KENDRIYA VIDYALAYA SANGATHAN (LUCKNOW REGION)
SESSION: 2024-25
SUBJECT:PHYSICS (THEORY)

Maximum Marks : **70** **CLASS : XII** **Time Allowed**: **3hours.**

General Instructions:

(1) There are **33** questions in all. All questions are compulsory.
(2) This question paper has five section :Section A, Section B, Section C,Section D and Section E.
(3) All the sections are compulsory.
(4) **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E.You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.
(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8$ m/s
ii. $m_e = 9.1 \times 10^{-31}$ kg
iii. $e = 1.6 \times 10^{-19}$ C
iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
v. $h = 6.63 \times 10^{-34}$ Js
vi. $\varepsilon_0 = 8.854 \times 10^{-12} C^2 N^{-1} m^{-2}$
vii. Avogadro's number $= 6.023 \times 10^{23}$ per gram mole

SECTION-A

1.Relative permittivity and permeability of a material are ε_r and μ_r respectively. Which of the following values of these quantities are allowed for a diamagnetic material?

a) $\varepsilon_r = 1.5$, $\mu_r = 1.5$ b) $\varepsilon_r = 0$, $\mu_r = 1.5$

c) $\varepsilon_r = 1.5$, $\mu_r = 0.5$ d) $\varepsilon_r = 0.5$, $\mu_r = 0.5$

2. An electric dipole placed in an electric field of intensity 2×10^5 N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2cm is
(a) 7 μC (b) 8 Mc (c) 2mC (d) 5 mC

3.Light of frequency 6.4×10^{14} Hz is incident on a metal of work function 2.14 eV. The maximum kinetic energy of the emitted electrons is about

(a) 0.25 eV (b) 0.51 eV (c) 1.02 eV (d) 0.10 eV

4.The refractive index of the material of an equilateral prism is $\sqrt{3}$ .What is the angle of Minimum deviation?

(a) 45° (b) 60° (c) 37° (d) 30°

5.Two α-particles have the ratio of their velocities as 3: 2 on entering the magnetic field. If they move in different circular paths, then the ratio of the radii of their paths is

a) 2 : 3 b) 3 : 2 c) 9 : 4 d) 4 : 9

6.The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then

(a) X is paramagnetic and Y is ferromagnetic

(b) X is diamagnetic and Y is ferromagnetic

(c) X and Y both are paramagnetic

(d) X is diamagnetic and Y is paramagnetic

7.If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a:

(a) low resistance in parallel (b) high resistance in parallel

(c) high resistance in series (d) low resistance in series

8.A force of 4N is acting between two charges in air. If the space between them is completely filled with glass (relative permittivity = 8), then the new force will be

(a) 2N (b) 5N (c) 0.5N (d) 0.2N

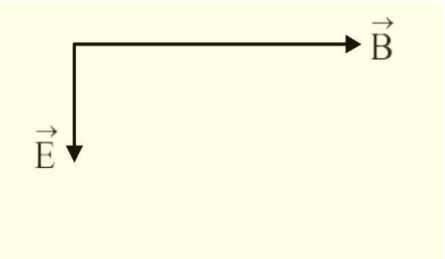
9. The large scale transmission of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up because of

(a) reduction of current (b) reduction of current and voltage both
(c) power loss is cut down (d) a and c both

10.A magnetic flux linked with a coil varies as $\phi = 2t^2 - 6t + 5$ where ϕ is in weber and t is in second. The induced current is zero at

a) t = 0 b) t = 1.5 c) t = 3 d) t = 5

11. The diagram below shows the electric field (**E**) and magnetic field (**B)** components of an electromagnetic wave at a certain time and location.



The direction of the propagation of the electromagnetic wave is

(a) perpendicular to E and B and out of plane of the paper

(b) perpendicular to E and B and into the plane of the paper

(c) parallel and in the same direction as E

(d) parallel and in the same direction as B

12. The ionisation potential of hydrogen is 13.6 V. The energy of the atom in n = 2 state will be

a) -10.2 eV b) - 6.4eV c) – 3.4 eV d) – 4.4 eV

For Questions 13 to 16, two statements are given –one labeled Assertion (A) and other labeled Reason (R). Select the correct answer to these questions from the options as given below.

(a)If both Assertion and Reason are true and Reason is correct explanation of Assertion.

(b)If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c)If Assertion is true but Reason is false.

(d)If both Assertion and Reason are false.

