INDIAN SCHOOL ALWADI ALKABIR
CLASS 12
PHYSICS SAMPLE PAPER - 3

General Instructions:

(1) All questions are compulsory. There are 33 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 ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

(4) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

Section – A

All questions are compulsory. In case of internal choices, attempt any one of

them.

1. Two identical balls having equal positive charge ‘q’ coulombs are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two?

2. If the length of a conductor is doubled by stretching it keeping potential difference constant, by what factor does the drift speed of the electron change?

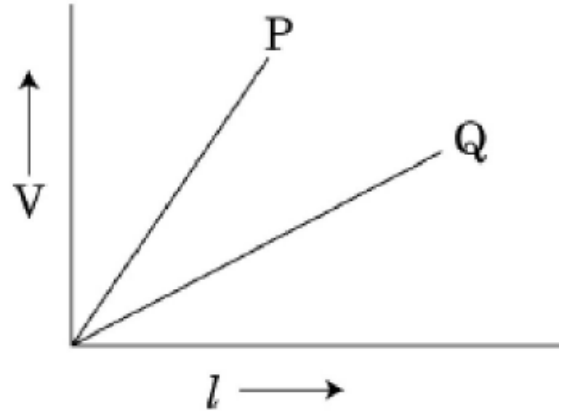
3. Why are infra-red radiations referred to as heat waves?

OR

The frequency of oscillation of the electric vector of a certain electromagnetic wave is 5×10^{14} Hz. What is the frequency of oscillation of the corresponding magnetic field vector ? Which part of the electromagnetic spectrum does it belong?

4. The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding, how will the focal length and power of the lens change?

5. The variation of potential difference 'V' with length l in case of two potentiometer wires P and Q is shown. Which one of these will you prefer for comparing emfs of two primary cells? Why?



6. A square loop of side 10 cm and resistance 0.5 Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in the north-east direction. The magnetic field is

decreased to zero in 0.70 s at a steady rate. Determine the magnitudes of induced emf during this time-interval.

OR

In a series LCR circuit, the voltage across an inductor, a capacitor and a resistor are 30 volt, 30 volt and 60 volt respectively. What is the phase difference between the applied voltage and current in the circuit?

7. When light travels from a rarer to a denser medium, the speed decreases. Does the reduction in speed imply a reduction in the energy carried by the light wave?

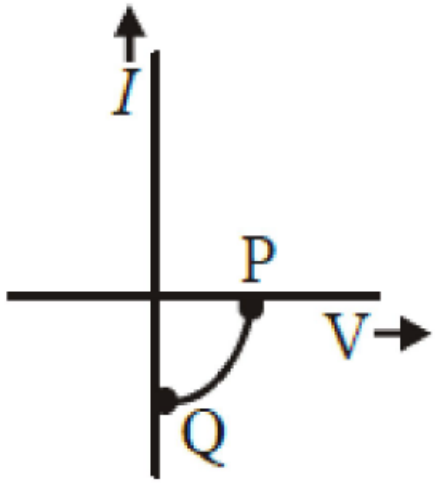
OR

If the path difference produced due to interference of light coming out of two slits for yellow colour of light at a point on the screen be $3\lambda/2$, what will be the colour of the fringe at the point?Give reason also.

8. A proton and an α – particle are accelerated, using the same potential difference. How are the de-Broglie wavelengths λ p and λ α related to each other?

9. (i)Name the type of diode whose characteristic curve is shown.

(ii)What does the point P in the given figure represent?



10. How does the angle of minimum deviation of a glass prism of refractive index 1.5 change, if it is immersed in a liquid of refractive index of 1.3?

For question numbers 11, 12, 13 and 14, two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

b) Both A and R are true but R is NOT the correct explanation of A

c) A is true but R is false

d) A is false and R is also false

11. Assertion(A):When the temperature of a conductor is increased, its resistance increases.

Reason(R): Free electrons start colliding faster.

12. Assertion(A): In Young's experiment, the fringe width for dark fringes is same as that for white fringes.

Reason(R): In Young's double slit experiment performed with a source of white light, only black and bright fringes are observed.

13. Assertion(A): When a negative (retarding) potential is given to the collector plate with respect to the emitter plate and make it increasingly negative gradually, the photocurrent is found to decrease rapidly and it drops to zero at stopping potential.

