ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

Pre – Test Examination – 2018

Class : 12

Sub :Physics F.M.: 70

DURATION:3 Hrs15Mins DATE:30.07.2018

PART-B

Section - I

1. MCQ Questions each of 1 mark.(Answer all the question) 1x14=14

i) Two infinite plane parallel uniformly charged sheets, placed in air and separated by a very small distance 'd' have equal and opposite surface charge densities $+\sigma$ and $-\sigma$ respectively. Electric field at a point between them

a) Depends upon the location of the point. b) zero c) $\frac{\sigma}{2\epsilon_0}$. d) $\frac{\sigma}{\epsilon_0}$

ii) A Four equal charges equal to '–Q', are placed at four corners of a square. What sould be the amount of charge placed at the centre of the square, such that the charge system will be in equilibrium?

a) $+\frac{Q}{4}$ b) $\frac{Q}{2}(1+2\sqrt{2})$ c) $\frac{Q}{4}(1+\sqrt{2})$ d) $\frac{Q}{4}(1+2\sqrt{2})$

iii) A 16μC charge is placed at one vertex of a cuboid of length 10cm, breadth 5cm and height 2.5cm. The net outward flux through the surfaces of cuboid is

a) $72\pi \times 10^3 Nm^2/C$ b) $36\pi \times 10^4 Nm^2/C$ c) $36\pi \times 10^5 Nm^2/C$ d) can't be calculated.

iv) The electric field at a certain region is given as $\vec{E} = 5\hat{\imath} - 25\hat{\jmath} + 10\hat{k}$ N/C. what will be the flux through a rectangular plane of length 1m and breadth 50cm, parallel to Y-Z plane?

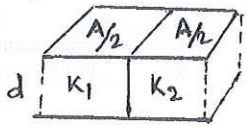
a) $2.5\ Nm^2/C$ b) $-12.5\ Nm^2/C$ c) $2\ Nm^2/C$ d) $250 Nm^2/C$

v) Four point charges 9nC, 15C, -45C and 30C are placed at four corners of a square of side $\sqrt{2}m$. The potential at the centre will be

a) $-45 \times 10^9 V$ b) $9 \times 10^9 V$ c) $9V$ d) $81V$

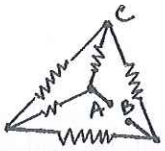
vi) The adjacent diagram is showing the cross-section of a capacitor of total plate area 'A' and plate separation of 'd'. The effective capacitance is –

a) $\frac{\epsilon_0 A}{d}(k_1+k_2)$ b) $\frac{\epsilon_0 A}{2d}(k_1+k_2)$ c) $\frac{k_1 k_2}{(k_1+k_2)} \cdot \frac{\epsilon_0 A}{2d}$ d) $\frac{k_1 k_2}{(k_1+k_2)} \cdot \frac{\epsilon_0 A}{d}$



vii) Five equal resistances each of resistance R ohm , are connected as shown in the figure. A battery of V volt is connected between A and B. The current flowing in AC path will be -

a) $\frac{3V}{R}\ amp$ b) $\frac{V}{R}\ amp$ c) $\frac{2V}{R}\ amp$ d) $\frac{V}{2R}$ amp



viii) For a semi conductive material, if temperature is increased then -

a) Resistivity increases b) conductivity increases c) conductivity decreases d) none of these

ix) An infinite current carrying wire is carrying a current of 5A. The magnetic field at a point near the middle of the wire at a perpendicular distance 10cm from the wire will be

a) $10^{-7}T$ b)$10^{-5}T$ c)$10^{7}T$ d)$10^{5}T$

x) Three point charges of charge 5C, 10C and 15C and of equal mass are projected with same velocity perpendicular to a uniform magnetic field such that they are executing circular motion. Then,

a) Radius of circular path for 5C charge will be greater than that of other two.
b) Radius of circular path for 10C charge will be greater than that of other two
c) Radius of circular path for 15C charge will be greater than that of other two
d) Radius of circular path for all the charges will be same.

xi) Two parallel straight current carrying wires are placed close to each other. Then which option is correct?
a) They will attract each other when current flows along same direction.
b) They will attract each other when current flows in opposite direction.
c) They repel each other when current flows along same direction.
d) None of these.

