INDIAN SCHOOL AL WADI AL KABIR

First Rehearsal Examination 2022-23

SUB: Physics (042)

Date: 04/12/2022 Time Allowed :3 hours

Class: XII **SET 1** Maximum Marks: 70

General Instructions:

[i] There are 35 questions in all. All questions are compulsory

[ii] This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

[iii] Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of 2 marks each, Section C contains five questions of 3 marks each, section D contains three long questions of 5 marks each and Section E contains two case study-based questions of 4 marks each.

[iv]There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

[v]Use of calculators is not allowed.

You may use the following values of physical constants wherever necessary:

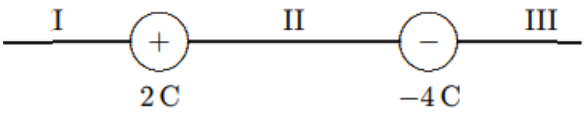
$c = 3 \times 10^8$ ms^{-1}, $h = 6.626 \times 10^{-34}$Js, $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\frac{1}{4\pi\epsilon o} = 9 \times 10^9$ N m^2 C^{-2}, $\epsilon o = 8.854 \times 10^{-12}$ C^{2}N^{-1}m^{-2}, $m_e = 9.1 \times 10^{-31}$kg,

Avogadro's number $= 6.023 \times 10^{23}$ per gram mole, Boltzmann Constant $= 1.38 \times 10^{-23}$ J/K, $m_n = 1.675 \times 10^{-27}$kg, $m_p = 1.673 \times 10^{-27}$ kg

SECTION A [18x1 =18]

[1] Two charged particles are arranged as shown. In which region could a third particle, with charge +1 C, be placed so that the net electrostatic force on it is zero?



[a] I only

[b] II only

[[c] III only

[d] I &111

[2] A body can't kept away from gravitational field, but can be kept away from electric field by keeping it inside a hollow metallic chamber. Also there is no electric field inside a uniformly charged spherical shell .This is due to

[a] dielectric effect

[b] electrostatic shielding

[c] electrostatic induction

[d] Gauss law

[3] In a certain 0.5 m of space, potential is found to be 50V throughout. What is the E.F?

[a] 10N/c

[b] 5N/c

[c] 2.5N/c

[d] zero

[4] A charged air capacitor has stored energy E. What will be the energy stored E1, when air is replaced by a dielectric of dielectric constant K, charge Q remaining the same ?

[a] $E_1 = E$ [b] $E_1 = \frac{2E}{K}$ [c] $E_1 = \frac{E}{K}$ [d] $E_1 = \frac{E}{2K}$

[5] Kirchhoff's II law for the electric network is based on

[a] Law of conservation of charge

[b] Law of conservation of energy

[c] Law of conservation of mass

[d] Law of conservation of momentum

[6] A conductor of length ℓ is connected to a dc source of emf V.If this conductor is repaced by another conductor of same material and same area of cross section but of length 3ℓ,how will the drift velocity change ?

[a] $\frac{v}{3}$

[b] $\frac{v}{2}$

[c] 3v

[d] 2v

[7] A constant current is sent through a helical coil[solenoid]. The coil

[a] tends to get shorter

[b] tends to get longer

[c]tends to rotate about its axis

[d] produces zero magnetic field at its center

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

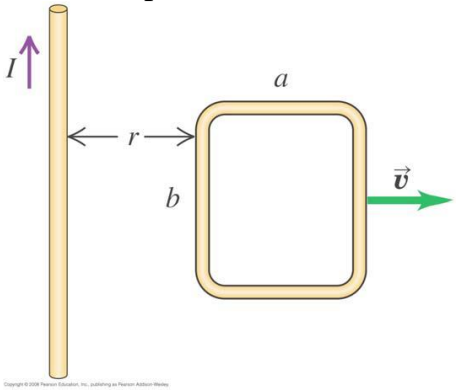
[a] ferro magnetic

[b] para magnetic

[c] diamagnetic

[d] none of these

[9] The loop of wire is being moved to the right at constant velocity. A constant current *I* flows in the long straight wire in the direction shown. The current induced in the loop is



[a] clockwise and proportional to *I*.

[b] counterclockwise and proportional to *I*.

[c] clockwise and proportional to *I*2.

[d] zero

[10] A light bulb and a solenoid are connected in series across an ac source of voltage. How the glow of the light bulb will be affected when an iron rod is inserted in the solenoid.

[a] increases

[b] decreases

[c] no change

[d] can't be predicted

[11] When a circuit element 'X' is connected across an a.c. source, a current of

$\sqrt{2}$ A flows through it and this current is in phase with the applied voltage. When another element 'Y' is connected across the same a.c. source, the same current flows in the circuit but it leads the voltage by $\pi/2$ radians.

Name the circuit element X and Y.

