Chemistry 122 | Winter 2006 | Oregon State University
Exam 1 | February 2, 2006 | Dr. Richard Nafshun

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED. CALCULATORS ARE NOT TO BE SHARED.

Test Form 3

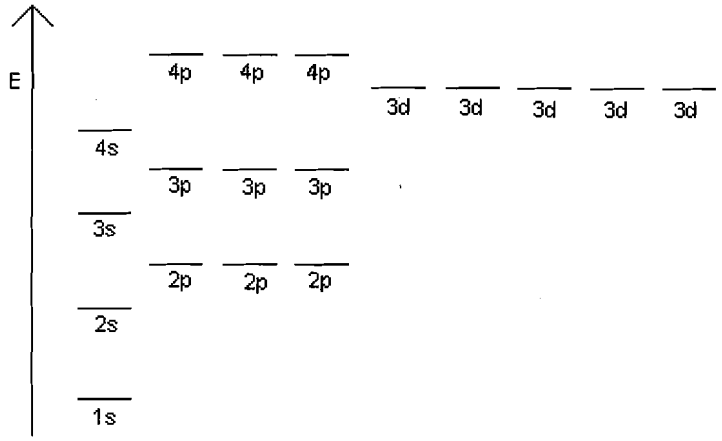
Instructions: You should have with you several number two pencils, an eraser, your 3" x 5" note card with notes on one side, a calculator, and your University ID Card. If you have notes with you, place them in a sealed backpack and place the backpack OUT OF SIGHT or place the notes directly on the table at the front of the room.

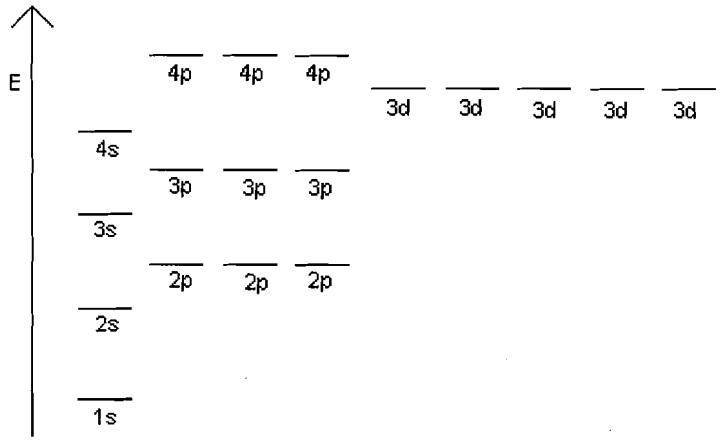
Fill in the front page of the Scantron answer sheet with your test form number (listed above), last name, first name, middle initial, and student identification number. **Leave the class section number blank.**

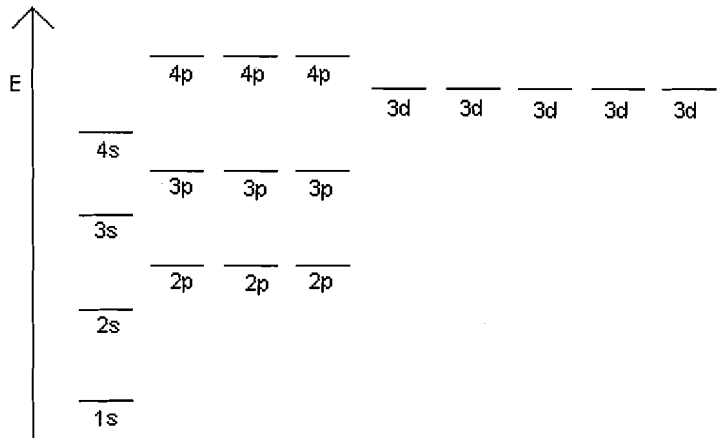
This exam consists of 25 multiple-choice questions. Each question has four points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the Scantron answer sheet. If you have any questions before the exam, please ask. If you have any questions during the exam, please ask the proctor. Open and start this exam when instructed. When finished, place your Scantron form in the appropriate stack and present your ID to the proctor. You may keep the exam packet, so please show your work and mark the answers you selected on it.

