

Chemistry 1035 – Exam #3

April 8, 2004

Name: _____

Student Number: _____

The Virginia Tech Honor Code

The Honor Code will be strictly enforced in this course. All assignments submitted shall be considered graded work, unless otherwise noted. All aspects of your coursework are covered by the Honor System. Any suspected violations of the Honor Code will be promptly reported to the Honor System. Honesty in your academic work will develop into professional integrity. The faculty and students of Virginia Tech will not tolerate any form of academic dishonesty.

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Calculator Policy – The use of scientific calculators is permitted for calculating the answers to numerical problems on this examination. Cellular telephones may not be used as calculators during this examination. Likewise, PDA's (e.g. Palm devices) may not be used as calculators during this examination.

Equations:

$$v\lambda = c$$

$$\lambda = \frac{h}{mu}$$

$$E = hv$$

$$q = c \cdot m \cdot \Delta T$$

$$\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Constants:

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

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{sec}$$

1. Consider the following balanced Thermochemical reaction:



What is the Enthalpy change (ΔH) if 20.00 gm of H_2S is formed?

- a. -11.85 kJ
- b. -94.82 kJ
- c. -161.6 kJ
- d. -758.6 kJ

$$20.0 \text{ gm H}_2\text{S} \times \frac{1 \text{ mole H}_2\text{S}}{34.016 \text{ gm H}_2\text{S}} \times \frac{-161.6 \text{ kJ}}{8 \text{ mole H}_2\text{S}} = -11.85 \text{ kJ}$$

2. What assumption did Plank make in his description of Blackbody radiation?

- a. Energy can only have certain, discrete values
- b. Energy from light can be accumulated
- c. The energy of light is proportional to the amplitude
- d. That frequency and wavelength are directly proportional

3. What is the frequency of light that has wavelength (λ) equal to 2.5 μm ?

- a. $8.3 \times 10^{-13} \text{ Hz}$
- b. 0.00133 Hz
- c. 750 Hz
- d. $1.20 \times 10^{14} \text{ Hz}$

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/sec}}{2.5 \times 10^{-6} \text{ m}} = 1.20 \times 10^{14} \text{ Hz}$$

4. A 505 gm piece of copper ($c=0.387 \text{ J/g}\cdot\text{K}$) tubing is heated to 99.9°C and placed in an insulated vessel containing 59.8 gm of water ($c = 4.184 \text{ J/g}\cdot\text{K}$) at 24.8°C . The heat capacity of the vessel is 10.0 J/K (e.g. $c=10.0 \text{ J/K}$). What is the final temperature of the system?

- a. 28.7°C
- b. 205.71°C
- c. 58.31°C
- d. 57.03°C

$$(505 \text{ gm})(0.387 \text{ J/g}\cdot\text{K})(T_f - 99.9) = -\{59.8 \text{ gm}(4.184 \text{ J/g}\cdot\text{K})(T_f - 24.8) + 10 \text{ J/K}(T_f - 24.8)\}$$

$$195.435(T_f - 99.9) = -\{250.20(T_f - 24.8) + 10(T_f - 24.8)\}$$

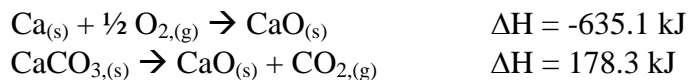
$$195.435T_f - 19523.96 = -\{260.20(T_f - 24.8)\}$$

$$195.435T_f - 19523.96 = -260.20T_f + 6452.96$$

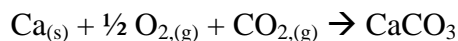
$$455.635T_f = 25.976.92$$

$$T_f = 57.03$$

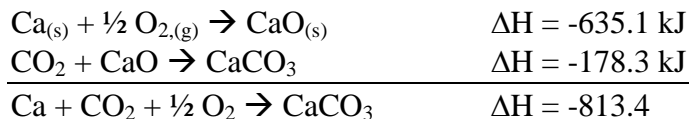
5. Given:



What is the ΔH for the reaction:



- a. -813.4 kJ
- b. -456.8 kJ
- c. 456.8 kJ
- d. 813.4 kJ



6. Which of the following is not part of Bohr's model for the Hydrogen atom?
- The H atom has only certain allowable energy levels (called stationary states)
 - Electrons can be described as either a particle or as a wave.
 - The atom changes to another stationary state only by absorbing or emitting a photon whose energy equals the difference in energy between 2 stationary states.
 - The atom does not radiate energy while in one of its stationary states
7. An Alpha-particle is frequently emitted during radioactive decay of elements. If the mass of an Alpha-particle is 6.6×10^{-24} gm, and the emitted particle has a velocity of 1.52×10^7 meters/sec, what is the wavelength (λ) of the alpha-particle?
- 3.35×10^{-19} m
 - 3.35×10^{-16} m
 - 6.60×10^{-18} m
 - 6.60×10^{-15} m

$$\lambda = \frac{h}{mu} = \frac{6.626 \times 10^{-34} \text{ J} \cdot \text{s}}{(6.6 \times 10^{-24} \text{ gm} \times \frac{1 \text{ kg}}{1000 \text{ g}})(1.52 \times 10^7 \text{ m/sec})} = 6.60 \times 10^{-15} \text{ m}$$

8. If the Principle Quantum Number (n) equals 3, which of the following is not an allowed value of the Angular Momentum Quantum Number (l).

