St. Mary's School, Dwarka
Holidays Homework
Class: XII
Subject: PHYSICS

Lesson : Current Electricity

Objective:

- To revise concepts.
- To develop skills to carry out research and develop scientific aptitude
- To encourage learning through experience

NOTE: Holidays HW assignments should be done in an assignment notebook and scanned copy should be mailed to me.

ACTIVITY 1

a) Research and find the current rating of any five of the following appliances used in your house: Toaster, Fan, Microwave oven, Geyser, Washing machine, Computer, Television and Refrigerator.

b) Find the resistance of each of these appliances by using Ohm's law if given that all these appliances are operated at 220 Volts.

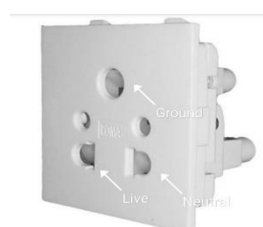
c) Is earth wire essential in all these appliances? Justify your answer.

d) Fill in your observations and calculations in the following table

S.no	Name of the appliance	Brand of the appliance	Wattage	Current rating	Resistance of the appliance as calculated by Ohm's law.

e) Why is the earth pin on a three pin plug made bigger than the others? (Refer to the fig given below)

Plug

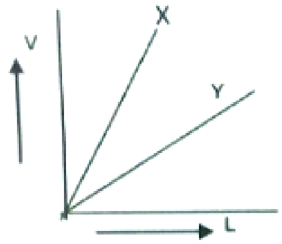


Socket

f) Why are there 5 holes in the socket shown above when only three pins are required for the working of an appliance?

Assignment 1

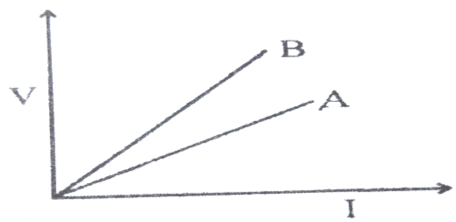
Q1. Arnav performed an experiment on comparison of emf with two different potentiometers X and Y. On plotting the variation of potential difference V with length *l*, in case of two potentiometers X and Y, he obtained the graph as shown below. Which one of these two potentiometers should he prefer for comparing emfs of two cells and why?



1

Q2.The voltage – current graphs for resistors of the same material and same radii with length $L_1$and L_2 are shown in the fig. If $L_1 > L_2$, state with reason, which of these graphs represent V – I graph for L_1. Justify.

1



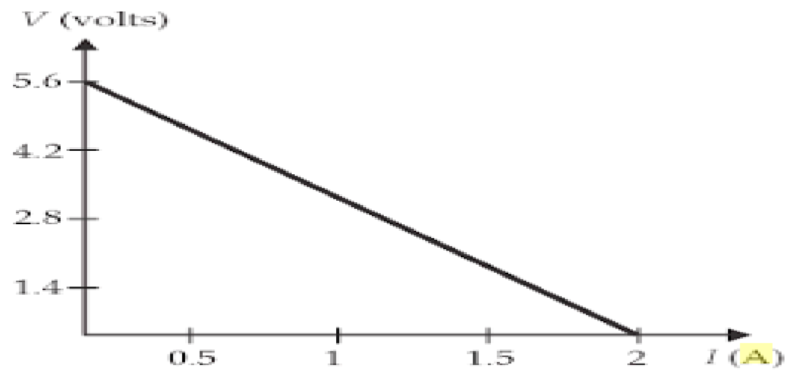
Q3.A heater coil is rated 100 W, 200 V. It is cut into two identical parts. Both parts are connected together in parallel to the same source of 200 V. Calculate the energy liberated per second in the new combination. 2

Q4. A battery of emf 10V and internal resistance 3Ω is connected to a resistor R. (*i*) If current in the circuit is 0.5 A, calculate the value of R. (*ii*) What is the terminal voltage of the battery when the circuit is closed? 2

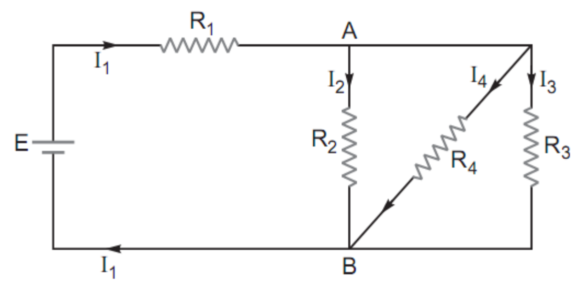
Q5. A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the percentage change in its resistance. 3