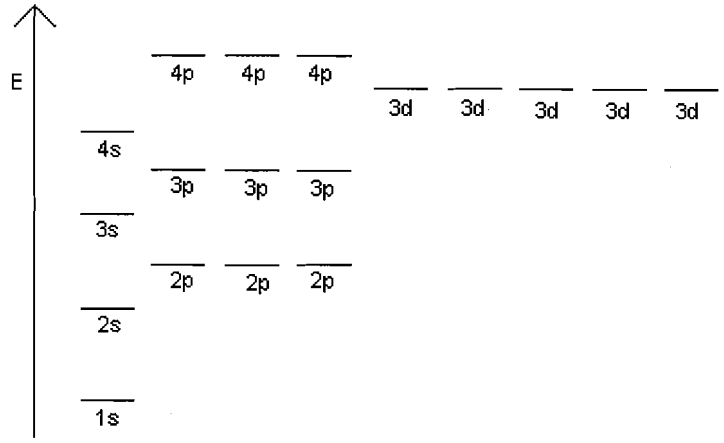
	1 H Hydrogen 1.0079																2 He Helium 4.0026
1																	
	3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.179
2																	
	11 Na Sodium 22.98977	12 Mg Magnesium 24.305											13 Al Aluminum 26.9815	14 Si Silicon 28.0855	15 P Phosphorus 30.97376	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
3																	
	19 K Potassium 39.0983	20 Ca Calcium 40.08	21 Sc Scandium 44.9559	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.996	25 Mn Manganese 54.9380	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.70	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
4																		
	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	40 Zr Zirconium 91.22	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.4	47 Ag Silver 107.868	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.9045	54 Xe Xenon 131.30
5																		
	55 Cs Cesium 132.9054	56 Ba Barium 137.33	57–71 *Rare earths	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
6																		
	87 Fr Francium (223)	88 Ra Radium 226.0254	89–103 †Actinides	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (263)	107 Ns Neilsbohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 ‡ (269)	111 ‡			114				
7														→ Stable region?				

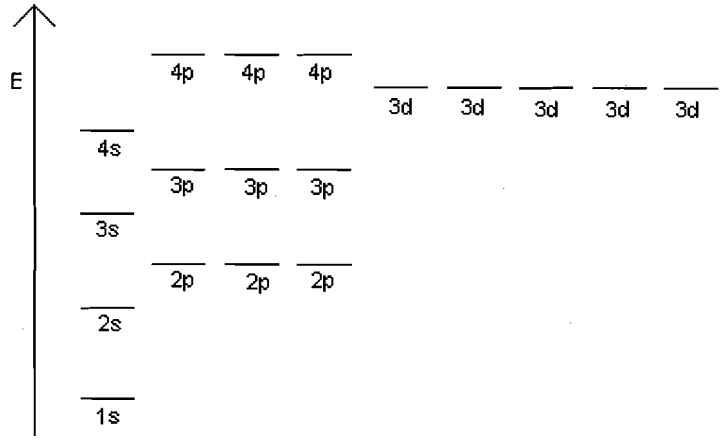
	57 La Lanthanium 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.9077	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9254	66 Dy Dysprosium 162.50	67 Ho Holmium 164.9304	68 Er Erbium 167.26	69 Tm Thulium 168.9342	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
6															
	89 Ac Actinium 227.0278	90 Th Thorium 232.0381	91 Pa Protactinium 231.0359	92 U Uranium 238.029	93 Np Neptunium 237.0482	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium 259	103 Lr Lawrencium 262
7															

