B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

PRE-BOARD-1 EXAMINATION (2025-26)

PHYSICS (042)

Class: XII **Time: 3hrs**
Date: 04.11.25 **Max Marks: 70**
Admission no: **Roll no:**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: 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. $\mu_0 = 4\pi \times 10^{-7}$ $Tm\boldsymbol{A^{-1}}$
v. $h = 6.63 \times 10^{-34}$ Js vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$ vii. Avogadro's number = 6.023×10^{23} per gram mole

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SECTION-A (16 Q X 1 M= 16 M)

1. 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 2 cm is
   (a) 7 µC (b) 8 mC (c) 2 mC (d) 5 mC

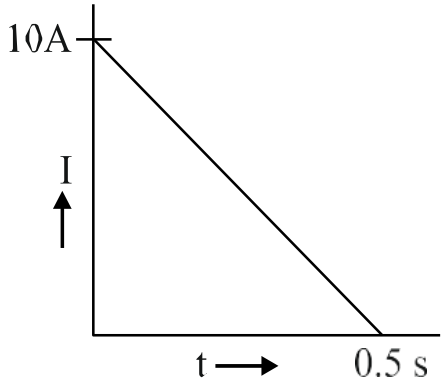
2. Which of the following is non-ohmic resistance?
   (a) Lamp filament (b)Copper wire (c) Carbon resistor (d)Diode

3. An ammeter of resistance 0.81 ohm reads up to 1 A. The value of the required shunt to increase the range to 10 A is
   (a) 0.9 ohm (b) 0.09 ohm (c) 0.03 ohm (d) 0.3 ohm

4. An electron is moving along positive x-axis in a magnetic field which is parallel to the positive y-axis. In what direction will the magnetic force be acting on the electron?

(a) Along -x axis (b) Along -z axis (c) Along +z axis (d) Along -y axis

5. In a coil of resistance 100 Ω, a current is induced by changing the magnetic flux through it. The variation of current with time is as shown in the figure. The magnitude of change in flux through coil is



(a) 200 Wb (b) 275 Wb (c) 225 Wb (d) 250 Wb

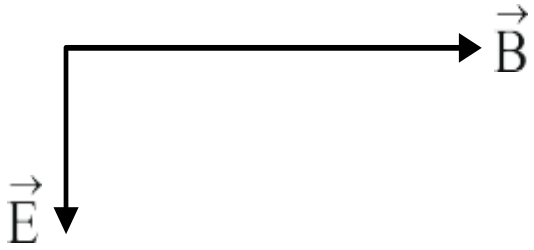
6. The large scale transmission of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up because of

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

7. What is the frequency of a 5μF capacitor that has a reactance of 1000 Ω?

(a) 200 cycle/sec (b) 100/π cycle/sec (c)5000 cycles/sec (d) 1000/π cycles/sec

8. 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**

9. If a medium has a critical angle for total internal reflection from the medium to vacuum as 300, what is the velocity of light in the medium?

(a) 0.5 × 108 m/s (b)3 × 108 m/s (c) 1.5 × 108 m/s (d) 0.2 × 108 m/s

10. A How does the diffraction band of blue light look in comparison with the red light?

(a) No changes (b) Diffraction pattern becomes narrower

(c) Diffraction pattern becomes broader (d) Diffraction pattern disappears

11. The energy of an electron in nth orbit of hydrogen atom is En= - 13.6/$n2eV$.The negative sign of energy indicates that

(a) Electron is free to move. (b) Electron is bound to the nucleus.

(c) Kinetic energy of electron is equal to potential energy of electron. (d) Atom is radiating energy.

12. For which one of the following, Bohr model is not valid?

(a) He+ (b) deuteron (c) Ne+ (d) Hydrogen Atom

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled 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): If there exists coulomb attraction between two bodies, both of them may not be charged.
Reason (R): In coulomb attraction two bodies are oppositely charged.

14. Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface.

Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

15. Assertion (A): It is necessary to have two waves of equal intensity to study interference pattern.
Reason(R): There will be an effect on clarity if the waves are of unequal intensity.

