Optics & electrostratics bc-00-phy-5

1. a) Define quantization of charge. (1)
   b) Two small spheres separated by a distance of 2cm have equal charges. Calculate the no of electrons present on each spheres if the magnitude of the force of repulsion between them is 4.57×10^{-21} N (3)
   c) What does $q_1 + q_2 = 0$ signify in in electrostatics? (1)
2. a) Define action of point. (1)
   b) Derive an expression for the coulombs' law in electrostatics. (2)
   c) Define relative permittivity in terms of force. (1)
   d) Why repulsion is sure test for testing a charged body? (1)
3. a) What is surface charge density? (1)
   b) Why sharp edges are avoided in the electrical machine? (1)
   c) Two charges 1×10^{-6}C and -4×10^{6}C are separated by a distance of 2m, Determine the position of the null point. (1)
4. a) Write down the methods of charging. (1)
   b) Can a body be permanently charged by the method of conduction? (3)
   c) How can a body be permanently charged by the method of induction? (1)
5. a) Why charge mostly concentrates on a sharped edge? (1)
   b) Write the basic property of charge.
   c) An α–particles is the nucleus of a helium atom. It has mass $M\alpha = 6.64\times10^{-27}$ kg and charge $q\alpha = +2e = 3.2\times10^{-19}$C. Compare the force of the electric repulsion between two α particles with the force of gravitational attraction between them. Comment your result. (3)
6. a) Define coulomb's law-in electrostatics . (1)
   b) How many electrons are there in the 1C charge? (3)
7. a) Di-electric constant of wate is 80. What does it mean? (1)
   b) Two equal charges are separated by a distance of 50 cm and exert the force of 0.1N.
      i) Calculate the value of each charge. (2)
      ii) What would be the number of each charges if they were kept in a medium whose dielectric constant is 10? (2)
8. The image distance in curved mirror depends on position of the object.
   a) Which type of curved mirror would you prefer for shaving purposes? Give reason.(1)
   b) State the nature of the image formed by a concave mirror when the object lies beyond the centre of curvature. Also draw ray diagram for the case. (2)
   c) Derive the relation R = 2f in case of concave mirror with the appropriate sign convention. (2)
9. a) State a condition in which a concave mirror forms a real image equal to the size of the object and also draw a ray diagram.
   b) Can a convex mirror ever form a real image? Explain. (2)
   c) Derive the relation R = 2f in case of convex mirror.

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Electrostatics Theory Questions

1. What are the difference between the method of charging by conduction and induction?
2. How can you charge a neutral body positively? Explain.
3. How can you charge a neutral body negatively? Explain.
4. Define linear charge, surface charge density and volume charge density.
5. State sand explain coulomb's law in electrostatics.
6. What are the limitations of the coulomb's law of electric force?
7. Bits of paper are attracted to an electrified comb, even though they have no net charge. How is it possible?
8. Petrol tankers plying on highways often have metal chains attached to that drag along the road. Could you say why ?
9. Find the charge in coulomb on 1 gram ion of N^{3-} Ans: 2.89×10^5 coulomb.
10. Why a man in an insulated metallic cage does not receive a shock even when the cage is connected to a high voltage source?
11. More charge can be stored on metal if it is highly polished. Then when its surface is rough. Explain.

Electrostatics Numericals

1. Two equally charged identical metal spheres A and B repel each other with a force 2.0×10^{-5}N. Another identical uncharged sphere C is touched to A and then placed at the mid point between A and B. What is the net electric force on C? Ans: $[2.0 \times 10^{-5} N]$
2. What is the magnitude of the electrostatic force between a singly charged sodium ion, and an adjacent singly charged chlorine ion in a salt crystal if their separation is 2.82×10^{-10}?
3. How far apart must two protons be if the magnitude of the electrostatic force acting on either one due to the other is equal to the magnitude of the gravitational force on a proton at Earth's surface?
4. Three point charges are arranged on a line. Charge q3 = $+5\ \eta$ C is at the origin charge q2 = $-3\ \eta$C is at x = + 4 cm and charge q1 is at x = +2 cm. What is the magnitude of q1 if the net force on q3 is zero?
5. A charge of 6.0 μ C is to be split into two parts that are then separated by 3.0 mm.What is the maximum possible magnitude of the electrostatic force between those two parts?
6. If a cat repeatedly rubs against your cotton slacks on a dry day, the charge transfer between the cat hair and the cotton can leave you with an excess charge of -2.00μC. (a) How many electrons are t ransferred between you and the cat?
7. Point charges of $+6.0\mu C$ and $-4.0\mu C$ are placed on an x axis, at x = 8.0 m and x = 16 m, respectively.What charge must be placed at x= 24 m so that any charge placed at the origin would experience no electrostatic force?
8. Three charges of 3×10^{-9} C, -3×10^{-9}C and 1.5×10^{-9}C are placed in air at the corners A, B and C of an equilateral triangle ABC having each side 5 cm. Find the force acting on the charge 1.5×10^{-9} C.
9. Suppose you, acquire a net charge of -2.0*mu* C while shufflihg across a carpeted floor. Will you have a deficiency or excess of electrons? How many missing or extra electrons will you have? Ans: $[1.3 \times 10^{13} electrons]$
10. Consider three charges q_1, q_2 and q_3 each equal to q at the vertices of an equilateral triangle of side 'a'. What is the force on a charge Q placed at the centroid of the triangle?
11. Two point charges A and B have charges respectively $\frac{1}{2}C$ and $2C$ with their position vectors respectively as $(\hat{i}+\hat{j}+\hat{k})$ and $(-\vec{i}-\vec{j}+3\vec{k})$.