INDIAN SCHOOL AL WADI AL KABIR

FIRST REHEARSAL EXAMINATION-2023-24

CLASS: XII **Sub: PHYSICS (042)** **MAX.MARKS: 70**

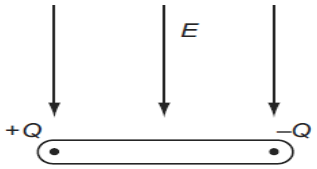
DATE: 28-11-2023 **Set -I** **TIME: 3 HOURS**

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. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-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 X 10^{23} per gram mole

SECTION A [1 MARK]

[1] An electric field of strength E acts on the rod in downward direction. Then the resultant force and resultant torque



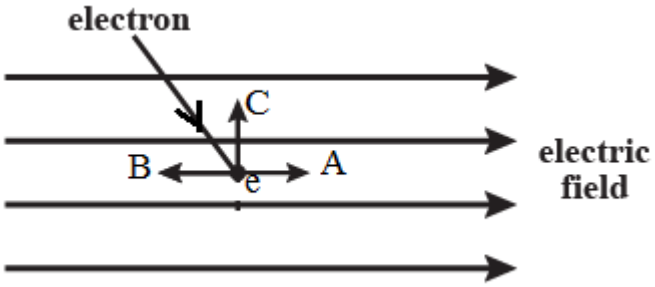
[a] resultant force is zero, resultant torque clockwise

[b] resultant force downwards, resultant torque clockwise.

[c] resultant force is zero, resultant torque anti – clockwise.

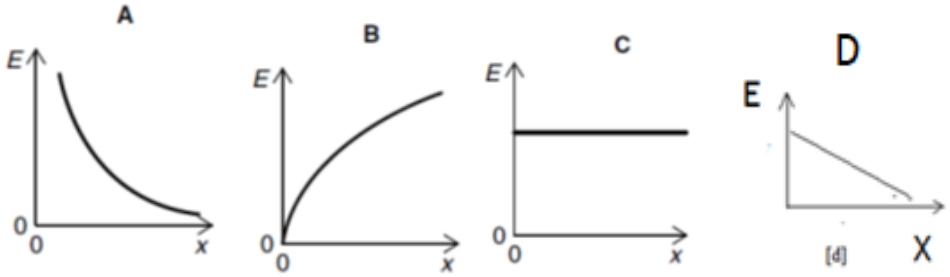
[d] resultant force is upwards, resultant torque clockwise.

[2] The diagram shows an electron in a uniform electric field. In which direction will the field accelerate the electron?



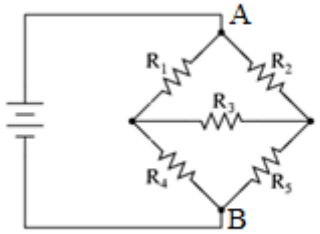
[a] direction A [b] direction B [c] direction C [d] execute circular motion

[3] Two parallel conducting plates are connected to a battery, one plate to the positive terminal and the other plate to the negative. The plate separation is gradually increased, the plates remaining connected to the battery.
Which graph shows how the electric field E between the plates depends on the plate separation X?



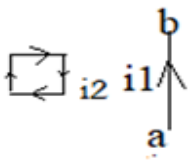
[a] graph A [b]graph B [c] graph C [d] graph D

[4] If R1 = R2 = R3 = R4 = R5 = 10 Ω, then the effective resistance between the points A and B is



[a] 5 ohm [b]10 ohm [c] 15ohm [d] 7.5 ohm

[5] In the figure, the straight wire 'ab' is fixed while the loop is free to move under the influence of the electric currents flowing in them. In which direction does the loop begin to move?



[a] towards the wire ab [b] away from the wire ab [c] it will not move [d] upwards

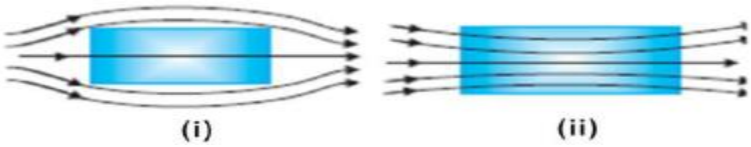
[6] A straight wire carrying current of 12A is bent into a semi-circular arc of radius 3.14 m. What is the magnetic field at the centre of the semicircle?

