KOTHARI INTERNATIONAL SCHOOL, NOIDA
PRE BOARD EXAMINATION-1, SESSION: 2023-24
GRADE: 12 SUBJECT: PHYSICS (042)
SET B

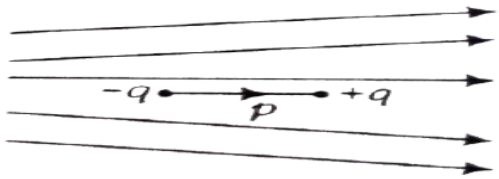
DATE & DAY: NOVEMBER 20, 2023 - MONDAY
MAXIMUM MARKS: 70 **TIME ALLOTTED: 3 HOURS**
NAME: _____ **ROLL NO: _____**

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 4 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 and one question in each CBQ in Section D and all the 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) $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
(v) $h = 6.63 \times 10^{-34}$ Js
(vi) $\varepsilon_0 = 8.854 \times 10^{-12}$ C^{2}N^{-1}m^{-2}
(vii) Avogadro's number = 6.023 X 10^{23} *per gram mole*

SECTION – A

Q1. The electric field lines in which an electric dipole P is placed is shown in figure. Which of the following statements is correct? **(1)**



(a) The dipole will not experience any force.
(b) The dipole will experience a force towards right.
(c) The dipole will experience a force towards left.
(d) The dipole will experience a force upwards.

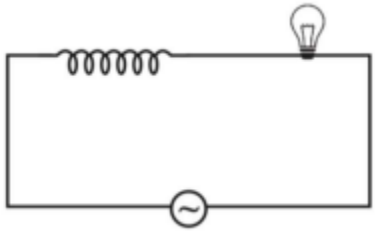
Q2. The self-inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as: **(1)**

(a) l and A increase
(b) l decreases and A increases
(c) l increases and A decreases
(d) both l and A decrease

Q3. When alpha particles are sent through a thin gold foil, most of them go straight through the foil, because **(1)**

(a) alpha particles are positively charged.
(b) the mass of an alpha particle is more than the mass of an electron.
(c) most of the part of an atom is empty space.
(d) alpha particles move with high velocity.

Q4. An iron cored coil is connected in series with an electric bulb with an AC source as shown in figure. When iron piece is taken out of the coil, the brightness of the bulb will **(1)**



(a) decrease
(b) increase
(c) remain unaffected
(d) fluctuate

Q5. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to **(1)**

(a) the speed of light in vacuum
(b) reciprocal of speed of light in vacuum
(c) the ratio of magnetic permeability to the electric susceptibility of vacuum
(d) unity

Q6. In a photoelectric experiment, the stopping- potential for the incident light of wavelength 4000 Å is 2 volt. If the wavelength be changed to 3000 Å, the stopping-potential will be: **(1)**

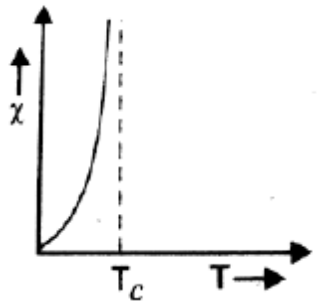
(a) 2V (b) less than 2V (c) zero (d) more than 2V

Q7. 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 **(1)**

(a) 0.9 ohm (b) 0.09 ohm (c) 0.03 ohm (d) 0.3 ohm

Q8. The variation of magnetic susceptibility with the temperature of a ferromagnetic material can be plotted as **(1)**

(a)



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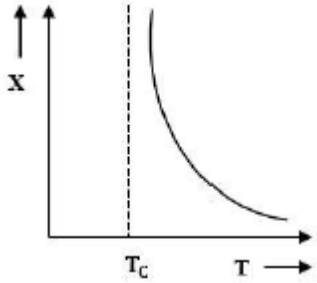

