HALF YEARLY EXAMINATION, 2017-18

PHYSICS

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

Date – 12.09.2017 (Tuesday)

Name of the student _____ Section _____

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}

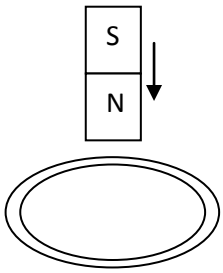
  $\in_0 = 8.854\times10^{-12}C^2N^{-1}M^{-2}$ $m_e = 9.1\times10^{-31}$kg, $m_n = 1.675\times10^{-27}$kg

Q.1 What is the electric flux through a cube of side 1 cm which encloses an electric dipole?

Q.2 Specific resistances of copper, silver and constantan are 1.78×10^{-6} Ωcm, 10^{-6} Ωcm and 48×10^{-6} Ωcm, respectively. Which is the best conductor and why?

Q.3 What is the main function of soft-iron cylinder between the poles of a galvanometer?

Q.4 A bar magnet falls from height 'h' through a metal ring as shown in the fig. Will its acceleration be equal to 'g' ? Give reason for your answer.



Q.5 Give the effect on image, if lower half of the concave mirror is blackened.

Q.6 A and B have identical size and same mass. A becomes A^{2+} and B becomes B^{2-}. Will A^{+2} and B^{2-} still have same mass? 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 the plot, show how the e.m.f. of the cell and its internal resistance can be determined.

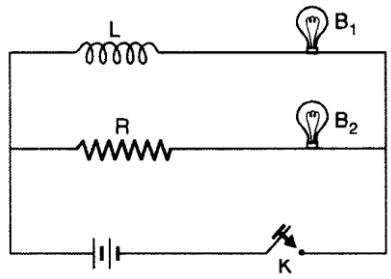
Q.8 A storage battery of emf 8V and internal resistance 0.5Ω is being charged by a 120V DC supply using a series resistor of 15.5Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

Q.9 Show that the electron revolving around the nucleus in an orbit of radius 'r' with speed 'v' has magnetic moment evr/2. Using Bohr's postulate, obtain the expression for the magnetic moment in the n^{th} orbit.

Q.10 Figure shows an inductor L, and a resistor R connected in parallel to a battery through a switch. The resistance of 'R' is same as that of the coil of L. Two bulbs (identical) are put in each arm of the circuit.

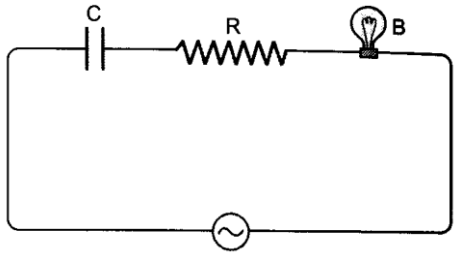
i) Which of the bulbs lights up bright when key is closed?

ii) Will the two bulbs be equally bright after some time?



OR

A capacitor 'c', a variable resistor 'R' and a bulb 'B' are connected in series to the a.c. mains as shown. The bulb glows with some brightness. How will be the glow of bulb if :



i) a dielectric slab is introduced between the plates of the capacitor, keeping 'R' to be same;

ii) the resistance 'R' is increased keeping the same capacitance?

Q.11 Find the electric field intensity due to a uniformly charged spherical shell at a point –

i) outside the shell and

ii) inside the shell

iii) plot the graph of electric field with distance from the centre of the shell.

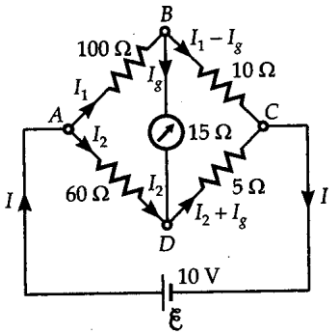
Q.12 Describe schematically the equipotential surfaces corresponding to

i) a constant electric field in the Z-direction.

ii) a single positive charge at the origin

iii) an electric dipole.

Q.13 The four arms of a wheatstone bridge have the following resistances :



AB = 100Ω, BC=10Ω, CD = 5Ω, DA = 60Ω.

A galvanometer of 15Ω resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of 10V is maintained across AC.

Q.14 State the working principle of a potentiometer. Explain with the help of a circuit diagram, how the emfs of two primary cells are compared by using a potentiometer.