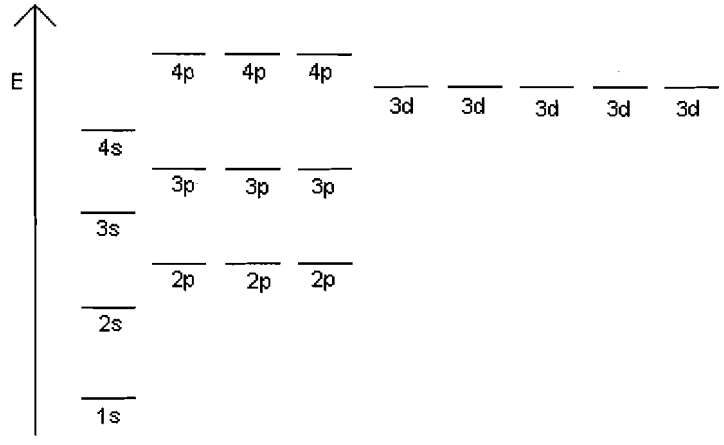

E
4p 4p 4p
3d 3d 3d 3d 3d
4s
3p 3p 3p
3s
2p 2p 2p
2s
1s

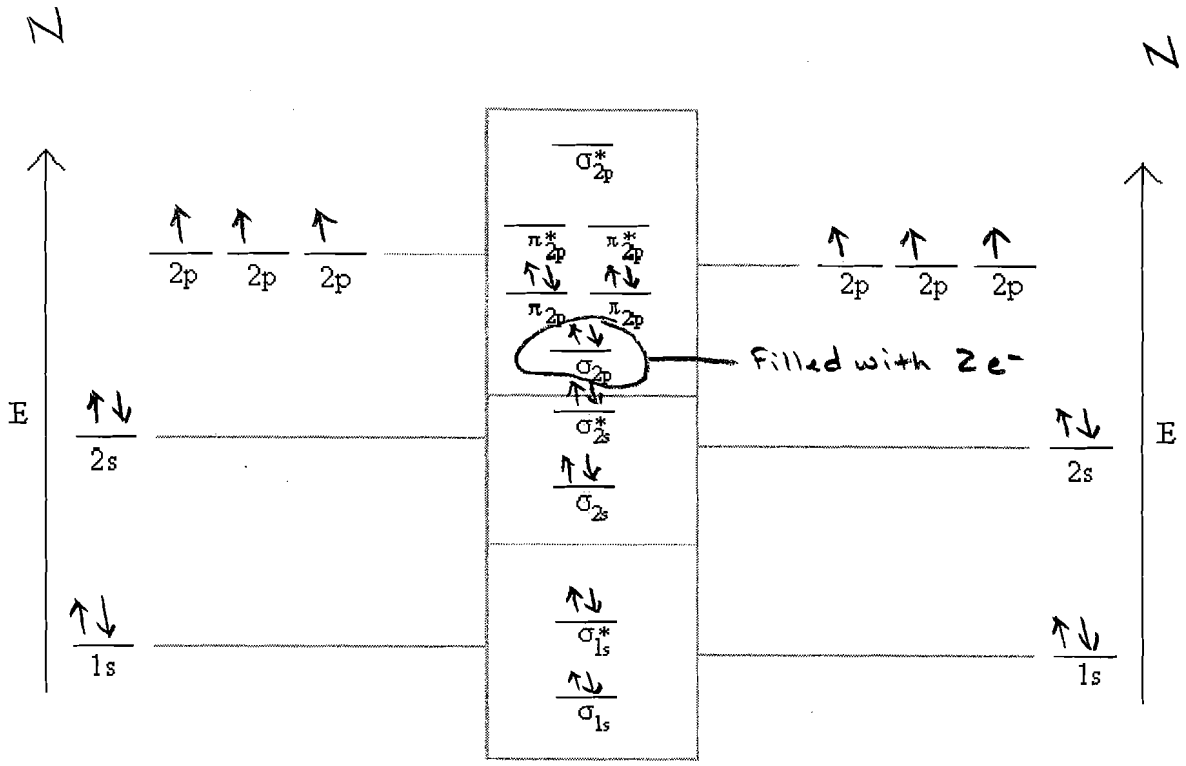

E
4p 4p 4p
3d 3d 3d 3d 3d
4s
3p 3p 3p
3s
2p 2p 2p
2s
1s


E
4p 4p 4p
3d 3d 3d 3d 3d
4s
3p 3p 3p
3s
2p 2p 2p
2s
1s

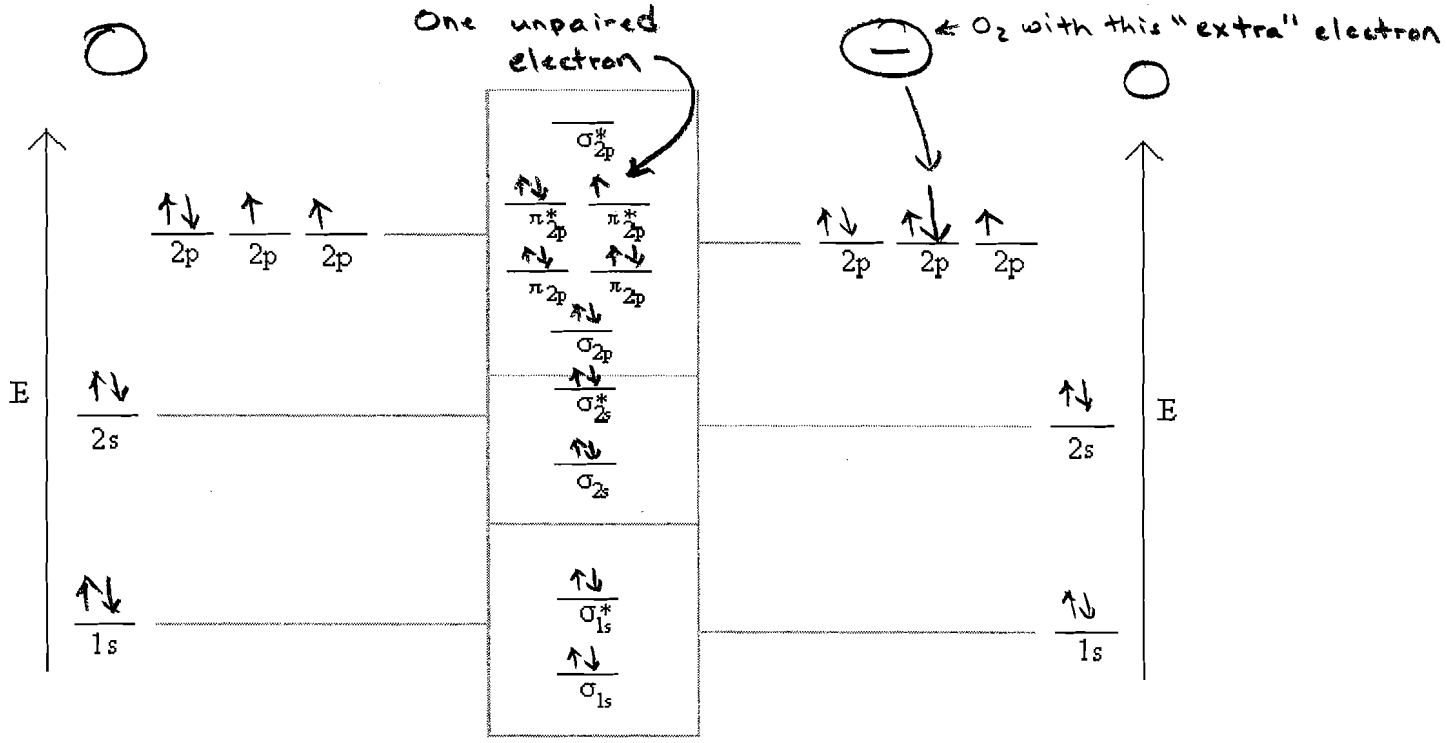