13. **Assertion (A) :** Photoelectric effect demonstrates the wave nature of light.

Reason(R): The number of photoelectrons is proportional to the frequency of light.

14. **Assertion (A)** : Putting p type semiconductor slab directly in physical contact with n type semiconductor slab cannot form the p-n junction.

Reason(R): The roughness at contact will be much more than inter atomic crystal spacing and continuous flow of charge carriers is not possible.

15. **Assertion (A):** In Bohr's model of the atom, the angular momentum of the electron is quantized.

Reason (R): The electron in an atom revolves in circular orbits around the nucleus under the influence of electrostatic forces.

16.**Assertion (A):** Refractive index of glass with respect to air is different for red light and violet light.

Reason (R): Refractive index of a pair of media does not depends on the wavelength of light used.

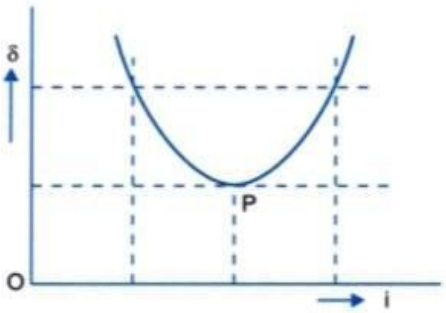
SECTION –B

17.(a)Name the device which utilizes unilateral action of a p-n diode to convert ac into dc.

(b)Draw the input &output waveform of a full wave rectifier.

18.Calculate binding energy per nucleon of $^{209}\mathbf{Bi}_{83}$ nucleus. Given that mass of $^{209}\mathbf{Bi}_{83}$ = 55.934939u, mass of proton = 1.007825u, mass of neutron = 1.008665u . (given: 1 u = 931 MeV) .

19.A plot, between the angle of deviation (δ) and angle of incidence (i), for a triangular prism is shown in figure: Explain why any given value of 'δ' corresponds to two values of angle of incidence. State the significance of point P on the graph.



20. A potential difference V is applied to a conductor of length L , diameter D. How are the electric field E, the drift velocity V_d and resistance R affected when

(i) V is doubled.

(ii) D is doubled.

21.Show that the least possible distance between an object and its real image in a convex lens is 4f, where f is the focal length of the lens.

OR

An astronomical telescope has focal lengths 100 cm & 10 cm of objective and eyepiece lens respectively when final image is formed at least distance of distinct vision, magnification power of telescope will be?

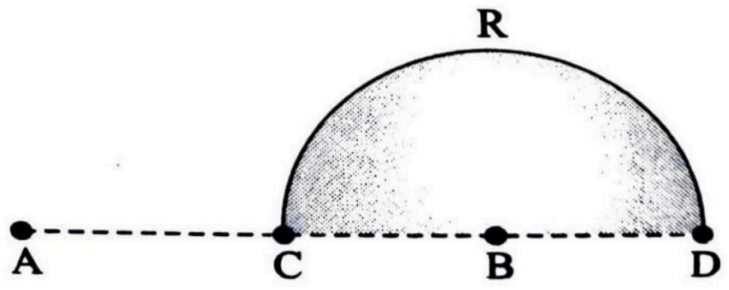
SECTION-C

22. (a)What are coherent sources.

(b)Explain Young's double slit experiment.

(c)Write the expression for the fringe width.

23.Charges (+*q*) and (–*q*) are placed at the points A and B respectively which are a distance 2L apart. C is the midpoint between A and B. What is the work done in moving a charge +Q along the semicircle CRD. (see figure)



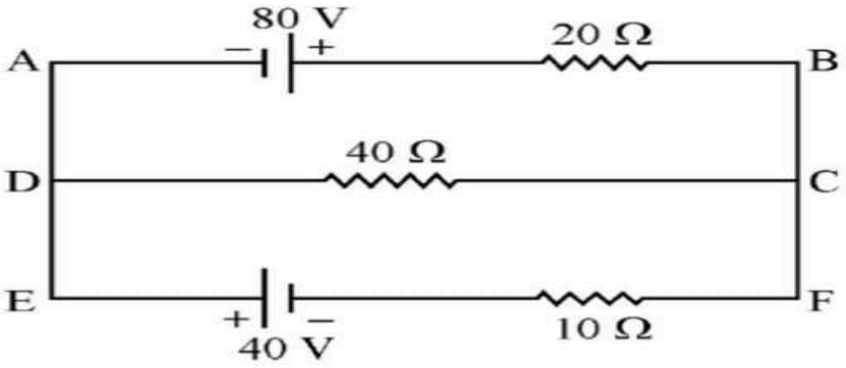
24.The ground state energy of hydrogen atom is -13.6 eV.

