

CBSE Class 12 Physics 2013 - 55/1/1 - Compartment



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 **29 questions**. All questions are **compulsory**.
- (ii) Questions 1 to 8 carry 1 mark each; questions 9 to 16 carry 2 marks each.
- (iii) Questions 17 to 25 carry 3 marks each. Question 26 is a value-based question carrying 4 marks.
- (iv) Questions 27 to 29 carry 5 marks each.
- (v) There is no overall choice. Where an internal choice is provided, attempt only one of the alternatives.
- (vi) Use of calculators is not permitted.

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

$$\begin{aligned}c &= 3 \times 10^8 \text{ m/s} \\h &= 6.63 \times 10^{-34} \text{ Js} \\e &= 1.6 \times 10^{-19} \text{ C} \\\mu_0 &= 4\pi \times 10^{-7} \text{ T m A}^{-1} \\\epsilon_0 &= 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2} \\\frac{1}{4\pi\epsilon_0} &= 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}\end{aligned}$$

$$\begin{aligned}\text{Mass of electron } (m_e) &= 9.1 \times 10^{-31} \text{ kg} \\\text{Mass of neutron} &= 1.675 \times 10^{-27} \text{ kg} \\\text{Mass of proton} &= 1.673 \times 10^{-27} \text{ kg} \\\text{Avogadro's number} &= 6.023 \times 10^{23} \text{ per gm mole} \\\text{Boltzmann constant} &= 1.38 \times 10^{-23} \text{ JK}^{-1}\end{aligned}$$

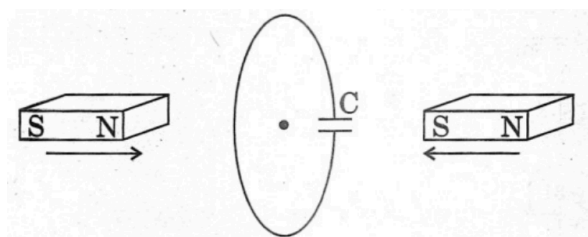
Questions

1. Write the expression for the work done on an electric dipole of dipole moment $\vec{p}$ in turning it from its position of stable equilibrium to a position of unstable equilibrium in a uniform electric field $\vec{E}$.

2. Is the steady electric current the only source of magnetic field? Justify your answer.

3. When is H_α line of the Balmer series in the emission spectrum of hydrogen atom obtained?

4. Predict the polarity of the capacitor in the situation described in the figure.



5. Why is the core of a transformer laminated?

6. Show on a plot the nature of variation of photoelectric current with the intensity of radiation incident on a photosensitive surface.

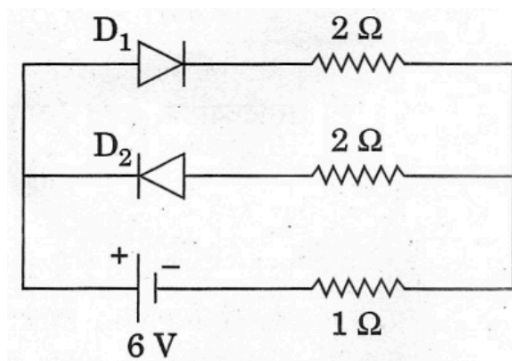
7. Where on the surface of Earth is the vertical component of Earth's magnetic field zero?

8. Two charges $2\mu\text{C}$ and $-2\mu\text{C}$ are placed at points A and B, 5 cm apart. Depict an equipotential surface of the system.

9. Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature.

10. A coil of N turns and radius R carries a current I . It is unwound and rewound to make a square coil of side a having the same number of turns (N), carrying the same current I . Find the ratio of the magnetic moments of the square coil and the circular coil.

11. Assuming that the two diodes D_1 and D_2 used in the electric circuit shown in the figure are ideal, find the value of the current flowing through the 1Ω resistor.



12. In the ground state of hydrogen atom, its Bohr radius is given as 5.3×10^{-11} m. The atom is excited such that the radius becomes 21.2×10^{-11} m. Find (i) the value of the principal quantum number and (ii) the total energy of the atom in this excited state.