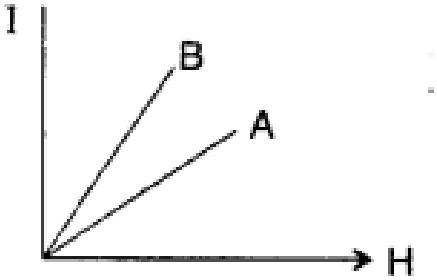
16. Assertion (A): Bohr had to postulate that the electrons in stationary orbits around the nucleus do not radiate.
Reason(R): According to classical physics all moving electrons radiate.

SECTION-B (5Q X 2M=10M)

17. Two charges +3 μC and −2μC are placed 4 m apart. Find the potential at the midpoint.

18. Two wires have same resistance. One is made of copper and other manganin. If they are equally thick which of the two must be longer.

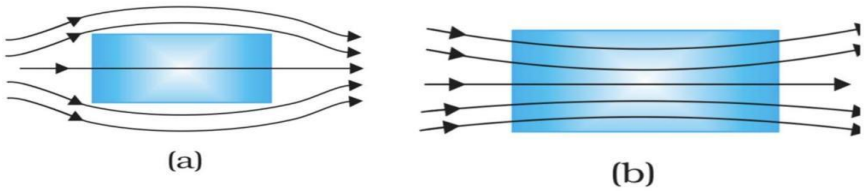
19. The figure shows the variation of intensity of magnetisation versus the applied magnetic field intensity, H, for two magnetic materials A and B: 2



(a) Identify the materials A and B.
(b) Why does the material B, has a larger susceptibility than A, for a given field at constant temperature?

OR

A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it.



(i)Identify the specimen A and B.

(ii) How is the magnetic susceptibility of specimen 'A' different from that of specimen 'B'?

20. Identify the part of the electromagnetic spectrum which: 2

(a) Produces heating effect,

(b) is absorbed by the ozone layer in the atmosphere,

Write any one method of the production of each of the above radiations.

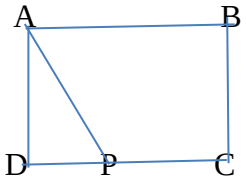
21. The wavelength λ of a photon and the de Broglie wavelength of an electron of mass m have the same value. Show that the energy of the photon is 2λmc/h times the kinetic energy of the electron, where c and h have their usual meanings.

OR

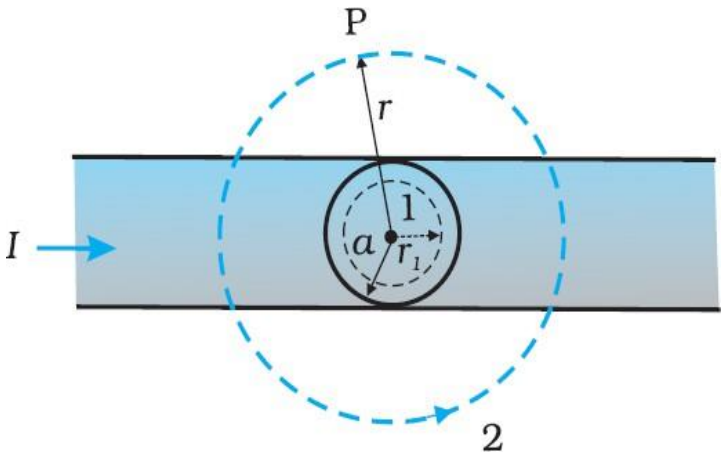
An α-particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelengths.

SECTION-C (7Q X3M=21M)

22. A wire of uniform cross-section and resistance 4 ohm is bent in the shape of square ABCD. Point A is connected to a point P on DC by a wire AP of resistance 1 ohm. When a potential difference is applied between A and C, the points B and P are seen to be at the same potential. What is the resistance of the part DP?

