MANAVA BHARATI

INDIA INTERNATIONAL SCHOOL

MID-TERM EXAMINATION -SEPTEMBER 2016
CLASS XII - PHYSICS

TIME : 3 HRS. MAX. MARKS: 70

General Instructions:

(i) All questions are compulsory.

(ii) There are 26 questions in total. Question nos. 1 to 5 are very short answer type questions and carry one mark each.

(iii) Question nos. 6 to 10 carry two marks each. Question nos. 11 to 22 carry three marks each. Question no. 23 carries four marks and question nos. 24 to 26 carry five marks each.

(iv) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks. You have to attempt only one of the given choices in each question.

(v) Use of calculator is not permitted.

1. Name any two basic properties of electric charge. 1

2. What is the source of magnetic field (magnetism)? 1

3. Write SI unit of magnetic flux. Is it scalar or vector quantity? 1

4. No work is done in moving a test charge over an equipotential surface. Why? 1

5. What is the source of an electromagnetic wave? 1

6. What is the force between two small charged sphere having charges of 2×10^{-7}C and 3×10^{-7}C placed 30cm apart in air? 2

7. Three capacitors each of capacitance 9pF are connected in series.
   (a) What is the total capacitance of the combination?
   (b) What is the potential difference across each capacitor if the combination is connected to a 120V supply?

   OR

   A parallel plate capacitor with air between the plates has a capacitance of 8pF. What will be the capacitance if the distance between the plates is reduced by half and the space between them is filled with a substance of dielectric constant 6? 2

8. State Ampere's circuital law. Show, how this law enables an easy evaluation of the magnetic field when there is a symmetry in the system. 2

9. Find an expression for the potential energy of a magnetic dipole placed in a uniform magnetic field. 2

10. What is meant by the sensitivity of a potentiometer? 2

11. Two point charges q_A=3μC and q_B=-3μC are located 20cm apart in vacuum.

(a) What is the electric field at the midpoint O of the line AB joining the two charges?

(b) If the negative test charge of magnitude 1.5 x 10^{-9}C is placed at this point, what is the force experienced by the test charge? 3

12. Calculate the electrostatic field at a point on the equatorial line of an electric dipole.

OR

Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field. 3

13. Calculate the electrostatic potential energy of a system of three point charges q_1, q_2 and q_3 located respectively at r_1, r_2 and r_3 with respect to a common origin O. 3

14. Define the term: (i) drift velocity and (ii) relaxation time.
A conductor of length L is connected to a d.c. source of emf E. If this conductor is replaced by another conductor of same material and same area of cross-section but of length 3L, how will the drift velocity change? 3

15. Draw a circuit showing a Wheatstone bridge. Use Kirchhoff's rule to obtain the balance condition in terms of the values of the four resistors for the galvanometer to give null deflection. 3

16. Two straight, parallel, current carrying conductors are kept at a distance d from each other in air. The direction of current in both the conductors is the same. Find the magnitude and direction of the force between them. Hence define one ampere. 3

17. The Horizontal and Vertical components of Earth's field at a place are 0.22gauss and 0.38gauss respectively. Calculate the angle of dip and resultant intensity of Earth's field. 3

18. A rectangular wire loop of sides 8cm and 2cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3T directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is 1cm/s in a direction normal to the (a)longer side, (b) shorter side of the loop? For how long does the induced voltage last in each case? 3

19. Derive an expression for: (i) induced emf, and (ii) induced current, when the conductor of length l is moved with a uniform velocity v, normal to the uniform magnetic field B. Assume the resistance of the conductor to be R. 3

20. The wires which connect the battery of an automobile to its starting motor carry a current of 300A(for a short time). What is the force per unit length between the wires if they are 70cm long and 1.5cm apart? Is the force attractive or repulsive? 3

21. Write two applications each of (i) microwaves, (ii) infrared waves and (iii) radio waves. 3

Suppose that the electric field amplitude of an electromagnetic wave is E_0=120N/C and that its frequency is ν=50.0MHz.

(a) Determine B_0, ω, k and λ.

(b) Find expression of **E** and **B**. 3

23. When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard. Ultimately her parents agreed.

(i) In what way can the setting of a transmission tower by a mobile company in a residential colony prove to be injurious to health?

(ii) By objecting to this move of her parents, what value did Sunita display.

(iii) Estimate the range of em waves which can be transmitted by an antenna of height 20m. (Given radius of the earth=6400km) 4

24. (a) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.

(b) The current flowing through an inductor of self-inductance L is continuously increasing. Plot a graph showing the variation of:

(i) Magnetic flux versus the current.

