FIRST TERMINAL EXAMINATION, 2016
PHYSICS

Time : 3 hrs. **Class XII** **M.M. : 70**

Date – 10.09.2016

General Instructions :

- All questions are compulsory.
- There are 26 questions in total. Q. Nos. **1 to 5** carry **1 mark** each, Q. nos. **6 to 10** carry **2 marks** each, Q. Nos. **11 to 22** carry **3 marks** each, Q. No. **23** is a value based question carrying **4 marks** and Q. Nos. **24 to 26** carry **5 marks** each.
- There is no overall choice. However, an internal choice has been provided in 1 question of 2 marks, 1 question of 3 marks and all 3 questions of 5 marks each. You have to attempt only one of the given choices in such questions.
- Use of calculator is not allowed. However, you may use log tables if necessary.
- You may use the following values if necessary :

$c = 3\times10^{8}$ m/s, $h = 6.63\times10^{-34}$ JS, $e = 1.6\times10^{-19}$ C, $\mu_0 = 4\pi\times10^{-7}$ TMA^{-1}

$\frac{1}{4\pi E_0} = 9\times10^{9}$ Nm^{2}C^{-2} $m_e = 9.1\times10^{-31}$kg, $m_n = 1.675\times10^{-27}$kg $m_p = 1.673\times10^{-27}$ kg

Q.1 Force between two point charges kept at a distance d apart in air is F. If these charges are kept at the same distance in water, how does the electric force between them change?

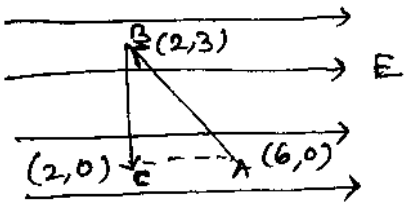
Q.2 Two wires of equal lengths, one of copper and the other of manganin have the same resistance. Which wire will be thicker?

Q.3 A beam of electrons projected along + x-axis, experiences a force due to a magnetic field along the y-axis. What is the direction of the magnetic field?

Q.4 Why can't transformer be used to step up d.c. voltage?

Q.5 For the same angle of incidence, the angles of refraction in three different media A, B and C are 15^0, 25^0 and 35^0 respectively. In which medium will the velocity of light be minimum?

Q.6 A test charge q is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure.



i) Calculate the potential difference between A and C

ii) At which point (of the two) is the electric potential more and why?

Q.7 A cell of e.m.f. 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing variation of terminal voltage 'v' of the cell versus the current 'I'. Using this graph, show how the e.m.f. of the cell and its internal resistance can be determined.

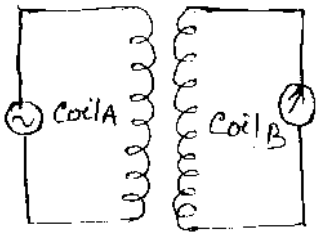
Q.8 Two substances A and B have their relative magnetic permeabilities slightly greater than and less than unity respectively. What do you conclude about the magnetic nature (dia, para or ferromagnetic) of A and B ? Will their susceptibilities be positive or negative?

Q.9 A metallic rod of length 'L' is rotated with angular frequency of 'w' with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A

constant and uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring.

OR

The circuit arrangement of the figure shows that when an a.c. passes through the coil A, the current starts flowing in the coil B.



a) Name the principle involved.

b) Mention two factors on which the current produced in the coil B depends.

Q.10 A 5cm long needle is placed 10 cm from a convex mirror of focal length 40 cm. Find the position, nature and size of the image of the needle. What happens to the size of the image when the needle is moved farther away from the mirror?

Q.11 Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with 'r', for r > R and r < R.

Q.12 a) Determine the electrostatic potential energy of a system consisting to two charges 7μc and -2μc (and with no external field) placed at (-9cm, 0, 0) and (9cm, 0, 0) respectively.

b) How much work is required to separate the two charges infinitely away from each other?

c) Suppose the same system of charges is now placed in an external electric field

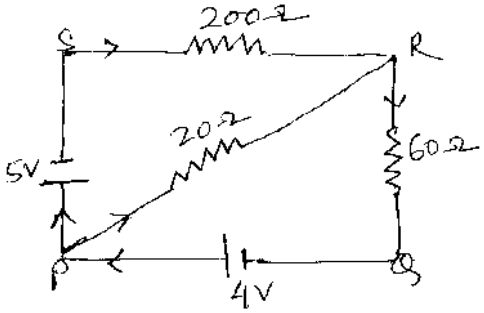
E=A $(\frac{1}{r^2})$, A=9×10^9 cm^{-2}. What would the electrostatic energy of the configuration be?

Q.13 Write the principle of working of a potentiometer. Describe briefly, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of the given cell.

OR

Draw a circuit diagram using a meter bridge and write the necessary mathematical relation used to determine the value of an unknown resistance. Why cannot such an arrangement be used for measuring very low resistances?

Q.14 Network PQRS is made as shown. PQ has a battery of 4v and negligible resistance with positive terminal connected to P, QR has a resistance of 60Ω, PS has a battery of 5V and negligible resistance with positive terminal connected to P, RS has a resistance of 200Ω. If a milliammeter, of 20Ω resistance is connected between P and R, calculate the reading of the milliammeter.



Q.15 The figure shows a potentiometer with a cell of 2.0 V and internal resistance 0.40Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02v (for very moderate currents upto a few A) gives a balance point at 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600kΩ is put in series with it, which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf E and the balance point found similarly turns out to be at 82.3 cm length of the wire.