xii) The torque on a current carrying rectangular loop when placed symmetrically in an uniform magnetic field is
a) Maximum when area vector of loop makes 0^0 angle with magnetic field.
b) Maximum when area vector of loop makes 90^0 angles with magnetic field.
c) Minimum when area vector of loop makes 90^0 angles with magnetic field.
d) Same for any orientation of the loop.

xiii) The magnetic field in a region is perpendicularly inward to the plane of paper. If one conducting wire of arbitrary shape is stretched to form a circle (as shown in the figure) , then what will happen?
a) The current will flow in clock wise direction.
b) The current in the loop will be anti – clockwise.
c) There will be current, but the direction can't be determined.
d) There will be no current induced in the loop.

xiv) A $\left(\frac{1}{\pi^2}\right) mF$ capacitor, 25mH inductor and an unknown resistor is connected in series with one unknown ac supply. What should be the frequency of that source, such that maximum current will flow in the circuit?
a) 50Hz b) 100 Hz c) 200 Hz d) 400 Hz

Section – II
Group – A

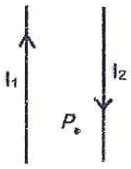
2. Answer the following question in brief. (Alternatives are to be noted) **1x4=4**

i) What is the dimension of electric potential?

ii) What is the difference between the e.m.f and potential difference of a cell?

iii) What do you mean by Ohmic conductors?
Or
Why does the resistance of a conductor increase with increase in temperature?

iv) What will be the direction of net magnetic field at the point 'P' due to the currents I_1 and I_2?
Or
If a neutron is projected with a speed 0.001c perpendicularly to a magnetic field of intensity 5T, what will be the force experienced by the neutron?



PART – A
Section – II
Group – B

Answer the following questions in short. (Alternatives are to be noted) **2x5 = 10**

1. A thin spherical shell of radius 'r' is uniformly charged by 'q' amount of charge. If a point charge 'q/4' is placed at the centre of the shell, what will be the force on the charge at centre?
2. If the radius of k-orbit of hydrogen isotope $_1H^1$ is $0.53A^0$, then calculate the electrostatic attractive force on k-orbit's electron by nucleus.
Or
Two point charges '+q' and '+4q' are separated by a distance '6a' in air. Find the point on the line joining the two charges where the electric field is zero.
3. For two concentric thin spherical shell containing same charge +q each as shown in the figure, what will be the potential at the point 'P'?
Or
What do you mean by Corona discharge?
4. Metals have a large number of electrons moving inside continuously at room temperature. Then why there is no current when not connected to any potential difference?
Or
The amount of charge passing through the cross-section of an wire is a time dependent function given by $q = (5t^2 + 3t + 1)$ C . Find the current through the wire at $t = 5\ sec.$

5. What will be the magnetic field at a point near one end of an infinitely long wire carrying a current 2A at a perpendicular distance 0.2 m ?

Group – C

Answer the following questions. (Alternatives are to be noted) 3x9=27

6. Define electric potential of a point? What do you mean by equipotential surface? What will be the work-done in displacing a charge particle in equipotential surface? 1+1+1
7. What do you mean by electric field intensity? Derive an expression for electric field intensity for a point charge at a finite distance. 1+2

   Or

   Determine the dimension of electric permittivity of any medium. What do you mean by dielectric constant? 2+1
8. State Gauss's theorem. Using this theorem find out the electric field for a charged wire at a distance 'r' from it. 1+2

   Or

   Prove Coulomb's law from Gauss's theorem. 3

9. Determine electric field for an infinite charged sheet of uniform surface charge density 'σ'. 3

   Or

   Determine electric field for any electric dipole at any axial point at a distance 'r' from the mid-point of the dipole. 3
10. Determine the electric potential due to a dipole at an axial point at a distance 'r' from the mid-point of it. 3

    Or

    What is Lenz's law? How is it equivalent to law of energy conservation? 1+2
11. Write down Farady's laws of electro-magnetic induction. Write down the mathematical form of Faraday's second law by mentioning the meaning of the symbols used. 1+1+1

    Or

    Calculate the self inductance of a solenoid of radius 'r', length 'L' and total number of turns N. 3
12. 'n' numbers of identical cells each of emf 'E' and internal resistance 'r' , are connected in series with an external load resistor of resistance 'R'. Determine the current through the load resistor. 3

    Or

    Discuss in brief, how the e.m.f of two cells can be compared by using a potentiometer. 3
13. Derive an expression for the magnetic field $\vec{B}$ inside a very long solenoid. 3
14. Establish the relation $k = 1 + \chi$. Symbols have usual meaning. 3

