Electric Charge & Charging Methods

Electric charge · 6 questions · step-by-step answers at the end

Name: Date: Score: / 6

USEFUL EQUATIONS

$q = ne$ $e = 1.6 \times 10^{-19}\ \text{C}$ $q' = (q_1 + q_2)/2$ $\Sigma q_{\text{before}} = \Sigma q_{\text{after}}$

Questions

Show your working in the space under each question.

1. A negatively charged rod is used to charge a sphere by induction. What sign does the sphere end with?

2. Identical metal spheres carry +6.0 µC and −2.0 µC. They touch and are then separated. Find the final charge on each, and how many electrons moved.

3. Could an oil drop carry a charge of 4.0×10^{-19} C?

4. A point charge +Q sits at the centre of a neutral conducting spherical shell. What charge appears on the inner and outer surfaces of the shell?

5. A negatively charged balloon sticks to a neutral wall. Explain.

6. Why is the field just outside a charged conductor always perpendicular to the surface?

Step-by-step answers

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1. **Positive.** The rod repels electrons into the ground, and they can't come back once the ground is disconnected.

2. 1. Total charge = +6.0 + (−2.0) = +4.0 µC, which is conserved.
   2. Identical spheres share it equally: each ends with **+2.0 µC**.
   3. The first sphere went from +6.0 to +2.0 µC, so it gained 4.0 µC of electrons.
   4. n = q/e = 4.0×10^{-6} / 1.6×10^{-19} = **2.5×10^{13} electrons** moved from the second sphere to the first.

   Answer: +2.0 µC each; 2.5×10^{13} electrons transferred

3. **No**: 4.0/1.6 = 2.5 is not a whole number of e.

4. Inner surface **−Q** (so that E = 0 in the metal); outer surface **+Q** (so the shell stays neutral).

5. The balloon **polarises** the wall's molecules: positive ends turn toward it and are closer, so attraction beats repulsion.

6. A parallel component would push free charges along the surface, so the conductor would **not** be in equilibrium.