Roll Number		

SET C

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION
PHYSICS

CLASS: XII | Sub. Code: 042 | Time Allotted: 3 Hrs

29.09.2019 | Max. Marks: 70

General Instructions:

a) **All questions are compulsory. There are 37 questions in all.**
b) **This question paper has four sections: Section A, Section B, Section C and Section D.**
c) **Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each and Section D contains three questions of five marks each.**
d) **There is no overall choice. However, an internal choice has been provided in two questions of two marks, two questions of three marks and three questions of five marks weightage. You have to attempt only one of choices in such questions.**
e) **You may use the following values of physical constants wherever necessary.**

$c = 3 \times 10^8$ m/s , $h = 6.63 \times 10^{-34}$ Js , $e = 1.6 \times 10^{-19}$ C , $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2} , $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m^2 C^{-2} , $m_e = 9.1 \times 10^{-31}$ kg

mass of neutron = 1.675×10^{-27} kg

mass of proton = 1.673×10^{-27} kg

Avogadro's number = 6.023×10^{23} per gram mole

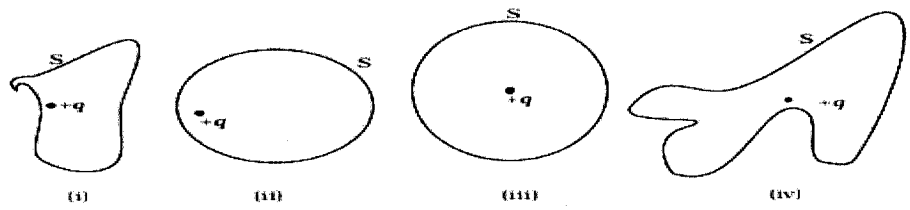
Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION - A

1. Which of the following characteristics of electrons determines the current in a conductor? 1
   (a) Drift velocity alone.
   (b) Thermal velocity alone.
   (c) Both drift velocity and thermal velocity.
   (d) Neither drift nor thermal velocity.

2. Kirchhoff's first and second laws of electrical circuits are consequences of 1
   (a) conservation of energy and electric charge respectively.
   (b) conservation of energy.
   (c) conservation of electric charge and energy respectively.
   (d) conservation of electric charge.

3. The electric flux through the surface 1



(a) in Figure (iv) is the largest.
(b) in Figure (iii) is the least.
(c) in Figure (ii) is same as Figure (iii) but is smaller than Figure (iv).
(d) is same for all the figures.

4. Three capacitors each of capacitance **4 μF** are to be connected in such a way that the effective capacitance is **6 μF**. This can be done by connecting 1
(a) all of them in series. (b) all of them in parallel.
(c) two in parallel and one in series. (d) two in series and one in parallel.

5. If we carry a charge once around an equipotential path, then work done by the charge is 1
(a) infinity. (b) positive. (c) negative. (d) zero.

6. A point charge **+q**, is placed at a distance d from an isolated conducting plane. The field at a point P on other side of the of the plane is 1
(a) directed perpendicular to the plane and away from the plane.
(b) directed perpendicular to the plane but towards the plane.
(c) directed radially away from the point charge.
(d) directed radially towards the point charge.

7. Two charges are at distance **d** apart in air. Coulomb force between them is **F**. If a dielectric material of dielectric constant **K** is placed between them, the Coulomb force now becomes 1
(a) F/K (b) FK (c) F/K^2 (d) K^2F

8. Electro-magnets are made of soft iron because soft iron has 1
(a) small susceptibility and small retentivity. (b) large susceptibility and small retentivity.
(c) large permeability and large retentivity. (d) small permeability and large retentivity.

9. Potentiometer measures the potential difference more accurately than a voltmeter, because 1
(a) it draws a heavy current from external source.
(b) it does not draw current from external circuit.
(c) it has a wire of high resistance.
(d) it has a wire of low resistance.

10. A current carrying loop is placed in uniform magnetic field. The torque acting on it does not depend upon the 1
(a) area of the loop. (b) value of current.
(c) shape of the loop. (d) magnetic field.

11. Transformer works on the principle of 1
(a) total internal reflection. (b) converter.
(c) inverter. (d) mutual induction.