Group – D

Answer the following questions. (Alternatives are to be noted)

15. Draw a circuit diagram of series L-C-R circuit. Find out the expression for the resonant frequency mentioning the condition clearly. 1+4

    Or

    Determine the magnetic field for a circular loop of radius 'R' carrying a current 'I', at an axial distance 'x' from the centre of the coil. 5
16. Determine the electric field for a dipole of dipole length $2l$, at a distance x from the mid-point of it on perpendicular bisector. 5

    Or

    What do you mean by electric dipole moment? Define polarization density vector. Determine the capacitance of a parallel plate capacitor of plate area 'A', plate separation 'd' , surface charge density σ and filled by a dielectric medium of dielectric constant 'k' . 1+1+3
17. Find out the expression for the magnetic moment of a revolving electron in a circular path of radius 'r' with linear velocity 'v'. What will be the direction of direction of magnetic moment if the electron is rotating in clock-wise direction in the plane of the paper? (Justify your answer). 3+2

    Or

    Derive the expression for the radius of circular path of a point charge '+q' of mass 'm' entering perpendicularly to an uniform magnetic field of intensity 'B', with a velocity 'V'. Hence find out the expression for angular frequency. 3+2

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01.08.18
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FOR GOD AND COUNTRY

ST. LAWRENCE HIGH SCHOOL

Model Answer

Pre-Test Exam – 2018

Sub: Physics | **Class: XII** | **F. M. : 70**
Duration: 3hrs 15 min | **Date: 30.07.18**

PART-B

Section - I

1. **MCQ Questions each of 1 mark.(Answer all the question)** 1x14=14

i) Two infinite plane parallel uniformly charged sheets, placed in air and separated by a very small distance 'd' have equal and opposite surface charge densities $+\sigma$ and $-\sigma$ respectively. Electric field at a point between them

d) $\frac{\sigma}{\epsilon_0}$

ii) A Four equal charges equal to '–Q', are placed at four corners of a square. What sould be the amount of charge placed at the centre of the square, such that the charge system will be in equilibrium?

d) $\frac{Q}{4}(1+2\sqrt{2})$

iii) A 16μC charge is placed at one vertex of a cuboid of length 10cm, breadth 5cm and height 2.5cm. The net outward flux through the surfaces of cuboid is

a) $72\pi \times 10^3 Nm^2/C$

iv) The electric field at a certain region is given as $\vec{E} = 5\hat{\imath} - 25\hat{\jmath} + 10\hat{k}$ N/C. what will be the flux through a rectangular plane of length 1m and breadth 50cm, parallel to Y-Z plane?

a) $2.5\ Nm^2/C$

v) Four point charges 9nC, 15C, -45C and 30C are placed at four corners of a square of side $\sqrt{2}m$. The potential at the centre will be

d) $81V$

vi) The adjacent diagram is showing the cross-section of a capacitor of total plate area 'A' and plate separation of 'd'. The effective capacitance is –

b) $\frac{\epsilon_0 A}{2d}(k_1 + k_2)$

vii) Five equal resistances each of resistance R ohm , are connected as shown in the figure. A battery of V volt is connected between A and B. The current flowing in AC path will be -

d) $\frac{V}{2R}$ **amp**

viii) For a semi conductive material, if temperature is increased then -

b) conductivity increases

ix) An infinite current carrying wire is carrying a current of 5A. The magnetic field at a point near the middle of the wire at a perpendicular distance 10cm from the wire will be

b) $10^{-5}T$

x) Three point charges of charge 5C, 10C and 15C and of equal mass are projected with same velocity perpendicular to a uniform magnetic field such that they are executing circular motion. Then,

a) Radius of circular path for 5C charge will be greater than that of other two.

xi) Two parallel straight current carrying wires are placed close to each other. Then which option is correct?

