CBSE Class 12 Physics 2014 - Set 55/1/3

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 3 Hours **Maximum Marks: 70**

General Instructions

(i) This question paper contains **30 questions**. All questions are compulsory.

(ii) Questions 1 to 8 carry 1 mark each; Questions 9 to 18 carry 2 marks each; Questions 19 to 27 carry 3 marks each; Questions 28 to 30 carry 5 marks each.

(iii) One of the questions carrying 3 marks is value based.

(iv) There is no overall choice. An internal choice is provided in one question of 2 marks, one question of 3 marks and all three questions of 5 marks. Attempt only one alternative in each such question.

(v) Use of calculators is not permitted. Log tables may be used, if necessary.

You may use the following values of physical constants wherever necessary:

$c = 3 \times 10^8$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2 C^{-2}

Mass of electron (m_e) $= 9.1 \times 10^{-31}$ kg

Mass of neutron $= 1.675 \times 10^{-27}$ kg

Mass of proton $= 1.673 \times 10^{-27}$ kg

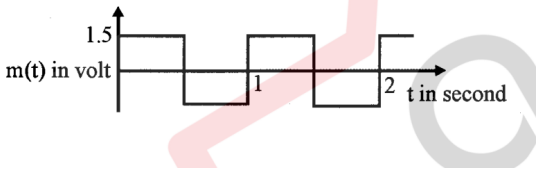
Avogadro's number $= 6.023 \times 10^{23}$ per gm mole

Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}

Section 1-Mark Questions

1. Define the term 'drift velocity' of charge carriers in a conductor and write its relationship with the current flowing through it.

2. The carrier wave of a signal is given by $C(t) = 3\sin(8\pi t)$ volt. The modulating signal is a square wave as shown. Find its modulation index.

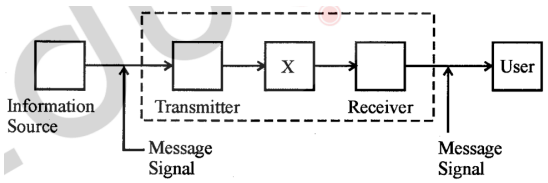


3. Write the expression, in a vector form, for the Lorentz magnetic force $\vec{F}$ due to a charge moving with velocity $\vec{V}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force ?

4. Plot a graph showing variation of current versus voltage for the material GaAs.

5. A convex lens is placed in contact with a plane mirror. A point object at a distance of 20 cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens ?

6. The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function.



7. Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why ?

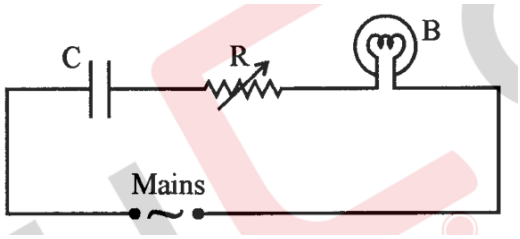
8. "For any charge configuration, equipotential surface through a point is normal to the electric field." Justify.

Section 2-Mark Questions

9. An electric dipole of length 1 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $6\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has a charge of ± 2 nC.

10. State the underlying principle of a cyclotron. Write briefly how this machine is used to accelerate charged particles to high energies.

11. A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the ac mains in circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if (i) a dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same; (ii) the resistance R is increased keeping the same capacitance ?



12. A deuteron and an alpha particle are accelerated with the same accelerating potential. Which one of the two has

(1) greater value of de-Broglie wavelength, associated with it and

(2) less kinetic energy ? Explain.

13. Out of the two magnetic materials, 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of the materials 'A' and 'B'. Will their susceptibilities be positive or negative ?

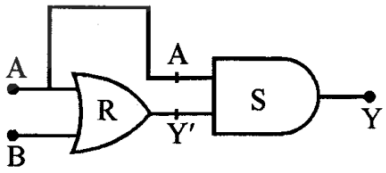
14. State Kirchhoff's rules. Explain briefly how these rules are justified.

15. Given a uniform electric field $\vec{E} = 4 \times 10^3 \hat{i}$ N/C. Find the flux of this field through a square of side 5 cm, whose plane is parallel to the Y-Z plane. What would be the flux through the same square, if the plane makes an angle of 30° with the X-axis?

16. (i) Monochromatic light of frequency 5.0×10^{14} Hz is produced by a laser. The power emitted is 3.0×10^{-3} W. Estimate the number of photons emitted per second on an average by the source.

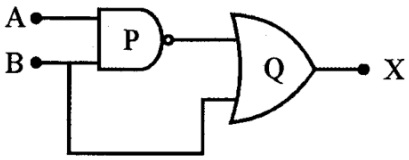
(ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.

