

Name \_\_\_\_\_

Avogadro's number =  $6.02 \times 10^{23}$ ,  $h = 6.626 \times 10^{-34}$  J s,  $c = 3 \times 10^8$  m/s**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. EACH QUESTION IS WORTH 2 PTS.**

- 1) For resonance forms of a molecule or ion, \_\_\_\_\_. 1) \_\_\_\_\_  
 A) all the resonance structures are observed in various proportions  
 B) the same atoms need not be bonded to each other in all resonance forms  
 C) there cannot be more than two resonance structures for a given species  
 D) one always corresponds to the observed structure  
 E) the observed structure is an average of the resonance forms
- 2) In which reaction does the oxidation number of hydrogen change? 2) \_\_\_\_\_  
 A)  $2 \text{HClO}_4 (\text{aq}) + \text{CaCO}_3 (\text{s}) \rightarrow \text{Ca}(\text{ClO}_4)_2 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$   
 B)  $2 \text{Na} (\text{s}) + 2 \text{H}_2\text{O} (\text{l}) \rightarrow 2 \text{NaOH} (\text{aq}) + \text{H}_2 (\text{g})$   
 C)  $\text{SO}_2 (\text{g}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_2\text{SO}_3 (\text{aq})$   
 D)  $\text{HCl} (\text{aq}) + \text{NaOH} (\text{aq}) \rightarrow \text{NaCl} (\text{aq}) + \text{H}_2\text{O} (\text{l})$
- 3) Screening by core electrons in atoms is \_\_\_\_\_. 3) \_\_\_\_\_  
 A) essentially identical to that by valence electrons  
 B) less efficient than that by valence electrons  
 C) more efficient than that by valence electrons  
 D) responsible for a general decrease in atomic radius going down a group  
 E) both essentially identical to that by valence electrons and responsible for a general decrease in atomic radius going down a group
- 4) How many unpaired electrons are there in an  $\text{O}^{2-}$  ion? 4) \_\_\_\_\_  
 A) 0  
 B) 1  
 C) 2  
 D) 3  
 E) This cannot be predicted.
- 5) Which equation correctly represents the first ionization of phosphorus? 5) \_\_\_\_\_  
 A)  $\text{P} (\text{g}) \rightarrow \text{P}^- (\text{g}) + \text{e}^-$   
 B)  $\text{P}^+ (\text{g}) + \text{e}^- \rightarrow \text{P} (\text{g})$   
 C)  $\text{P} (\text{g}) + \text{e}^- \rightarrow \text{P}^- (\text{g})$   
 D)  $\text{P}^- (\text{g}) \rightarrow \text{P} (\text{g}) + \text{e}^-$   
 E)  $\text{P} (\text{g}) \rightarrow \text{P}^+ (\text{g}) + \text{e}^-$
- 6) A strong electrolyte is one that \_\_\_\_\_ completely in solution. 6) \_\_\_\_\_  
 A) decomposes                      B) reacts                      C) ionizes                      D) disappears

7) Which of the following is an illustration of the law of constant composition? 7) \_\_\_\_\_  
 A) Water is a compound.  
 B) Water boils at 100°C at 1 atm pressure.  
 C) Water and salt have different boiling points.  
 D) Water can be separated into other substances by a chemical process.  
 E) Water is 11% hydrogen and 89% oxygen by mass.

8) The formula of a salt is XCl<sub>2</sub>. The X-ion in this salt has 28 electrons. The metal X is \_\_\_\_\_. 8) \_\_\_\_\_  
 A) Zn                      B) V                      C) Ni                      D) Pd                      E) Fe

9) Which element would be expected to have chemical and physical properties closest to those of fluorine? 9) \_\_\_\_\_  
 A) Ne                      B) Cl                      C) Fe                      D) O                      E) S

10) There are \_\_\_\_\_ significant figures in the answer to the following computation: 10) \_\_\_\_\_

$$\frac{(29.2 - 20.0) (1.79 \times 10^5)}{1.39}$$

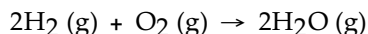
A) 1                      B) 2                      C) 3                      D) 4                      E) 5

11) The value of ΔE for a system that performs 213 kJ of work on its surroundings and loses 79 kJ of heat is \_\_\_\_\_ kJ. 11) \_\_\_\_\_  
 A) +134                      B) -213                      C) -134                      D) +292                      E) -292

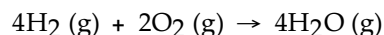
12) What is the maximum number of double bonds that a carbon atom can form? 12) \_\_\_\_\_  
 A) 4                      B) 2                      C) 1                      D) 0                      E) 3

13) Combining aqueous solutions of BaI<sub>2</sub> and Na<sub>2</sub>SO<sub>4</sub> affords a precipitate of BaSO<sub>4</sub>. Which ion(s) is/are spectator ions in the reaction? 13) \_\_\_\_\_  
 A) Na<sup>+</sup> only  
 B) Ba<sup>2+</sup> only  
 C) Na<sup>+</sup> and I<sup>-</sup>  
 D) SO<sub>4</sub><sup>2-</sup> and I<sup>-</sup>  
 E) Ba<sup>2+</sup> and SO<sub>4</sub><sup>2-</sup>