- a. -1 if $n = 3$, then l can equal 0, 1, or 2
- b. 0
- c. 1
- d. 2

9. For a d-orbital, how many values of the Magnetic Quantum Number (m_l) are allowed?

- a. 1 for a d orbital, $l = 2$; and $m_l = -2, -1, 0, 1, 2$
- b. 3
- c. 5
- d. 7

10. The Heisenberg uncertainty principle tells us that we cannot know _____ simultaneously?

- a. Energy and Position
- b. Mass and wavelength
- c. Position and momentum
- d. Mass and momentum
- e. Position and wavelength

11. Hund's rule says that:

- a. Electrons fill orbitals in the order of increasing energy
- b. Electrons will pair before filling degenerate orbitals
- c. Electrons fill degenerate orbitals to maximize the number of unpaired electrons with parallel spins
- d. No 2 electrons in the same atom can have the same 4 Quantum numbers

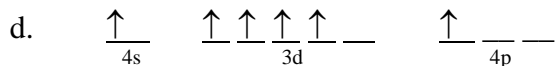
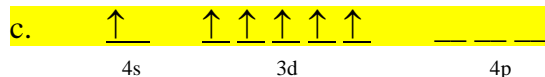
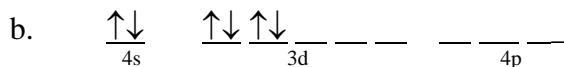
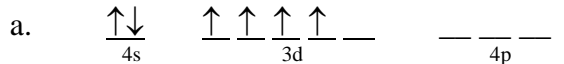
12. What is the electron configuration for As:

- a. $[\text{Ar}]4s^23d^{10}4p^3$ As is element # 33
- b. $[\text{Ar}]4s^24d^{10}4p^3$
- c. $[\text{Ar}]4s^24p^63d^7$
- d. $[\text{Ar}]4s^13d^{10}4p^4$

13. What is the electron configuration for the ion Ti^{+2}
- a. $[\text{Ar}]4s^23d^2$ Transition elements ionize by losing electrons with the highest principle Quantum number first
 - b. $[\text{Ar}]4s^2$
 - c. $[\text{Ar}]3d^2$
 - d. $[\text{Ar}]4s^13d^1$
14. The Pauli Exclusion Principle says that:
- a. No 2 electrons in the same atom can have the same 4 Quantum numbers
 - b. Electrons will pair before filling degenerate orbitals
 - c. Electrons fill orbitals in the order of increasing energy
 - d. You cannot know the wavelength and mass of an electron simultaneously
15. Which of the following will have the largest Ionization Energy?
- a. Li
 - b. Be
 - c. O Oxygen is furthest of these to the upper right corner
 - d. Cs
16. Of the following, which is not isoelectronic with Argon (Ar)?
- a. Ne Isoelectronic means having the same electron configuration
 - b. K^+
 - c. Cl^-
 - d. Ca^{+2}
 - e. S^{-2}
17. Of the following ionic compounds, which will have the greatest lattice energy?
- a. NaCl
 - b. MgCl_2
 - c. CsCl
 - d. BaCl_2

18. Of the following covalent bonds, which will be the most polar?
- C-H
 - C-N
 - C-O** The bond between C and O has the greatest (of the choices) electronegativity difference
 - C-S
19. Which atom in the periodic chart has the largest electronegativity?
- Oxygen
 - Hydrogen
 - Fluorine**
 - Neon
20. Is Zn^{+2} paramagnetic or diamagnetic?
- Paramagnetic
 - Diamagnetic** electron configuration is: $[\text{Ar}]3d^{10}$
21. What is the Bond Order for the C-S bonds in a CS_2 molecule? (You will need to work out the Lewis Dot structure to arrive at an answer for this)
- 0
 - 1
 - 2**
 - 3
- $$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \cdot\cdot \\ \cdot\cdot \end{array} = \text{C} = \begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \cdot\cdot \\ \cdot\cdot \end{array}$$
22. Of the following, which will have the longest covalent bond?
- C-F
 - C-O
 - C=O
 - C-S** Sulfur is the largest of these atoms, leading to the longest C-S bond
23. Which of the following will have the greatest bond energy?
- C-O
 - C=O** double bonds have larger bond strength, and oxygen is smaller than sulfur leading to a shorter bond
 - C-S
 - C=S

24. Which of the following is the correct simplified orbital diagram for Cr.



$\frac{1}{2}$ filled s and $\frac{1}{2}$ filled d orbitals are unusually stable electron configuration

25. Which of the following sets of Quantum numbers correctly identifies the highest energy electron in a ground state Br atom?

a. $n = 4, l = 0, m_l = 0, m_s = \frac{1}{2}$

b. $n = 4, l = 1, m_l = 1, m_s = -\frac{1}{2}$

c. $n = 4, l = 2, m_l = 1, m_s = \frac{1}{2}$

d. $n = 4, l = 3, m_l = 1, m_s = -\frac{1}{2}$

the highest energy electron of Bromine is in the "p" orbital, therefore, l must equal 1

