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Modern Physics: Quiz II: 2006: Open Book, NOT open
discussion. Note, some problems marked ”HW” can be
completed at home.

(1) (a) If \( \psi(r) = Ae^{-ar} \) describes the spatial part of the ground
state wave function of the electron in H-atom, what is total wave
function of the electron?
(b) What is the de-Broglie wave length of the above
electron?
(c) Spatial part of the Wave function of a particle moving in
one-dimension is \( \psi(x) = Ae^{-|x|} \).
What is the probability that it will be found in the region
\( x \geq 0 \)?
Where is the particle most likely to be found?
Calculate the normalization constant \( A \). (HW)
What is the probability that the particle will be found in \(-2 \leq x \leq 2\). (HW)
(d) The wave function of a free particle is \( \psi(x) = e^{ikx} \). Where is
the expectation value of \( x \)? What is the expectation value of
\( p \). How is it consistent with uncertainty principle? (HW) (e)
True or False

(1) Solutions of the Schroedinger equation have to be complex.
(2) Harmonic oscillator and H-atom could have same time-dependent
part of the wave function
(3) A particle with energy less than the height of the barrier,
can penetrate classically forbidden regime
(4) A particle with energy greater than barrier, may not enter
the region with a potential barrier.