12. The angle of dip at a place, where horizontal and vertical components of earth's magnetic field are same, 1

(a) 60^0 (b) 90^0 (c) 0^0 (d) 45^0

13. Induced e. m. f. is produced in a coil 1

(a) when placed in a uniform magnetic field.
(b) when placed in a changing magnetic field.
(c) when placed in a uniform electric field.
(d) when placed in vacuum.

14. In an a.c. circuit , resonance will take place when inductive reactance is 1

(a) one-third of the capacitive reactance. (b) half of the capacitive reactance.
(c) double of the capacitive reactance. (d) equal to the capacitive reactance.

15. A bar magnet of magnetic moment **m** is placed in a uniform magnetic field **B.** The torque exerted on it is 1

(a) $\vec{m}.\vec{B}$ (b) $\vec{m}\times\vec{B}$ (c) $-\vec{m}.\vec{B}$ (d) $-\vec{m}\times\vec{B}$

16. The area of a square shaped coil is $\mathbf{10^{-2}}$ m^2. Its plane is perpendicular to a magnetic field of strength $\mathbf{10^{-3}}$ T. The magnetic flux linked with the coil is 1

(a) 10 Wb (b) 100 Wb (c) 10^{-5} Wb (d) 10^5 Wb

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

17. Assertion : Magnetic lines of force form continuous closed loops whereas electric lines of force do not. 1
Reason : Magnetic poles always occur in pairs as north pole and south pole.

18. Assertion : The magnetic poles of a magnet can never be separated. 1
Reason : Every atom of a magnetic substance is a complete dipole.

Fill in the blanks:

19. Magnetic susceptibility of a paramagnetic material is _____proportional to absolute temperature. 1

20. When a charged particle moves in a region, where both electric field and magnetic field exit, it experiences a net force called_____. 1

SECTION - B

21. Derive expression for drift velocity of free electrons in a metallic conductor. 2

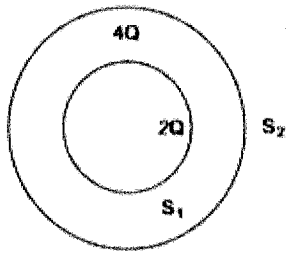
22. A dipole with a dipole moment of magnitude **p** is in stable equilibrium in an electrostatic field of magnitude **E**. Find the work done in rotating this dipole to its position of unstable equilibrium. 2

23. A cell of emf **4**V and internal resistance **1**Ω is connected to a d.c. source of **10** V through a resistor of **5**Ω. Calculate the terminal voltage across the cell during charging. 2

OR

Two cells of emfs **1.5** V and **2.0** V having internal resistances **0.2** Ω and **0.3** Ω respectively are connected in parallel. Calculate the emf and internal resistance of equivalent cell.

24. Consider two hollow concentric spheres S_1 and S_2 enclosing charges **2Q** and **4Q** respectively, as shown in figure. 2
(i) Find out the ratio of electric flux through them.
(ii) How will the electric flux through the spheres S_1 change if a medium of dielectric constant ε_r is introduced in the space inside S_1 in place of air? Deduce the necessary expression.



25. The vertical component of Earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. What is the value of angle of dip at this place? 2

26. Show that the current leads the voltage in phase by $\pi/2$ in an a.c. circuit containing an ideal capacitor. 2

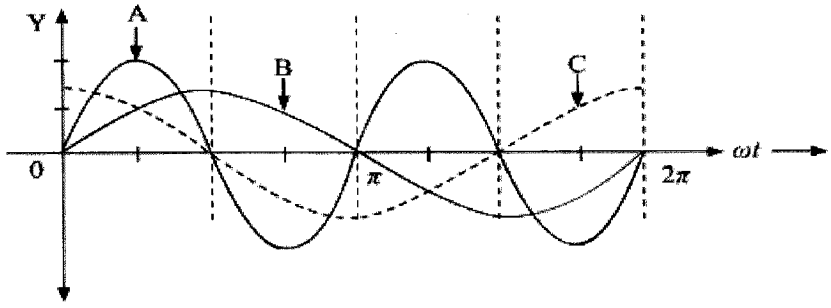
27. A long solenoid of length **L** having **N** turns carries a current **I.** Obtain with help of a necessary diagram, the expression for magnetic field in the interior of the solenoid. 2

OR

Obtain with help of a necessary diagram, the expression for magnetic field in the interior of a toroid carrying current **I**.

