AMRITA VIDYALAYAM

FIRST TERMINAL EXAMINATION 2018 -'19

Class : XII **Marks : 70**

Time : 3 hrs

PHYSICS (042)

GENERAL INSTRUCTIONS:

1. All questions are compulsory. There are 27 questions in all.

2. This question paper has four sections:
Section A, Section B, Section C and Section D.

3. Section A contains 5 questions of 1 mark each, Section B contains 7 questions of 2 marks each, Section C contains 12 questions of 3 marks each and Section D contains 3 questions of 5 marks each.

4. There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks. You have to attempt only one of the choices in such questions.

5. Use log tables if necessary. Use of calculators is not allowed.

6. You may use the following values of physical constants wherever necessary.

$C = 3 \times 10^8$ m / sec $\quad h = 6.63 \times 10^{-34}$ JS

$e = 1.6 \times 10^{-19}$C $\quad \mu_0 = 4\pi\ 10^{-7}$ TmA^{-1}

SECTION - A

1. How does the electric flux due to a point charge enclosed by a spherical Gaussian surface gets affected when its radius is doubled?
2. A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colours respectively. Calculate the current in mA through the resistor.
3. Two wires A and B of the same material and having the same length have their cross sectional areas in the ratio 1 : 4. What would be the ratio of the heat produced in these wires, when the same voltage is applied across each?
4. The current flowing through a pure inductor of inductance 2 m H, is I = 15 Sin 300 t ampere. What is the r.m.s and average value of current over a complete cycle?
5. Horizontal component of Earth's magnetic field at a place is $\sqrt{3}$ times the vertical component. What is the value of dip angle at that place?

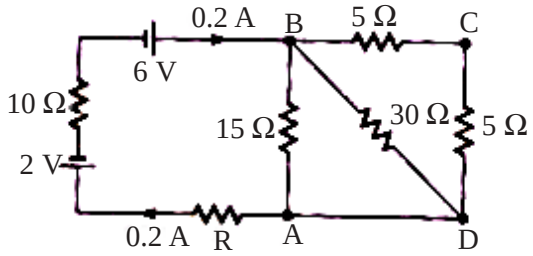
SECTION - B

6. An electric dipole is held in a uniform electric field. Show that the net force acting on it is zero. The dipole is aligned parallel to the field. Find the work done in rotating it through an angle of 180^0.
7. A slab of material of dielectric constant K has the same area as that of a parallel plate capacitor but has the thickness d / 2 where d is the separation between the plates. Find an expression for the capacitance, when the slab is introduced between the plates.
8. A copper wire has a resistance of 10 ohm and an area of cross section 1 mm^2. A potential difference of 10 volt exists across the wire. Calculate the drift speed of the electrons if the number density of electrons in copper is 8×10^{28} per m^3.
9. A Hydrogen ion of mass m and charge q travels with a speed v along a circle of radius r in a uniform magnetic field of flux density B. Obtain expression for the magnetic force on the ion and determine its time period.
10. The magnetic flux through a coil perpendicular to the plane is varying according to the relation $\theta = [5t^3 + 4t^2 + 2t - 5]$ Wb. Calculate the induced current through the coil at t = 2 sec if the resistance of the coil is 5 ohm.

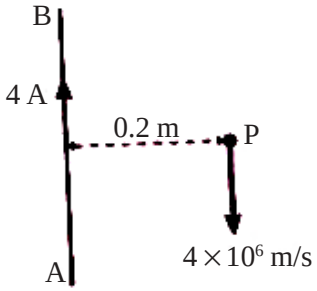
OR

State the laws of electromagnetic induction. Express these laws mathematically.

11. Calculate the value of resistance R in the circuit, so that current in the circuit is 0.2 A. What would be the potential difference between A and B?



12. A long straight wire AB carries a current of 6 A. A proton P travels at 4×10^6 m / s parallel to the wire, 0.2 m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnetic field of current exerts on the proton. Also specify the direction of force.



SECTION - C

13. State Gauss's theorem and express it mathematically. Using this law derive an expression for the electric field intensity at a point near a thin infinite plane sheet of charge density σ C / m^2.
14. A 4 μ F capacitor is charged by a 200 volt supply. It is then disconnected from the supply and is connected to another uncharged 2 μ F capacitor. How much electric energy of the first capacitor is lost in the form of heat and e.m. radiation?
15. Derive the relation between electric current and drift velocity. Hence deduce Ohm's law. Also derive the expression for resistivity in terms of number density of free electrons and relaxation time.
16. Derive the formula for the force between two parallel straight conductors carrying current in the opposite direction. Write the nature of the force. Hence define one ampere.
17. Derive an expression for the torque on a rectangular coil of area A carrying a current I and placed in a magnetic field B. The angle between and vector perpendicular to the plane of the coil is θ. Indicate the direction of torque acting on the coil.
18. Derive an expression for the magnetic dipole moment of an electron revolving around a nucleus. Hence define Bohr magnetron.
19. An electron moves around the nucleus in a hydrogen atom of radius 0.51 A^0 with a velocity 2×10^6 m/sec. Calculate
    a) the equivalent current due to the orbital motion of the electron.
    b) the magnetic field produced at the centre of the nucleus.
    c) the magnetic moment associated with the electron.

