

Chemistry 150

Exam 4

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} units/mol

$32.00^\circ\text{F} = 0.000^\circ\text{C} = 273.15\text{K}$

1 foot = 12 inches

1 inch = 2.54cm (exactly)

1 pound = 453.6 g = 16 ounces

1 amu = 1.6605×10^{-24} g

Masses of subatomic particles:

Proton $1.00728\text{amu} = 1.6726 \times 10^{-24}$ g

Neutron $1.00866\text{amu} = 1.6749 \times 10^{-24}$ g

Electron $0.000549\text{amu} = 9.1094 \times 10^{-28}$ g

Density of Water = $1.000^{\text{g}}/\text{mL}$

$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$

$PV = nRT$

1 calorie = 4.184 J = 0.001 Calorie

$h = 6.626 \times 10^{-34}$ Jsec

$\lambda = h/mv$

$1 \text{ J} = 1 \text{ kg (m/sec)}^2$

$c = \lambda\nu = 3.00 \times 10^8 \text{ m/sec}$

$E_{\text{photon}} = h\nu$

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|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 1 H 1.0079 | | | | | | | | | | | | | | | | | 2 He 4.0026 |
| 3 Li 6.941 | 4 Be 9.0122 | | | | | | | | | | | 5 B 10.811 | 6 C 12.011 | 7 N 14.007 | 8 O 15.999 | 9 F 18.998 | 10 Ne 20.180 |
| 11 Na 22.990 | 12 Mg 24.305 | | | | | | | | | | | 13 Al 26.982 | 14 Si 28.086 | 15 P 30.974 | 16 S 32.066 | 17 Cl 35.453 | 18 Ar 39.948 |
| 19 K 39.098 | 20 Ca 40.078 | 21 Sc 44.956 | 22 Ti 47.88 | 23 V 50.942 | 24 Cr 51.996 | 25 Mn 54.938 | 26 Fe 55.847 | 27 Co 58.933 | 28 Ni 58.69 | 29 Cu 63.546 | 30 Zn 65.39 | 31 Ga 69.723 | 32 Ge 72.61 | 33 As 74.922 | 34 Se 78.96 | 35 Br 79.904 | 36 Kr 83.80 |
| 37 Rb 85.468 | 38 Sr 87.62 | 39 Y 88.906 | 40 Zr 91.224 | 41 Nb 92.906 | 42 Mo 95.94 | 43 Tc (98) | 44 Ru 101.07 | 45 Rh 102.91 | 46 Pd 106.42 | 47 Ag 107.87 | 48 Cd 112.41 | 49 In 114.82 | 50 Sn 118.71 | 51 Sb 121.76 | 52 Te 127.60 | 53 I 126.90 | 54 Xe 131.29 |
| 55 Cs 132.91 | 56 Ba 137.33 | 57 La 138.91 | 72 Hf 178.49 | 73 Ta 180.95 | 74 W 183.84 | 75 Re 186.21 | 76 Os 190.23 | 77 Ir 192.22 | 78 Pt 195.08 | 79 Au 196.97 | 80 Hg 200.59 | 81 Tl 204.38 | 82 Pb 207.2 | 83 Bi 208.98 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra 226.03 | 89 Ac 227.03 | 104 Rf (261) | 105 Db (262) | 106 Sg (263) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 (269) | 111 (272) | 112 (277) | | 114 | | 116 | | |

| | | | | | | | | | | | | | |
|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 58 Ce 140.12 | 59 Pr 140.91 | 60 Nd 144.24 | 61 Pm (145) | 62 Sm 150.36 | 63 Eu 151.97 | 64 Gd 157.25 | 65 Tb 158.93 | 66 Dy 162.50 | 67 Ho 164.93 | 68 Er 167.26 | 69 Tm 168.94 | 70 Yb 173.04 | 71 Lu 174.97 |
| 90 Th 232.04 | 91 Pa 231.04 | 92 U 238.03 | 93 Np 237.05 | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (251) | 99 Es (252) | 100 Fm (258) | 101 Md (258) | 102 No (259) | 103 Lr (260) |

Multiple Choice: Circle the letter of the most correct response. (6pts. per question)

- Which of the following is **not** a possible set of quantum numbers for an electron?
 - $n = 4, \ell = 3, m_\ell = -2, m_s = +1/2$
 - $n = 3, \ell = 1, m_\ell = -1, m_s = -1/2$
 - $n = 1, \ell = 2, m_\ell = +1, m_s = +1/2$
 - $n = 2, \ell = 0, m_\ell = 0, m_s = +1/2$
 - $n = 3, \ell = 2, m_\ell = +2, m_s = -1/2$
- Electronegativity
 - Is the negative charge of an ion
 - Is a measure of how strongly an atom attracts electrons in a covalent bond
 - Is determined by assigning one electron to each atom of a bond
 - Is the energy required to remove an electron from an atom in the gas phase
 - Is the energy required to remove a *pair* of electrons from an atom
- A covalent bond:
 - Always contains a metal
 - Involves sharing electrons
 - Always has high bond energy
 - Is always polar
 - Forms ions in solution
- Electronegativity **increases**:
 - Top to bottom on the Periodic Table
 - Left to right across the Periodic Table
 - In the center of the Periodic Table
 - As the quantum number “n” increases
 - As atoms get larger
- What orbital hybridization gives a ***square pyramid molecular shape***?
 - sp
 - sp²
 - sp³
 - sp³d
 - sp³d²

Trends: For each of the following, circle the correct response (1pts) and give a *brief* explanation of your choice (5pts).

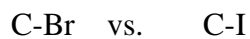
6. Which atom is larger? Explain:

Zn vs. Si

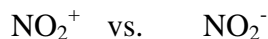
7. Which ion is smaller? Explain:

Cl⁻ vs. K⁺

8. Which bond is longer? Explain:



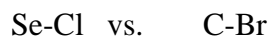
9. Which NO bond is shorter? Explain:



10. Which element is more electronegative? Explain:



11. Which bond is more polar? Explain:



For each of the following, write out a correct electron configuration. You may use noble gas shorthand notation for species below the 2nd row of the Periodic Table. (6pts each)

12. Nickel (At.# = 28)

13. Silicon (At.# = 14)

14. Oxide ion (At.# = 8)

15. Gallium(III) ion (At.# = 31)

16. What are the 3 most likely charges (+ or -) of a sulfur ion (At.# = 16)? Explain your answers. (15pts)

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For each of the following, draw a correct Lewis Structure, determine the formal charge on each atom, name the electronic geometry, draw an appropriate VSEPR structure, name the molecular shape, and show the dipole moment of any polar molecules/ions. (15pts each)

17. POF_3 18. BrO_3^- 19. SeF_5^+