[a] 12 x 10^{-7}T [b] 6 x 10^{-7}T [c] 2 x 10^{-7}T [d] zero

[7] The susceptibility of a magnetic material is -1.6 x 10^{-5}. Identify the type of the magnetic material

[a] ferromagnetic [b] paramagnetic [c] diamagnetic [d] none of these

[8] Two magnetic materials are subjected to an external magnetic field. Study the figures carefully and identify the specimens



[a] fig.[i] diamagnetic & fig.[ii] paramagnetic
[b] fig.[i] paramagnetic & fig.[ii] diamagnetic
[c] fig.[i] ferromagnetic & fig.[ii] diamagnetic
[d] fig.[i] ferromagnetic & fig.[ii] paramagnetic

[9] Lenz's law is a consequence of the law of conservation of

[a]charge [b] mass [c] momentum [d] energy

[10] An a.c. source of frequency 50 Hz is connected to a 50 mH inductor and a bulb. The bulb glows with some brightness. Calculate the capacitance of the capacitor to be connected in series with the circuit, so that the bulb glows with maximum brightness.

[a] 2 x10^{-4} F [b] 4 x10^{-4} F [c] 10^{-4} F [d] 0.5 x10^{-4} F

[11] De Broglie wavelength associated with an electron accelerated through a potential difference V is λ. What will be the wavelength when the accelerating potential is increased to 4V?

[a] λ [b] $\frac{\lambda}{2}$ [c] $\frac{\lambda}{4}$ [d] 4 λ

[12] What is the ratio of nuclear radii if the mass number of two nuclei are 4 and 32?
[a] 1:2 [b] 1:3 [c] 1:4 [d] 1:1

For questions 13 -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 the true explanation of the assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(c) If assertion is true, but reason is false.
(d) If both assertion and reason are false.

[13] Assertion: A convex lens and a concave lens are kept in contact. They will behave as a diverging lens if focal length of convex lens is more.
Reason: Power of a concave lens is always less than the power of a convex lens, as power of concave lens is negative whereas power of convex lens is positive.

[14] Assertion: On increasing the frequency of light, larger number of photoelectrons are emitted.
Reason: The number of electrons emitted is directly proportional to the applied voltage

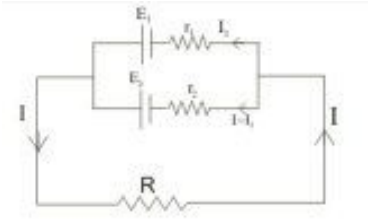
[15] Assertion: Energy is released when heavy nuclei undergo fission or light nuclei undergo fusion.
Reason: Mass defect is the source of energy released.

[16] Assertion: Pentavalent impurities are called donor impurities
Reason: It creates a vacancy of electron.

SECTION B [2 MARKS]

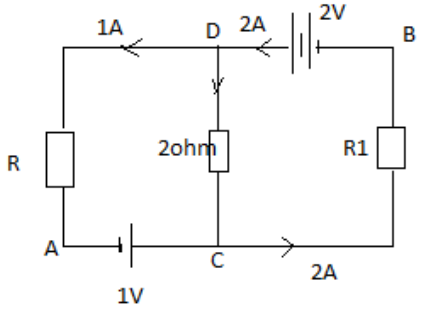
[17] On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time.

[18] Two cells of emfs 1.5V and 2V having internal resistances 0.2 ohm and 0.3 ohm respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.



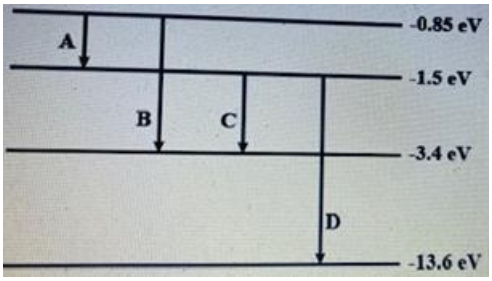
OR

In the given circuit, assuming point 'A' to be at zero potential, use Kirchoff's rule to determine the potential at point 'B'



[19] With the help of a ray diagram, explain how a virtual image is formed in a compound microscope in distinct vision adjustment. Also write the expression for magnifying power.

[20] The energy level diagram of an element is given alongside. Identify by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7nm.



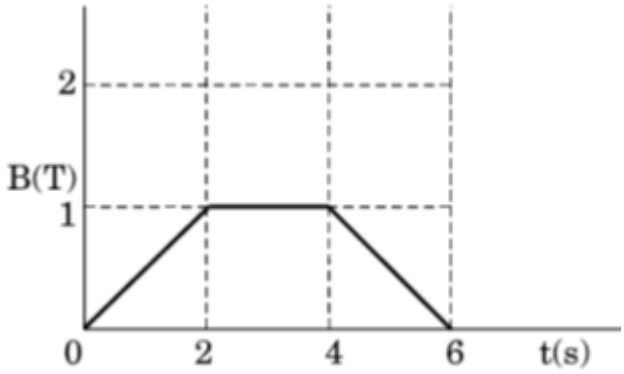
[21] Draw the circuit diagram of full wave rectifier. Draw the corresponding input and output wave form.