SECTION - C

28. A device **X** is connected to an a.c. source, $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in following graph. 3



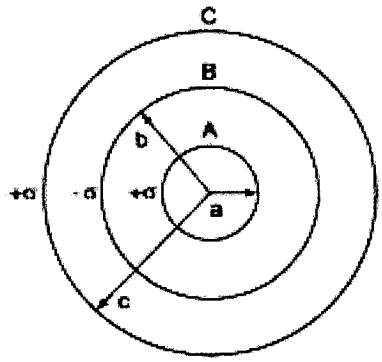
(a) Identify the device **X**.
(b) Which of curves **A, B** and **C** represent the voltage, current and the power consumed in the circuit?
(c) How does its impedance vary with frequency of a.c. source? Show graphically.

29. (a) Obtain the expression for the torque $\vec{\tau}$ experienced by an electric dipole of dipole moment $\vec{p}$ in a uniform electric field, $\vec{E}$. 3
(b) What will happen if the field were not uniform?

OR

(a) Define torque acting on dipole moment $\vec{p}$ placed in a uniform electric field $\vec{E}$. Express it in the vector form.
(b) An electric dipole is kept in a uniform electric field $\vec{E}$, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on dipole in both the cases

30. Three concentric metallic shells **A, B** and **C** of radii **a, b** and **c** (**a< b< c**) have surface charge densities **+σ , - σ** and **+ σ** respectively as shown in the figure. 3



If shells **A** and **C** are at the same potential, then obtain the relation between the radii **a, b** and **c**.

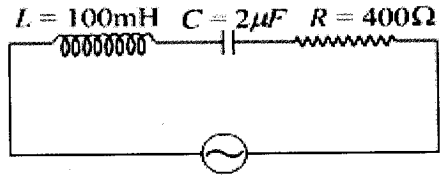
31. Draw a circuit diagram of a potentiometer. State its working principle. Derive the necessary formula to describe how it is used to compare the emfs of the two cells. 3

OR

With the help of the circuit diagram, explain the working principle of meter bridge. How is it used to determine the unknown resistance of a given wire?

32. Distinguish between diamagnetic and ferromagnetic materials in respect of their 3
(a) intensity of magnetization (b) behavior in non uniform magnetic field and
(c) susceptibility

33. (a) Find the value of the phase difference between the current and the voltage in the series LCR circuit shows below. Which one leads in phase: current or voltage? 3
(ii) Without making any other change, find the value of the additional capacitor, C_1 , to be connected in parallel with the capacitor **C** , in order to make the power factor of the circuit unity.



34. A jet plane is travelling westward at a speed of **1800** km/h. What is the potential difference developed between the ends of a wing **25** m long, its earth's magnetic field at the location has a magnitude of **5 X 10^{-4}** T and the dip angle is **30^0**. 3

SECTION - D

35. (a) Define mutual inductance and write its SI unit. 5
(b) Derive an expression for the mutual induction of two long co-axial solenoids of same length wound one over the other. State two factors on which mutual inductance depend.

OR

(a) Define self inductance and write its SI unit.
(b) Derive an expression for the self induction of a long solenoids of length **L**, cross-sectional area **A** and having number of turns **N**. State two factors on which self inductance of a coil depend.

36. (a) Obtain an expression for the energy stored per unit volume in a charged parallel capacitor. 5

(b) Find the ratio of the potential differences that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitances in the ratio **1:2** so that the energy stored in the two cases becomes the same.

OR

(i) Define the capacitance of a capacitor. Obtain the expression for capacitance of a parallel plate capacitor in vacuum in terms of plate area a and separation d between the plates.

(ii) A slab of material of dielectric constant k has the same area as the plates of a parallel plate capacitor but has thickness **3d/4**. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

37. Explain, using a labeled diagram, the principle and working of a moving coil galvanometer. What is function of (i) uniform radial magnetic field (ii) soft iron core? 5
Define the terms (i) current sensitivity and (ii) voltage sensitivity of a galvanometer.

OR

Draw a schematic diagram of a cyclotron. State its working principle. Show that the period of a revolution of an ion is independent of its speed or radius of the orbit. Write two important uses of a cyclotron.

End of the Question Paper