14) The enthalpy change for the following reaction is -483.6 kJ: 14) \_\_\_\_\_



Therefore, the enthalpy change for the following reaction is \_\_\_\_\_ kJ:



A) 967.2                      B) -967.2                      C) 483.6                      D) 2.34 × 10<sup>5</sup>                      E) -483.6

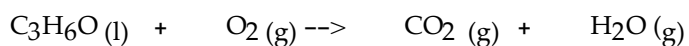
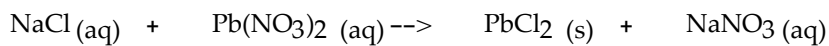
- 15) Which pair of atoms constitutes a pair of isotopes of the same element? 15) \_\_\_\_\_
- A)  ${}^{14}_6\text{X}$      ${}^{12}_6\text{X}$
- B)  ${}^{14}_6\text{X}$      ${}^{14}_7\text{X}$
- C)  ${}^{20}_{10}\text{X}$      ${}^{21}_{11}\text{X}$
- D)  ${}^{17}_9\text{X}$      ${}^{17}_8\text{X}$
- E)  ${}^{19}_{10}\text{X}$      ${}^{19}_9\text{X}$
- 16) Oxidation cannot occur without \_\_\_\_\_. 16) \_\_\_\_\_
- A) air                      B) acid                      C) oxygen                      D) reduction                      E) water
- 17) The formula weight of potassium dichromate ( $\text{K}_2\text{Cr}_2\text{O}_7$ ) is \_\_\_\_\_ amu. 17) \_\_\_\_\_
- A) 333.08                      B) 242.18                      C) 255.08                      D) 107.09                      E) 294.18
- 18)  $[\text{Ar}]4s^23d^{10}4p^3$  is the electron configuration of a(n) \_\_\_\_\_ atom. 18) \_\_\_\_\_
- A) Sb                      B) Sn                      C) V                      D) As                      E) P
- 19) What is the coefficient of  $\text{O}_2$  when the following equation is completed and balanced? 19) \_\_\_\_\_
- $\text{C}_4\text{H}_8\text{O} + \text{O}_2 \rightarrow \text{_____}$
- A) 18                      B) 6                      C) 4                      D) 11                      E) 12
- 20) How many p-orbitals are occupied in a Ne atom \_\_\_\_\_? 20) \_\_\_\_\_
- A) 3                      B) 6                      C) 2                      D) 0                      E) 1
- 21) The uncertainty principle states that \_\_\_\_\_. 21) \_\_\_\_\_
- A) it is impossible to know how many electrons there are in an atom
- B) there can only be one uncertain digit in a reported number
- C) it is impossible to know the exact position and momentum of an electron
- D) it is impossible to know anything with certainty
- E) matter and energy are really the same thing
- 22) Which one of the following compounds is insoluble in water? 22) \_\_\_\_\_
- A)  $\text{K}_2\text{SO}_4$                       B)  $\text{Fe}(\text{NO}_3)_3$                       C)  $\text{Na}_2\text{CO}_3$                       D)  $\text{ZnS}$                       E)  $\text{AgNO}_3$
- 23) A typical triple bond \_\_\_\_\_. 23) \_\_\_\_\_
- A) consists of six shared electron pairs
- B) is longer than a single bond
- C) consists of one  $\sigma$  bond and two  $\pi$  bonds
- D) consists of two  $\sigma$  bonds and one  $\pi$  bond
- E) consists of three shared electrons

- 24) The internal energy of a system is always increased by \_\_\_\_\_. 24) \_\_\_\_\_
- A) withdrawing heat from the system
  - B) adding heat to the system
  - C) having the system do work on the surroundings
  - D) adding heat to the system and having the system do work on the surroundings
  - E) a volume compression
- 25) The hybridization of orbitals on the central atom in a molecule is  $sp^2$ . The electron-domain geometry about this central atom is \_\_\_\_\_. 25) \_\_\_\_\_
- A) trigonal bipyramidal
  - B) tetrahedral
  - C) linear
  - D) octahedral
  - E) trigonal planar

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 26) (5 pts) Draw the Lewis structure for carbon monoxide. Indicate the formal charge on each atom. 26) \_\_\_\_\_

- 27) (4 pts) Balance the follow two equations: 27) \_\_\_\_\_



28) (4 pts) Draw the correct shape and orientation of the three 'p' orbitals ( $p_x$ ,  $p_y$ ,  $p_z$ ) on a set of x, y, z axes. 28) \_\_\_\_\_

29) (4 pts) Draw the shape of an  $sp^2$  hybridized orbital. What is the name of this geometric shape? 29) \_\_\_\_\_

30) (4 pts) Name the following compounds: 30) \_\_\_\_\_



31) (6 pts) Write the condensed electron configuration for the following elements:

31) \_\_\_\_\_

48Cd :

14Si :

40Zr :

32) (5 pts) Draw the Lewis structure and any resonance structures for the nitrate ion. Indicate the formal on all the atoms for one Lewis structure.