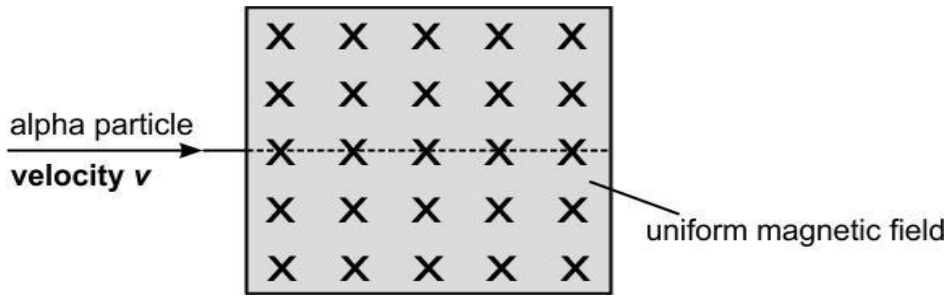


23. The given figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross- section. Calculate the magnetic field in the region r < a and r > a.



Or

An alpha particle is moving with a velocity v. It enters a magnetic field (B) as shown below. The magnetic field is perpendicular and into the plane of paper. 3



(a) A uniform electric field is applied in the same region as the magnetic field so that the alpha particle passes un-deviated through the combined fields. What should be the direction of the electric field?

(b) Without any change in the electric field and magnetic field, the alpha particle is replaced by the following particles:

(i) Proton moving with a velocity 'v'

(ii) Electron moving with a velocity v/2,

Will there be a deviation in the path of particles? Give a reason for your answer.

24. Two long straight parallel current carrying conductors are kept 'a' distant apart in air. The direction of current in both the conductors is same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere.

25. In an astronomical telescope in normal adjustment a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line whose length is l. What is the angular magnification of the telescope?

26. What is wave front? Derive laws of reflection using wave optics concepts.

27. A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of Cu atoms (of mass 62.92960 u). Given m_p = 1.007825u and m_n = 1.008665u.

28. (a) Explain the formation of depletion layer and potential barrier in a p-n junction.
(b) In fig input waveform is converted into output waveform by device X. Name the device and draw its circuit diagram.

SECTION-D **(2Q X4M= 8M)**

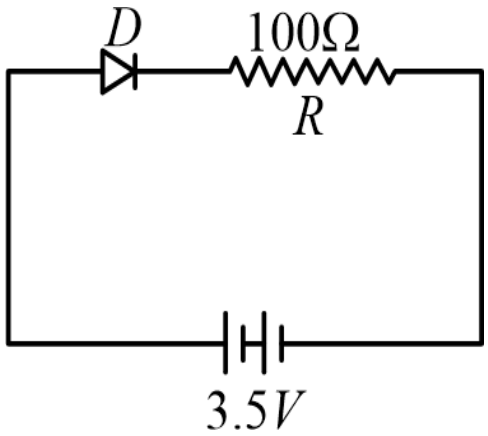
Case Study Based Questions

29. Read the following paragraph and answer the questions that follow.

A semiconductor diode is basically a pn junction with metallic contacts provided at the ends for the application of an external voltage. It is a two terminal device. When an external voltage is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal, it is said to be forward biased. When an external voltage is applied across the diode such that n-side is positive and p-side is negative, it is said to be reverse biased. An ideal diode is one whose resistance in forward biasing is zero and the resistance is infinite in reverse biasing. When the diode is forward biased, it is found that beyond forward

voltage called knee voltage, the conductivity is very high. When the biasing voltage is more than the knee voltage the potential barrier is overcome and the current increases rapidly with increase in forward voltage. When the diode is reverse biased, the reverse bias voltage produces a very small current about a few microamperes which almost remains constant with bias. This small current is reverse saturation current.

