1. The asymptotic scattering wavefunction far from the nucleus is:

A. $\psi \to \sin(kr)$
B. $\psi \to e^{ikz} + f(\theta)\, e^{ikr}/r$
C. $\psi \to e^{ikr}$ only
D. $\psi \to \cos(kr - \delta)$

2. A positive phase shift $\delta_\ell > 0$ indicates:

A. Repulsive potential
B. No interaction
C. Attractive potential
D. Complete absorption

3. A real potential gives $\sigma_R = 0$ because:

A. The nucleus is too small
B. Hermitian H conserves flux; $|S_\ell| = 1$ for all ℓ
C. Phase shifts are always zero
D. The Coulomb barrier prevents reactions

4. At low beam energies, the dominant absorption mechanism is:

A. Volume absorption $-iW_V\, f(r)$
B. Surface absorption $-iW_S\, df/dr$
C. Spin-orbit coupling
D. Coulomb excitation

5. The optical model potential $U(r) = V(r) - iW(r)$ is needed because:

A. Real potentials give wrong nuclear radii
B. Reactions require flux absorption, which needs $\mathrm{Im}(U) \neq 0$
C. Coulomb scattering cannot be computed otherwise
D. Plane waves are not solutions of the Schrödinger equation

6. The distorted waves χ from the optical model are used as:

A. Final answers for reaction cross sections
B. Input to the DWBA transition amplitude
C. Replacements for the Q-value equation
D. Corrections to the Rutherford formula

PH501 · Lecture 4 — Answer Key

Scattering theory and the optical model

Q1: B **Q2: C** **Q3: B** **Q4: B** **Q5: B** **Q6: B**