SECTION C [3 MARKS]

[22] State Gauss's law. Derive an expression for the intensity of electric field due to a line charge of linear charge density λ.

[23] State Biot's Savarts law. Derive the expression for the Intensity of magnetic field due to a current carrying coil at the centre of the coil.

[24] [i] The magnetic field through a circular loop of wire 12cm in radius and 8.5 ohm resistance changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop.
Calculate the induced current in the loop and plot it as a function of time.



OR

[ii] The current through two inductors of self-inductance 12 mH and 30 mH is increasing with time at the same rate.
Draw graphs showing the variation of the
[a] emf induced with the rate of change of current in each inductor
[b] energy stored in each inductor with the current flowing through it
[c] Compare the energy stored in the coils, if the power dissipated in the coils is the same

[25] When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. How does one explain this, based on the concept of displacement current?
What is the equation for displacement current?

[26] Draw a ray diagram showing the geometry of formation of image of a point object situated on the principle axis and on the convex side of a spherical surface of radius of curvature 'R' .Taking the rays as incident from a rarer medium of refractive index n1 to a denser medium of refractive index n2 ,derive the relation $\frac{n2}{v} - \frac{n1}{u} = \frac{n2-n1}{R}$

[27] Using Rutherford model of the atom, derive the expression to find the total energy of the electron in hydrogen atom.

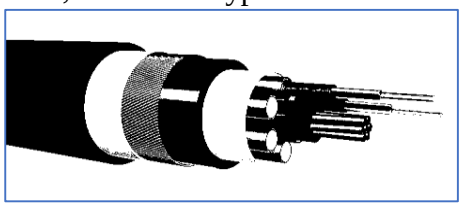
[28] [i] Find the binding energy of an unknown element $_{26}X^{54}$ [ii] binding energy/nucleon?
Given: , m_p = 1.007277u, m_n = 1.008665u , mass of the element X = 53.9396u

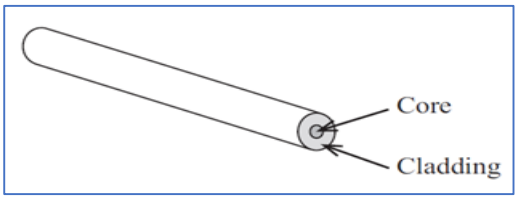
SECTION D Case-based questions [2x4 = 8]

[29] **Read the following paragraph and answer the questions.**

A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilizing the reflecting and refracting properties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices.

Optical fiber communication is a communication method in which light is used as an information carrier and optical fiber is used as a transmission medium. First, an electrical signal is converted into an optical signal, and then an optical signal is transmitted through the optical fiber, which is a type of wired communication.





Some optical fibers are made from a central core of transparent material surrounded by a material of a different refractive index as a cladding.

[i] In an optical fiber, the speed of light is

[a] more in cladding as the refractive index is more
[b] less in cladding as the refractive index is less
[c] more in cladding as the refractive index is less
[d] less in cladding as the refractive index is more

[ii] Why is total internal reflecting prism preferred over plane mirror in periscopes?
[a] more magnification
[b] free from chromatic aberration
[c] free from spherical aberration
[d] provide maximum brighter image

[iii]What will be the speed of light in the core, whose critical angle is 30^0
[a] 3 x 30^8m/s
[b] 1.5 x 30^8m/s
[c] 2x 30^8m/s
[d] 2.5 x 30^8m/s

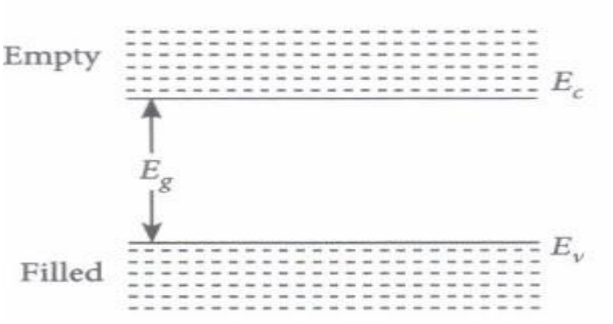
OR

[iii] The refractive index of glass is 1.5 for light whose wavelength is 6000 x 10^{-10}m in vacuum. Calculate the wavelength of the light when it passes through glass.
[a] 4 x10^{-7} m
[b] 2 x10^{-7} m
[c] 3 x10^{-7} m
[d] 5 x10^{-7} m

[iv] Mirage is an optical illusion due to

[a] reflection [b] refraction [c] total internal reflection [d] diffraction

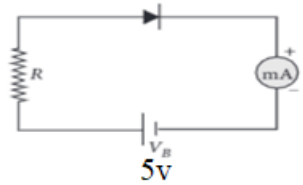
[30] From Bohr's atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to interatomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