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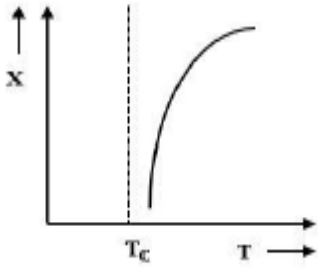
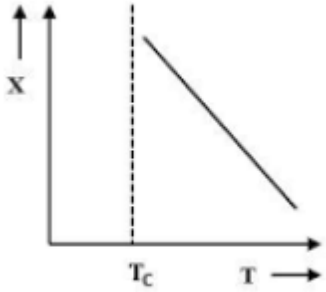


(d)



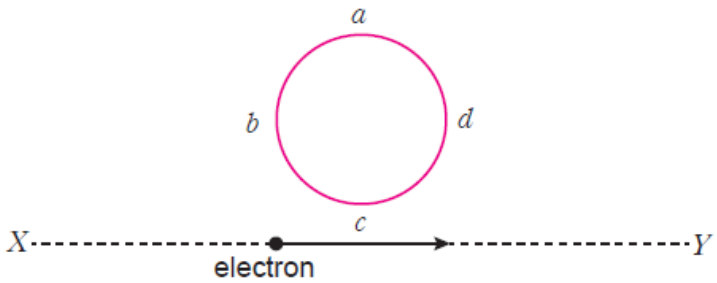
Q9. If the electron in the hydrogen atom jumps from third orbit to second orbit, the wavelength of the emitted radiation in terms of Rydberg constant is **(1)**

(a) 6/5R
(b) 36/5R
(c) 64/7R
(d) 2/R

Q10. According to Coulomb's law, which is the correct relation for the following figure? **(1)**

(a) $q_1\, q_2 > 0$
(b) $q_1\, q_2 < 0$
(c) $q_1\, q_2 = 0$
(d) $1 > q_1/q_2 > 0$

Q11. An electron moves on a straight line path XY as shown. The abcd is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil? **(1)**



(a) The current will reverse its direction as the electron goes past the coil.
(b) No current induced
(c) abcd
(d) adcb

Q12. The sensitivity of a moving coil galvanometer increases with the decrease in: **(1)**
(a) number of turns
(b) area of coil
(c) magnetic field
(d) torsional rigidity

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.

Q13. **Assertion (A):** Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. **(1)**
Reason(R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

Q14. **Assertion (A):** The resistivity of a semiconductor increases with temperature. **(1)**
Reason(R): The atoms of a semiconductor vibrate with larger amplitudes at higher temperature thereby increasing its resistivity.

Q15. **Assertion (A):** In photoelectron emission, the velocity of electron ejected from near the surface is larger than that coming from interior of metal. **(1)**
Reason(R): The velocity of ejected electron will be zero.

Q16. **Assertion (A):** Bohr's third postulate states that the stationary orbits are those for which the angular momentum is some integral multiple of $h/2\pi$. **(1)**
Reason(R): Linear momentum of the electron in the atom is quantised.

SECTION – B

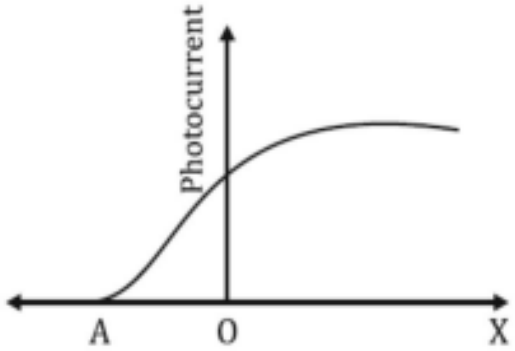
Q17. A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required, if the focal length is 20 cm. **(2)**

Q18. Draw energy band diagrams of an *n*-type and *p*-type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels with their energies. **(2)**

Q19. (i)A battery of emf **E** and internal resistance **r** is connected to a resistance **R** and a current I flows through it. Derive the relation between **E**, **I**, **r** and **R**. **(2)**

(ii) Define relaxation time of the free electrons drifting in a conductor. Write the relation between drift velocity of free electrons and relaxation time.