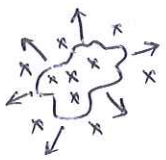
a) They will attract each other when current flows along same direction.

xii) The torque on a current carrying rectangular loop when placed symmetrically in an uniform magnetic field is

b) Maximum when area vector of loop makes 90^0 angles with magnetic field.

xiii) The magnetic field in a region is perpendicularly inward to the plane of paper. If one conducting wire of arbitrary shape is stretched to form a circle (as shown in the figure) , then what will happen?

b) The current in the loop will be anti – clockwise.



xiv) A $\left(\frac{1}{\pi^2}\right)$ mF capacitor, 25mH inductor and an unknown resistor is connected in series with one unknown ac supply. What should be the frequency of that source, such that maximum current will flow in the circuit?

b) 100 Hz

Section – II
Group – A

2. Answer the following question in brief. (Alternatives are to be noted) 1x4=4

i) What is the dimension of electric potential? **Ans:** $ML^2T^{-3}A^{-1}$

ii) What is the difference between the e.m.f and potential difference of a cell?

Ans:

e.m.f		Potential difference	
i.	This is the potential drop across the terminals of a cell when no current is drawn from it.	i.	This is the potential drop across the terminals of a cell when the cell is connected to external load i.e. while the cell delivers some current is drawn from it.
ii.	It is always greater than the potential difference.	ii.	Practically, it is always less than e.m.f.

iii) What do you mean by Ohmic conductors?

Ans : the conductors which obey Ohm's law, while conduct electrically.

Or

Why does the resistance of a conductor increase with increase in temperature?

Ans: The charge carriers (i.e. electrons) inside the metal gain heat energy and become more random in nature hence collide with each other more. This fact acts as an obstruction to the flow of the electrons along a particular direction and thereby increasing the resistance.

iv) What will be the direction of net magnetic field at the point 'P' due to the currents I_1 and I_2?

Ans: Perpendicularly inward to the plane of paper

Or

If a neutron is projected with a speed 0.001c perpendicularly to a magnetic field of intensity 5T, what will be the force experienced by the neutron?

Ans: Zero as neutron is charge-less.

PART – A
Section – II
Group – B

Answer the following questions in short. (Alternatives are to be noted) 2x5 = 10

1. A thin spherical shell of radius 'r' is uniformly charged by 'q' amount of charge. If a point charge 'q/4' is placed at the centre of the shell, what will be the force on the charge at centre?

Ans: The electric field inside the shell is zero, so the force on any charge placed inside will be zero.

2. If the radius of k-orbit of hydrogen isotope $_1H^1$ is $0.53A^0$, then calculate the electrostatic attractive force on k-orbit's electron by nucleus.

Ans: Required force $= \frac{9\times10^9\times1.6\times1.6\times10^{-38}}{0.53\times0.53\times10^{-20}} N = 8.2\times10^{-8}\ N$

Or

Two point charges '+q' and '+4q' are separated by a distance '6a' in air. Find the point on the line joining the two charges where the electric field is zero.

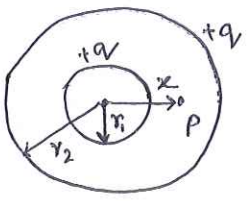
Ans: Let the resultant field will be zero at a distance x from +q charge. So at that point we have –

$\frac{q}{4\pi\epsilon_0 x^2} = \frac{4q}{4\pi\epsilon_0(6a-x)^2}$. Solving it, we get $x = 2a$ and $x = -6a$. But the field gets cancelled out in the region in-between two charges. So, physically acceptable solution will be $x = 2a$.

Hence at a distance 2a from +q charge or 4a from +4q charge, the net field will be zero.

3. For two concentric thin spherical shell containing same charge +q each as shown in the figure, what will be the potential at the point 'P'?

Ans: The total potential at point P will be $V_{total} = \frac{q}{4\pi\epsilon_0 r_2} + \frac{q}{4\pi\epsilon_0 x} = \frac{q}{4\pi\epsilon_0}\left(\frac{1}{r_2}+\frac{1}{x}\right)$



Or

What do you mean by Corona discharge?

Ans: Refer to any standard book.

4. Metals have a large number of electrons moving inside continuously at room temperature. Then why there is no current when not connected to any potential difference?
Ans: Although at room temperature the electrons move but their motion is completely random, they collide randomly and change their direction continuously. So, the average velocity becomes zero. The current generated by one electron gets cancelled by another which moves exactly along opposite direction. Hence the net current becomes zero.
Or
The amount of charge passing through the cross-section of an wire is a time dependent function given by $q = (5t^2 + 3t + 1)$ C . Find the current through the wire at $t = 5\ sec.$
Ans: $I = \frac{dq}{dt} = (10t + 3)$. **So, the current at 5sec will be (10x5+3)A = 53A.**

5. What will be the magnetic field at a point near one end of an infinitely long wire carrying a current 2A at a perpendicular distance 0.2 m ?
Ans: **At one end,** $B = \frac{\mu_0 I}{4\pi r} = \frac{(10^{-7}\times 2)}{0.2} = 10^{-6}T.$

Group – C

Answer the following questions. (Alternatives are to be noted) **3x9=27**

6. Define electric potential of a point? What do you mean by equipotential surface? What will be the work-done in displacing a charge particle in equipotential surface? **Ans:** refer to any standard book.

