NAME _____

CHEMISTRY 101
EXAM 3   FORM C   SECTION 503

SPRING 2010
DR. KEENEY-KENNICUTT

Directions: (1) Put your name and signature on PART 2 of the exam where indicated.
(2) Sign the Aggie Code on PART 2 of this exam.
(3) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, **put the same answer down for both questions** for 5 pts. If you cannot decide between two answers, put your best answer down for the first (odd) question and the other answer down for the second (even) question. If you get the first one correct you'll get 3 pts; if you get the second one correct you'll get 2 pts. If there is an ambiguous multiple choice question, use the last page to explain your answer.
(4) Do NOT write on the envelope. There is a periodic table on the last page to write on.
(5) When finished, wait to be excused. You can pick up the multiple choice part with the answers outside my office after 2:30pm.
(6) There are a total of 34 questions (18 actual questions). The last question is extra credit.

PART 1

1&2. Which of the following is a non-polar covalent bond?

(a) P-As   (b) H-Cl   (c) O-S   (d) Na-Ca   (e) Te-I

3&4. Which statement is WRONG?

(a) The most stable ion of oxygen is O^{2-}.

(b) A magnesium atom is smaller than a sodium atom.

(c) The sodium cation is smaller than the sodium atom.

(d) Br^- and Cl^- are isoelectronic with each other.

(e) Sodium has a less negative electron affinity than fluorine.

5&6. Which of the responses contains all the TRUE statements regarding electromagnetic radiation (light)?

(1) As wavelength increases, frequency decreases.
(2) As energy increases, frequency decreases.
(3) As wavelength increases, energy decreases.
(4) The product of wavelength and frequency is constant.

(a) 1,3,4   (b) 1,2   (c) 1,2,4   (d) 2,3,4   (e) 3,4

7&8. Which element is paramagnetic with 1 unpaired electron?

(a) Mg   (b) F   (c) C   (d) O   (e) Be

9&10. Which statement is FALSE?

    (a) If an electron has the quantum number n=3, the electron could be in a d energy subshell.

    (b) If an electron has the quantum number ℓ=2, the only possible values of m_ℓ are 0 and 1.

`   (c) If an electron has m_ℓ= −1, it might be in a p, d, or f energy subshell, but not in an s subshell.

    (d) An electron that has n=3 cannot be in an f energy subshell.

    (e) An electron that has n=5 could be in an s, p, d, or f energy subshell.

11&12. Which of the following is the CORRECT Lewis structure for bromous acid showing all the valence electrons?

(a) :Ö::Ö:Br:H

(b) H:Ö::Ö:Br:

(c) H:Ö:Br::Ö

(d)   H
     :Ö:Br:Ö:

(e) H:Ö:Br:Ö:
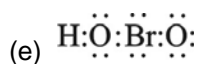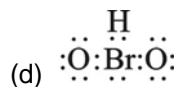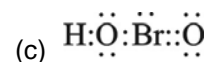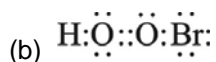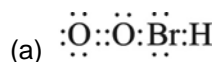
13&14. For which of the following reactions would the ΔH^o for the reaction be labeled ΔH_f^o?

    (a) $Al(s) + 3/2\ O_2(g) + 3/2\ H_2(g) \rightarrow Al(OH)_3(s)$

    (b) $PCl_3(g) + 1/2\ O_2(g) \rightarrow POCl_3(g)$

    (c) $1/2\ N_2O(g) + 1/4\ O_2(g) \rightarrow NO(g)$

    (d) $CaO(s) + SO_2(g) \rightarrow CaSO_3(s)$

    (e) The ΔH^o for all the reactions would be labeled ΔH_f^o.

15&16. Which molecule exhibits resonance?

    (a) BeI_2 (b) H_2S (c) SO_2 (d) PF_3 (e) CO_2

17&18. Which ground state electronic configuration is **NOT** correct?