E
4p
4p
4p
3d
3d
3d
3d
3d
4s
3p
3p
3p
3s
2p
2p
2p
2s
1s


E
4p
4p
4p
3d
3d
3d
3d
3d
4s
3p
3p
3p
3s
2p
2p
2p
2s
1s

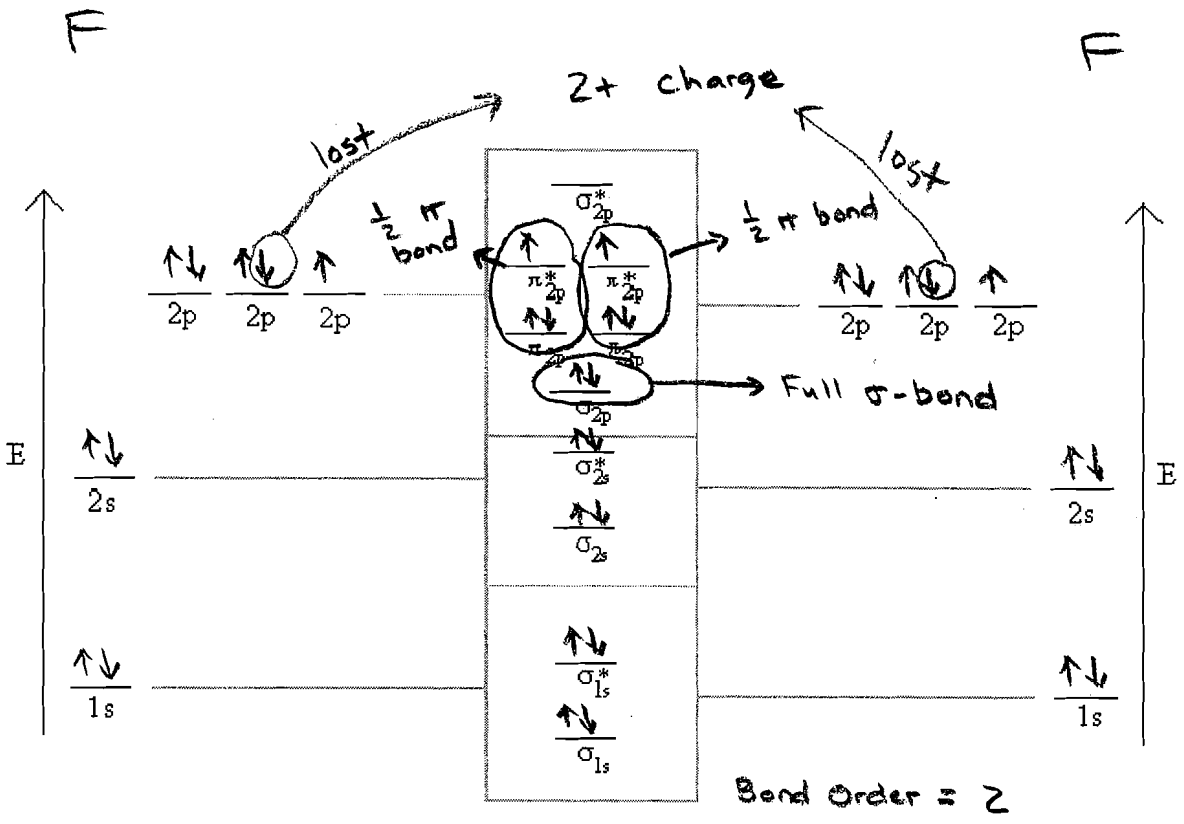

E
4p
4p
4p
3d
3d
3d
3d
3d
4s
3p
3p
3p
3s
2p
2p
2p
2s
1s



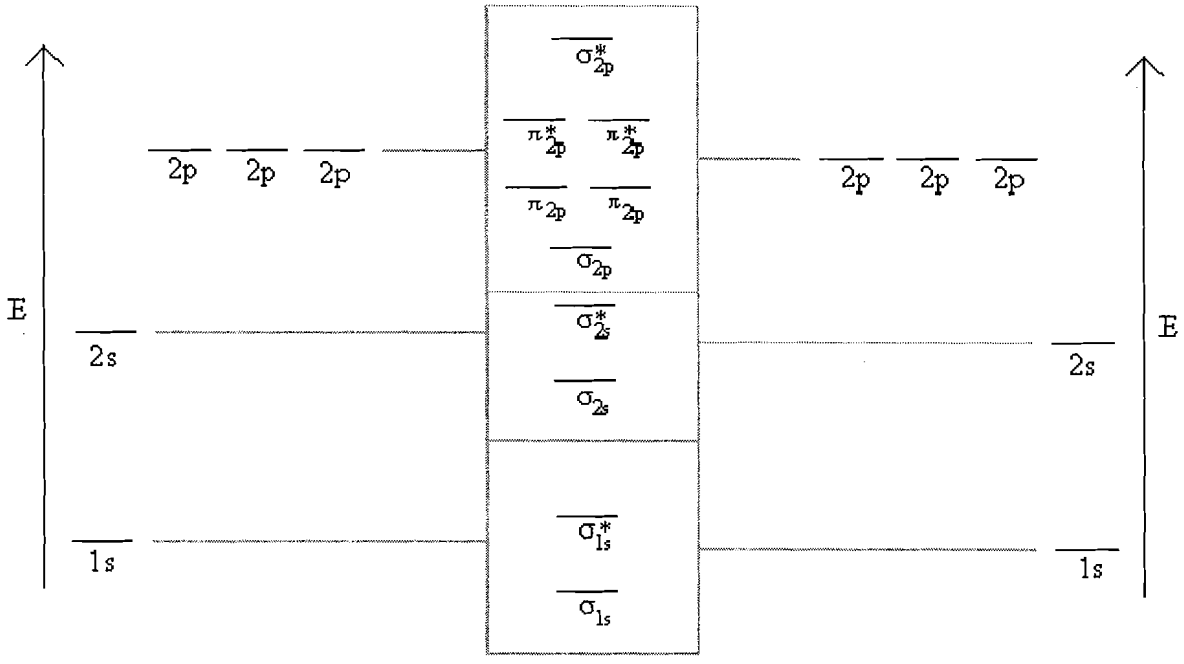
N_2 (Question 21) and (Question 23)



O_2^- ion (Question 22)



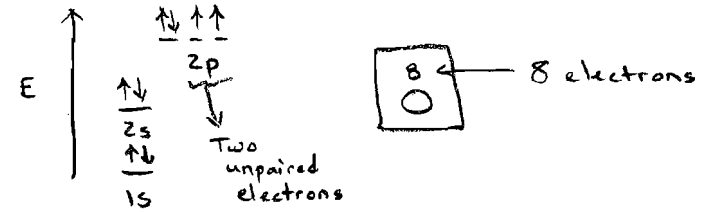
F_2^{2+} ion (Question 24)



Please read each exam question carefully. Terms such as *correct, false, unpaired, pairs, H-C-F bond angle, H-C-H angle, greatest, and smallest are* used.