Reason(R): All the photoelectrons emitted from the metal do not have the same energy.

14. Assertion(A): 1 amu =931.5MeV

Reason(R): The density of nucleus is a constant, independent of mass number, for all nuclei.

Section – B

Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

15. Semiconductors

Semiconductors are the basic building block of modern electronics, including transistors, pn junction diodes, rectifiers, photodiodes, solar cells, LEDs, digital and analog integrated circuits. Semiconductors have crystalline structure and contains very few electrons at room temperature. Its resistivity lies between that of conductors and insulators A pure semiconductor is called as intrinsic semiconductor. The semiconductor with suitable impurity atom added to it is called extrinsic semiconductor which is of two types- n-type and p-type semiconductors.

(i)An n-type semiconductor is

a. Positively charged

b. Negatively charged

c. Uncharged

d. Uncharged at 0 K but charged at higher temperatures

(ii)When an impurity is doped into an intrinsic semiconductor, the conductivity of the semiconductor
a. Decreases

b. Increases

c. Remain the same

d. Becomes zero

(iii)The Fermi level in p-type semiconductor lies

a. Half way in the energy gap

b. Above the valence band in energy gap

c. Below the conduction band in the energy gap

d. Any of the above

(iv)Which of the following statements is wrong?

a. Electrons are the majority carriers in n-type semiconductors

b. Impurity atoms are called donor in p-type semiconductors

c. Number of free electrons is equal to number of holes in intrinsic semiconductors

d. The difference in the resistivity of C, Si and Ge depends upon the energy gap

(v)The depletion layer in the p-n junction arises due to

a. Drift of holes

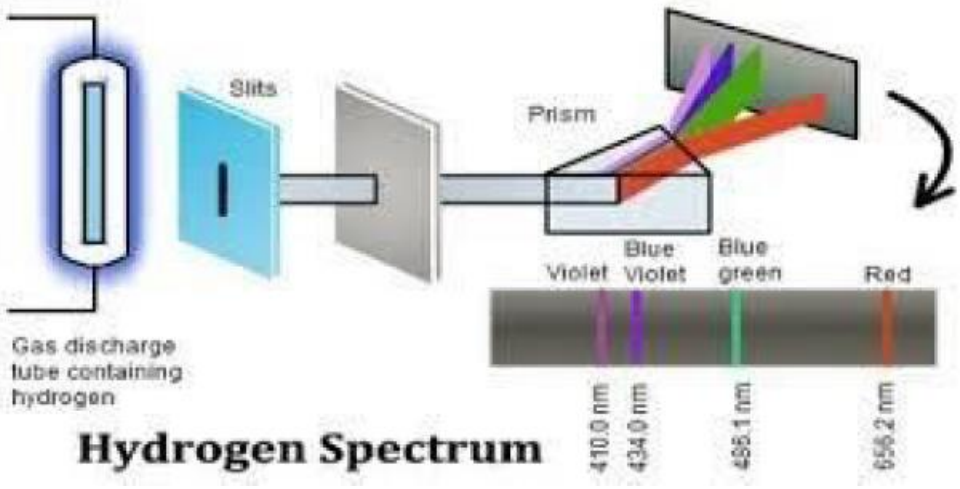
b. Drift of electrons

c. Diffusion of charge carriers

d. Migration of impurity ions

16.Hydrogen spectrum

Electrons in an atom or a molecule absorb energy and get excited, they jump from a lower energy level to a higher energy level and they emit radiation when they come back to their original states. This phenomenon accounts for the emission spectrum through hydrogen also, better known as hydrogen emission spectra.



(i)If 13.6eV of energy is needed to ionize the hydrogen atom, then energy needed to remove electron from n=2 is ---

a. 10.2eV

b. 0eV

c. 3.4eV

d. 6.8eV

(ii)The longest wavelength in Balmer series is

a. H α

b. H β

c. Hγ

d. H δ

(iii)The hydrogen spectrum which lies in the ultraviolet region is

a. Brackett

b. Paschen

c. Lyman

d. Balmer

(iv)On moving up the energy states of H-like atoms, the energy difference between consecutive energy states

a. Increase

b. Decrease

c. Remain the same

d. May increase or decrease

(v)The Bohr atom model

a. Assumes that the angular momentum of electrons is quantized

b. Uses Einstein's photoelectric equation

c. Predicts continuous emission spectrum for atoms

d. None of these

Section – C

All questions are compulsory. In case of internal choices, attempt anyone.