Q6. 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 a cell. 3

Q7 Four cells of identical emf E, internal resistance *r*, are connected in series to a variable resistor. The graph shows the variation of terminal voltage of the combination with the current output: (i) What is the emf of each cell used? (ii) Calculate the internal resistance of each cell. (iii) For what current from the cells, does maximum power dissipation occur in the circuit? 3

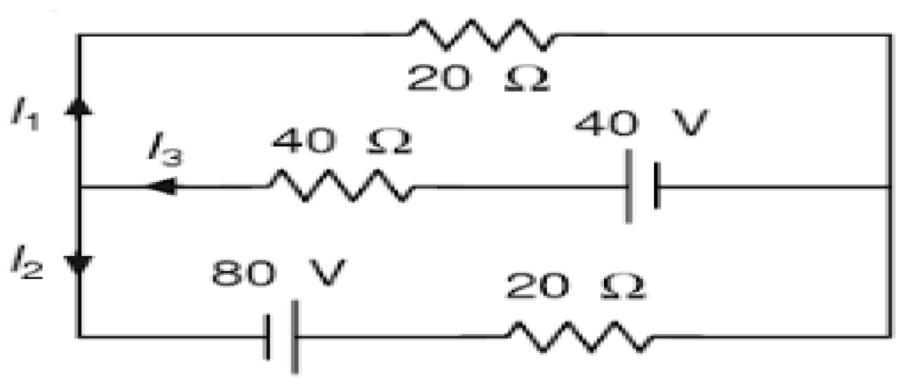


Q8. In the circuit shown, R1 = 4ohm, R2 = R3 = 15 ohm, R4 = 30 ohm and E = 10 V. Calculate the equivalent resistance of the circuit and the current in each resistor. 3



Q9 (i) At room temperature (27.0°C) the resistance of a heating element is 100 Ω. What is the temperature of the element if the resistance is found to be 117 Ω, given that the temperature coefficient of the material of the resistor is 1.70×10^{-4o} C^{-1}. (ii) Define the term drift speed and relaxation time. Establish a relation between electric current and drift speed. (2.5+2.5=5)

Q.10 State Kirchoff's rules of current distribution in an electrical network. Using these rules find the value of the current in all the branches of the given electrical circuit (2+3=5)



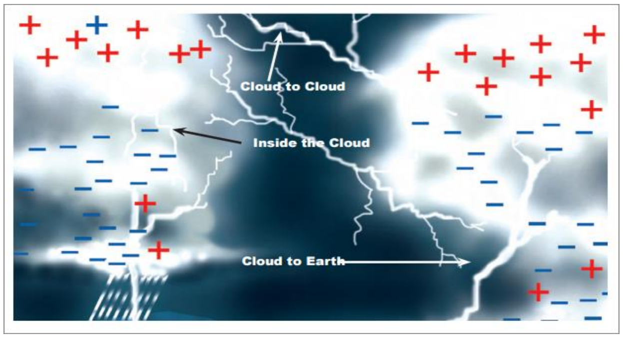
Unit: Electrostatics

ACTIVITY 2

Please refer to the given article and answer the following questions:

Atmospheric electricity: It is the study of electrical charges in the Earth's atmosphere (or that of another planet). The movement of charges between the Earth's surface, the atmosphere, and the ionosphere is known as the global atmospheric electrical circuit.

The total electric current reaching the earth's surface at any time is very nearly constant at 1800 amperes. This current, of course, is “positive”—it carries plus charges to the earth. So, we have a voltage supply of 400,000 volts with a current of 1800 amperes—a power of 700 megawatts!