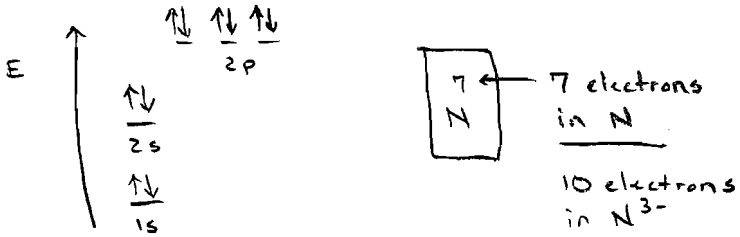
1. There are ___ **unpaired** electrons in a ground-state oxygen atom.

(A) 0
(B) 1
(C) (2)
(D) 3
(E) 4



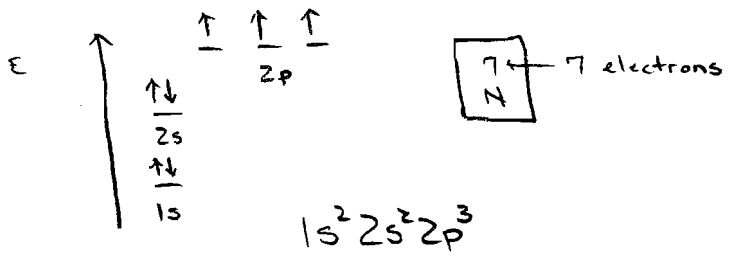
2. There are ___ **unpaired** electrons in a ground-state nitride ion (N^{3-}).

(A) (0)
(B) 1
(C) 2
(D) 3
(E) 4



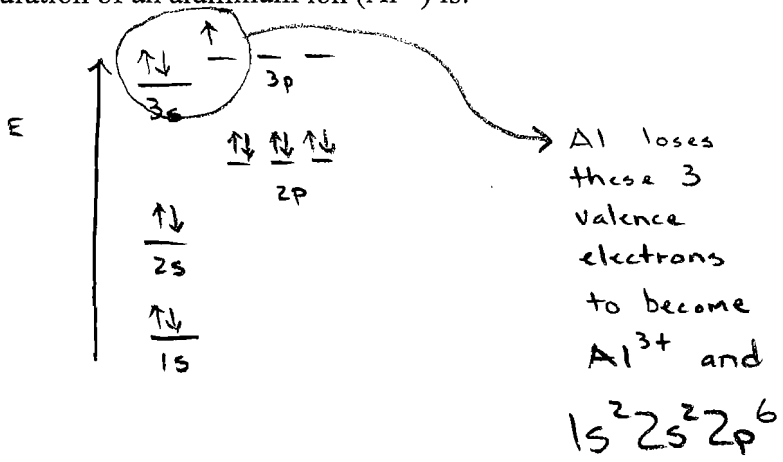
3. The ground-state electron configuration of a nitrogen atom is:

(A) $1s^2 2s^2 3s^2 3p^1$
(B) $1s^2 2s^2 3s^1$
(C) $1s^2 2s^2 2p^5$
(D) $1s^2 2s^2 2p^3$
(E) $1s^2 2s^2 3s^3$



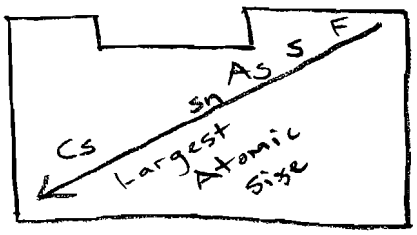
4. The ground-state electron configuration of an aluminum ion (Al^{3+}) is:

(A) $1s^2 2s^2 3s^2 3p^2$
(B) $1s^2 2s^2 3s^1$
(C) $1s^2 2s^2 2p^6$
(D) $1s^2 2s^2 2p^6 3s^2 3p^2$
(E) $1s^2 2s^2 2p^4$



5. Consider S, As, F, Sn, and Cs. The atom with the **smallest** atomic size is:

(A) S
(B) As
(C) F
(D) Sn
(E) Cs



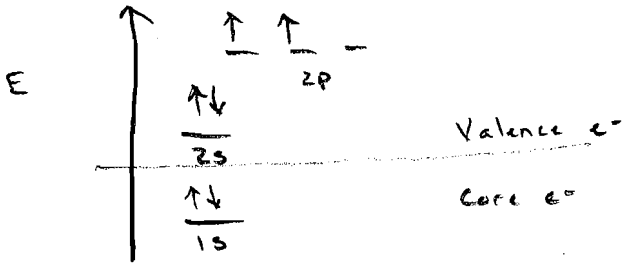
6. Consider Li^+ and Li. Consider O^{2-}, and O. Which of the following statements is correct?

(A) Li^+ is larger than Li. ← Li is larger than Li^+ because it has the same number of protons, but one more electron
(B) O^{2-} is larger than O.