(a) Na $1s^2\,2s^2\,2p^6\,3s^1$

(b) As $[Ar]\,3d^{10}\,4s^2\,4p^3$

(c) Cu $[Ar]\,3d^{10}\,4s^1$

(d) Bi $[Xe]\,6s^2\,5d^{10}\,6p^3$

(e) Mn $[Ar]\,3d^5\,4s^2$

19&20. The following set of 4 quantum numbers: $n = 4$, $\ell = 2$, $m_\ell = -1$, $m_s = -1/2$ could be an appropriate set for the last electron to go into an element of: (Assume that the element is not an exception to the normal filling rule.)

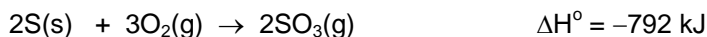(a) V   (b) Ca   (c) Zr   (d) Se   (e) Kr

21&22. Which one of the following thermodynamic quantities is NOT a state function?

(a) ΔE (b) T   (c) ΔH (d) (q+w)   (e) q

23&24. If a system loses 10 J of heat and does 40 J of work on the surroundings, the change in internal energy is

(a) −50 J   (b) +50 J   (c) −10 J   (d) +10 J   (e) 0 J

25&26. Given the heats of reaction below, calculate ΔH° for the reaction: $SO_2(g) + 1/2\,O_2(g) \rightarrow SO_3(g)$

$$S(s) + O_2(g) \rightarrow SO_2(g) \qquad\qquad \Delta H^\circ = -297 \text{ kJ}$$
$$2S(s) + 3O_2(g) \rightarrow 2SO_3(g) \qquad\qquad \Delta H^\circ = -792 \text{ kJ}$$

(a) +297 kJ   (b) −693 kJ   (c) −99 kJ   (d) +693 kJ   (e) +99 kJ

C3

27&28. A 5.000 g sample of methanol, CH_3OH, was completely burned in a bomb calorimeter that was surrounded by 4000. g of water. The temperature of the water rose from $23.000^\circ C$ to $29.765^\circ C$. The heat capacity of the calorimeter was 2657 J/$^\circ$C. The specific heat of water is 4.184 J/g$^\circ$C. Calculate ΔE for the reaction in kJ/mol.

(a) -137 kJ/mol   (b) -789 kJ/mol   (c) -56 kJ/mol   (d) -840 kJ/mol   (e) -69.5 kJ/mol

29&30. Which is the correct order of bond length?

(a) single bond > double bond > triple bond

(b) double bond > single bond > triple bond

(c) triple bond > double bond > single bond

(d) triple bond > single bond > double bond

(e) single bond > triple bond > double bond

C5

31&32. In 1947 a ship loaded with ammonium nitrate exploded in the harbor of Texas City. Calculate the standard enthalpy change associated with the reaction of 20.0 grams of NH_4NO_3, according to the equation:

$$2 NH_4NO_3(s) \rightarrow 2N_2(g) + O_2(g) + 4H_2O(g)$$
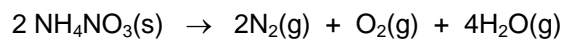
Compound	ΔH°_f (kJ/mol)
Ammonium nitrate (s)	−366
Water (g)	−242

(a) −425 kJ   (b) −54.0 kJ   (c) −152 kJ   (d) +14.7 kJ   (e) −29.5 kJ

PART 2

(16 pts) **33.**   For each of species, draw the Lewis dot structure (3 pts and don't forget all the electrons). For the central atom, give the electronic geometry (2 pts), the molecular (or ionic) geometry (2 pts), and say if the species has a dipole moment (is polar) or not (1pt).

(a) BeF_2 (b) SF_5^-

	BeF_2	SF_5^-
Electronic Geometry		
Molecular/Ionic Geometry		
Has dipole moment (yes/no) (is polar)		

(4 pts)   Draw a 3-dimensional representation of these 2 species using wedges and dotted lines. **Show ALL lone pairs of electrons. Show and state the bond angles.**

OVER $\Rightarrow$

C8

EXTRA CREDIT:

(2 pts) **34.** Sketch the pictures of the following orbitals :

(a) s

(b) d_{xy}

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Periodic Table of Elements