Exercises: Suggested exercises include Level 1 problems 9, 14, 16, 21, 27 and 28 from Chapter 7.

Problems to be handed in:
1) TL problem 7-2.
2) TL problem 7-22.
3) (a) What are the possible values of \( \ell \) for \( n = 5 \).
    (b) Give the appropriate label for each of these states in spectroscopic notation.
    (c) What values of \( m \) are possible for \( \ell = 3 \)?
    (d) What is the lowest possible value of \( n \) for which an electron can have \( \ell = 3 \)?
4) (a) For an electron in the 4d state in hydrogen, find the numerical values for the energy and the magnitude of the orbital angular momentum vector.
    (b) How many different values of \( L_z \) are possible for this state?
5) Show by direct substitution into the Schrödinger Equation (7-9 in the text) that

\[
\psi(r, \theta, \phi) = Cr e^{-r/2a_0} \cos \theta
\]

is an acceptable wave function for the hydrogen atom. For what value of \( E \) is the equation satisfied?
6) Make a sketch of the radial wave function \( R(r) \) and the radial probability density \( P(r) \) for the 2s state in hydrogen.
7) Find the most probable value of \( r \) for electrons in the 2s and 2p states in hydrogen.
8) For an electron in the ground state of hydrogen, find the probability that the electron is farther than \( 2a_0 \) from the nucleus.
9) Starting from the fact that the radial wave function for an electron in the 2p state of hydrogen is \( Cr e^{-r/2a_0} \) find the expectation value of \( r \) for an electron in this state.