32) \_\_\_\_\_

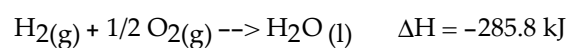
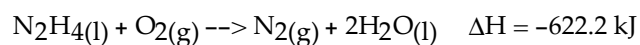
33) (4 pts) Sketch how alpha, beta, and gamma radiation deflect between positively and negatively charged plates. What subatomic particle is beta radiation made of?

33) \_\_\_\_\_

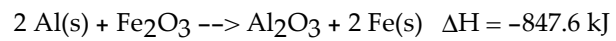
**Calculations: Do 9 out of the following 10 questions and cross out the one you do not want graded. If none is crossed out then the last question will not be graded. Show as much work as possible for partial credit. All answers should have a number AND a unit.**

34) (6 pts) If you have 4 moles of  $\text{CO}_2$ , how many atoms of O do you have?

35) (6 pts) Given the two equations below, what is the enthalpy change for the formation of hydrazine,  $\text{N}_2\text{H}_4(\text{l})$ , formed from its elements?

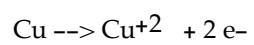
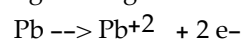
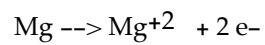


36) (6 pts) Using the equation below, how many grams of  $\text{Fe}_2\text{O}_3$  was used if 2000 kJ were released?

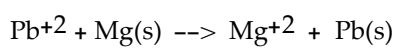
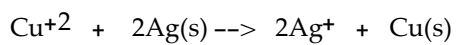


37) (6 pts) Convert the density  $8.16 \text{ kg / m}^3$  into  $\text{mg / mm}^3$

38) (6 pts) Indicate whether or not the following reaction will occur: Given that the condensed table below:



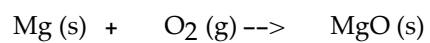
where Mg is easiest to oxidize and Ag is the most difficult



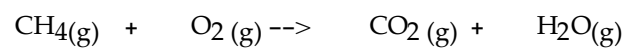
39) (6 pts) What is the molar concentration of a bright blue solution of  $\text{Cu}(\text{SO}_4)$  made by adding 79.8 g of this salt to 1 L of water? Using this stock solution, if you wanted to make 10 mL of 0.1 M solution what volume of stock solution would you use?

40) (6 pts) What is the frequency ( $\nu$ ) of a photon with wavelength of 632 nm? What is the energy of this photon in Joules?

41) (6 pts) BALANCE the equation below, then use it to calculate how many grams of MgO will be produced if you start with 3.11 moles of Mg and 1.66 moles of O<sub>2</sub>.



42) (6 pts) BALANCE the equation below, then use it to calculate how many grams of water are produced when 15 grams of CH<sub>4</sub> burn in a natural gas flame:



43) (6 pts) If the density of Al is 2.7 g / cm<sup>3</sup>, then what is the volume in cm<sup>3</sup> of a block of Al that weighs 10 kg?

## Answer Key

Testname: FINAL B

- 1) E
- 2) B
- 3) C
- 4) A
- 5) E
- 6) C
- 7) E
- 8) A
- 9) B
- 10) B
- 11) E
- 12) B
- 13) C
- 14) B
- 15) A
- 16) D
- 17) E
- 18) D
- 19) D
- 20) A
- 21) C
- 22) D
- 23) C
- 24) B
- 25) E
- 26) :CO: with a triple bond in between.
- 27)  $2\text{NaCl} + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{PbCl}_2 + 2 \text{NaNO}_3$   
 $\text{C}_3\text{H}_6\text{O} + 4\text{O}_2 \rightarrow 3 \text{CO}_2 + 3 \text{H}_2\text{O}$
- 28) Figure 6.22b in text.
- 29) Figure 9.18 in text. Trigonal Planar
- 30) Sulfuric Acid, Carbon tetrachloride, potassium iodide, sulfur trioxide
- 31) Cd :  $[\text{Kr}] 4d^{10}5s^2$ , Si:  $[\text{Ne}] 3s^23p^2$ , Zr:  $[\text{Kr}] 4d^25s^2$
- 32) page 323 of text.
- 33) See figure 2.8 in the text. Beta radiation is made of electrons.
- 34)  $4.8 \times 10^{24}$  O atoms
- 35)  $\text{N}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{N}_2\text{H}_4(\text{l}) \quad \Delta H = 50.6 \text{ kJ}$
- 36) 376.8 g  $\text{Fe}_2\text{O}_3$
- 37)  $8.16 \times 10^{-3} \text{ mg} / \text{mm}^3$
- 38) Pb/Mg will occur, Cu/Ag will not occur
- 39) Stock concentration is 0.5 M  $\text{CuSO}_4$ , and 2 mL of stock would be used to make 10 mL of 0.1M  $\text{CuSO}_4$
- 40)  $4.75 \times 10^{14} \text{ 1/s}$
- 41)  $\text{O}_2$  is limiting, and 125.3 g of MgO will be produced.
- 42)  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$ , 33.75 g  $\text{H}_2\text{O}$  produced
- 43)  $3.7 \times 10^3 \text{ cm}^3$