O^{2-} has the same number of protons as O, but has two more electrons than O

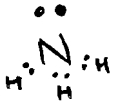
7. Consider a carbon atom in the ground-state. Which of the following statements is **false**?

(A) The carbon atom has 6 electrons; 2 are core electrons and 4 are valence electrons. True
(B) The valence electrons in the carbon atom are all located in 2p orbitals. False. 2 are in the 2p and 2 are in the 2s
(C) The core electrons in the carbon atom are all located in the 1s orbital. True
(D) There are two unpaired electrons in the carbon atom. True
(E) The carbon atom is paramagnetic. True



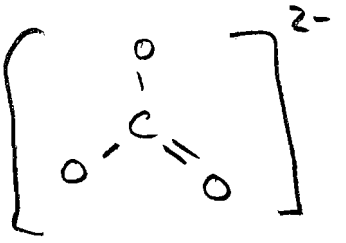
8. The Lewis Dot Structure of NH_3 depicts:

(A) There are no lone **pairs** of electrons.
(B) There is one lone **pair** of electrons.
(C) There are two lone **pairs** of electrons.
(D) There are three lone **pairs** of electrons.
(E) There are four lone **pairs** of electrons.

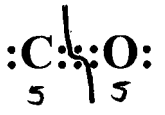


9. The ~~nitrogen~~ carbon oxygen bond order in the carbonate ion (CO_3^{2-}) is:

(A) 1.00.
(B) 1.33.
(C) 1.50.
(D) 1.75.
(E) 2.00.



Bond Order = $\frac{4 \text{ bonds}}{3 \text{ locations}} = 1.33 \text{ or } 1\frac{1}{3}$

10. A student () proposes  as a Lewis Structure for carbon monoxide.

FC = group # − assigned e⁻

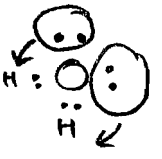
C = 4 − 5 = −1

O = 6 − 5 = +1

(A) Carbon has a formal charge of 0 and oxygen has a formal charge of 0.
(B) Carbon has a formal charge of +1 and oxygen has a formal charge of 0.
(C) Carbon has a formal charge of 0 and oxygen has a formal charge of +1.
(D) Carbon has a formal charge of +1 and oxygen has a formal charge of -1.
(E) Carbon has a formal charge of -1 and oxygen has a formal charge of +1.

11. The H-O-H bond angle in water, H_2O, is:

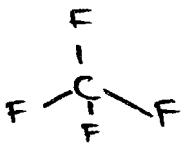
(A) 180°.
(B) 120°.
(C) 109.5°.
(D) A little greater than 109.5°.
(E) A little less than 109.5°.



109.5° minus a little because of the lone pairs of e⁻ pushing the hydrogens together

12. The F-C-F bond angle in tetrafluoromethane, CF_4 is:

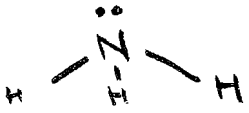
(A) 360°.
(B) 180°.
(C) 120°.
(D) 109.5°.
(E) 90°.



Ideal tetrahedral

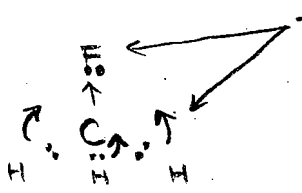
13. The molecular geometry of NH_3 is:

(A) bent.
(B) trigonal planar.
(C) trigonal pyramidal.
(D) tetrahedral.
(E) octahedral.



14. The F-C-H bond angle in monofluoromethane (CH_3F) is:

(A) 90°.
(B) 120°.
(C) 109.5°.
(D) A little greater than 109.5°.
(E) A little less than 109.5°.

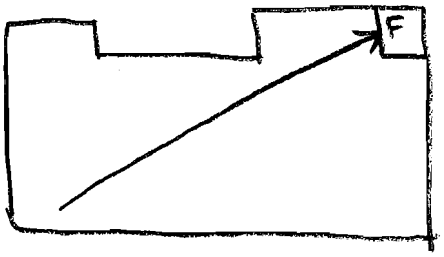


The F and H atoms are 109.5° minus a little close together

109.5 minus a little because F is pulling e⁻ in the F-C bond away from C allowing the hydrogens to move up.