(a)What is the kinetic energy of the electron in this state?

(b)What is the potential energy of the electron in this state?

(c)Which of the answers above would change if the choice of the zero of potential energy is changed?

25. Using Kirchhoff's rules, calculate the current through 40Ω and 20Ω in the circuit shown in below figure



26. (a) State the principle & the working of a moving coil galvanometer.

(b) Why concave magnets are used in it , give reason.

27. (i) Arrange the following electromagnetic waves in the descending order of their wavelengths.

(a) Microwaves (b) Infrared rays (c) Ultraviolet radiation (d) g-rays

(ii) Write one use each of any two of them.

28.(a) Define mutual inductance and write its SI unit.

(b) Two circular loops, one of small radius *r* and other of larger radius R, such that R>>*r*, are placed coaxially with centres coinciding . Obtain the mutual inductance of the arrangement.

OR

(a) Two long straight parallel current carrying conductors are kept 'r' distant apart in air.The direction of current in both the conductors is same. Find the magnitude of force per unit length.

(b) What will be the direction of the force between them when

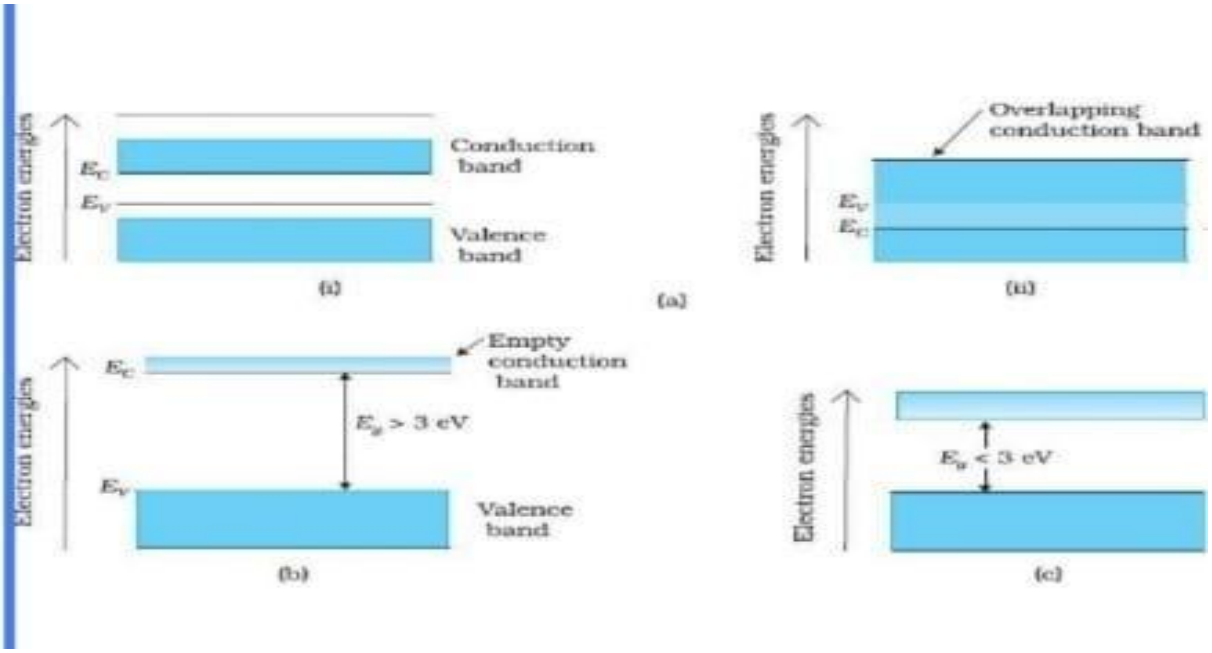
(i) When current flows in same direction.

(ii)When current flows in opposite direction.

SECTION -D

CASE STUDY BASED QUESTIONS

29.From Bohr's atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to inter atomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



Following are the energy band diagrams for conductor fig (ii), for insulators fig (b) and for semiconductors fig (c).

