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Chem 111 *10:10a section* *Evening Exam #2v2*

This exam is composed of 25 questions. Go initially through the exam and answer the questions you can answer *quickly*. Then go back and try the ones that are more challenging to you and/or that require calculations.

As discussed on the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

$E = h\nu = \frac{hc}{\lambda}$

1 mL = 1 cm^3

$h = 6.626x10^{-34}\ J\ s$

$c = 2.998x10^{8}\ m\ s^{-1}$

$N = 6.022x10^{23}\ mol^{-1}$

1. Which radiation below has the shortest wavelength (don't use your calculator!)?

   1) blue light ($6.8x10^{14}$ Hz)
   2) green light ($6.0x10^{14}$ Hz)
   3) red light ($4.5x10^{14}$ Hz)
   4) microwaves ($2.4x10^{9}$ Hz)
   5) x-rays ($5.0x10^{18}$ Hz)

   (5) It has the highest frequency. Remember that $\lambda = c/\nu$
   From OWL Unit 7-1b (and from last exam)

2. A local AM radio station broadcasts at an energy of **$5.55x10^{-31}$**. Does this number likely represent:

   1) kJ/atom 2) kJ/mole 3) kJ/photon 4) kJ/song played

   (3) From lecture. I stressed that it was important to have a feel for the magnitudes of energies – molecule (photon) vs mole.

3 Calculate the frequency at which the above radio station is broadcasting.

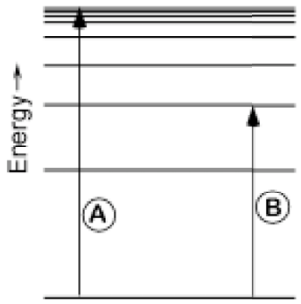
   1) 1.39 MHz 2) 838 KHz 3) 1.39 KHz 4) 838 Mhz 5) Cant' tell

   (2) $\nu = \frac{E}{h} = \frac{5.55x10^{-31}\,kJ}{6.626x10^{-34}\,J\,s}\frac{10^{3}\,J}{kJ} = 8.38x10^{5}\,s^{-1} = 838\ KHz$
   From OWL Unit 7-2c and Unit 7-3c

4. Consider the diagram at right. The transition labeled A is ***best*** described as :

   1) emission 2) absorption
   3) ionization 4) electron capture

   (3) From OWL Unit 7-4c



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5. In the same diagram, the energy of transition B is ***best*** described as:

   1) absorption energy 2) emission energy
   3) ionization energy 4) electron affinity

   (1) From OWL Unit 7-4c

6. The principle quantum number n specifies:

   1) orbital orientation 2) subshell orbital shape
   3) transition probability 4) orbital karma
   5) energy and distance from nucleus

   (5) From OWL Unit 7-7b

7. The angular momentum quantum number *l* specifies:

   1) orbital orientation 2) subshell orbital shape
   3) transition probability 4) orbital karma
   5) energy and distance from nucleus

   (2) From OWL Unit 7-7b

8. The magnetic quantum number m_l specifies:

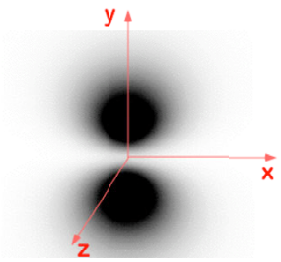
   1) orbital orientation 2) subshell orbital shape
   3) transition probability 4) orbital karma
   5) energy and distance from nucleus

   (1) From OWL Unit 7-7b

9. The orbital depicted at right is what type of orbital?

   1) $3d_z$ 2) $2p_x$
   3) $3p_x$ 4) $2p_y$ 5) $3p_y$

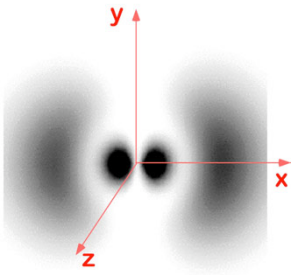
   (4) From OWL Unit 7-8c



10. The orbital depicted at right is what type of orbital?

    1) $3d_z$ 2) $2p_x$
    3) $3p_x$ 4) $2p_y$ 5) $3p_y$

    (3) From OWL Unit 7-8c



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11. The correct spectroscopic notation for phosphorous (P) is:

1) $1s^2 2s^2 2p^6 3s^2 3p^2$ 2) $1s^2 2s^2 2p^6 3s^2 3p^3$
3) $1s^2 2s^2 2p^6 3s^2 3p^4$ 4) $1s^2 2s^2 2p^6 3s^2 3p^5$
5) $1s^2 2s^2 2p^6 3s^2 3p^6$

(2) From OWL Unit 8-5b

12. The correct spectroscopic notation for phosphorous ion (P^{2-}) is:

1) $1s^2 2s^2 2p^6 3s^2 3p^2$ 2) $1s^2 2s^2 2p^6 3s^2 3p^3$
3) $1s^2 2s^2 2p^6 3s^2 3p^4$ 4) $1s^2 2s^2 2p^6 3s^2 3p^5$
5) $1s^2 2s^2 2p^6 3s^2 3p^6$

(4) From OWL Unit 8-7c

13. If an element with the valence configuration $\mathbf{4s^2 3d^7}$ loses **2** electron(s), these electron(s) would be removed from the following **subshell(s)**.

