

Name \_\_\_\_\_

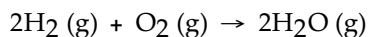
Avogadro's number =  $6.02 \times 10^{23}$ ,  $h = 6.626 \times 10^{-34}$  J s,  $c = 3 \times 10^8$  m/s**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. EACH QUESTION IS WORTH 2 PTS.**

- 1) The formula weight of potassium dichromate ( $K_2Cr_2O_7$ ) is \_\_\_\_\_ amu. 1) \_\_\_\_\_  
 A) 242.18      B) 333.08      C) 255.08      D) 294.18      E) 107.09
- 2) In which reaction does the oxidation number of hydrogen change? 2) \_\_\_\_\_  
 A)  $2 Na (s) + 2 H_2O (l) \rightarrow 2 NaOH (aq) + H_2 (g)$   
 B)  $2 HClO_4 (aq) + CaCO_3 (s) \rightarrow Ca(ClO_4)_2 (aq) + H_2O (l) + CO_2 (g)$   
 C)  $HCl (aq) + NaOH (aq) \rightarrow NaCl (aq) + H_2O (l)$   
 D)  $SO_2(g) + H_2O (l) \rightarrow H_2SO_3 (aq)$
- 3) Screening by core electrons in atoms is \_\_\_\_\_. 3) \_\_\_\_\_  
 A) less efficient than that by valence electrons  
 B) essentially identical to that by valence electrons  
 C) responsible for a general decrease in atomic radius going down a group  
 D) more efficient than that by valence electrons  
 E) both essentially identical to that by valence electrons and responsible for a general decrease in atomic radius going down a group
- 4) Combining aqueous solutions of  $BaI_2$  and  $Na_2SO_4$  affords a precipitate of  $BaSO_4$ . Which ion(s) 4) \_\_\_\_\_  
 is/are spectator ions in the reaction?  
 A)  $Na^+$  and  $I^-$   
 B)  $Na^+$  only  
 C)  $Ba^{2+}$  and  $SO_4^{2-}$   
 D)  $Ba^{2+}$  only  
 E)  $SO_4^{2-}$  and  $I^-$
- 5) Which pair of atoms constitutes a pair of isotopes of the same element? 5) \_\_\_\_\_  
 A)  ${}^{17}_9 X$        ${}^{17}_8 X$   
 B)  ${}^{14}_6 X$        ${}^{12}_6 X$   
 C)  ${}^{14}_6 X$        ${}^{14}_7 X$   
 D)  ${}^{20}_{10} X$        ${}^{21}_{11} X$   
 E)  ${}^{19}_{10} X$        ${}^{19}_9 X$
- 6) Which element would be expected to have chemical and physical properties closest to those of 6) \_\_\_\_\_  
 fluorine?  
 A) Ne      B) O      C) S      D) Fe      E) Cl

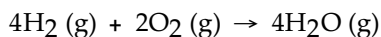
- 7) Which equation correctly represents the first ionization of phosphorus? 7) \_\_\_\_\_
- A)  $P^+(g) + e^- \rightarrow P(g)$   
 B)  $P(g) \rightarrow P^-(g) + e^-$   
 C)  $P(g) \rightarrow P^+(g) + e^-$   
 D)  $P(g) + e^- \rightarrow P^-(g)$   
 E)  $P^-(g) \rightarrow P(g) + e^-$
- 8) The value of  $\Delta E$  for a system that performs 213 kJ of work on its surroundings and loses 79 kJ of heat is \_\_\_\_\_ kJ. 8) \_\_\_\_\_
- A) -292                      B) +134                      C) +292                      D) -134                      E) -213
- 9) The uncertainty principle states that \_\_\_\_\_. 9) \_\_\_\_\_
- A) it is impossible to know how many electrons there are in an atom  
 B) it is impossible to know anything with certainty  
 C) matter and energy are really the same thing  
 D) it is impossible to know the exact position and momentum of an electron  
 E) there can only be one uncertain digit in a reported number
- 10) What is the maximum number of double bonds that a carbon atom can form? 10) \_\_\_\_\_
- A) 2                              B) 0                              C) 3                              D) 4                              E) 1
- 11) Oxidation cannot occur without \_\_\_\_\_. 11) \_\_\_\_\_
- A) water                      B) oxygen                      C) acid                      D) reduction                      E) air
- 12)  $[Ar]4s^23d^{10}4p^3$  is the electron configuration of a(n) \_\_\_\_\_ atom. 12) \_\_\_\_\_
- A) As                              B) V                              C) Sb                              D) P                              E) Sn
- 13) A typical triple bond \_\_\_\_\_. 13) \_\_\_\_\_
- A) consists of three shared electrons  
 B) consists of six shared electron pairs  
 C) is longer than a single bond  
 D) consists of one  $\sigma$  bond and two  $\pi$  bonds  
 E) consists of two  $\sigma$  bonds and one  $\pi$  bond
- 14) The internal energy of a system is always increased by \_\_\_\_\_. 14) \_\_\_\_\_
- A) withdrawing heat from the system  
 B) adding heat to the system and having the system do work on the surroundings  
 C) a volume compression  
 D) having the system do work on the surroundings  
 E) adding heat to the system
- 15) A strong electrolyte is one that \_\_\_\_\_ completely in solution. 15) \_\_\_\_\_
- A) reacts                      B) ionizes                      C) decomposes                      D) disappears
- 16) How many p-orbitals are occupied in a Ne atom \_\_\_\_\_? 16) \_\_\_\_\_
- A) 1                              B) 0                              C) 3                              D) 6                              E) 2

- 17) Which of the following is an illustration of the law of constant composition? 17) \_\_\_\_\_
- A) Water boils at 100°C at 1 atm pressure.
  - B) Water and salt have different boiling points.
  - C) Water is 11% hydrogen and 89% oxygen by mass.
  - D) Water can be separated into other substances by a chemical process.
  - E) Water is a compound.