Q20. The graph shows the variation of photocurrent for a photosensitive metal **(2)**



(a)What does X and A on the horizontal axis represent?
(b)Draw this graph for three different values of frequencies of incident radiation υ_1, υ_2 and υ_3 ($\upsilon_3 > \upsilon_2 > \upsilon_1$) for the same intensity.

Q21. Draw the diagrams to show the behaviour of plane wavefronts as they **(2)**
(i) pass through a thin prism
(ii) pass through a thin convex lens.

OR

Write two points of difference between an interference and a diffraction pattern.

SECTION – C

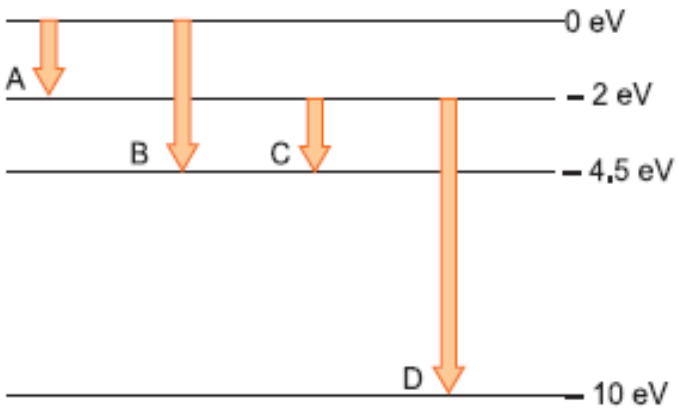
Q22. Two long straight parallel current carrying conductors are kept ‘a’ distant apart in air. The direction of current in both the conductors is same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere. **(3)**

Q23. (a)Using Bohr's postulates, obtain the expression for the total energy of the electron in the stationary states of the hydrogen atom. **(3)**

(b)The Bohr radius of Hydrogen atom is 5.3×10^{-11}m. Find its radius in the first excited state. Also calculate the total energy in this state.

OR

The energy levels of an atom are as shown in figure. (a) Which one of these transitions will result in the emission of photon of wave length 275nm? (b) Which transition corresponds to emission of radiation of maximum wave length?



Q24. (a) A point charge of 2.0 μC is at the centre of a cubic gaussian surface 9.0 cm on edge. What is the net electric flux through the surface? **(3)**
(b) Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude 17.7×10^{-22} C/m^2. What is electric field intensity E:
(i) in the outer region of the first plate, and
(ii) between the plates?

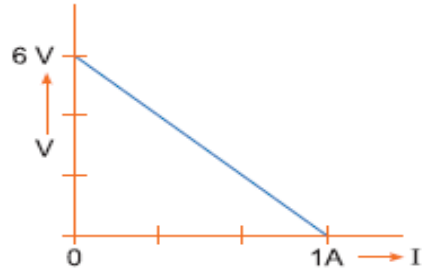
Q25. (a)What is the nuclear radius of ^{125}**Fe**, if that of ^{27}**Al** is 3.6 fermi? **(3)**
(b)Write two characteristic features of nuclear force which distinguish it from Coulomb's force.

Q26. Electromagnetic waves with wavelength **(3)**
(i) λ_1 is suitable for radar systems used in aircraft navigation.
(ii) λ_2 is used to kill germs in water purifiers.
(iii) λ_3 is used to improve visibility in runways during fog and mist conditions.

Identify and name the part of the electromagnetic spectrum to which these radiations belong. Write any one method of the production of each of the above equation.

Q27. (a)Define self-inductance and write its SI unit. **(3)**
(b) Derive expression for self-inductance of a long air-cored solenoid of length l, cross-sectional area A and having number of turns N.