1) 4s 2) 3d 3) 4s and 3d 4) 3p 5) 4p

(1) From OWL Unit 8-7d

14. If an element with the valence configuration $\mathbf{4s^1 3d^5}$ loses **2** electron(s), these electron(s) would be removed from the following **subshell(s)**. Think carefully about this one!

1) 4s 2) 3d 3) 4s and 3d 4) 3p 5) 4p

(3) From OWL Unit 8-7d

15. Which of the following elements has the greatest difference between the first and second ionization energies?

1) Na 2) Si 3) P 4) Mg 5) Cl

(1) See Study Questions 67-68 & 72, Chapter 8 of K&T

16. Which molecule below does not exist?

1) BeF_2 2) CaF_3 3) MgO 4) KCl 5) $BeCl_2$

(2) See Study Question 33, Chapter 9 of K&T – think about ionization required to make ionic compounds (Chapt 9.3)

17. Which of the following correctly compares atomic sizes?

1) Li < B < C < N < Ne 2) O < N < C < Be < Ne
3) Ne < Li < B < C < N 4) Ne < O < N < C < Be
5) none of the above

(4) From OWL Unit 8-8c

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18. Which of the following correctly compares ionic/atomic sizes?

1) $Mg^{2+} < Na^{+} < Ne < O < C$ 2) $Ne < Mg^{2+} < Na^{+} < O < C$

3) $Ne < O < C < Mg^{2+} < Na^{+}$ 4) $C < O < Ne < Na^{+} < Mg^{2+}$

5) none of the above

(1) From OWL Unit 8-9c

19. The molecule HF can be thought of as having both ionic and covalent character. Given that statement, which of the following is likely to best describe the charge on each atom?

	H	**F**
1)	+1.0	–1.0
2)	+0.7	–0.7
3)	0.0	0.0
4)	-0.7	+0.7
5)	-1.0	+1.0

(2) This question is intended to get you thinking about concepts we will need in the next chapter. The key here is BOTH ionic and covalent. Answers (4) and (5) should be immediately eliminated – F wants to be negative, H positive. If the molecule were purely covalent (as in FF), (3) would be correct – but the molecule is not purely covalent. If the molecule were purely ionic (as in NaCl), (1) would be correct – but the molecule is not purely ionic. This leaves (2) as the only reasonable answer.

20. Which of the following is most likely to be the correct assignment of effective nuclear charges for a 2s electron in each of the atoms below?

	B	**C**	**N**	**O**	**F**
1)	2.58	3.22	3.85	4.49	5.13
2)	5.13	4.49	3.85	3.22	2.58
3)	3.58	4.22	4.85	5.49	6.13
4)	6.13	5.49	4.85	4.22	3.58

(1) This question is designed to test whether you understand the concept of effective nuclear charges (p. 294 K&T). (2) and (4) can be *immediately* ruled out – the trend is in the wrong direction! If one recognizes that the two electrons in the 1s shell are focused tightly at the nucleus and so effectively shield it, then the effective nuclear charge must be less than [actual nuclear charge – 2]. This rules out (3).

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21. The CO bond in the molecule CH_2O is best described as a:

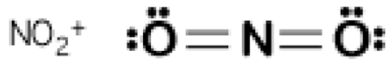
1) ionic bond
2) single bond
3) double bond
4) triple bond
5) the molecule doesn't exist

(3) From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T. This and the following 3 questions are basic exercises in drawing Lewis structures.

22. Draw the Lewis structure for $\mathbf{NO_2^+}$

Your resulting molecule has a total of:

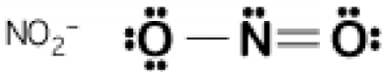
1) Two single bonds
2) Two double bonds
3) One single and one double bond
4) One double and one triple bond
5) Two triple bonds

(2)  **From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T**

23. Draw the Lewis structure for $\mathbf{NO_2^-}$

Your resulting molecule has a total of:

1) Two single bonds
2) Two double bonds
3) One single and one double bond
4) One double and one triple bond
5) Two triple bonds

(3)  **From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T**

24. The NO bond in HNO is a:

1) single bond 2) double bond 3) triple bond 4) ionic bond

(2) From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T

25. The correct designator for this course is:

1) Chem 363 2) Chem 111 3) PolSci 101 4) Sports 01

(2)