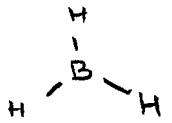
15. Consider S, As, F, Sn, and Cs. The atom with the **greatest** electronegativity is:

(A) S
(B) As
(C) F
(D) Sn
(E) Cs

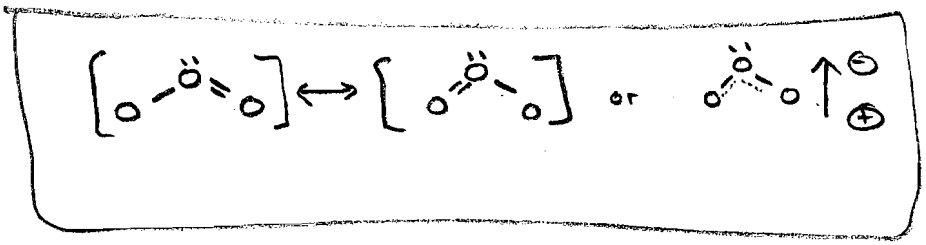


16. Consider BH_3, O_2, O_3, and CO_2. Which is the **polar** molecule?

(A) BH_3
(B) O_2
(C) O_3
(D) CO_2



O = O

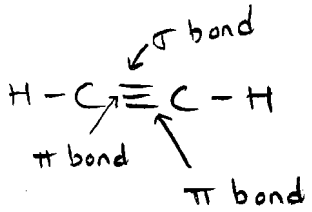


O_3 is bent and polar

O = C = O

17. Consider ethyne, C_2H_2. Ethyne contains:

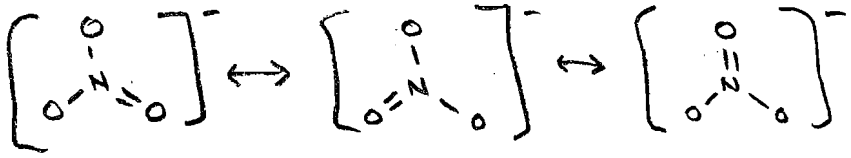
(A) no π-bonds.
(B) one π-bond.
(C) two π-bonds.
(D) three π-bonds.



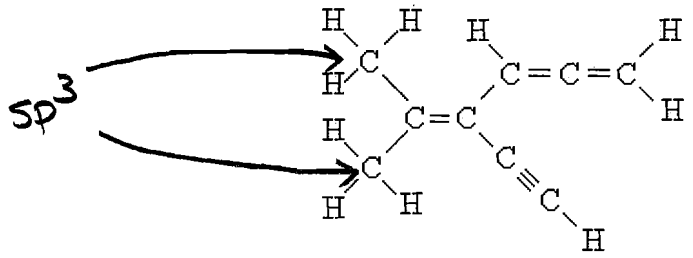
A "triple bond" is a σ bond and two π bonds.

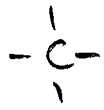
18. There are 3 resonance forms for the nitrate ion (NO_3^-).

(A) 0.
(B) 1.
(C) 2.
(D) 3.
(E) 4.



19. Consider the molecule below and identify the **correct** statement.





sp³ carbons have four single bonds with ideal angles of 109.5°

(A) There is one carbon that has an sp^3 hybridization scheme.
(B) There are two carbons that have sp^3 hybridization schemes.
(C) There are three carbons that have sp^3 hybridization schemes.
(D) There are four carbons that have sp^3 hybridization schemes.
(E) There are six carbons that have sp^3 hybridization schemes.

20. Consider C_2H_6, C_2H_4, and C_2H_2. Which of these has the **shortest** carbon-carbon bond?

C≡C shortest
C=C
C—C longest

(A) C_2H_6.
(B) C_2H_4.
(C) C_2H_2.

H-C≡C-H

21. Consider MO (Molecular Orbital Theory). For the N_2 molecule, there are 2 electrons in the σ_{2p} bonding orbital?

(A) 0.
(B) 1.
(C) 2.
(D) 3.
(E) 4.

22. Molecular orbital theory predicts the O_2^- ion (a minus one charge) has:

(A) no unpaired electrons.
(B) one unpaired electron.
(C) two unpaired electrons.
(D) three unpaired electrons.
(E) six unpaired electrons.

23. Consider MO (Molecular Orbital Theory). The N_2 molecule is:

(A) paramagnetic.
(B) diamagnetic. ← All electrons are paired
(C) submagnetic.
(D) supermagnetic.
(E) Superbowl magnetic.

24. Molecular orbital theory predicts the F_2^{2+} ion (a positive two charge) has a bond order of:

(A) 0.0
(B) 0.5
(C) 1.0
(D) 1.5
(E) 2.0

25. Because of Chemistry 122...

(A) I blackout when I hear the name "Lewis."
(B) I have a blister on my brain.
(C) I get lots of dates by using words like dipole, lobes, 180 degrees, see-saw, and orbitals.
(D) I have been able to shed my guilt and enjoy life again.
(E) I am changing my major to chemistry... today!

[Any response will receive full credit; even no response.]