Q1. Is Earth a charged body? Justify. 1

Q2. Does earth have electric field ? Justify. 1

Q3. What is the voltage of earth? 1

Q4. How many coulombs are there in a lightning bolt? 1

Q5Why is it safe to sit inside a car during a thunderstorm? Explain with the concept of electrostatic shielding. 2

Assignment 2

Q1. A point charge placed at any point on the axis of an electric dipole at a distance r experiences a force F. Find the force acting on the point charge when its distance from the dipole is quadrupled. 1

Q2. Can a metal sphere of radius 1cm hold a charge of 1coulomb? Justify your answer. 1

Q3. Three charges of +0.1C each is placed at the corners of an equilateral triangle with each side of 1m. If energy is supplied at the rate of 1kW, how many days would be required to move one of the charges to the midpoint of the line joining the other two? 2

Q4. You are given three capacitors of value 2μF, 3μF, 6μF. How will you connect them to get a resultant capacitance of 4μF? 2

Q5. A parallel plate capacitor is made by stacking 'n' equally spaced plates connected alternatively. If the capacitance between any two plates is 'C', determine the resultant capacitance of the combination. 3

Q6 When two capacitors are connected in series, the effective capacitance is 2.4μF and when connected in parallel, the effective capacitance is 10μF. Calculate the individual capacitances. 3

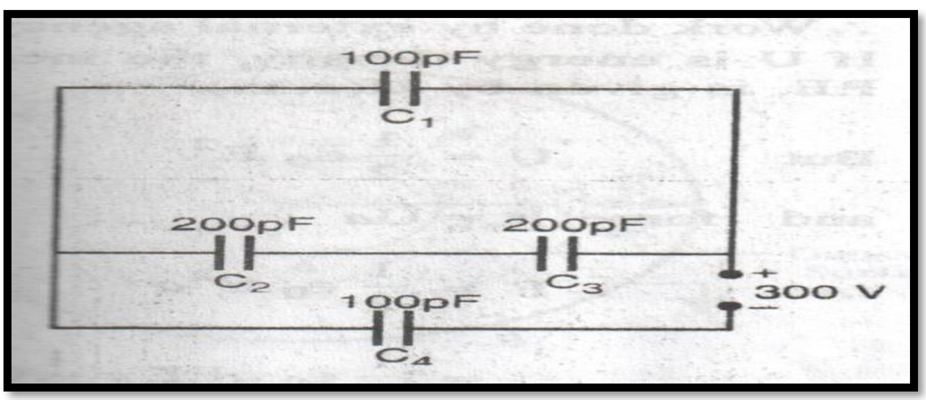
Q7State Gauss theorem and derive an expression for electric field intensity at a point outside a hollow charged conducting sphere. (b) What will be the electric field intensity at a point inside the hollow sphere? 3

Q8The distance between two equal point charges is tripled and the magnitude of each charge is doubled, what would happen to the force between them? 3

Q9Define electric flux and give its SI unit. If electric field intensity E=6i + 3j+4k, calculate the electric flux through a surface of area 15 units in X-Z plane. 3

Q10. (a) The top of the atmosphere is at about 400 kV with respect to the surface of the earth, corresponding to an electric field that decreases with altitude. Near the surface of the earth, the field is about 100 Vm^{-1}. Why then do we not get an electric shock as we step out of our house into the open? (Assume the house to be a steel cage so there is no field inside !)

(b) . Obtain the equivalent capacitance of the network in figure. For a 300 V supply, determine the charge and voltage across each capacitor. 5



Lesson: Electric Potential and Capacitance

ACTIVITY 3

Given below is a picture to show the circuit inside a mobile charger.

a) Name any four electrical components as shown in the circuit. 2

b) Write the resistance as per the color code, of all the carbon resistors, shown in the circuit. 2

c)Name the form of input and output current of an adaptor of a mobile charger. 2

d) Note down the following specifications as mentioned on the charger of your mobile: 3

S.NO	Features	Specifications
1	Model no	
2	Input Voltage	
3	Input Current	
4	Output voltage	
5	Output current	

Assignment 3

Q1 What is the work done in moving a 100nc charge between two points 5cm apart on an equipotential surface? 1

Q2. Draw the electric lines of forces for (i) two equal &opposite charges (ii) a uniform electric field 1

Q3. Define relative permittivity. Why does water have very high dielectric constant? 2

Q4. A charge of 5uc is placed 5cm above a square sheet of side 10cm.Find the electric flux through the sheet. 2

Q5. A hollow charged conductor has a tiny hole cut into its surface. Show that the electric field is (Ϭ/2€0) n, where n is the unit vector in the outward direction, and the surface charge density is near the hole. 2

Q6 (a) A 900 pF capacitor is charged by 100V battery. How much electrostatic energy is stored in the capacitor? (b) The capacitor is disconnected from the battery & connected to another 900pF capacitor. What is the electrostatic energy stored by the system? 3

