

Solutions

2.1 Answer: D. Inner surface has $-3Q$; shell total $-Q$ therefore leaves $+2Q$ outside.

Compare the rejected options: $-3Q$; $-Q$; 0 ; $+3Q$. Use the stated model and conditions.

2.2 Answer: C. $\sqrt{6^2+8^2}=10$ N.

Compare the rejected options: 2 N; 7 N; 14 N; 48 N. Use the stated model and conditions.

2.3 0.5. The plane subtends half the full solid angle.

2.4 True. The field is the negative potential gradient, not the potential itself.

3.1 The inner total remains $-Q$ because the metal field stays zero, but its distribution is generally nonuniform. Outer total remains $q+Q$. The spherical exterior is equipotential; uniqueness with zero at infinity gives $V = k(q + Q)/r$ outside, so metal potential and exterior field retain their centred values. Cavity field changes. Award inner total, redistribution, outer total, uniqueness argument and unchanged exterior/potential.