Please read all the questions VERY carefully before answering. Ask your instructor if you do not understand. No outside paper is allowed. The last page is a periodeic table with constants. Total points = 64 + (24 * 3 =) 72 = 136

SHORT ANSWER. Please write the set-up equation first, then put the raw data with units before calculating. Write the word or phrase that best completes each statement or answers the question.

1) Phosphorus (P_4) reacts with chlorine gas, Cl_2 to produce PCl_5 according to the following reaction: 1) _____

$$P_4\,(s) + 10\,Cl_2\,(g) \text{ ------> } 4\,PCl_5\,(s)$$

a) How many grams of PCl_5 is formed from 95.0 g of P_4 (3 pts.).

b) How many grams of PCl_5 is formed from 235.2 g of Cl_2 gas (3 pts.).

c) Which is the limiting agent if 95.0 g of P_4 and 235.2 g of Cl_2 gas was used in the rxn. (2 pts.)

d) Calculate the % yield of PCl_5 if one obtains 120.0 g PCl_5 in the above reaction (2 pts.)

2) Iron, Fe(s) reacts with oxygen gas, O_2(g) to produce Fe_2O_3 (s). Calculate how many grams of (a) Fe and (b) O are necessary to make 23.7 g of Fe_2O_3 (4 pts. each, total 8 pts) 2) _____

3) Write the net-ionic equation for the following reactions: Include phase labels for both reactants and products. Also classify each reaction, giving its type. (4 pts/each; 8 pts. tot) 3) _____

a. $2Li(s) + Cu(NO_3)_2(aq) \text{ -----> } 2LiNO_3(aq) + Cu(s)$
Net Ionic Equation: Reaction Type:

b. $3Na_2CO_3(aq) + 2Fe(NO_3)_3(aq) \text{ -----> } Fe_2(CO_3)_3(s) + 6NaNO_3(aq)$
Net Ionic Equation: Reaction Type:

4) Draw the complete ground state electron configuration for (4 pts./each; Total = 8pts.) 4) _____
(a) Vanadium (V; Z=23):

(b) Bromine (Z=35)

5) Write the name of the element with the valence electron configuration given below (3 pts) 5) _____
(a) $4s^2 4p^4$

6) Using only periodic table, 6) _____
(a) List atomic numbers 15, 16, 33 in order of increasing atomic size (6 pts.)

(b) List elements Cl, Br, I in order of increasing first ionic ionization energy (6 pts.)

7) A monoatomic ion with a charge of 1- has an electronic configuration of $1S^2 2S^2 2p^6$. 7) _____

(a) Circle the correct answer: It is a CATION/ It is an ANION (3pts.)

(b) Write the name and the symbol of the noble gas it is isoelectronic with(3 pts.)

(c) What is the symbol of the ion ? (3 pts.)

8) (a) Calculate how many grams of anhydrous magnesium sulfate ($MgSO_4$) is in 63.6 grams of its hydrate salt . The hydrate salt contains 51.1% water by weight. (3 pts.) 8) _____

(b) Calculate how many grams of water is in the 63.6 grams of the magnesium sulfate hydrate salt (3 pts.)

MULTIPLE CHOICE. On the scantron, fill up the circle with the same number as the question number. Choose the one alternative that best completes the statement or answers the question (3 pts each).

9) A precipitate is expected to be formed when an aqueous solution of sodium sulfate is added to an aqueous solution of 9) _____
   A) potassium chloride.
   B) magnesium chloride.
   C) barium chloride.
   D) iron(III) chloride.
   E) none of the above

10) What type of a reaction occurs when a sodium hydroxide solution is mixed with an acetic acid solution? 10) _____
   A) gas evolution
   B) acid-base neutralization
   C) precipitation
   D) oxidation-reduction
   E) no reaction