(ii) Induced emf versus dI/dt.

(iii) Magnetic potential energy stored versus the current.

OR

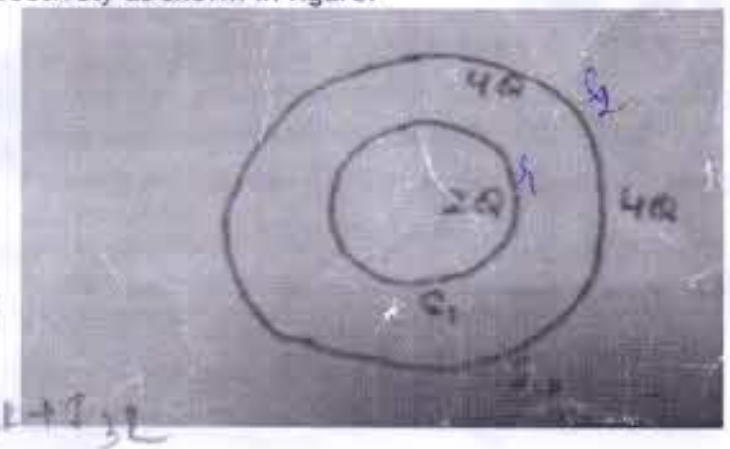
Draw a schematic sketch of an a.c. generator describing its basic elements. State briefly its working principle. Show a plot variation of: 5

(i) Magnetic flux and magnetic field

(ii) Alternating emf versus time generated by a loop of wire rotating in a magnetic field.

25. (a) Deduce an expression for the torque acting on a dipole of dipole moment **p** in a presence of a uniform electric field **E**.

(b) Consider two hollow concentric spheres, S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in figure.



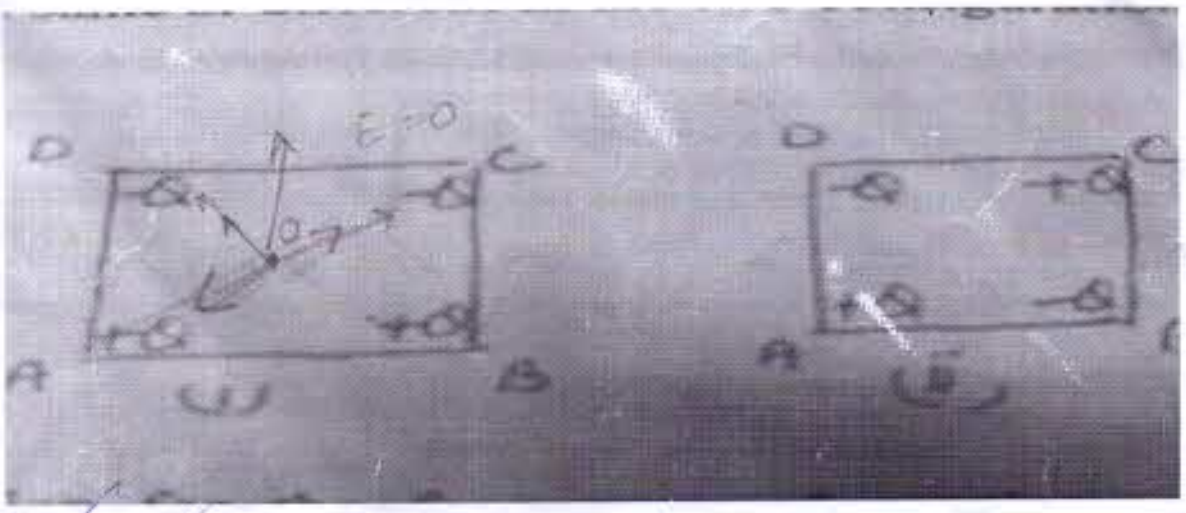
(i) Find out the ratio of the electric flux through them.

(ii) How will the electric flux through the sphere 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.

OR

(a) A long charged cylinder of linear charged density 'λ' is surrounded by a hollow co-axial conducting cylinder. What is the electric field in the space between the two cylinders?

(b) Four point charges are placed at the four corners of a square in the two ways (i) and (ii) as shown in figure. Will the (i) electric field, (ii) electric potential at the centre of the square, be the same or different in the two configurations and why? 5



26. (a) Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle.

(b) Show a schematic sketch of a cyclotron. Explain giving the essential details of its construction, how it is used to accelerate the charged particles.

OR

(a) Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working.

(b) Answer the following:

(i) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer?

(ii) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain, giving reason. 5

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