[i] What is the energy gap in a semiconductor at room temperature?
[a] 0.1 ev
[b] 1.1 ev
[c] 6 ev
[d] 0 ev

[ii] What will happen to the size of the deletion layer, when a PN junction diode is reverse biased?
[a] remains the same
[b] increases
[c] decreases
[d] depends upon the nature of impurities

[iii] The knee voltage of the diode in the circuit is V_N = 0.7V and the diode requires a minimum current of 1mA to attain a value higher than the knee point on V-I characteristics of this junction diode. Assuming that the voltage V across the junction is independent of the current above the knee point,
What is the maximum value of R so that the voltage V is above the knee point voltage?

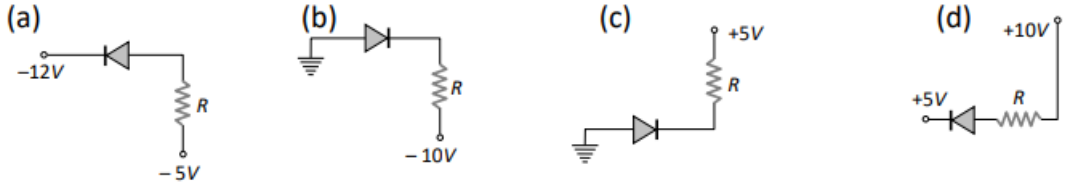


[a] 40 K ohm
[b.] 4.3 Kohm
[c] 50 K ohm
[d] 5.7K ohm

OR

[iii] What should be the value of R in the above circuit in order to establish a current of 6Ma?
[a] 859 ohm
[b] 198 ohm
[c] 659 ohm
[d.] 717 ohm

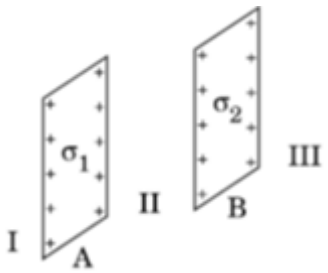
[iv] In which of the following figures, the pn diode is reverse biased?



[a]fig[a] [b] fig[b] [c] fig[c] [d] fig[d]

SECTION E LONG ANSWER [5 MARKS]

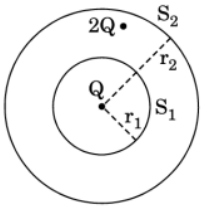
[31] [a] Two infinitely large plane thin parallel sheets having surface charge densities σ1and σ2 [σ1> σ2] are shown in the fig. Write the magnitudes and directions of the net fields in the regions marked II and III



[b] In a parallel plate capacitor with air between the plates, each plate has an area 5 x10^{-3} m^2 and the separation between the plates is 2.5mm.
[i] Calculate the capacitance of the capacitor.
[ii] If this capacitor is connected to100V, what would be the charge on each plate?
[iii] How would charge on the plates be affected, if a 2.5mm thick mica sheet of K = 8 is inserted between the plates while the voltage supply remains connected?

OR

[i] Derive the expression for electrostatic potential energy of a system of 3 charges q1, q2 and q3
[ii] [a] A sphere S1 of radius r1 encloses a net charge 'Q'. If there is another concentric sphere S2 of radius r2 [r2 > r1] enclosing charge 2Q, find the ratio of the electric flux through S1 and S2.



[b] How will the electric flux through sphere S1 change if a medium of dielectric constant 'K' is introduced in the space inside S2 in place of air?

[32] [a]With the help of phasor diagram, derive an expression for impedance in LCR circuit and hence derive the expression for resonant frequency

[b] What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit?

OR

[a] Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write any 2 sources of energy loss in this device.

[b] A small town with a demand of 1200 kW of electric power at 220 V is situated 20 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5 ohm per km. The town gets the power from the line through a 4000-220 V step-down transformer at a sub-station in the town. Estimate the line power loss in the form of heat town. Estimate the line power loss in the form of heat

[33]

[a] Using Huygens's principles draw a ray diagram to show how an incident ray at the interface of the two media gets refracted when it propagates from a rarer [refractive index n1] to a denser medium [refractive index n2]. Hence verify Snell's law of refraction.

[b] When monochromatic light travels from a rarer to a denser medium, speed decreases. Does the decrease in speed imply a reduction in the energy carried by light wave?Explain

OR

[a] State Huygens's Principle. Show, with the help of a ray diagram, how this principle is used to obtain diffraction pattern by a single slit on a screen also write the condition for maxima

[b] Write two differences between interference pattern and diffraction pattern.

[c] A slit of width 'd' is illuminated by light of wavelength 700nm.what will be the value of slit width 'd' when first minimum falls at an angle of diffraction 30^0?