

Quiz 1 – August 28, 2019

Complete the following problems. Write your final answers in the blanks provided. You must show your work to receive full credit. Show your answers to the correct number of significant figures with the correct units.

1. Consider light with wavelength of 410 nm.
 - a. What is the energy of a photon of this light? (4 pts)

Answer _____

- b. An electronic transition in a hydrogen atom, starting at $n_i = 7$, produces light of 410 nm wavelength. What is the final n for this transition? REMEMBER: n is an integer! (5 pts)

Answer _____

2. Determine if each of the sets of quantum numbers below is **valid** or **invalid**, given the rules of quantum mechanics. For each set that is **invalid** provide a brief explanation of what makes the set invalid. (8 points)
 - a. $n = 3, \ell = 3, m_\ell = 1$

 - b. $n = 3, \ell = 1, m_\ell = -1$

 - c. $n = 3, \ell = 2, m_\ell = 3$

 - d. $n = 2, \ell = 0, m_\ell = 0$

3. Sketch an example of each of the two orbitals below. For each orbital indicate the number of radial and angular nodes. (8 pts)

| Orbital | $n = 2, \ell = 1$ | $n = 4, \ell = 0$ |
|-------------------------|-------------------|-------------------|
| Sketch | | |
| Number of Radial Nodes | | |
| Number of Angular Nodes | | |

Possibly Useful Information

| | | | |
|--|---|---|---------------------------------|
| $h = 6.626 \times 10^{-34} \text{ J s}$ | $c = 2.998 \times 10^8 \text{ ms}^{-1}$ | $E = h\nu = \frac{hc}{\lambda}$ | $\Delta E \cdot \Delta(mv) > h$ |
| $R_H = 2.179 \times 10^{-18} \text{ J/atom}$ | $E = -\frac{R_H}{n^2}$ | $\Delta E = R_H \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$ | $H\psi = E\psi$ |

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | |
|---|--|--|--|--|---|---|---|---|---|--|--|--|---|---|--|---|--|--|
| 1 H Hydrogen 1.008 | 2 He Helium 4.003 | | | | | | | | | | | | | | | | | |
| 3 Li Lithium 6.941 | 4 Be Beryllium 9.012 | | | | | | | | | | | 5 B Boron 10.811 | 6 C Carbon 12.011 | 7 N Nitrogen 14.007 | 8 O Oxygen 15.999 | 9 F Fluorine 18.998 | 10 Ne Neon 20.180 | |
| 11 Na Sodium 22.990 | 12 Mg Magnesium 24.305 | 3 III B 3B | 4 IV B 4B | 5 V B 5B | 6 VIB 6B | 7 VII B 7B | 8 VIII 8 | 9 VIII 9 | 10 VIII 10 | 11 IB 1B | 12 IIB 2B | 13 Al Aluminum 26.982 | 14 Si Silicon 28.086 | 15 P Phosphorus 30.974 | 16 S Sulfur 32.066 | 17 Cl Chlorine 35.453 | 18 Ar Argon 39.948 | |
| 19 K Potassium 39.098 | 20 Ca Calcium 40.078 | 21 Sc Scandium 44.956 | 22 Ti Titanium 47.867 | 23 V Vanadium 50.942 | 24 Cr Chromium 51.996 | 25 Mn Manganese 54.938 | 26 Fe Iron 55.845 | 27 Co Cobalt 58.933 | 28 Ni Nickel 58.693 | 29 Cu Copper 63.546 | 30 Zn Zinc 65.38 | 31 Ga Gallium 69.723 | 32 Ge Germanium 72.631 | 33 As Arsenic 74.922 | 34 Se Selenium 78.971 | 35 Br Bromine 79.904 | 36 Kr Krypton 83.798 | |
| 37 Rb Rubidium 85.468 | 38 Sr Strontium 87.62 | 39 Y Yttrium 88.906 | 40 Zr Zirconium 91.224 | 41 Nb Niobium 92.906 | 42 Mo Molybdenum 95.95 | 43 Tc Technetium 98.907 | 44 Ru Ruthenium 101.07 | 45 Rh Rhodium 102.906 | 46 Pd Palladium 106.42 | 47 Ag Silver 107.868 | 48 Cd Cadmium 112.414 | 49 In Indium 114.818 | 50 Sn Tin 118.711 | 51 Sb Antimony 121.760 | 52 Te Tellurium 127.6 | 53 I Iodine 126.904 | 54 Xe Xenon 131.294 | |
| 55 Cs Cesium 132.905 | 56 Ba Barium 137.328 | 57-71 Lanthanide Series | 72 Hf Hafnium 178.49 | 73 Ta Tantalum 180.948 | 74 W Tungsten 183.84 | 75 Re Rhenium 186.207 | 76 Os Osmium 190.23 | 77 Ir Iridium 192.217 | 78 Pt Platinum 195.085 | 79 Au Gold 196.967 | 80 Hg Mercury 200.592 | 81 Tl Thallium 204.383 | 82 Pb Lead 207.2 | 83 Bi Bismuth 208.980 | 84 Po Polonium [208.982] | 85 At Astatine 209.987 | 86 Rn Radon 222.018 | |
| 87 Fr Francium 223.020 | 88 Ra Radium 226.025 | 89-103 Actinide Series | 104 Rf Rutherfordium [261] | 105 Db Dubnium [262] | 106 Sg Seaborgium [266] | 107 Bh Bohrium [264] | 108 Hs Hassium [269] | 109 Mt Meitnerium [278] | 110 Ds Darmstadtium [281] | 111 Rg Roentgenium [280] | 112 Cn Copernicium [285] | 113 Nh Nihonium [286] | 114 Fl Flerovium [289] | 115 Mc Moscovium [289] | 116 Lv Livermorium [293] | 117 Ts Tennessine [294] | 118 Og Oganesson [294] | |
| 57 La Lanthanum 138.905 | 58 Ce Cerium 140.116 | 59 Pr Praseodymium 140.908 | 60 Nd Neodymium 144.243 | 61 Pm Promethium 144.913 | 62 Sm Samarium 150.36 | 63 Eu Europium 151.964 | 64 Gd Gadolinium 157.25 | 65 Tb Terbium 158.925 | 66 Dy Dysprosium 162.500 | 67 Ho Holmium 164.930 | 68 Er Erbium 167.259 | 69 Tm Thulium 168.934 | 70 Yb Ytterbium 173.055 | 71 Lu Lutetium 174.967 | | | | |
| 89 Ac Actinium 227.028 | 90 Th Thorium 232.038 | 91 Pa Protactinium 231.036 | 92 U Uranium 238.029 | 93 Np Neptunium 237.048 | 94 Pu Plutonium 244.064 | 95 Am Americium 243.061 | 96 Cm Curium 247.070 | 97 Bk Berkelium 247.070 | 98 Cf Californium 251.080 | 99 Es Einsteinium [254] | 100 Fm Fermium 257.095 | 101 Md Mendelevium 258.1 | 102 No Nobelium 259.101 | 103 Lr Lawrencium [262] | | | | |