WIS Quantum Mechanics

1. The Δ of visible & IR radiation are not short enough (and hence not energetic enough) to affect the dark pigment-producing melanocyte cells beneath the skin.

2. To distinguish the quantum mechanical description of an atom from Bohr's model, we speak of an atomic orbital, rather than an orbit. When we say that an e- is in a certain orbital, we mean that the distribution of e-density (i.e., probability of locating an e- in space) is defined. An atomic orbital has a characteristic energy & characteristic distribution of e-density (i.e., shape).

3. Shell = principle quantum number
   Subshell = principle quantum number & shape
   (angular momentum quantum number)

4. a) A 2s orbital is larger than a 1s orbital. Both have the same spherical shape. The 1s orbital is lower in energy than the 2s.

   b) The two orbitals are identical in size, shape, & energy. They differ only in their orientation with respect to each other.
5. a) 2  b) 0  c) 10  d) 14

6. 5 possible subshells: 5s, 5p, 5d, 5f

7. 

<table>
<thead>
<tr>
<th>n value</th>
<th>Sublevels</th>
<th>Total # of Orbitals</th>
<th>Total # of e-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>S, P</td>
<td>1 + 3 = 4</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>S, P, d</td>
<td>1 + 3 + 5 = 9</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>S, P, d, f</td>
<td>1 + 3 + 7 = 11</td>
<td>32</td>
</tr>
</tbody>
</table>

In each case the # of orbitals is the square of the n value \((n^2)\). The total # of e- is \(2n^2\).

8. 3s: 2e-; 3d: 10e-; 4p: 10e-; 4f: 14 e-; 5f: 14 e-

9. In the many-electron atom, the 3p orbital electrons are more effectively shielded by the inner e- of the atom (that is the 1s, 2s, & 2p e-) than the 3s e-. The 3s orbital is said to be more "penetrating" than the 3p & 3d orbitals. It feels proton pull.

In the hydrogen atom there is only 1 e- so the 3s, 3p & 3d orbitals have the same nrg.

10. a) N: 1s\(^2\) 2s\(^2\) 2p\(^3\) \(\underline{3}\) \(\text{p-type e-}\)

b) Si: 1s\(^2\) 2s\(^2\) 2p\(^6\) 3s\(^2\) 3p\(^2\) \(\underline{1}\) \(\text{s-type e-}\)

c) S: 1s\(^2\) 2s\(^2\) 2p\(^6\) 3s\(^2\) 3p\(^4\) \(\text{no d-type e-}\)
11. a) 2s\rightarrow 1s  
   b) 3p\rightarrow 2p  
   c) equal  
   d) equal  
   e) 5s\rightarrow 4f  

12. a) 2s\leq 2p  
   b) 3p\leq 3d  
   c) 3s\leq 4s  
   d) 4d\leq 5f  

13. \textbf{Ar}: ground state e-config: 1s^2 2s^2 2p^6 3s^2 3p^6  
   noble gas e-config: [Ar]  
   Orbital diagram: 1k 1k 1l 1l 1l 1l 1l 1l 1l 1l 1l  
   1s 2s 2p 3s 3p  
   Noble gas orbital diagram: [Ar]  

\textbf{Mg}: 1s^2 2s^2 2p^6 3s^2  
   1l 1k 1l 1l 1l 1l 1l  
   Noble gas: [Ne] 3s^2  
   1k 3s  

\textbf{N}: 1s^2 2s^2 2p^3  
   1l 1k 1l 1l 1l  
   Noble gas: [Ne] 2s^2 2p^3  
   1k 1l 1l  

\textbf{Li}: 1s^2 2s^1  
   Noble gas: [He] 2s^1  
   1k 1l  

\textbf{P}: 1s^2 2s^2 2p^6 3s^2 3p^3  
   Noble gas: [Ne] 3s^2 3p^3  
   1l 1k 1l 1l 1l 1l 1l  
   Noble gas: [Ne] 3s 3p  

\textbf{Cl}: 1s^2 2s^2 2p^6 3s^2 3p^5  
   Noble gas: [Ne] 3s^2 3p^5  
   1l 1k 1l 1l 1l 1l 1l 1l 1l 1l 1l  
   Noble gas: [Ne] 3s 3p
Fe: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

$[\text{Ar}] 4s^2 3d^4$

$[\text{Ar}] 1s^2 4s^2 3d^9$

Al: $1s^2 2s^2 2p^3 3s^2 3p^3$

not enough e- in 2p (possible excited state)

B: $1s^2 2s^2 2p^3$

too many e-; B atomic # = 5

F: $1s^2 2s^2 2p^6$

too many e-; F atomic # = 9

or Ne

Para magnetic substances are those that contain net unpaired spins.
Diamagnetic substances do not contain net unpaired spins.

ex) Para: Li: $1s^2 2s^1$

$\underline{1s}$

dia: He $1s^2$

$1s$

B: $[\text{He}] 2s^2 2p^1$

unpaired e-

P: $[\text{Ne}] 3s^2 3p^3$

3 unpaired e-

Mn: $[\text{Ar}] 4s^2 3d^5$

5 unpaired e-

Kr: 0 unpaired e-

Cd: $[\text{Kr}] 5s^2 4d^{10}$

0 unpaired e-
Pb: \([\text{Xe}] 6s^2 4f^{14} 5d^{10} 6p^2\) \(\text{2 unpaired e}^-\)
Ne: \(\text{0 unpaired e}^-\)
Sc: \([\text{Ar}] 4s^2 3d^1\) \(\text{1 unpaired e}^-\)
Se: \([\text{Ar}] 4s^2 3d^{10} 4p^4\) \(\text{2 unpaired e}^-\)
Fe: \([\text{Ar}] 4s^2 3d^{10} 4p^5\) \(\text{1 unpaired e}^-\)
I: \([\text{Kr}] 5s^2 4d^{10} 5p^5\) \(\text{1 unpaired e}^-\)

\(\overset{17}{\text{S}}\): (6 valence e\(^-\)) \([\text{Ne}] 1\upsilon 1\kappa 1\upsilon 1\upsilon 3s 3p\) \(\text{2 unpaired}\)

\(\overset{18}{\text{S}^+}\): (5 valence e\(^-\)) \([\text{Ne}] 1\upsilon 1\kappa 1\upsilon 1\upsilon 1\upsilon 3s 3p\) \(\text{3 unpaired}\)

\(\overset{18}{\text{S}^-}\): (7 valence e\(^-\)) \([\text{Ne}] 1\upsilon 1\kappa 1\upsilon 1\kappa 1\upsilon 3s 3p\) \(\text{1 unpaired}\)

\(\overset{18}{\text{Cr}}\): \([\text{Ar}] 1\upsilon 1\kappa 1\upsilon 1\upsilon 1\upsilon 1\upsilon 4s 3d\) \(\text{Why}\)
\(\overset{18}{\text{Cr}}\): \([\text{Ar}] 1\upsilon 1\kappa 1\upsilon 1\kappa 1\upsilon 1\upsilon 4s 3d\) \(\text{Why}\)

\(\overset{18}{\text{Cu}}\): \([\text{Ar}] 1\upsilon 1\kappa 1\upsilon 1\kappa 1\upsilon 1\upsilon 1\upsilon 4s 3d\) \(\text{Why}\)
\(\overset{18}{\text{Cu}}\): \([\text{Ar}] 1\upsilon 1\kappa 1\upsilon 1\kappa 1\upsilon 1\upsilon 1\upsilon 4s 3d\) \(\text{Why}\)

\* in general, half-filled & completely filled subshells have extra stability