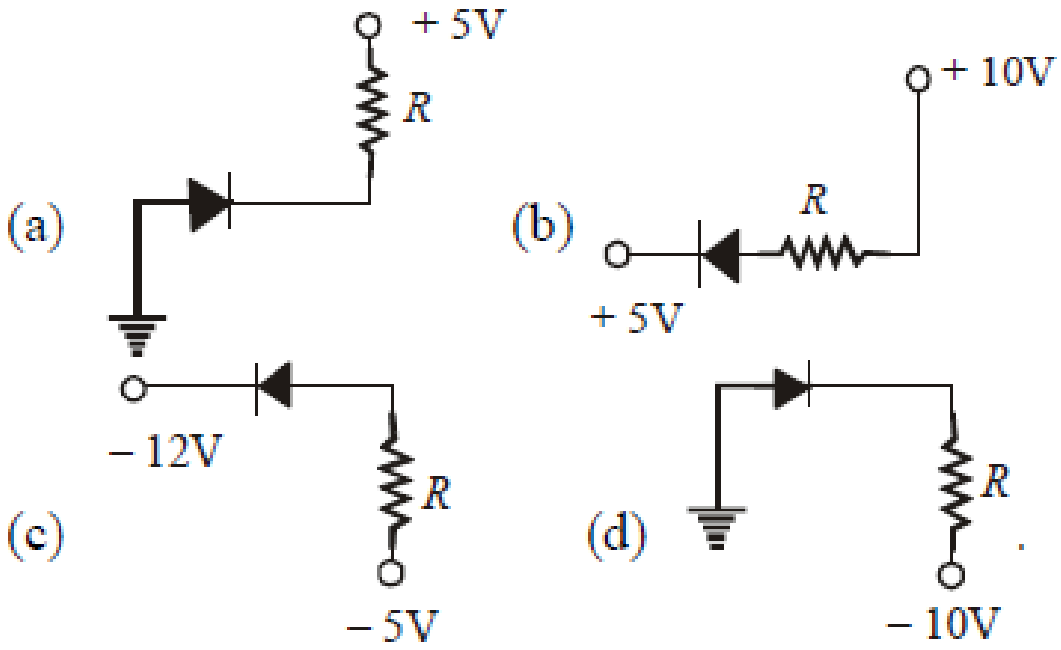
(i) In the given figure, a diode D is connected to an external resistance R = 100 Ω and an emf of



3.5 V. If the barrier potential developed across the diode is 0.5 V, the current in the circuit will be:

(a) 40 mA (b) 20 mA (c) 35 mA (d) 30 mA

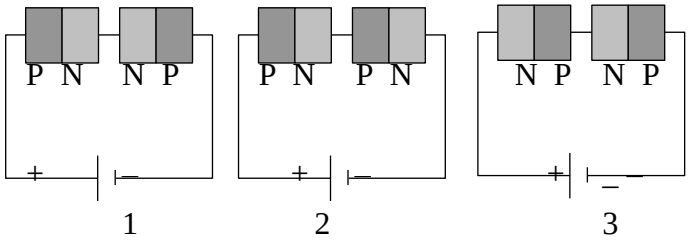
(ii) In which of the following figures, the pn diode is reverse biased?



(iii) Based on the V-I characteristics of the diode, we can classify diode as

(a) Bilateral device (b) ohmic device (c) non-ohmic device (d) passive element

(iv) Two identical PN junctions can be connected in series by three different methods as shown in the figure. If the potential difference in the junctions is the same, then the correct connections will be

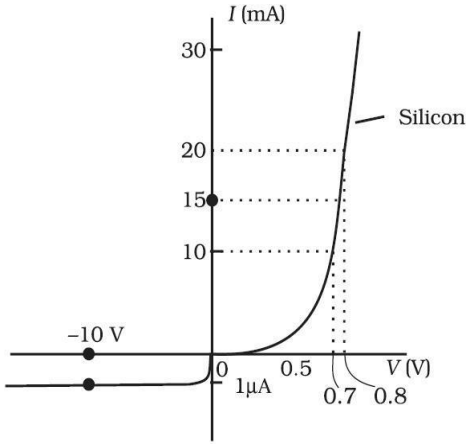


(a) In the circuits (1) and (2) (b) in the circuits (2) and (3)

(c) In the circuits (1) and (3) (d) only in the circuit (1)

Or

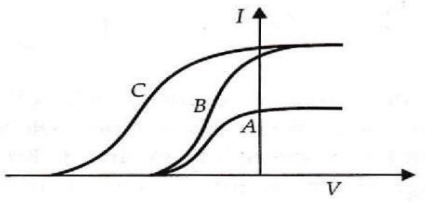
(iv) The V-I characteristic of a diode is shown in the figure. The ratio of the resistance of the diode at I = 15 mA to the resistance at V = -10 V is



(a) 100 (b) 10^6 (c) 10 (d) 10^{-6}

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 photoelectrons. 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.