17. Write the truth table for the combination of the gates shown. Name the gates used.



OR

17. Identify the logic gates marked 'P' and 'Q' in the given circuit. Write the truth table for the combination.

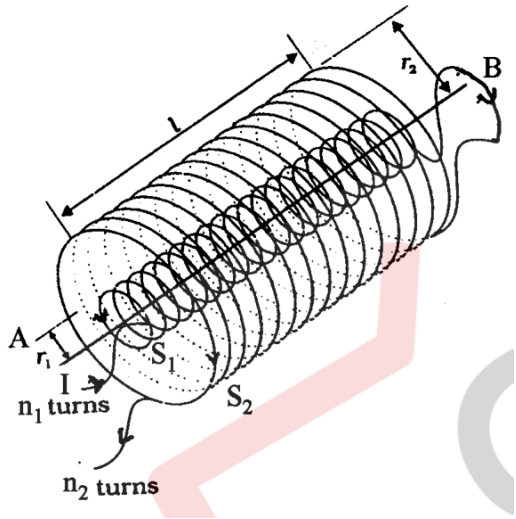


18. For a single slit of width "a", the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of $\frac{\lambda}{a}$. At the same angle of $\frac{\lambda}{a}$, we get a maximum for two narrow slits separated by a distance "a". Explain.

Section 3-Mark Questions

19. (a) State Ampere's circuital law, expressing it in the integral form.

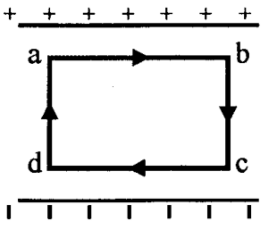
(b) Two long coaxial insulated solenoids, S_1 and S_2 of equal lengths are wound one over the other as shown in the figure. A steady current "I" flow through the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current "I" flows in the opposite direction so as to come out at end A. If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point (i) inside on the axis and (ii) outside the combined system.



20. A 12.3 eV electron beam is used to bombard gaseous hydrogen at room temperature. Upto which energy level the hydrogen atoms would be excited? Calculate the wavelength of the second member of Lyman series and second member of Balmer series.

21. (a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.

(b) The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop *abcda*.



OR

21. (a) Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d.

(b) Two charged spherical conductors of radii R_1 and R_2 when connected by a conducting wire acquire charges q_1 and q_2 respectively. Find the ratio of their surface charge densities in terms of their radii.

22. (a) A mobile phone lies along the principal axis of a concave mirror. Show, with the help of a suitable diagram, the formation of its image. Explain why magnification is not uniform.

(b) Suppose the lower half of the concave mirror's reflecting surface is covered with an opaque material. What effect this will have on the image of the object ? Explain.

23. (a) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.

(b) The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

24. Answer the following the questions :

(a) Name the em waves which are produced during radioactive decay of a nucleus. Write their frequency range.

(b) Welders wear special glass goggles while working. Why ? Explain.

(c) Why are infrared waves often called as heat waves ? Give their one application.

25. A potentiometer wire of length 1 m has a resistance of 5 Ω. It is connected to an 8 V battery in series with a resistance of 15 Ω. Determine the emf of the primary cell which gives a balance point at 60 cm.

26. (a) Deduce the expression, $N = N_0 e^{-\lambda t}$, for the law of radioactive decay.

(b) (i) Write symbolically the process expressing the β^+ decay of $^{22}_{11}\text{Na}$. Also write the basic nuclear process underlying this decay.

(ii) Is the nucleus formed in the decay of the nucleus $^{22}_{11}\text{Na}$, an isotope or isobar ?

27. When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard.

Ultimately her parents agreed :

(1) In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health ?

(2) By objecting to this move of her parents, what value did Sunita display ?

(3) Estimate the range of e.m. waves which can be transmitted by an antenna of height 20 m. (Given radius of the earth = 6400 km)

Section 5-Mark Questions

28. (a) State briefly the processes involved in the formation of p-n junction explaining clearly how the depletion region is formed.

(b) Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in

(i) Forward biasing

(ii) Reverse biasing

How are these characteristics made use of in rectification ?

OR

28. (a) Differentiate between three segments of a transistor on the basis of their size and level of doping.

(b) How is a transistor biased to be in active state ?

(c) With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the ac current gain.

29. (a) (i) 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reason.

(ii) Light waves each of amplitude "a" and frequency "ω", emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by $y_1 = a\cos\omega t$ and $y_2 = a\cos(\omega t + \phi)$ where ϕ is the phase difference between the two, obtain the expression for the resultant intensity at the point.

(b) In Young's double slit experiment, using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. Find out the intensity of light at a point where path difference is $\lambda/3$.

OR

29. (a) How does one demonstrate, using a suitable diagram, that unpolarised light when passed through a Polaroid gets polarised ?

(b) A beam of unpolarised light is incident on a glass-air interface. Show, using a suitable ray diagram, that light reflected from the interface is totally polarised, when $\mu = \tan i_B$, where μ is the refractive index of glass with respect to air and i_B is the Brewster's angle.

30. (a) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.

(b) The current flowing through an inductor of self inductance L is continuously increasing. Plot a graph showing the variation of

(i) Magnetic flux versus the current

(ii) Induced emf versus dI/dt

(iii) Magnetic potential energy stored versus the current.

OR

30. (a) Draw a schematic sketch of an ac generator describing its basic elements. State briefly its working principle. Show a plot of variation of

(i) Magnetic flux and

(ii) Alternating emf versus time generated by a loop of wire rotating in a magnetic field.

(b) Why is choke coil needed in the use of fluorescent tubes with ac mains ?

- End of Question Paper -