Q7. Define electric dipole moment. Derive an expression for the total work done in rotating the dipole through an angle in uniform electric field. 3

Q8. Derive an expression for the capacitance of a parallel plate capacitor when the space between the plates is filled with a dielectric. 3

Q9 Two similarly and equally charged identical metal spheres A and B repel each other with a force of 2×10^{-5} N. A third identical uncharged sphere C is touched with A and then placed at the mid-point between A and B. Calculate the net electric force on C. 3

Q10. (a) Four-point charges $q_A = 2\mu C$, $q_B = -5\mu C$, $q_C = 2\mu C$, and $q_D = -5\mu C$ are located at the corners of a square ABCD of side 10 cm. What is the force on charge of 1μC placed at the centre of the square? (b) Two-point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 20 cm apart in vacuum. (i) What is the electric field at the mid-point O of the line AB joining the two charges? (ii) If negative test charge of magnitude 1.5×19^{-9} C is placed at this point, what is the force experienced by the test charge? (2.5+2.5=5)

Lesson : Electrostatics

ACTIVITY 4

THUNDERSTORM AND LIGHTNING

Thunderstorms act as a giant battery *in* the atmosphere, charging up the electro sphere to about 400,000 volts with respect to the surface. Lightning is produced in thunderstorms when liquid and ice particles above the freezing level collide, and build up large electrical fields in the clouds. The lightning spark can occur between clouds, between the cloud and air, or between the cloud and ground.

Q1. What is the form of current produced during lightning? Justify. 2

Q2. The flash of lightning is seen before the sound of thunderstorm is heard. Why? 2

Q3. What is a lightning conductor? Why is it used? 2

Q4. What is the average duration for which a flash of lightning strikes? How many volts are there in a lightning strike? 2

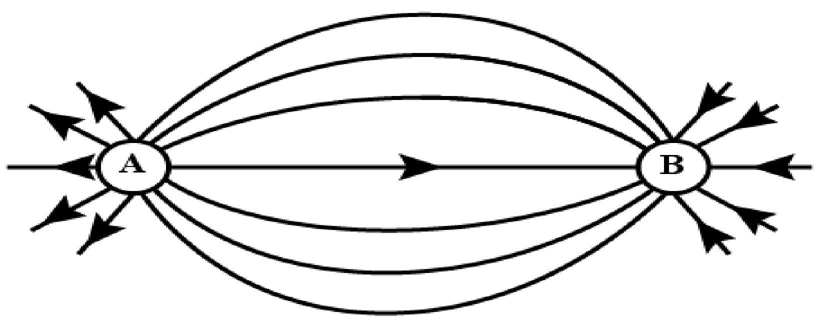
<u>Assignment 4</u>

There are 20 MCQ type questions. Each question carries 1 mark.

Q1. The insulation property of air breakdown is E = 3×10^6 volt per meter. The maximum charge in coulomb that can be given to a sphere of diameter 5 metre is approximately:

(a) 2×10^{-2}C (b) 2×10^{-3}C (c) 2×10^{-4}C (d) 2×10^{-5}C

Q2. The spatial distribution of the electric field due to two charges (A, B) is shown in figure. Which of the following statements is correct?



(a) A is +ve and B is –ve and $|A| = |B|$. (b) A is –ve and B is +ve and $|A| = |B|$.

(c) Both are +ve but A > B. (d) Both are negative but A > B

Q3. The point charges Q and -2Q are placed some distance apart. If the electric field at the location of Q is E, then electric field at the location -2Q will be

(a) $-\frac{E}{2}$ (b) $-\frac{3E}{2}$ (c) –E (d) –2E

Q4. The electric field required to keep a water drop of mass m just to remain suspended, when charged with one electron of charge e (take g as acceleration due to gravity) is:

(a) mg (b) mg/e (c) emg (d) em/g

Q5. Two small charged spheres A and B have changes 10μC and 40μC respectively and are held at a separation of 90cm from each other. At what distance from A, electric field intensity would be zero?

(a) 22.5cm (b) 18cm (c) 30cm (d) 36cm

Q6. What is the angle between the electric dipole moment and the electric field strength due to it on the equatorial line?

