

## Tareas 8 Tópicos de la Física Moderna

31 de octubre 2020

1. Estimate the energy of an innermost electron in (a) the sodium atom, (b) the silver atom, and (c) the uranium atom.
2. Consider the total wave function  $\Psi$  for three electrons. Give an expression for  $\Psi$  as a function of the individual wave functions  $\Psi_{\vec{a}}(\vec{r}_1)$ ,  $\Psi_{\vec{b}}(\vec{r}_2)$ , and  $\Psi_{\vec{c}}(\vec{r}_3)$ , where  $\vec{a}$ ,  $\vec{b}$ , and  $\vec{c}$  represent the quantum numbers of each electron and  $\vec{r}_1$ ,  $\vec{r}_2$ , and  $\vec{r}_3$  represent the coordinates.
3. (a) List the possible values of the quantum numbers  $n$ ,  $l$ ,  $m_l$  and  $m_s$  for a  $2p$  state. (b) If an atom has two  $2p$  electrons, how many states are there?
4. If there were a stable element 113, what would be your guess of the quantum numbers  $n$  and  $l$  of the most energetic electron? Why might such an element not exist?
5. Determine the possible values of the total angular momentum,  $J$ , for an outer electron in the scandium atom ( $Z = 21$ ). Express your answer in units of  $\hbar$ .
6. An atom has two electrons in the  $d$  sub-shell. What are the possible values of the  $z$  component of the total angular momentum?
7. In an energy level diagram for a multi-electron atom, why must we specify the quantum numbers of every electron in the atom to define an energy level?
8. What is the highest energy photon that can be emitted from the Helium atom?
9. Make a qualitative sketch of the energy levels in the arsenic atom ( $Z = 33$ ).
10. A  $3d_{5/2}$  state with an unsplit energy of  $E$  is placed in a weak magnetic field. Determine the number of states that level split into and make a sketch of the resulting energy levels.