11) How many eggs are needed to make 1 dozen waffles, assuming you have enough of all other ingredients? 11) _____
   Given: 2 cups flour + 3 eggs + 1 tbs oil $\rightarrow$4 waffles
   A) 48
   B) 12
   C) 9
   D) 16
   E) not enough information

12) What is the theoretical yield of a reaction if 25.0 grams of product were actually produced from a reaction that has a 88% yield? 12) _____
   A) 28.4
   B) 352
   C) 22.0
   D) 3.52
   E) none of the above

13) Which of the following types of compounds will NOT undergo a gas evolution reaction when acid is added? 13) _____
   A) carbonates
   B) bisulfites
   C) sulfides
   D) hydroxides
   E) none of the above

14) How many moles of H_2 can be made from complete reaction of 3.0 moles of Al? 14) _____
   Given: $2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$
   A) 9.0 moles
   B) 3.0 moles
   C) 3 moles
   D) 4.5 moles
   E) none of the above

15) Which among the following statements is TRUE? 15) _____

A) Red light has a shorter wavelength than violet light.
B) The wavelength of light is inversely related to its energy.
C) As the energy increases, the frequency of radiation decreases.
D) As the wavelength increases, the frequency also increases.
E) none of the above

16) Which color of the visible spectrum has the shortest wavelength (400 nm)? 16) _____

A) green B) red C) yellow D) orange E) violet

17) Which color of the visible spectrum has photons with the most energy? 17) _____

A) violet B) red C) yellow D) orange E) green

18) Which form of electromagnetic radiation has the highest frequency? 18) _____

A) Gamma Rays
B) Microwaves
C) Infrared Radiation
D) Radio Waves
E) X-rays

19) Which statement below does NOT follow the Bohr Model? 19) _____

A) The energy emitted from a relaxing electron can have any wavelength.
B) When an atom emits light, electrons fall from a higher orbit into a lower orbit.
C) When energy is absorbed by atoms, the electrons are promoted to higher-energy orbits.
D) Electrons exist in specific, quantized orbits.
E) none of the above

20) How many subshells are there in the n = 2 principal shell? 20) _____

A) 2
B) 4
C) 1
D) 3
E) not enough information

21) Which one of the following is the correct orbital diagram for nitrogen? 21) _____

A) ⇅ ⇅ ↓ ↓ ↑
B) ⇅ ⇊ ↓ ↑ ↑
C) ⇅ ⇅ ↑ ↑ ↑
D) ⇅ ⇊ ↑ ↑ ↑
E) none of the above

22) The "d" subshell can hold a maximum of _____ electrons. 22) _____

A) 5
B) 6
C) 10
D) 2
E) none of the above

23) How many electrons are unpaired in the orbitals of carbon? 23) _____

A) 6
B) 12
C) 2
D) 4
E) none of the above

24) How many valence electrons are in a chlorine atom? 24) _____

A) 17
B) 1
C) 10
D) 7
E) none of the above

25) What is the element in which at least one electron is in the d-orbital? 25) _____

A) Sc
B) K
C) Ar
D) Ca
E) none of the above

26) The size of an atom generally increases 26) _____

A) down a group and from right to left across a period.
B) down a group and from left to right across a period.
C) up a group and from left to right across a period.
D) up a group and diagonally across the Periodic Table.
E) up a group and from right to left across a period.

27) Which of the following elements has the highest ionization energy? 27) _____

A) Ba B) Cl C) Ca D) Ne E) Al

TRUE/FALSE. On the scantron, fill up circle "A" for a true answer and "B" for wrong answer (3 pts each).

28) The formation of a gas is evidence of a chemical reaction while the emission of light is not. 28) _____

29) Mixing two aqueous solutions will always result in formation of a precipitate. 29) _____

30) A photon of red light contains the same amount of energy as a photon of blue light. 30) _____

31) Wavelength of visible light determines color. 31) _____

32) The possible values for the principal quantum numbers are: n = 0, 1, 2, 3, 4. 32) _____