17. What is a light emitting diode (LED)? Mention two important advantages of LEDs over conventional lamps.

18. A charge having magnitude Q is divided into two parts q and (Q - q). If the two parts exert a maximum force of repulsion on each other, then find the ratio of q/Q.

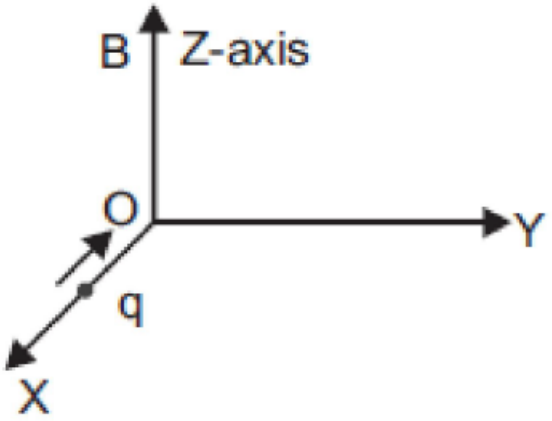
OR

Derive the expression for the electric potential at a point distant r from a point charge q.

19. A cell of emf ε and internal resistance r is connected across a variable resistance R. Plot a graph showing the variation of terminal voltage V of the cell verses the current I. Using the graph, show how the emf of the cell and its internal resistance be determined.

20. A charge ‘q’ moving along the X-axis with a velocity v is subjected to a uniform magnetic field B acting along the Z-axis as it crosses the origin O. (i) Trace its trajectory. (ii) Does the charge gain kinetic energy as it enters the magnetic field?

Justify your answer.



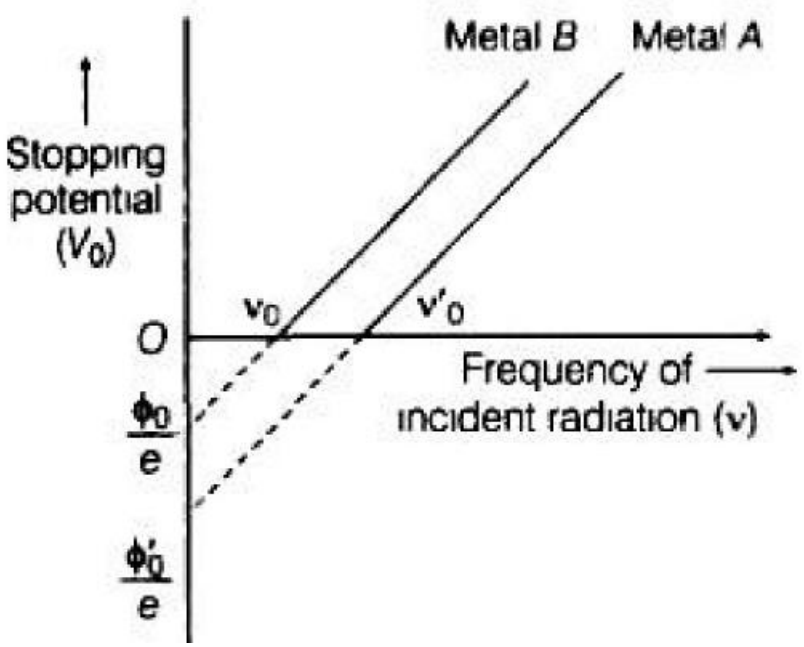
21. A series LCR circuit with L = 4.0 H, C = 100 mF and R = 60 is connected to a Ω variable frequency 240 V source. Calculate: (i) the angular frequency of the source which derives the circuit at resonance; (ii) the current at the resonating frequency.

OR

A circular copper disc 10 cm in radius rotates at a speed of 2π rad/s about an axis through its centre and perpendicular to the disc. A uniform magnetic field of 0.2T acts perpendicular to the disc. (i) Calculate the potential difference developed between the axis of the disc and the rim. (ii) What is the induced current if the resistance of the disc is 2Ω ?