(a) 0° (b) 90° (c) 180° (d) None of these

Q7. An electric dipole of moment p is lying along a uniform electric field E. The work done in rotating the dipole by 90° is:

(a) pE (b) $\sqrt{2}p$E (c) pE/2 (d) 2pE

Q8. Three point charges +q, -2q and +q are placed at point (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the dipole moment vector of this assembly are:

(a) $\sqrt{2}qa$ along +x direction
(b) $\sqrt{2}qa$ along + y direction
(c) $\sqrt{2}qa$ along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)
(d) qa along the line joining points (x = 0, y = 0, z = 0) and (x = 0, y = 0, z = 0)

Q9. A dipole of dipole moment $\vec{P}$ is placed in uniform electric field $\vec{E}$, then torque acting given by:

(a) $\tau = \vec{P}.\vec{E}$ (b) $\tau = \vec{P} \times \vec{E}$ (c) $\tau = \vec{P} + \vec{E}$ (d) $\tau = \vec{P} - \vec{E}$

Q10. Two equal and opposite charges of 2×10^{-10}C are placed at a distance of 1cm forming a dipole and are placed in an electric field of 2×10^{5}N C^{-1}, The maximum torque on dipole is:

(a) $2\sqrt{2} \times 10^{-6}$Nm (b) 8×10^{8}Nm (c) 4×10^{-9}Nm (d) 4×10^{-7}Nm

Q11. Which one out of the following is not a property of electric field lines:

(a) Field lines are continuous curves without any breaks.
(b) Two field lines cannot cross each other.
(c) Field lines start at a positive charge and end at a negative charge.
(d) Field lines form closed loops.

Q12. An electric dipole is placed at an angle of 30˚ to a non – uniform electric field. The dipole will experience:

(a) A torque only

(b) A translational force only in the direction of field

(c) A translational force only in the direction normal to the direction of field

(d) A torque as well as a translational force.

Q13. Eight dipoles of charges of magnitude $\pm e$ are placed inside a cube. The total flux coming out of the cube is

(a) 0 (b) ∞ (c) e (d) $-e$

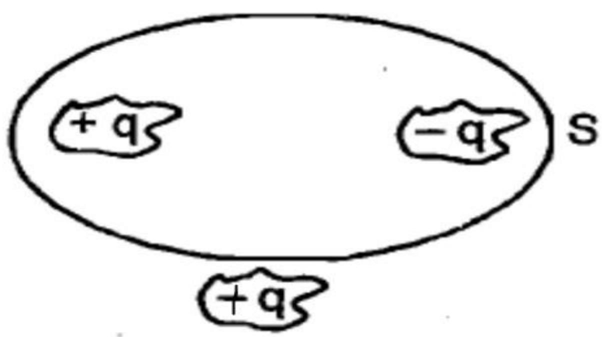
Q14. If Q is situated at the centre of a cube, then the electric flux through one of the faces of the cube is :

(a) $\frac{Q}{\epsilon_0}$ (b) $\frac{Q}{2\,\epsilon_0}$ (c) $\frac{Q}{4\,\epsilon_0}$ (d) $\frac{Q}{6\,\epsilon_0}$

Q15. A charge q is placed at the centre of a cube with side L. The electric flux linked with cubical surface is:

(a) $\frac{q}{6L^2\,\epsilon_0}$ (b) $\frac{q}{L^2\,\epsilon_0}$ (c) $\frac{q}{4\,\epsilon_0}$ (d) zero

Q16. The given figure shows distribution of charges. The flux of electric field due to these charges through the surface S is:



(a) $\frac{3q}{\epsilon_0}$ (b) $\frac{2q}{\epsilon_0}$ (c) $\frac{q}{\epsilon_0}$ (d) zero

Q17. In case of infinite long wire, electric field is proportional to:

(a) r^3 (b) $1/r^3$ (c) $1/r^2$ (d) $1/r$

Q18. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

(a) be reduced to half (b) remain the same

(c) be doubled (d) increase four times

Q19. A sphere of radius R has a uniform distribution of electric charge in its volume. At a distance x from its centre for $x < R$, the electric field is directly proportional to:

(a) $1/x^2$ (b) $1/x$ (c) x (d) x^2

Q20. The charged spherical shell of radius 1m does not produce as electric field at any:

(a) Interior point (b) point beyond 2m

(c) point beyond 10m (d) none of these