13. Draw a schematic arrangement of a reflecting telescope (Cassegrain), showing how rays coming from a distant object are received at the eye-piece. Write its two important advantages over a refracting telescope.

14. A message signal of frequency 10 kHz and peak voltage 10 V is used to modulate a carrier of frequency 1 MHz and peak voltage 20 V. Determine (i) the modulation index, (ii) the side bands produced.

15. (a) How are electromagnetic waves produced?

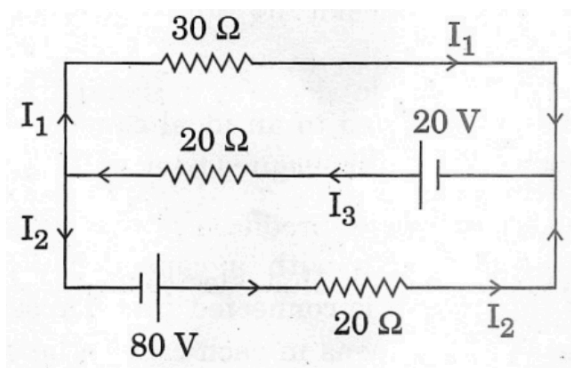
(b) How do you convince yourself that electromagnetic waves carry energy and momentum?

OR

(a) Arrange the following electromagnetic waves in the descending order of their wavelengths: (i) Microwaves (ii) Infra-red rays (iii) Ultra-violet radiation (iv) Gamma rays.

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

16. Using Kirchhoff's rules, determine the value of the current I_1 flowing in the circuit shown in the figure.



17. Draw a labelled schematic diagram of a Van de Graaff generator. State its working principle. Describe briefly how it is used to generate high voltages.

18. Starting from the expression for the energy $W = \frac{1}{2}LI^2$, stored in a solenoid of self-inductance L to build up the current I , obtain the expression for the magnetic energy in terms of the magnetic field B , area A and length l of the solenoid having n number of turns per unit length. Hence show that the energy density is given by $B^2/2\mu_0$.

19. (a) When an ac source is connected to an ideal capacitor, show that the average power supplied by the source over a complete cycle is zero.

(b) A lamp is connected in series with a capacitor. Predict your observations when this combination is connected first across a d.c. and then an a.c. source. What will happen in each case if the capacitance of the capacitor is reduced?

20. A small bulb (assumed to be a point source) is placed at the bottom of a tank containing water to a depth of 80 cm. Find out the area of the surface of water through which light from the bulb can emerge. Take the value of the refractive index of water to be $4/3$.

21. What is meant by 'detection of a modulated signal'? Draw a block diagram of a detector for AM waves and state briefly, showing the waveforms, how the original message signal is obtained.

OR

Write the function of each of the following used in a communication system: (i) Transducer (ii) Repeater (iii) Transmitter.

22. (a) Define electric flux. Write its S.I. unit.

(b) Consider a uniform electric field $\vec{E} = 3 \times 10^3 \hat{i}$ N/C. Calculate the flux of this field through a square surface of area 10 cm^2 when (i) its plane is parallel to the y-z plane, and (ii) the normal to its plane makes a 60° angle with the x-axis.

23. (a) The number of nuclei of a given radioactive sample at time $t = 0$ and $t = T$ are N_0 and N_0/n respectively. Obtain an expression for the half-life ($T_{1/2}$) of the nucleus in terms of n and T .

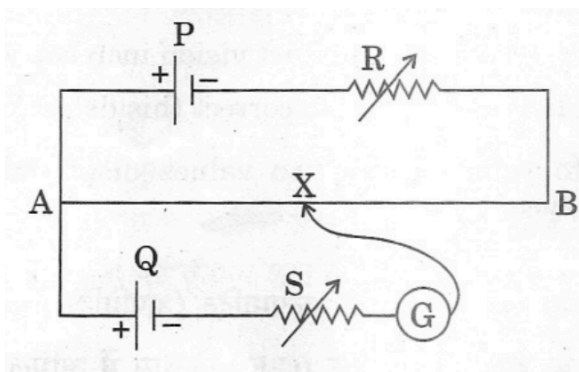
(b) Write the basic nuclear process underlying β^- decay of a given radioactive nucleus.