Find the relation of cutoff voltage and saturation current between A, B and C based on the above figure. (2)

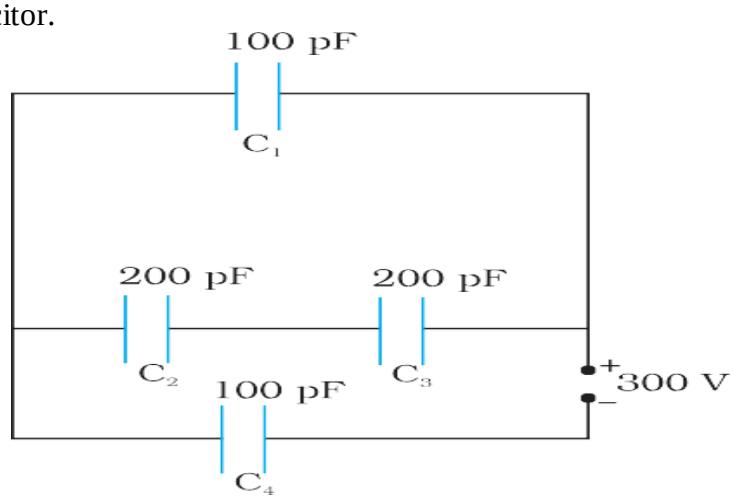
(ii) Under what conditions photoelectrons are emitted from a zinc plate. (1)

(iii) If the threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 500 nm. Calculate its work function. (1)

SECTION-E

31. (i) Derive an expression for the capacitance of a parallel plate capacitor with air present between the two plates. (3)

(ii) Obtain the equivalent capacitance of the network shown in figure. For a 300 V supply, determine the charge on each capacitor.

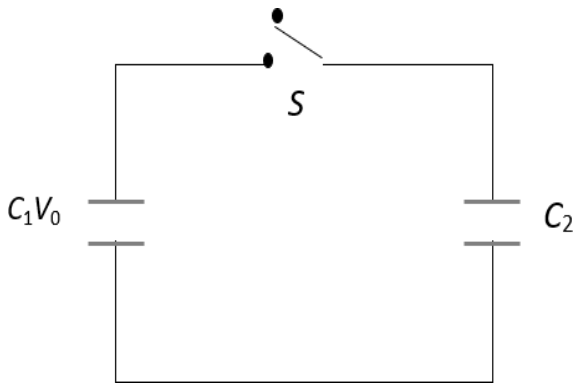


2

Or

(i) A dielectric slab of thickness 't' is kept between the plates of a parallel plate capacitor with plate separation 'd' ($t < d$). Derive the expression for the capacitance of the capacitor.

(ii) A capacitor of capacity C_1 is charged to the potential of V_o. On disconnecting with the battery, it is connected with an uncharged capacitor of capacity C_2 as shown in the adjoining figure. Find the ratio of energies before and after the connection of switch S.



32. (i) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source.
(ii)Draw the phasor diagram for a series LRC circuit connected to an AC source.
(iii) 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.
(a) Name the devices X and Y.
(b) Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

Or

(i) A series LCR circuit is connected to an ac source. Using the phasor diagram, derive the expression for the impedance of the circuit.
(ii) 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 R1 and R2 (R1< R2) at resonance.

33. (i) Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R1 and R2. Hence derive lens maker's formula. (3)
(ii) 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. (2)

Or

(i) Draw a labeled diagram of compound microscope when final image is formed at least distance of distinct vision.
(ii) A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at:
(a) The least distance of distinct vision (25 cm)?
(b) Infinity? What is the magnifying power of the microscope in each case?

ALL THE BEST