

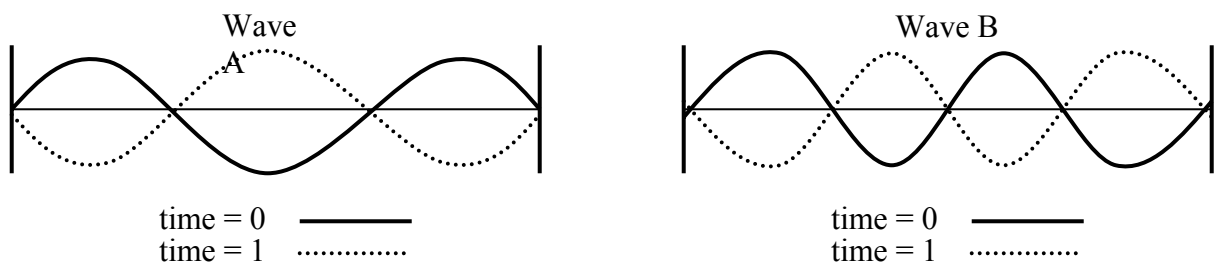
Name
Section
Rec TA

Side 1 of 2

Ch 1a, Problem Set Three
Due Friday, Oct. 13, 2006
at 4 PM in the Drop Box

Problems #1 and #3 are designated (👏) as “no collaboration” problems.

Certain problems require answers in specific units! Please note this, or suffer the consequences! Also, consider the uncertainties given in some problems. For numbers that are reported as $x \pm y$, use the convention that the uncertainty is $2y$! For numbers with no reported uncertainty, assume the values are known to infinite certainty.

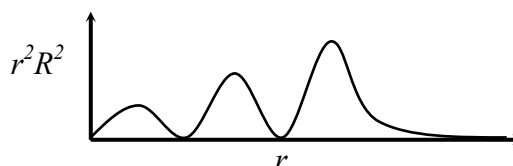


- 👏 1. (25 Points, 5 Each) The sketches above illustrate two 1-D standing waves over time.
- How many nodes does Wave A have?
 - How many nodes does Wave B have?
 - Which of the two standing waves is higher in energy? Justify your answer. (The two waves are occurring in physically identical systems.)
 - Assume a Wave C that is higher in energy than either A or B. What is the minimum number of nodes that Wave C may have? Again, all waves occur in physically identical systems.
 - What is the principle quantum number, n , for waves A and B? Justify your answer.
2. (15 Points) The velocity of a certain proton is 5.7×10^5 m/s. If the uncertainty in its momentum is to be reduced to 0.00025 percent, what uncertainty in its location must be tolerated according to the Heisenberg Uncertainty Principle?

3. (35 Points, 5 Each) Answer the questions below:

- Name the orbital with four angular nodes and one radial node.
- Name the orbital with three angular nodes and two radial nodes.
- How many angular nodes are in an 8p orbital?
- How many 8f orbitals are required to produce a degenerate set?
- How many radial nodes are in a 9d orbital?

- Name the orbital with 3 angular nodes and the following radial distribution function qualitatively shown on the right.



- For the 6f orbital, draw a qualitative sketch of the radial distribution function ($r^2 \psi^2$ vs. r) at an angular antinode. You do not need to indicate quantitatively the positions of the radial nodes, but as in part (f.) the number of nodes is important.
4. (25 Points) During a trip to Roswell, New Mexico, you find yourself at a cocktail party with aliens from another universe. You are at a loss for conversation so you offer to reconstruct the periodic table from memory (chemistry being the most exciting thing you can think of). The aliens are stupefied at your choice of conversation, but inform you that in their universe, certain key rules governing the properties of atoms are different. Not wishing to offend your charming hosts, you naturally take their physical laws into consideration. They are:
- We have the same rules for n and l
 - The only allowed values for m_l are from $-2l$ to $+2l$
 - Only one value is allowed for m_s , that is, each orbital may hold only 1 electron.
 - We have the same rule for orbital energies (i.e. 4s lower in energy than 3d, etc.)

Use the rules above to answer the following questions:

- (10pts) What is the maximum number of electrons held in each alien quantum level, n , for $n = 1$ through $n = 6$?
- (10pts) List all the electron configurations for the alien version of the elements from Carbon through Vanadium. Assume each element still has the same number of electrons.
- (5pts) From part b., what are the first 4 alien halogen elements?