[a] X- resistor, Y- inductor

[b] X- Inductor, Y- capacitor

[c] X- resistor, Y – capacitor

[d] Y- capacitor, X - inductor

[12] A series LCR circuit is connected to a variable frequency 220 V ac supply. When the frequency of the supply equals the natural frequency of the circuit, what is the power factor?

[a] zero

[b] 1

[c] 0.5

[d] 0.2

[13] The maximum electric field in a plane electromagnetic wave is 900N/C.The wave is going in the X direction and the electric field is in the Y direction. Then the maximum magnetic field in the wave is

[a] 3×10^{-8} T [b] 3×10^{-6} T [c] 33×10^{-6} T [d] 23×10^{-6}T

[14] The objective of telescope A has diameter 3 times that of the objective of telescope. How much light is gathered by A compared to B?

[a] 3:1 [b] 9:1 [c] 6:1 [d] 12:1

[15] Find the intensity at a point on a screen in Young's double slit experiment where the interfering waves of equal intensity and amplitude 'a' have a path difference of $\lambda/4$.

[a] a^2

[b] $0.5\ a^2$

[c]$2a^2$

[d]$4\ a^2$

[16-18] For the following questions two statements are given-one labelled as Assertion (A) and the other labelled as 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

[16] **Assertion (A):**

In a non-uniform electric field, a dipole will have translatory as well as rotatory motion.

Reason (R):

In a non-uniform electric field, a dipole experiences a force as well as torque

[17] **Assertion(A):**

An electron and a proton moving with same velocity enters a magnetic field. The force experienced by the proton is more than the force experienced by the electron.

Reason (R):

The mass of electron is more than the mass of the proton.

[18] **Assertion (A):**

Fringes of interference pattern produced by blue light is narrower than that produced by red light.

Reason (R):

In Young's double slit experiment, band width = $\frac{D}{\lambda d}$

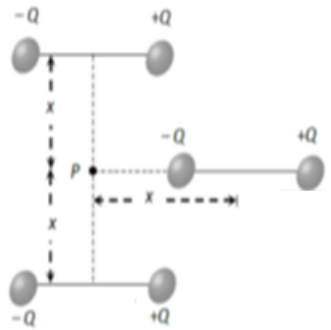
SECTION B [7x2 = 14]

[19] Derive an expression to find the intensity of electric field at a point on the axial line of an electric dipole .

[20] An electric field is uniform and acts along + x direction in the region of positive x. It is also uniform with the same magnitude but acts in – x direction in the region of negative x. The value of the field is E = 200 N/C for x > 0 and E = – 200 N/C for x < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one flat face is at x = + 10 cm and the other is at x = – 10 cm. Find : (i) The net outward flux through the cylinder. (ii) The net charge present inside the cylinder.

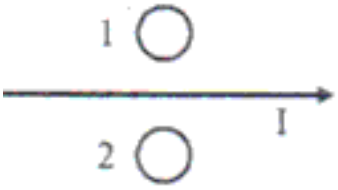
OR

Three identical dipoles are arranged as shown below. What will be the net electric field at the point 'P'



[21] Draw magnetic field lines when a [i] diamagnetic [ii] paramagnetic substance is placed in an external magnetic field.

[22] Predict the directions of induced currents in metal rings 1 and 2 lying in the same plane where current I in the wire is increasing steadily



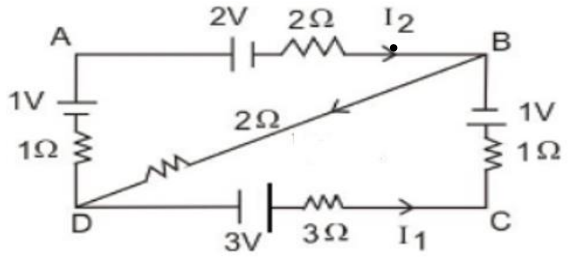
[23] Name the constituent radiations of em spectrum which[i] produce intense heating effect[ii] is used for studying crystal structure.

[24] An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is 1·5, find the position and nature of the image formed.

[25] Using Huygen's wave theory, explain the refraction of light when it enters from rarer to denser medium .

SECTION C [5 x3 = 15]

[26] Using Kirchhoff's rules, calculate the potential difference between B and D in the circuit diagram as shown in the figure.



[27] Two current carrying parallel conductors of infinite length are separated by a distance r. Derive the expression to find the force per unit length between them and hence define 1 ampere

[28] Define mutual induction. Derive the expression for coefficient of mutual inductance of a pair of solenoids.

OR

[i]State Lenz's law

[ii]A conducting rod of length 'L' with one end pivoted is rotated with uniform angular speed 'ω' in a vertical plane, normal to the uniform magnetic field 'B'. Deduce an expression for emf induced.