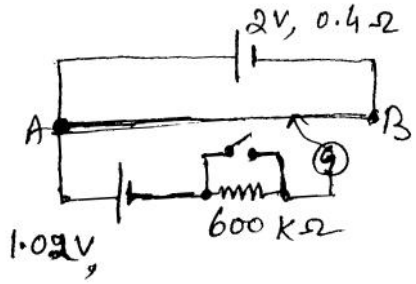
a) What is the value of E?

b) What purpose does the high resistance of 600kΩ have?

c) Is the balance point affected by this high resistance?

d) Is the balance point affected by the internal resistance of the driver cell?

e) Would the method work in the above situation if the drive cell of the potentiometer had an emf of 1.0V instead of 2.0V?



Q.16 A galvanometer with a coil of resistance 12.0 Ω shows full scale deflection for a current of 2.5 mA. How will you convert the meter into :

a) an ammeter of range 0 to 7.5A.

b) a voltmeter of range 0 to 10.0 V?

Determine the net resistance of the meter in each case. When an ammeter is put in a circuit, does it read (slightly) less or more than the actual current in the original circuit? When a voltmeter is put across a part of the circuit, does it read (slightly) less or more than the original voltage drop? Explain.

Q.17 Derive the expression for force per unit length between two long straight parallel current carrying conductors. Hence define one ampere.

Q.18 Using Biot-Savart's law, deduce the expression for the magnetic field produced at a point on the axial line of a current carrying circular coil.

Q.19 A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180^0 in 0.25 sec. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place 3.0×10^{-5} T.

Q.20 Derive the expression for the self-inductance of a long solenoid of cross-sectional area A and length '*l*', having 'n' turns per unit length.

Q.21 A resistor of 200Ω and a capacitor of 15.0 μF are connected in series to a 220V, 50Hz ac source.

a) Calculate the current in the circuit.

b) Calculate the voltage (rms) across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? Explain.

Q.22 a) Draw ray diagram to show the image formation in case of a concave mirror when object is placed between f and c of the mirror.

b) Derive relation between object distance (u), image distance (v) and focal length of the mirror (f) [from the above situation].

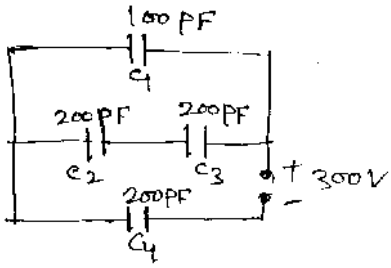
Q.23 Mrs. Sharma parked her car and forgot to switch off the car headlights. When she returned, she could not start the car. Rohit, a passerby came to her for help. After knowing about her problem, he went to a nearby garage and called mechanic Ramu. Ramu noticed that the car battery has been discharged as the head lights were left on for a long time. He brought another battery from his garage and connected its terminals to the terminals of the car battery. He succeeded in starting the engine and then disconnected his battery. This is called 'jump starting'. Mrs. Sharma felt happy and thanked both Rohit and Ramu.

a) What values were displayed by Rohit?

b) A storage battery of emf 12V and internal resistance 0.5Ω is to be charged by a battery charger which supplied 110V d.c. How much resistance must be connected in series with the battery to limit the charging current to 5A ? What will be the potential difference across the terminals of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

Q.24 a) Derive an expression for the energy stored in a parallel plate capacitor C, charge to a potential difference V.

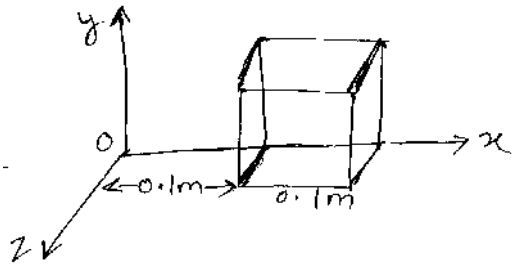
b) Obtain the equivalent capacitance of the network given below. For a supply 300v, determine the charge and voltage across C_4.



OR

a) Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field.

b) The electric field components due to a charge inside the cube of side 01.m are as shown in the figure.



c) $E_x=\alpha x$ where $\alpha=500$ N/Cm, $E_y=0$, $E_z=0$. Calculate :

i) the flux through the cube, and

ii) the charge inside the cube.

Q.25 a) With the help of a labelled diagram, state the underlying principle of a cyclotron. Explain clearly how it works to accelerate the charged particle.

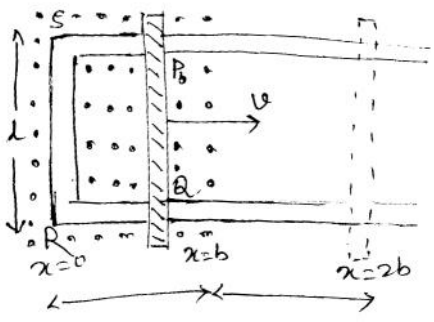
b) Show that the cyclotron frequency is independent of energy of the particle. Is there an upper limit on the energy acquired by the particle? Explain.

OR

a) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

b) What is the importance of a radial magnetic field and how is it produced?

Q.26 The arm PQ of the rectangular conductor is moved from x=0 to the right side in the given figure. The uniform magnetic field is perpendicular to the plane and extends from x=0 to x=b and is zero for x>b. Only the arm PQ possesses substantial resistance 'r' consider the situation when the arm PQ is pulled outwards from x=0 to x=2b and is then moved back to x=0 with constant speed 'v'. Obtain expressions for the flux, the induced emf, the force necessary to pull the arm and the power dissipated as Joule heat. Sketch the variation of these quantities with time.



OR

a) Using phasor diagram, derive an expression for the impedence of a series LCR-circuit.

b) What do you mean by resonance condition of such a circuit?