

CHEM-1110
July, 29, 2003

TEST # 3

NAME: _____

1. For H-like species the energy of the electron is given by the formula

$$E_n = -\frac{1312(Z^2)}{n^2} \text{ kJ/mol}$$

The ionization energy of H-like species X^{n+} in its ground state is 12.25 times larger than for the ground state of the He^+ ion. Determine X and n. **[4]**

2. The energy from radiation can be used to cause the rupture of chemical bonds. A minimum energy of 495 kJ/mol is required to break the oxygen to oxygen bond in O_2 . What is the longest wavelength of radiation that possesses the necessary energy to break the bond and what type of electromagnetic radiation is this? **[4]**

3. An ion of He^+ can be treated like an H atom in terms of Bohr energy levels. If the electron of He^+ ion is excited to the $n = 4$ level, predict how many different emission lines are possible as the electron relaxes to the ground state. **[2]**

$n = 4$ _____

$n = 3$ _____

$n = 2$ _____

$n = 1$ _____

4. Give the **complete** ground state electron configuration, numbers of unpaired electrons, and indicate whether the species is paramagnetic or diamagnetic. **[4]**

Cr _____

Mo _____

5. What is the theoretical maximum number of electrons that can be accommodated in the following energy levels? **[4]**

a) 7th shell. _____

b) 3d sub level. _____

c) 3f sub level. _____

d) 4s + 3d levels. _____

6. State whether or not each of the following is an acceptable designation for an atomic orbital. **[2]**

a) 1p _____

b) 4g _____

7. What is the total number of orbitals in the 6th shell? **[1]**

8. What is the total number of electrons in the 6th shell with $m_l = 0$ and $m_s = \frac{1}{2}$? **[1]**

9. Which of the following are possible sets of quantum numbers for an electron in an atom (write OK)? For the sets of quantum numbers that are not possible, state what is wrong with each set. **[4]**

	n	l	m_l	m_s	
a)	1	0	1	+1/2	_____
b)	6	5	5	-1/2	_____
c)	3	2	3	+1/2	_____
d)	2	1	0	0	_____

10. Given below are several electron configurations for the oxygen atom. Indicate whether each represents the ground state, excited state, or an impossible state and also give the charge. **[4]**

a) $1s^2 2s^2 2p^3$	_____
b) $1s^2 2s^2 2p^3 3s^1$	_____
c) $1s^2 2s^2 2p^3 2d^1$	_____
d) $1s^2 2s^2 2p^2 5f^1$	_____

11. Consider the element Tantalum, $Z=73$. Give the number of **[4]**

a) 2p electrons that have $m_s = \frac{1}{2}$	_____
b) 2s + 4d electrons that have $m_l = 0$	_____
c) all electrons that have $m_l = +1$	_____
d) all electrons with $m_l = 0$ and $m_s = -1/2$	_____

12. Give the formula of a cation and an anion that is isoelectronic with Xe.

[1] _____

13. Select the best answer and write it on the line. **[11]**

- | | | |
|-------------------------------|--|-------|
| a) largest radius | Na, Li, F | _____ |
| b) largest 1 st IE | P, Se, S | _____ |
| c) smallest radius | Se ²⁻ , K ⁺ , Ca ²⁺ | _____ |
| d) smallest lattice energy | MgO, NaCl, CsCl | _____ |
| e) largest electronegativity | Sb, O, N | _____ |
| f) most unpaired electrons | I, As, Cr | _____ |
| g) most polar bond | CsCl, Cl ₂ , HCl | _____ |
| j) largest dipole moment | SiH ₄ , NH ₃ , NF ₃ | _____ |
| k) largest bond angle | NO ₂ , NO ₂ ¹⁻ , NO ₂ ⁺ | _____ |
| l) largest 2 nd IE | K ⁺ , Ca ⁺ , Na ⁺ | _____ |
| m) least negative EA | Cr, Cl, Br | _____ |

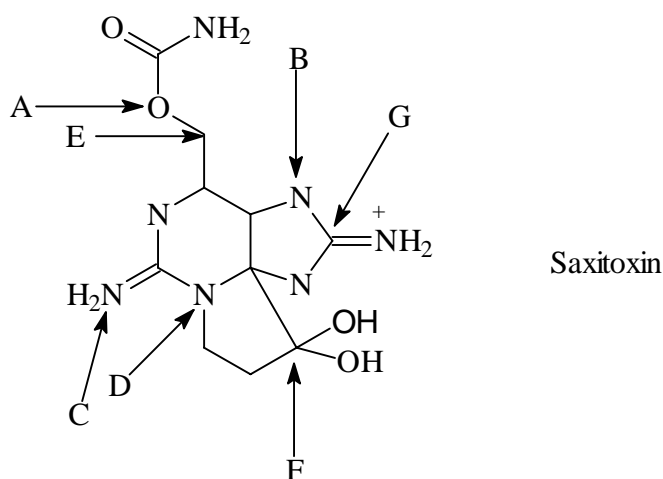
14. Explain why SF₄ can exist while OF₄ cannot exist. **[2]**

15. Explain CO₂ is non polar while OCS is polar. **[2]**

16. Complete the following table: [12]

SPECIES	NAME OF MOLECULAR SHAPE	HYBRIDIZATION OF THE CENTRAL ATOM UNDERLINED	POLAR OR NONPOLAR
<u>Kr</u> F ₂			
<u>I</u> F ₄ ⁺			
<u>As</u> Cl ₃			
<u>Xe</u> OF ₂			
<u>I</u> Br ₂ ⁻			
O ₂ <u>N</u> Cl			
F ₃ <u>Cl</u> O ₂			
<u>Br</u> F ₅			

17. Saxitoxin is a fatally toxic natural product produced by certain marine organism. The molecules occasionally accumulate in clams and muscles during condition of red tide. **[6]**



Give the hybridization for the atoms labeled

A: _____ B: _____ C: _____ D: _____

Give approximate bond angles about the atoms labeled

E: _____ F: _____ G: _____

c) How many pi bonds are there? _____

d) How many lone pairs of electrons are there? _____

e) What is the total number of sp^2 hybrid orbitals? _____

f) What is the approximate size of the angle around _____

i) atom labeled G? _____

ii) atom labeled A? _____

18. a) Give **three** resonance structures for XeO_3 and circle the most likely by using formal charges. **[4]**

b) Give **three** resonance structures for NNO and circle the least likely by using formal charges. **[4]**

19. Explain why H_2O is a liquid at room temperature while H_2S is a gas. **[2]**

20. Arrange the following in increasing order of boiling point. **[2]**

$\text{C}_2\text{H}_5\text{OH}$, C_3H_8 , $\text{C}_2\text{H}_5\text{NH}_2$, CH_3OCH_3

21. a) Write three different arrangements for SCN^- with three different central atom. Based on formal charges tell what is most likely to be the arrangement of atoms. **[4]**

b) Could these three different arrangements be called resonance forms of the same thing? EXPLAIN. **[1]**