(i) In an insulator energy band gap is
(a) Eg = 0 eV (b) Eg>3eV (c) Eg<3eV (d) None of this
(ii)In a semiconductor, separation between conduction and valence band is of the order of

(a) Eg = 0 eV (b) Eg>3eV (c) Eg<3eV (d) None of these
(iii) Based on the band theory of conductors, insulators and semiconductors, the forbidden gap is smallest in

(a) conductor (b) insulators (c) semiconductors (d) All of these
(iv) Solids having highest energy level partially filled with electrons are
(a) semiconductor (b) conductor (c) insulator (d) none of these

OR

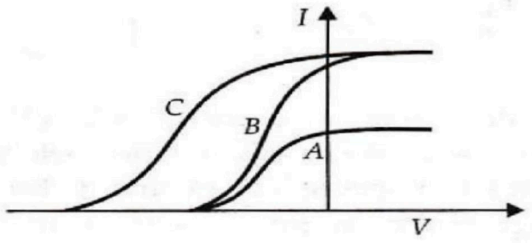
What is the highest occupied band in solids?
(a) conduction band (b) valence band (c) forbidden band (d) semiconductor band

30. It is the phenomenon of emission of electrons from a metallic surface when light of a suitable frequency is incident on it. The emitted electrons are called photo electrons.

Nearly all metals exhibit this effect with ultraviolet light but alkali metals like lithium, sodium, potassium, cesium etc. show this effect even with visible light. It is an instantaneous process i.e. photoelectrons are emitted as soon as the light is incident on the metal surface. The number of photoelectrons emitted per second is directly proportional to the intensity of the incident radiation.

The maximum kinetic energy of the photoelectrons emitted from a given metal surface is independent of the intensity of the incident light and depends only on the frequency of the incident light. For a given metal surface there is a certain minimum value of the frequency of the incident light below which emission of photoelectrons does not occur.

(i)In a photoelectric experiment plate current is plotted against anode potential.



(A) A and B will have same intensities while B and C will have different frequencies.

(B) B and C will have different intensities while A and B will have different frequencies.

(C) A and B will have different intensities while B and C will have equal frequencies

(D) B and C will have equal intensities while A and B will have same frequencies.

(ii) Photoelectrons are emitted when a zinc plate is

(A)Heated (B) hammered (C) Irradiated by ultraviolet light (D) subjected to a high pressure

(iii)The threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 500nm.

Its work-function is about

(A) $4x10^{-19}J$ (B) 1J (C) $2x10^{-19}J$ (D) $3x10^{-19}J$

(iv)The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is

(A) 2V (B) 4V (C) 6V (D) 10V

OR

The minimum energy required to remove an electron from a substance is called its

(A) Work function (B) kinetic energy (C) stopping potential (D) potential energy

SECTION - E

31.(a)Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2.Hence derive lens maker's formula.

(b) A converging lens has a focal length of 10 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length.

OR

(a)Define a wavefront. How is it different from a ray?

(b)Using Huygens's construction of secondary wavelets draw a diagram showing the passage of a plane wavefront from a denser to a rarer medium.Using it verify Snell's law.

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

(d)Write two differences between interference pattern and diffraction pattern.

32.(a) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source.

(b)Draw the phasor diagram for a series LRC circuit connected to an AC source.

(c)When an alternating voltage of 220V is applied across a device X, a current of 0.25A flows which lags behind the applied voltage in phase by $\pi/2$ radian. If the same voltage is applied

across another device Y, the same current flows but now it is in phase with the applied voltage.

(i)Name the devices X and Y.

(ii)Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

OR

(a) A series LCR circuit is connected to an ac source.Using the phasor diagram ,derive the expression for the impedance of the circuit.

(b)Plot a graph to show the variation of current with frequency of the ac source, explaining the nature of its variation for two different resistances R_1 and R_2 ($R_1<R_2$) at resonance.

33.(a)Find the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t(t<d) is introduced between the plates of capacitor.

(b)A parallel plate capacitor, of capacitance 20 pF, is connected to a 100 V supply. After sometime the battery is disconnected, and the space, between the plates of the capacitor is filled with a dielectric, of dielectric constant 5. Calculate the energy stored in the capacitor.

OR

A parallel plate capacitor of capacitance C is charged to a potential ‘V' by a battery. Q is the charge stored on the capacitor .Without disconnecting the battery, the plates of the capacitor are pulled apart to a larger distance of separation.

What changes will occur in each of the following quantities? Will they increase, decrease or remain the same? Give an explanation in each case.

(a) Capacitance
(b) Charge
(c) Potential difference
(d) Electric field
(e) Energy stored in the capacitor.