[29] A 200 V variable frequency ac source is connected to a series combination of L = 5 H,C = 80 μF and R = 40 ohm .Calculate (i) angular frequency of source to get the maximum current in the circuit (ii) current amplitude at resonance and (iii) power dissipation in the circuit.

[30] In a single slit experiment, a monochromatic source of light of wave length 900×10^{-9} m is used to get [i] 3rd minima at an angle of diffraction 30^0.Find the value of slit width used.[ii] 2nd maxima at an angle of diffraction 30^0. What should be the slit width to be used.

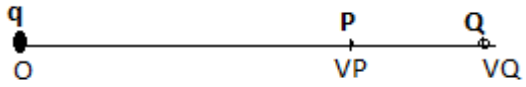
SECTION D [3x5= 15]

[31] [a]Define electrostatic potential energy[b] Derive the expression for electrostatic potential energy of a system of 3 charges q1, q2 and q3

OR

[a]Derive an expression for the potential energy of an electric dipole of dipole moment 'P' kept in an electric field of strength 'E' . At what orientation of the electric dipole, the dipole is said to be in [i] stable equilibrium[ii] unstable equilibrium

[b]A point charge 'q' is placed at 'O' as shown in the fig. Is Vp - Vq positive or negative when q is a positive charge ?



[32] [i] Derive the mathematical relation for the resistivity of material in terms of relaxation time, number density and mass and charge of charge carriers in it.

[ii] Explain, using this relation, why the resistivity of a metal increases and that of semi-conductor decreases with rise in temperature.

[iii]Why alloys like constantan and manganin are used for making standard resistors?

OR

[i] Define the term drift velocity and electron mobility.

[ii] Derive the mathematical relation between electron mobility and drift velocity of current carriers in Conductor.

[33] [i] 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 $\frac{n2}{v} - \frac{n1}{u} = \frac{n2-n1}{R}$

OR

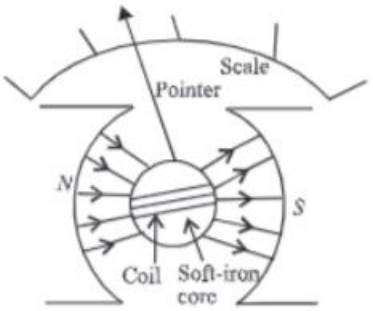
[i]Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point[distinct vision]

[ii] A compound microscope can be arranged both in Distinct vision and Normal vision. In which arrangement will have more magnification power? Why?

SECTION E

CASE STUDY [2 x 4 = 8]

[34] Moving coil galvanometer operates on permanent magnet moving coil mechanism and was designed by the scientist D'arsonval. Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum



[i] To make the field radial in a moving coil galvanometer ,

[a] number of turns of coil is kept small

[b] poles are of very strong

[c] poles are cut cylindrically

[d] magnetic field is produced only by a solenoid

[ii] The deflection torque in a moving coil galvanometer is,

[a] directly proportional to torsional constant of spring

[b] directly proportional to the number of turns in the coil

[c] inversely proportional to the area of the coil

[d] inversely proportional to the current in the coil

[iii] In a moving coil galvanometer we must use radial magnet field ,

[a] so that we can use linear scale to take the readings

[b] so that we can use nonlinear scale to take the readings

[c] so that voltage sensitivity is high

[d] so that current sensitivity is high

[iv] To increase the voltage sensitivity of a moving coil galvanometer, we should decrease,

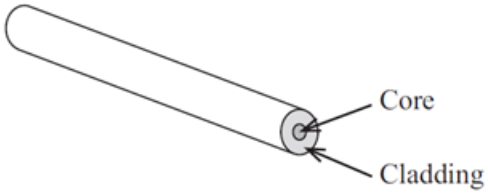
[a] strength of the magnet

[b] torsional constant of the spring and the resistance of the coil

[c] number of turns in the coil

[d] area of the coil and the resistance of the coil [4x1= 4]

[35] 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 fibres are made from a central core of transparent material surrounded by a material of a different refractive index as a cladding.
speed of light in the core = 1.9×10^8 m/s
speed of light in the cladding = 2×10^8 m/s

[i] The basic principle of optical fiber is
[a] reflection
[b] refraction
[c] total internal reflection
[d] interference

[ii]The refractive index of core should be
[a] equal to the refractive index of cladding
[b] more than the refractive index of cladding
[c] less than the refractive index of cladding
[d] equal to zero

[iii] Why is total internal reflecting prism preferred over plane mirror in periscopes
[a] There is no loss of intensity of light in reflecting prism

[b] to reduce the size of the periscope

[c] The size of the image of the enemy ship seems to be bigger in total internal reflecting prism

[d] both [b] & [c]

[iv] If the angle of incidence is 80^0,then the possible value of critical angle for the core-cladding boundary is
[a] 78^0 [b] 80^0 [c] 89^0 [d] zero [4x1 =4]

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