- 18) The enthalpy change for the following reaction is -483.6 kJ: 18) \_\_\_\_\_

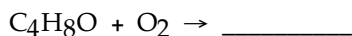


Therefore, the enthalpy change for the following reaction is \_\_\_\_\_ kJ:



- A) 967.2                      B) -483.6                      C) 483.6                      D)  $2.34 \times 10^5$                       E) -967.2
- 19) The hybridization of orbitals on the central atom in a molecule is  $sp^2$ . The electron-domain geometry about this central atom is \_\_\_\_\_. 19) \_\_\_\_\_
- A) octahedral
  - B) tetrahedral
  - C) trigonal planar
  - D) linear
  - E) trigonal bipyramidal

- 20) What is the coefficient of  $\text{O}_2$  when the following equation is completed and balanced? 20) \_\_\_\_\_



- A) 4                      B) 12                      C) 11                      D) 18                      E) 6
- 21) The formula of a salt is  $\text{XCl}_2$ . The X-ion in this salt has 28 electrons. The metal X is \_\_\_\_\_. 21) \_\_\_\_\_
- A) Pd                      B) Ni                      C) Fe                      D) Zn                      E) V

- 22) There are \_\_\_\_\_ significant figures in the answer to the following computation: 22) \_\_\_\_\_

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

- A) 1                      B) 2                      C) 3                      D) 4                      E) 5
- 23) Which one of the following compounds is insoluble in water? 23) \_\_\_\_\_
- A)  $\text{K}_2\text{SO}_4$                       B)  $\text{Fe}(\text{NO}_3)_3$                       C)  $\text{AgNO}_3$                       D)  $\text{Na}_2\text{CO}_3$                       E)  $\text{ZnS}$

- 24) For resonance forms of a molecule or ion, \_\_\_\_\_. 24) \_\_\_\_\_
- A) there cannot be more than two resonance structures for a given species
  - B) all the resonance structures are observed in various proportions
  - C) one always corresponds to the observed structure
  - D) the observed structure is an average of the resonance forms
  - E) the same atoms need not be bonded to each other in all resonance forms

25) How many unpaired electrons are there in an  $O^{2-}$  ion?

25) \_\_\_\_\_

A) 0

B) 1

C) 2

D) 3

E) This cannot be predicted.

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

26) (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.

26) \_\_\_\_\_

27) (6 pts) Write the condensed electron configuration for the following elements:

27) \_\_\_\_\_

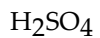
$48\text{Cd}$  :

$14\text{Si}$  :

$40\text{Zr}$  :

28) (5 pts) Draw the Lewis structure for carbon monoxide. Indicate the formal charge on each atom. 28) \_\_\_\_\_

29) (4 pts) Name the following compounds: 29) \_\_\_\_\_



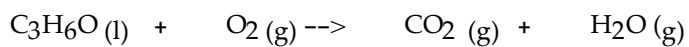
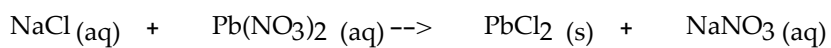
30) (5 pts) Draw the Lewis structure and any resonance structures for the nitrate ion. Indicate the formal on all the atoms for one Lewis structure. 30) \_\_\_\_\_

31) (4 pts) Draw the shape of an  $sp^2$  hybridized orbital. What is the name of this geometric shape?

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

32) (4 pts) Balance the follow two equations:

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



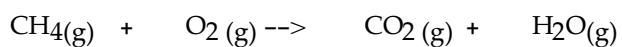
33) (4 pts) Sketch how alpha, beta, and gamma radiation deflect between positively and negatively charged plates. What subatomic particle is beta radiation made of?

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) BALANCE the equation below, then use it to calculate how many grams of water are produced when 15 grams of  $\text{CH}_4$  burn in a natural gas flame:

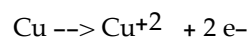
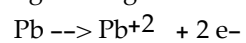
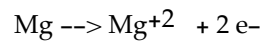


36) (6 pts) What is the frequency ( $\nu$ ) of a photon with wavelength of 632 nm? What is the energy of this photon in Joules?

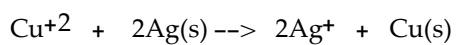
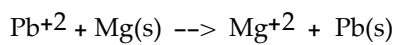
37) (6 pts) If the density of Al is  $2.7 \text{ g / cm}^3$ , then what is the volume in  $\text{cm}^3$  of a block of Al that weighs 10 kg?



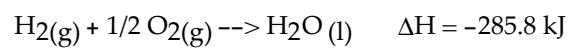
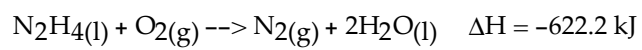
38) (6 pts) Indicate whether or not the following reaction will occur: Given that the condensed table below:



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

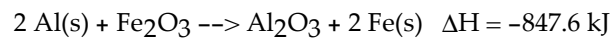


39) (6 pts) Given the two equations below, what is the enthalpy change for the formation of hydrazine,  $\text{N}_2\text{H}_4(\text{l})$ , formed from its elements?



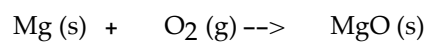
40) (6 pts) Convert the density  $8.16 \text{ kg} / \text{m}^3$  into  $\text{mg} / \text{mm}^3$

41) (6 pts) Using the equation below, how many grams of  $\text{Fe}_2\text{O}_3$  was used if 2000 kJ were released?



42) (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?

43) (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>.



## Answer Key

Testname: FINAL A

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