7. What do you mean by electric field intensity? Derive an expression for electric field intensity for a point charge at a finite distance. **Ans :** refer to any standard text book.
Or
Determine the dimension of electric permittivity of any medium. What do you mean by dielectric constant?
Ans: refer to any standard book.

8. State Gauss's theorem. Using this theorem find out the electric field for a charged wire at a distance 'r' from it.
Ans: refer to any standard book.
Or
Prove Coulomb's law from Gauss's theorem. **Ans:** refer to any standard book.

9. Determine electric field for an infinite charged sheet of uniform surface charge density $'\sigma'$.
Ans: refer to any standard book.
Or
Determine electric field for any electric dipole at any axial point at a distance 'r' from the mid-point of the dipole.
Ans: refer to any standard book.

10. Determine the electric potential due to a dipole at an axial point at a distance 'r' from the mid-point of it.
Ans: refer to any standard book.
Or
What is Lenz's law? How is it equivalent to law of energy conservation? **Ans:** refer to any standard book.

11. Write down Farady's laws of electro-magnetic induction. Write down the mathematical form of Faraday's second law by mentioning the meaning of the symbols used. **Ans:** refer to any standard book.
Or
Calculate the self inductance of a solenoid of radius 'r', length 'L' and total number of turns N.
Ans: **Inside the solenoid ,** $B = \frac{\mu_0 NI}{L}$. **So the flux =** $\emptyset = NB.A = \frac{\mu_0 N^2 I}{L} \times \pi r^2$. **So self inductance =** $\frac{\emptyset}{I} = \frac{\mu_0 \pi r^2 N^2}{L}$

12. 'n' numbers of identical cells each of emf 'E' and internal resistance 'r' , are connected in series with an external load resistor of resistance 'R'. Determine the current through the load resistor. **Ans:** refer to any standard book.
Or
Discuss in brief, how the e.m.f of two cells can be compared by using a potentiometer. **Ans:** refer to any standard book.
13. Derive an expression for the magnetic field $\vec{B}$ inside a very long solenoid. **Ans:** refer to any standard book.
14. Establish the relation $k = 1 + \chi$. Symbols have usual meaning. **Ans:** refer to any standard book.

Group – D

Answer the following questions. (Alternatives are to be noted)

15. Draw a circuit diagram of series L-C-R circuit. Find out the expression for the resonant frequency mentioning the condition clearly. **Ans:** refer to any standard book.

    Or

    Determine the magnetic field for a circular loop of radius 'R' carrying a current 'I', at an axial distance 'x' from the centre of the coil. **Ans:** refer to any standard book.

16. Determine the electric field for a dipole of dipole length $2l$, at a distance x from the mid-point of it on perpendicular bisector.

    Or

    What do you mean by electric dipole moment? Define polarization density vector. Determine the capacitance of a parallel plate capacitor of plate area 'A', plate separation 'd' , surface charge density σ and filled by a dielectric medium of dielectric constant 'k' . **Ans:** refer to any standard book.

17. Find out the expression for the magnetic moment of a revolving electron in a circular path of radius 'r' with linear velocity 'v'. What will be the direction of direction of magnetic moment if the electron is rotating in clock-wise direction in the plane of the paper? (Justify your answer).

    Ans: **For the revolving electron, current** $= \frac{ev}{2\pi r}$

    Magnetic moment = current x area of the loop $= \frac{ev}{2\pi r} \times \pi r^2 = \frac{evr}{2}$.

    - The current will be anti-clockwise. So the magnetic field and hence the magnetic moment will be directed perpendicularly outward to the plane of the paper.

    Or

    Derive the expression for the radius of circular path of a point charge '+q' of mass 'm' entering perpendicularly to an uniform magnetic field of intensity 'B', with a velocity 'V'. Hence find out the expression for angular frequency.
    Ans: refer to any standard book. (Cyclotron).