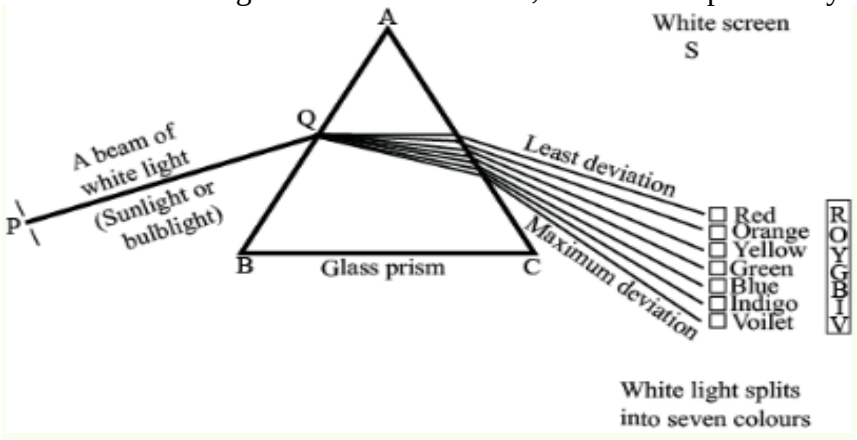
Q28. (a)Write two factors on which internal resistance of a cell depends. **(3)**
(b)The plot of the variation of potential difference across a combination of three identical cells in series, versus current is shown alongside. What is the emf and internal resistance of each cell?



SECTION – D
Case Study Based Questions

Q29. **Read the following paragraph and answer the questions that follow.** **(4)**

The phenomenon of spliting of light into its component colours is known as dispersion. The pattern of colour components of light is called the spectrum of light. The word spectrum is now used in a much more general sense. The electromagnetic spectrum over the large range of wavelength, from gamma waves to radio-waves, of which the spectrum of light (visible spectrum) is only a small part. If two similar prisms are placed together such that the second prism is inverted with respect to first, then the resulting emergent beam is found to be white light. The explanation is clear that the first prism splits the white light into its component colours, while inverted prism recombines them to give the white light. Thus, white light itself consists of light of different colours, which are separated by the prism.



(i) Which ray is most deviated by a prism?
(a)blue (b) green (c) violet (d) red

(ii) A ray of light incident at an angle **θ** on refracting face of a prism emerges from the other normally. If the angle of the prism is 30° and the prism is made up of a material of refractive index 1.5, the angle of incidence is

(a) 30° (b) 45° (c) 60° (d) 90°

(iii) When light rays are incident on a prism at an angle of 45°, the minimum deviation is obtained. If refractive index of prism is $\sqrt{2}$, then the angle of prism will be

(a) 60° (b) 40° (c) 50° (d) 30°

(iv) A spectrum is formed by a prism of dispersive power '**ω**'. If the angle of deviation is '**δ**' then angular dispersion is

(a) ω/δ (b) δ/ω (c) 1/ ωδ (d) ωδ

OR

Dispersion power depends upon

(a) height of the prism

(b) angle of prism

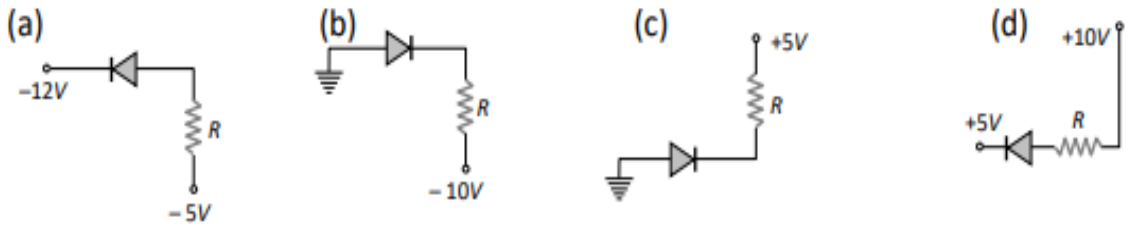
(c) material of prism

(d) the shape of prism

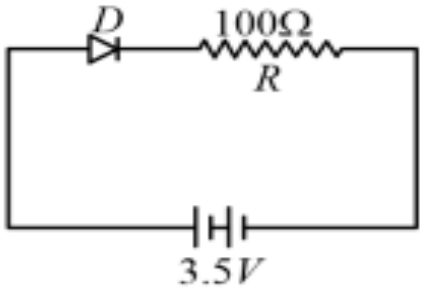
Q30. **Read the following paragraph and answer the questions that follow.** **(4)**

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 which of the following figures, the pn diode is reverse biased?