OR

How will a dia, para and ferro magnetic material behave when kept in a non uniform magnetic field? Name two main characteristics of a ferro magnetic material which helps us to decide its suitability for making

a) a permanent magnet. b) an electro magnet.

Which of these characterestic should have high or low values for each of these two types of magnets?

20. Define self inductance and write its S.I unit. Derive an expression for the self inductance of a long air cored solenoid of length *l*, area of cross section A and having N number of turns.

21. A metallic rod of length L is rotated at an angular speed ω normal to a uniform magnetic field B. Derive an expression for the
    a) e.m.f induced in the rod. b) current induced.
    c) heat dissipation if the resistance of the rod is R.

22. A resistor, an inductor, and a capacitor are connected separately to the same a.c source and equal currents are flowing through each. If the frequency of the e.m.f is increased, how will the current be affected in these circuits? Give reason for your answer.

23. A series LCR circuit with L = 4 H, C = 100 μ F and R = 60 ohm is connected to a variable frequency 240 volt a.c source. Calculate
    a) angular frequency of the source which drives the circuit to resonance.
    b) current at the resonating frequency.
    c) The r.m.s potential drop across the inductor at resonance.

24. Prove that an ideal inductor does not dissipate power in an a.c. circuit.

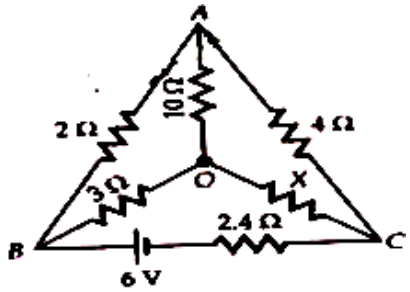
SECTION - D

25. Derive an expression for the electric potential at a distance r from a point charge q. What is the nature of this potential? A charge of 24 μ C is given to a hollow metallic sphere of radius 0.2 m. Find the potential
    a) at the surface of the sphere.
    b) at a distance 0.1 cm from the centre of the sphere.

    OR

    Find the electric field intensity and electric potential due to a dipole at a point on the equatorial line. Will the electric field be necessarily zero at a point where the electric potential is zero? Electric field intensity at a point B due to a point charge q kept at a point A is 24 N/C and the electric potential at B due to the same charge is 12 J / C. Calculate the distance AB and also the magnitude of the charge q.

26. a) State Kirchoff's laws for an electric circuit. Using Kirchoff's laws find the relation between the resistances of the four arms of a Wheatstone bridge, when the bridge is balanced.
    b) Find the value of the unknown resistance X in the following circuit if no current flows through AO. Also calculate the current drawn by the circuit from the battery of e.m.f 6 volt and negligible internal resistance.



    OR

    You are required to find the internal resistance of a primary cell in the laboratory. Draw a circuit diagram of the apparatus you will use to determine it. Explain the principle of the experiment. Give the formula used.
    A 10 m long wire of uniform cross section and 20 ohm resistance is used as a potentiometer wire. This wire is connected in series with a battery of 5 volt along with an external resistance of 480 ohm. If an unknown e.m.f E is balanced at 600 cm of this wire, calculate the potential gradient of the potentiometer wire and the unknown e.m.f E.

27. Explain briefly with help of a labeled diagram the basic principle of working of an a.c generator. In an a.c generator a coil of N turns, area A is rotated, at an angular frequency ω in a uniform magnetic field B. Derive an expression for the instantaneous value of the e.m.f. induced in the coil. Why is the e.m.f. maximum when the plane of the armature coil is parallel to the magnetic field? What is the source of energy generation in this device?

OR

Draw a schematic arrangement of the winding of the primary and secondary coils in a transformer, when the two coils are wound one over the other. State the underlying principle of a transformer and obtain expression for the ratio of secondary to primary voltage in terms of the

a) number of secondary and primary windings.

b) primary and secondary currents.

c) Write the main assumption involved in deriving the above relation.

d) How is the transformer used in large scale transmission and distribution of electrical energy over long distance.