विद्या सर्वार्थि साधिका

ANANDALAYA
FIRST PRE-BOARD EXAMINATION
CLASS –XII

Subject: PHYSICS M.M: 70
Date : 30 /11/ 2015 Time: 3 Hour

General Instructions

1. All questions are compulsory. There are 26 questions in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
4. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. 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 $\mu_o = 4\pi \times 10^{-7}$ 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}	$m_e = 9.1 \times 10^{-31}$ kg mass of neutron = 1.675×10^{-27} kg mass of proton = 1.673×10^{-27} kg Avogadro's number = 6.023×10^{23} per gram mole Boltzmann constant = 1.38×10^{-23} JK^{-1}

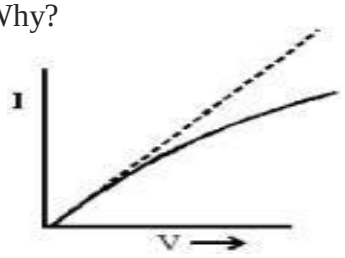
Section A

1. A planar loop of rectangular shape is moved within the region of a uniform magnetic field acting perpendicular to its plane. What is the direction and magnitude of the current induced in it? 1

2. A device X can convert one form of energy into another. Another device Y can be regarded as a combination of a transmitter and a receiver. Name the devices X and Y used in a communication system. 1

3. When light travels from an optically denser medium to a rarer medium, why does the critical angle of incidence depend on the colour of light? 1

4. The I-V characteristics of a resistor are observed to deviate from a straight line for higher values of current as shown below. Why? 1



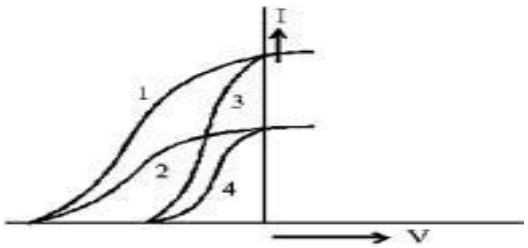
5. Identify the nature of radioactive radiations emitted in each step of the decay process given: 1

$^{A}_{Z}X$ $^{A-4}_{Z-2}Y$ $^{A-4}_{Z-1}W$

Section B

6. A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R1 in series with the coil. If a resistance R2 is connected in series with it, then it can measure upto V/2 volts. Find the resistance G of the galvanometer in terms of R1 and R2. 2

7. The given graphs show the variation of photo electric current (I) with the applied voltage (V) for two different materials and for two different intensities of the incident radiations. Identify the pairs of curves that correspond to different materials but same intensity of incident radiations. 2



8. Show that the radius of the orbit in hydrogen atom varies as n^2, where n is the principal quantum number of the atom. **(OR)** 2
Draw a plot of potential energy of a pair of nucleons as a function of their separations. Mark the regions where the nuclear force is (i) attractive and (ii) repulsive.

9. Figure shows a triangular prism of glass. A ray incident normal on one face is totally reflected. What can you conclude about the minimum value of index of refraction of glass? 2

10. Write Einstein's photoelectric equation and mention which important features in photoelectric effect can be explained with the help of this equation. 2

Section C

11. (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. 3
(b) Light of wavelength 5000 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?

12. (a) Define electrostatic potential at a point. 3
Write its S.I unit.
(b) Three point charges q_1, q_2 and q_3 are kept respectively at points A, Band C as shown in the figure. Derive an expression for the electrostatic potential energy of the system.

OR

Dipole is made up of two charges + q and – q separated by a distance 2a. Derive an expression for the electric field E_{eq} due to this dipole at a point distant r from the centre of the dipole on the equatorial plane.

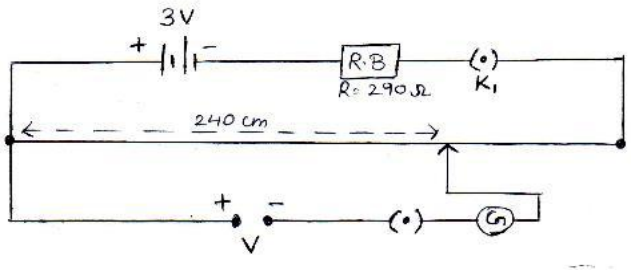
13. An alternating e.m.f. of 110 V is applied to a circuit containing a resistance of 40 Ω and an inductance L in series. The current is found to lag behind the voltage by an angle $\phi = \tan^{-1}$ ¾. Find the (a) inductive reactance, (b) impedance of the circuit and (c) current flowing in the circuit. If the inductance has a value of 0.1H, find the frequency of the applied e.m.f. 3

14. (a) What type of waves show the property of polarization? . 3
(b) Find an expression for intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids. In which position of the polaroid sheet will the transmitted intensity be maximum?

15. Distinguish between diamagnetic and ferromagnetic materials in respect of their 3
(i) intensity of magnetization, (ii) behavior in a non uniform field and (iii) susceptibility.