22. A wire AB is carrying a current of 12Aand is lying on the table. Another wire CD, carrying a current of 5A, is arranged just above AB at a height of 1mm. What should be the weight per unit length of this wire so that CD remains suspended at its position? Indicate the direction of current in CD and the nature of force between the two wires.

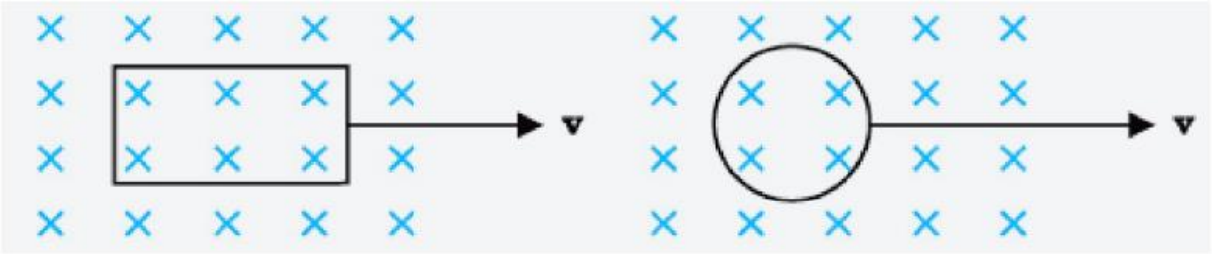
23. (i)The graph shows the variation of stopping potential with frequency of incident radiation for two photosensitive metals A and B. Which one of the two has higher work function? Justify your answer.



(ii)Give any two properties of photon.

24. (i)State Lenz's rule.

(ii) A rectangular loop and a circular loop are moving out of a uniform magnetic field region to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



OR

(i)Define mutual inductance.

(ii) How is the mutual inductance of a pair of coils affected when : (a) Separation between the coils is increased. (b) The number of turns of each coil is increased?

25. Which constituent radiation of the electromagnetic spectrum is used? (i) To photograph internal parts of human body. (ii) For air aircraft navigation

Section –D

All questions are compulsory. In case of internal choices, attempt any one.

26. A storage battery is of emf 8V and internal resistance 0.5 ohm is being charged by d.c supply of 120 V using a resistor of 15.5 ohm

a) Draw the circuit diagram.

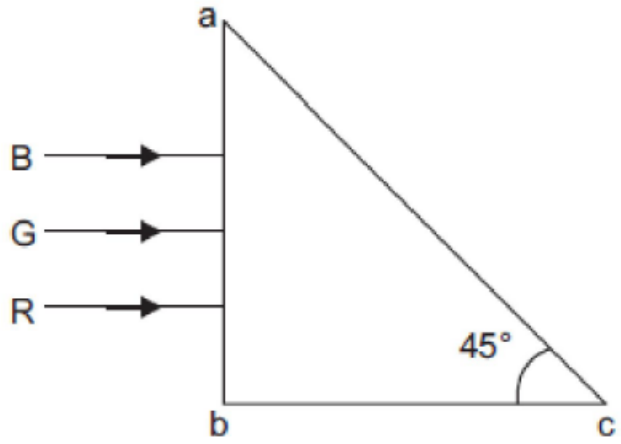
b) Calculate the potential difference across the battery.

c) What is the purpose of having series resistance in this circuit?

27. For a single slit of width a, the first minimum of the diffraction pattern of a monochromatic light of wavelength λ occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum for two narrow slits separated by a distance a. Explain.

OR

Three light rays red (R), green (G) and blue (B) are incident on a right angled prism 'abc' at face 'ab'. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Out of the three which colour ray will emerge out of face 'ac'? Justify your answer. Trace the path of these rays after passing through face 'ab'.



28. (i) If both the number of protons and the number of neutrons are conserved in each nuclear reaction, in what way is mass converted into energy (or vice-versa) in a nuclear reaction?

(ii) Two nuclei have mass numbers in the ratio 1 : 8. What is the ratio of their nuclear radii?
(iii) Draw a graph showing variation of potential energy of a pair of nucleon as a function of their separation indicate the region in which the nuclear force is (a) Attractive (b) Repulsive?