(ii) 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:

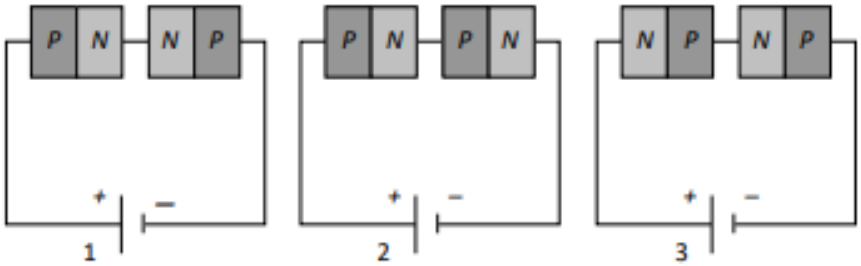


(a) 40 mA
(b) 20 mA
(c) 35 mA
(d) 30 mA

(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

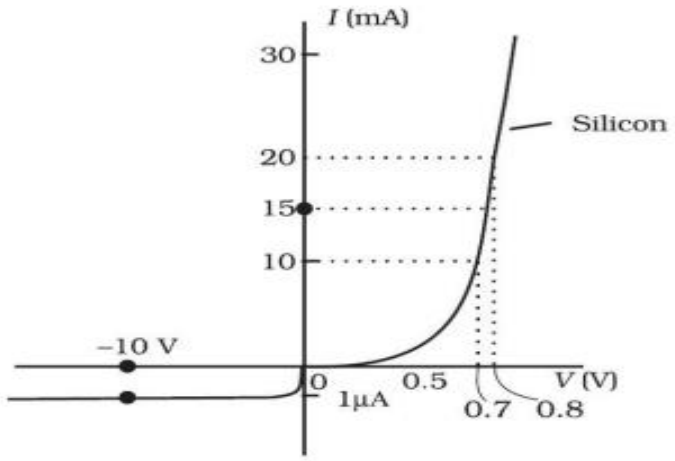
OR

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) and (iv)

(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}

SECTION – E

Q31. (i)In Young's double slit experiment, deduce the conditions for (a) constructive and (b) destructive interference at a point on the screen. Draw a graph showing variation of intensity in interference pattern against the position on the screen. **(5)**

(ii)In Young`s double slit experiment, the two slits 0.15mm apart are illuminated by monochromatic light of wavelength 450 nm. The screen is 1.0 m away from the slits. Find the distance of second bright fringe from the central maximum**.**

OR

(i)Draw the ray diagram of compound microscope. Write its magnifying power.

(ii)Using the data given below, state and justify which two of the given lenses will you prefer to construct a best possible (i) Telescope (ii) Microscope. Also indicate which of the selected lenses used as an objective and an eye piece.

Lens	Power	Aperture
L1	6D	8cm
L2	3D	8cm
L3	10 D	1cm

Q32. (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. **(5)**

(ii)In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} m^2$ and the separation between the plates is 3 mm.
(a) Calculate the capacitance of the capacitor.
(b) If the capacitor is connected to 100V supply, what would be the charge on each plate?
(c) How would charge on the plate be affected if a 3 mm thick mica sheet of k=6 is inserted between the plates while the voltage supply remains connected?

OR

(i) Draw equipotential surfaces for (i) an electric dipole and (ii) two identical positive charges placed near each other.
(ii) Derive an expression for the electric potential at an axial point due to an electric dipole of dipole length 2a.
(iii) Two point charges 3×10^{-8} C and -2×10^{-8} C are separated by a distance of 15 cm in air. Find the point on the line joining the charges, where the electric potential is zero.

Q33. (i) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source. **(5)**
(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 R_1 and R_2 ($R_1 < R_2$) at resonance.