

Charge collected by a satellite

Potential at the surface of a sphere of charge Q , radius R , is

$$V = \frac{1}{4\pi\epsilon_0} \frac{Q}{R}.$$

If $\Delta V = -1.0$ V, then -1.0 V = $\frac{1}{4\pi\epsilon_0} \frac{\Delta Q}{R}$.

Using MKS units (with $R = 10$ m),

$$-1.0 = (9.0 \times 10^9) \frac{\Delta Q}{10} \implies \Delta Q = -1.1 \times 10^{-9} \text{ C} = -1.1 \text{ nC}.$$

You know it, and I know it: most satellites are not spheres. This calculation, therefore, is an estimate not an exact result. Some people think that if you can't get an exact result, there's no use trying. That's totally false! A quick and imperfect estimate is far better than complete ignorance. (This applies not only to science and engineering, but also to finance, home budgets, personal relations, and foreign policy. See, for example, "Blind into Baghdad" by James Fallows, *The Atlantic Monthly*, Jan/Feb 2004.)

Grading: 3 points for invoking the formula for "potential at the surface of a sphere"

2 points for the numerical value

2 points for units

2 points for two significant figures