the electrical resistivity of the material.

28. Draw a labelled diagram of a moving coil galvanometer and explain its working. What

is the function of radial magnetic field inside the coil?

29. (i) Define self-inductance. Write its SI unit.

(ii) A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

30. A series *LCR* circuit is connected to a 220 V variable frequency (ac) supply. If $L = 10$ mH, $C = \left(\frac{400}{\pi^2}\right)\mu F$ and $R = 55\ \Omega$.

(a) Find the frequency of the source, for which the average power absorbed by the circuit is maximum.

(b) Calculate the value of maximum current amplitude.

31. (a) When the oscillating electric and magnetic fields are along the *x*-and *y*-direction respectively.

(i) point out the direction of propagation of electromagnetic wave.

(ii) express the velocity of propagation in terms of the amplitudes of the oscillating electric and magnetic fields.

(b) How do you show that the e.m. wave carries energy and momentum?

32. (a) Draw a ray diagram showing the formation of image by a reflecting telescope.

(b) Write two advantages of a reflecting telescope over a refracting telescope.

33. Answer the following questions :

(a) In a double slit experiment using light of wavelength 600 nm, the angular width of the fringe formed on a distant screen is 0.1°. Find the spacing between the two slits.

(b) Light of wavelength 500 Å propagating in air gets partly reflected from the surface of water. How will the wavelengths and frequencies of the reflected and refracted light be affected?

34. Explain giving reasons for the following:

(a) Photoelectric current in a photocell increases with the increase in the intensity of the incident radiation.

(b) The stopping potential (V_0) varies linearly with the frequency (υ) of the incident radiation for a given photosensitive surface with the slope remaining the same for different surfaces

35. Using the postulates of Bohr's model of hydrogen atom, obtain an expression for the frequency of radiation emitted when atom make a transition from the higher energy state with quantum number n_i to the lower energy state with quantum number n_f ($n_f < n_i$).

36. (a) Complete the following nuclear reactions:

(i) $^{208}_{84}\text{Po} \rightarrow ^{204}_{82}\text{Pb} + ...$

(ii) $^{32}_{15}\text{P} \rightarrow ^{32}_{16}\text{S} + ...$

(b) Write the basic process involved in nuclei responsible for (i) β^- and (ii) β^+ decay.

(c) Why is it found experimentally difficult to detect neutrinos?

37. For a CE-transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 2 V. Suppose the current amplification factor of the transistor is 100, find the input signal voltage and base current, if the base resistance is 1 kΩ.

38. What is the space wave propagation? Give two example of communication system which use space wave mode.

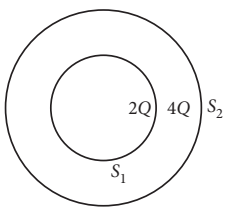
A TV tower is 80 m tall. Calculate the maximum distance upto which the signal transmitted from the tower can be received.

LA Type Important Questions

39. Consider two hollow concentric spheres S_1 and S_2, enclosing charges $2Q$ and $4Q$ respectively as shown in figure.

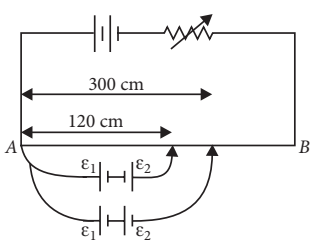
(i) Find out the ratio of the electric flux through them.

(ii) How will the electric flux through the sphere S_1 change if a medium of dielectric constant 'ε_r' is introduced in the space inside S_1 in place of air? Deduce the necessary expression.



40. (a) State the principle of a potentiometer. Define potential gradient. Obtain an expression of potential gradient in terms of resistivity of the potentiometer wire.

(b) Figure shows a long potentiometer wire AB having a constant potential gradient. The null points for the two primary cells of emfs ε_1 and ε_2 connected in the manner shown are obtained at a distance of $l_1 = 120$ cm and $l_2 = 300$ cm from the end A. Determine (i) $\varepsilon_1/\varepsilon_2$ and (ii) position of null point for the cell ε_1 only.



41. (a) Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle.

(b) Draw a schematic sketch of a cyclotron. Explain, giving the essential details of its construction, how it is used to accelerate the charged particles.

42. (a) Draw a labelled diagram of ac generator. Derive the expression for the instantaneous value of the emf induced in the coil.

(b) A circular coil of cross-sectional area 200 cm^2 and 20 turns is rotated about the vertical diameter with angular speed of 50 rad s^{-1} in a uniform magnetic field of magnitude 3.0×10^{-2} T. Calculate the maximum value of the current in the coil.

43. (a) Using phasor diagram for a series LCR circuit connected to an ac source of voltage $V = V_0 \sin \omega t$, derive the relation for the current flowing in the circuit and the phase angle between the voltage across the resistor and the net voltage in the circuit.

(b) Draw a plot showing the variation of the current I as a function of angular frequency 'ω' of the applied ac source for the two cases of a series combination of (i) inductance L_1, capacitance C_1 and and resistance R_1 and (ii) inductance L_2, capacitance C_2 and resistance R_2 where $R_2 > R_1$. Write the relation between L_1, C_1 and L_2, C_2 at resonance. Which one, of the two, would be better suited for fine tuning in a receiver set? Give reason.

44. (a) Draw a ray diagram showing image formation in a compound microscope. Define the term 'limit of resolution' and name the factors on which it depends. How is it related to resolving power of a microscope?

(b) Suggest two ways by which the resolving power of a microscope can be increased.

(c) 'A telescope resolves whereas a microscope magnifies.' Justify this statement.

45. (a) Using Huygens' construction of secondary wavelets explain how a diffraction pattern is obtained on a screen due to a narrow slit on which a monochromatic beam of light is incident normally.

(b) Show that the angular width of the first diffraction fringe is half that of the central fringe.

(c) Explain why the maxima at $\theta = \left(n+\frac{1}{2}\right)\frac{\lambda}{a}$ become weaker and weaker with increasing n.

46. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state, (n_f). When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3, 2, 1$. Identify the spectral series to which the emission lines belong.

47. (a) Derive the law of radioactive decay, viz. $N = N_0 e^{-\lambda t}$.

(b) Explain, giving necessary reactions, how energy is released during (i) fission and (ii) fusion.

48. Draw the circuit diagram of a base-biased *n-p-n* transistor in CE configuration. Explain how this circuit is used to obtain the transfer characteristic ($V_o - V_i$ characteristics). How do we explain the working of a transistor as a switch using the characteristic?

49. Draw the circuit diagram of a *p-n* diode used as a half-wave rectifier. Explain its working.

50. Explain the formation of depletion region for *p-n* junction diode. How does the width of this region change when the junction is (i) forward biased, (ii) reverse biased?