OR

Draw circuit diagram using a meter bridge and derive necessary mathematical relation used to determine the value of unknown resistance.

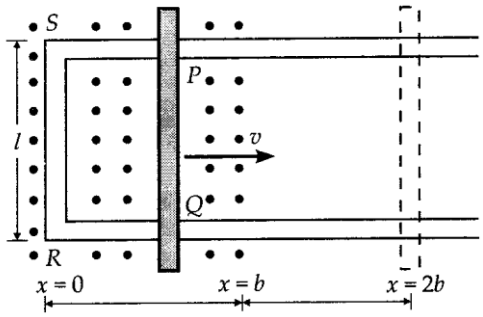
Q.15 Apply Biot-Savart law to find the magnetic field due to a circular current carrying loop at a point on the axis of the loop.

Q.16 Derive an expression for the force per unit length between two infinitely long straight parallel current carrying wires. Hence define one ampere.

Q.17 A telephone cable at a place has four long straight horizontal wires carrying a current of 1.0A in the same direction east to west. The earth's magnetic field at the place is 0.39G, and the angle of dip is 35^0. The magnetic declination is nearly zero. What are the resultant magnetic fields at points 4.0 cm below, and above the cable?

Q.18 A solenoid of length 50cm with 20 turns per cm and area of cross-reaction $40cm^2$ completely surrounds another co-axial solenoid of the same length, area of cross-section $25cm^2$ with 25 turns per cm. Calculate the mutual-inductance of the system.

Q.19 Refer to fig. The arm PQ of the rectangular conductor is moved from x = 0 to the right side. 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 expression for the flux, the induced emf, the force necessary to pull the arm and the power dissipated.

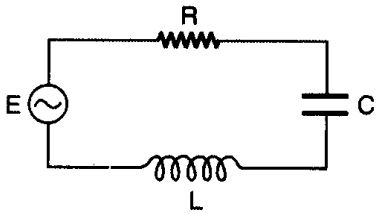


Q.20 Fig. shows a series LCR-circuit connected to a variable frequency 230V source. L = 5.0 H, C = 80 μF, R = 40 Ω.

a) Determine the source frequency, which drives the circuit in resonance.

b) Determine the r.m.s. potential drops across the three elements of the circuit.

c) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.



Q.21 A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to displacement current.

Q.22 Derive the relation between object distance 'u', image distance 'v' and focal length 'f' for a concave mirror when it forms a real image of an object of finite size.

Q.23 Munish had gone out of station, on a vacation for one week. After coming back, he tried to start his car but failed. He was facing such problems frequently and his friends suggested him to change the battery. He went to the workshop and hire a battery charger. He was successful in charging the car battery.

a) What according to you, are the values displayed by Munish?

b) How should a battery charger be connected to a car battery?

c) Is it necessary to change battery after a few years?

Q.24 i) Derive an expression for the energy stored in a capacitor.

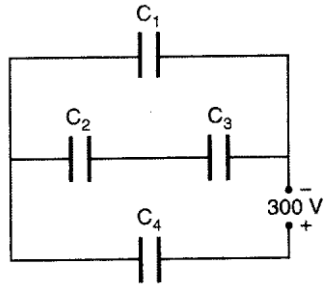
ii) If A is the area of plate and d is plate separation find the expression for the energy density of an electric field.

iii) A 12 pF capacitor is connected to a 50V battery. How much electrostatic energy is stored in the capacitor?

OR

Obtain the equivalent capacitance of the following network shown in fig. For a 300 V supply, determine the charge and voltage across each capacitor.

Given that C1 = C4 = 100 pF and C2 = C3 = 200 pF.



Q.25 i) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

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

OR

i) Discuss the principle, construction, theory and working of a cyclotron.

ii) Show that the frequency is independent of both velocity and radius of the orbit.

Q.26 In a series LCR circuit connected to an a.c. source of voltage $E = E_0 \sin wt$, use phasor diagram to derive an expression for the current in the circuit. Hence, obtain the expression for the power dissipated in the circuit. Show that power dissipated at resonance is maximum.

OR

i) Derive the relationship between the peak and the rms value of current in an ac circuit.

ii) Show that in an ac circuit containing a pure inductor, the voltage is ahead of current by $\pi/2$ in phase.