16. Two cells of EMF 1V, 2V and internal resistances 2 Ω and 1 Ω respectively are connected in (i) series, (ii) parallel. What should be the external resistance in the circuit so that the current through the resistance be the same in the two cases? In which case more heat is generated in the cells? 3

17. A 400 cm long potentiometer wire of uniform cross section of 10 Ω is connected in series with a battery of 3V, along with an external resistance 290 Ω. If an unknown emf V is balanced at 240cm of this wire. 3



Calculate
(i) the potential gradient of the potentiometer wire and (ii) the value of unknown emf V.

18. (a) In the study of Geiger-Marsdon experiment on scattering of α particles by a thin foil of gold, draw the trajectory of α-particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study. 3
(b) From the relation $R = R_0 A^{1/3}$, where R_0 is constant and A is the mass number of the nucleus, show that nuclear matter density is independent of A.

19. With what considerations in view, a photodiode is fabricated? 3
Explain its working with the help of a suitable diagram. Even though the current in the forward bias is known to be more than in the reverse bias, yet the photodiode works in reverse bias. What is the reason?

20. A capacitor of capacitance 'C' is being charged by connecting it across a dc source along with an ammeter. Will the ammeter show a momentary deflection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Write the expression for the current inside the capacitor. 3

21. (a) Name the type of waves which are used for line of sight (LOS) communication. (b) What is the range of their frequencies? 3
(c) A transmitting antenna at the top of a tower has a height of 45 m and the height of the receiving antenna is 80 m. Calculate the maximum distance between them for satisfactory communication in LOS mode. (Radius of the Earth = 6.4×10^6 m)

22. A charged particle moving with a uniform velocity V enters a region where uniform electric and magnetic fields E and B are present. It passes through the region without any change in its velocity. 3
(i) What is the name of this set up?
(i) Write the relative directions of E, B and V.
(iii) How are the magnitudes of E and B related?

Section D

23. A group of students while coming from the school noticed a box marked "Danger H.T. 2200 V" at a substation in the main street. They did not understand the utility of a such a high voltage, while they argued, the supply was only 220 V. They asked their teacher this question the next day. The teacher thought it to be an important question and therefore explained to the whole class. Answer the following questions: 4
(a) What device is used to bring the high voltage down to low voltage of a.c. current and what is the principle of its working ?

(b) Is it possible to use this device for bringing down the high dc voltage to the low voltage? Explain

(c) Write the values displayed by the students and the teacher.

Section E

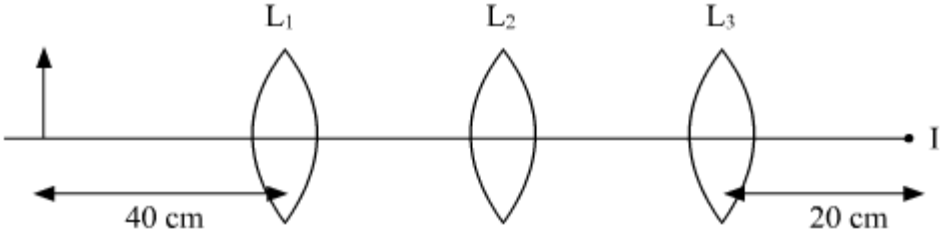
24. (a) Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence obtain the conditions for the angular width of secondary maxima and secondary minima. 5

(b) Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture 2×10^{-6} m. The distance between the slit and the screen is 1·5 m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.

OR

(a) Draw a labelled ray diagram of a refracting telescope. Define its magnifying power and write the expression for it. Write two important limitations of a refracting telescope over a reflecting type telescope.

(b) You are given three lenses L_1, L_2 and L_3 each of focal length 20 cm. A object is kept at 40 cm in front of L1, as shown. The final real image is formed at the focus 'I' of L_3. Find the separation between L_1, L_2 and L_3.



25. (a) State Gauss's law in electrostatics. Show, with the help of a suitable example along with the figure, that the outward flux due to a point charge 'q', in vacuum within a closed surface, is independent of it size or shape and is given by q/ε_o. 5

(b) Two parallel uniformly charged infinite plane sheets, '1' ans '2', have charge densities +σ and -2σ respectively. Give the magnitude and direction of the net electric field at a point (i) in between the two sheets and (ii) outside near the sheet '1'.

OR

(a) Derive an expression for the energy stored in a parallel plate capacitor. Hence show that electric field E is a source of energy with energy density $\frac{1}{2}\varepsilon_0 E^2$ Jm^{-1}

(b) A parallel plate capacitor of plate area A and separation d is charged to a potential V. The battery is then disconnected and a dielectric slab of thickness d and dielectric constant K is inserted in the capacitor. What change, if any, will take place in (i) Electric field between the plates and (ii) Capacitance of the capacitor.

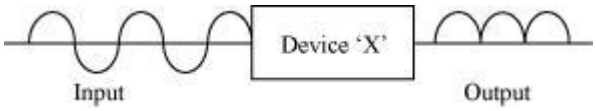
26. (a) Draw a circuit diagram of a transistor amplifier in CE configuration. 5

(b) Define the terms : (i) Input resistance and (ii) Current amplification factor. How are these determined using typical input and output characteristics?

OR

(a) Explain the formation of depletion layer and potential barrier in a p−n junction.

(b) In the figure given below the input waveform is converted into the output waveform by a device 'X'. Name the device and draw its circuit diagram.



(c) Identify the logic gate represented by the circuit as shown and write its truth table.