Solutions

Problem 1:
(B) In a symmetric potential well, the wave function is either symmetric or antisymmetric. The ground-state wave function is symmetric.

Problem 2:
(B) Indistinguishable bosons are more likely to condense into the lowest energy state than classical particles. Indistinguishable fermions obey the Pauli exclusion principle.

Problem 3:
(E) Filled shells are spherically symmetric and s-states ($l = 0$) are spherically symmetric.

Problem 4:
(E) In a symmetric potential the eigenstates of H are either even or odd.
The ground state has no nodes and therefore is even.

Problem 5:
(B) The electrons do not interact. Each will occupy the lowest available energy eigenstate. The spin function will be antisymmetric (singlet state).

Problem 6:
(C) Since $V > E$, we have an exponentially decaying wave function.

Problem 7:
(A) The photoelectric effect: $E = hf - W$

Problem 8:
(E) Hydrogenic atoms: For the H atom $E_n = -13.6\ \text{eV}/n^2$. E_n scales with the reduced mass μ, which for positronium is $\frac{1}{2}m_e$.

Problem 9:
(E) The hydrogen atom: $E_n = -13.6\ \text{eV}/n^2$.

Problem 10:
(B) Spreading of wave packets, the uncertainty principle

Problem 11:
(C) The periodic table: Sodium has one electron outside closed shells. It appears in the first column of the periodic table.

Problem 12:
(A) Hydrogenic atoms: For the He ion $E_I' = 4*13.6$ eV. $E_n = -54.4\ \text{eV}/n^2$. $E_4 = -3.4$ eV.
$\Delta E = E_4 – E_{nf} = hc/\lambda = 2.6$ eV. $E_{nf} = -6$ eV, $n_f = 3$.

Problem 13:
(E) Cs has one electron outside a closed shell. We expect a large drop in the binding energy as we start filling a new shell.