24. (a) State three important properties of photons which describe the particle picture of electromagnetic radiation.

(b) Use Einstein's photoelectric equation to define the terms (i) stopping potential and (ii) threshold frequency.

25. State the underlying principle on which a potentiometer works. Write two factors on which the sensitivity of a potentiometer depends.

In the potentiometer circuit shown in the figure, the balance point is at X. State, giving reason, how the balance point is shifted when (i) resistance R is increased? (ii) resistance S is increased, keeping R constant?



26. Amit's uncle was finding great difficulty in reading a book placed at normal distance. He was not going to the doctor because he could not afford the cost. When Amit came to know of it, he took his uncle to the doctor. After thoroughly checking his eyes, the doctor prescribed the proper lenses for him. Amit bought the spectacles for his uncle from his pocket money. By using spectacles he could now read with great ease. For this, he expressed his gratitude to his nephew.

Based on the above paragraph, answer the following:

(a) (i) Why does least distance of distinct vision increase with age? (ii) What type of lens is required to correct this defect?

(b) What, according to you, are the two values displayed by Amit towards his uncle?

27. (a) Why is the base region of a transistor thin and lightly doped?

(b) Draw the circuit diagram for studying the characteristics of an n-p-n transistor in common emitter configuration. Sketch the typical (i) input and (ii) output characteristics in this configuration.

(c) Describe briefly how the output characteristics can be used to obtain the current gain in the transistor.

OR

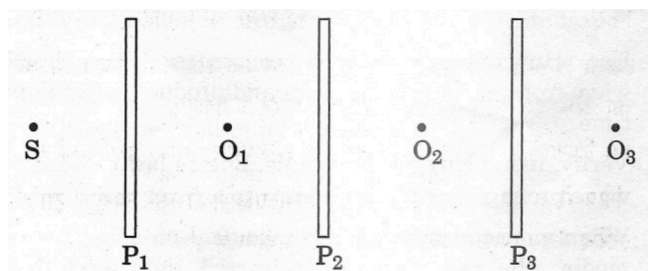
(a) How is a depletion region formed in a p-n junction?

(b) With the help of a labelled circuit diagram, explain how a junction diode is used as a full wave rectifier. Draw its input, output wave-forms.

(c) How do you obtain steady d.c. output from the pulsating voltage?

28. (a) Describe briefly how unpolarized light gets linearly polarized after passing through a polaroid.

(b) Three identical polaroid sheets P_1 , P_2 and P_3 are oriented so that the pass axis of P_2 and P_3 are inclined at angles of 60° and 90° respectively with respect to the pass axis of P_1 . A monochromatic source S of unpolarized light of intensity I_0 is kept in front of the polaroid sheet P_1 as shown in the figure. Determine the intensities of light as observed by the observers O_1 , O_2 and O_3 as shown.



OR

(a) Use Huygens' geometrical construction to show how a plane wave-front at $t = 0$ propagates and produces a wave-front at a later time.

(b) Using Huygens' principle, verify Snell's law of refraction for a plane wave, for a plane wave going from a denser medium to a rarer medium.

(c) When monochromatic light is incident on a surface separating two media, the reflected light and the refracted light both have the same frequency. Explain why.

29. State Biot-Savart law and express it in vector form. Use it to obtain an expression for the magnetic field at an axial point of a circular coil carrying current I , radius a , at a distance d from the centre of the coil. Also find the ratio of the magnitudes of the magnetic field at the centre of the coil and at an axial point for which $d = a\sqrt{3}$.

OR

(a) Draw the magnetic field lines due to a current carrying loop.

(b) State, using a suitable diagram, the working principle of a moving coil galvanometer. What is the function of the radial magnetic field and the soft iron core used in it?

(c) For converting a galvanometer into an ammeter, a shunt resistance of small value is used in parallel, whereas in the case of a voltmeter a resistance of large value is used in series. Explain why.

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