29. Define angle of dip and angle of declination. Deduce the relation connecting angle of dip and horizontal component of earth's total magnetic field with the horizontal direction

30. Draw a schematic diagram of a reflecting telescope (Cassegrain). Write two important advantages that the reflecting telescope has over a refracting type.

Section – E

All questions are compulsory. In case of internal choices, attempt any one.

31. A thin convex lens having two surfaces of radii of curvature R 1 and R 2 is made of a material of refractive index n 2 . It is kept in a medium of refractive index n 1 . Derive, with the help of a ray diagram, the lens maker formula when a point object placed on the principal axis in front of the radius of curvature R1 produces an image I on the other side of the lens.

OR

Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width. What happens to fringe width if the experiment is conducted in water?

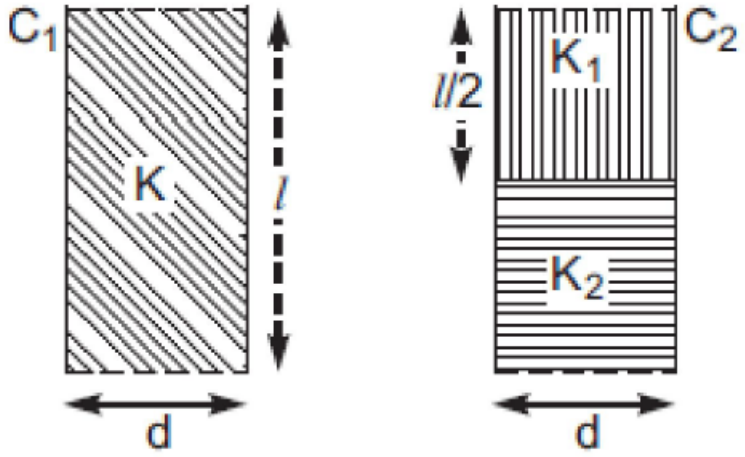
32. (a) Define electric flux. Write its S.I. units.

(b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

OR

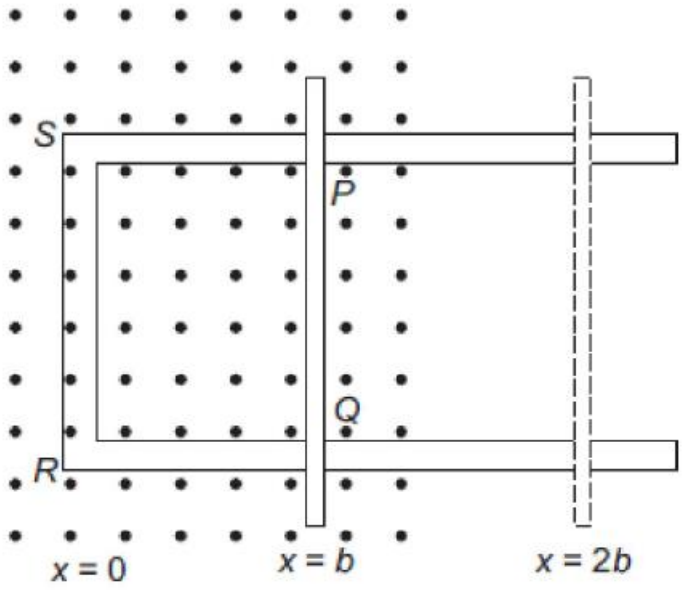
(i)Define dipole moment. Give its unit

(ii)Two identical parallel plate (air) capacitors C 1 and C 2 have capacitances C each. The gap between their plates is now filled with dielectrics as shown. If the two capacitors still have equal capacitance, obtain the relation between dielectric constants K, K1 and K 2 .



33. State Faraday's law of electromagnetic induction.

Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses resistance r. When the arm PQ is pulled outward from x = 0 to x = 2b and is then moved backward to x = 0 with constant speed v, obtain the expressions for the flux and the induced emf. Sketch the variations of these quantities with distance $0 \leq x \leq 2b$.



OR

Draw a schematic diagram of a step-up transformer. Explain its working principle. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the two coils. In an ideal transformer, how is this ratio related to the currents in the two coils? How is the transformer used in large scale transmission and distribution of electrical energy over long distances?