

Name: Key

Chemistry 120, Section A  
Hour exam 1, September 17, 2004

General Instructions: Read each question carefully and answer in the expected format, using proper English spelling, punctuation, and grammar. The back of the periodic table contains conversion factors. SHOW YOUR WORK for all calculation problems, include appropriate units, and express your final answer in the correct number of significant figures. Refer to the periodic table for additional information but do not write on it and do not believe anything written on it by hand.

- Part A. Definitions. (1 point each)
1. empirical formula- Simplest whole number ratio to describe compound
  2. Stoichiometry is a ratio describing how many moles react to form moles product.
  3. limiting reagent- reactant which runs out first
  4. atomic number- # of protons, determines element
  5. matter is anything that has mass and occupies space.
  6. hypothesis- "educated guess" concerning how or why something happens
  7. exact number- not a measurement, e.g. 12 eggs = 1 dozen
  8. temperature is a measure of the average kinetic energy of matters.
  9. density- amount of matter per unit volume; e.g.  $g/cm^3$
  10. element is a pure substance composed of only one type of atom.

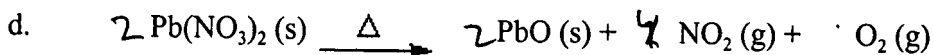
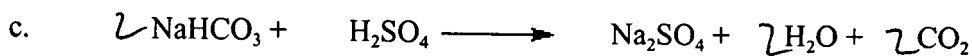
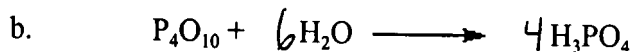
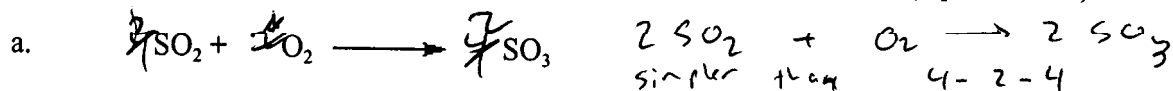
Differentiate between the following pairs of terms (2 points each)

11. formula weight vs. molar mass amu vs  $g/mol$ , but # is the same
12. atomic mass vs. atomic weight — average mass of all atoms  
↳ mass of one atom
13. qualitative vs. quantitative data — number + units; e.g. 6 g  
↳ descriptive; e.g. red
14. fundamental vs. derived measurement  
↳ one unit      ↳ two or more units      g vs  $\frac{g}{m^3}$ , e.g.
15. random error vs. systematic error — always high or low.  
↳ high or low

You can put all of these in your own words.

Part B. Concepts and Applications Thereof

16. Balance the following reactions or indicate they are balanced as written. (3 points each)



17. Name the following compounds. (5 points)

- a.  $Na_2SO_4$  sodium sulfate  
 b.  $(NH_4)_3PO_4$  ammonium phosphate  
 c.  $Na_2CrO_4$  sodium chromate  
 d.  $CS_2$  carbon disulfide  
 e.  $Fe_2(CO_3)_2$  iron(II) carbonate

18. Write formulas of the following compounds. (5 points)

- a. tetraphosphorous decaoxide  $P_4O_{10}$   
 b. nitrogen triiodide  $NI_3$   
 c. hydroiodic acid  $HI$   
 d. sulfurous acid  $H_2SO_3$   
 e. sodium acetate  $NaC_2H_3O_2$

19. The incandescent white of fireworks is caused by the reaction of phosphorous with oxygen to give  $P_4O_{10}$  by the reaction  $4P + 5O_2 \longrightarrow P_4O_{10}$ .

i. How many grams of  $O_2$  are needed to combine with 6.85 g of P? (5 points)

$$(6.85g P) \left( \frac{1 \text{ mol}}{30.974g P} \right) \left( \frac{5 \text{ mol } O_2}{4 P} \right) \left( \frac{32.00g}{1 \text{ mol } O_2} \right) = 8.85g O_2$$

ii. How many moles of  $P_4O_{10}$  can be made from 8.00 g of  $O_2$ ? (3 points)

$$\left( 8.00 \text{ g } O_2 \right) \left( \frac{1 \text{ mol } O_2}{32.00 \text{ g } O_2} \right) \left( \frac{1 \text{ mol } P_4O_{10}}{5 \text{ mol } O_2} \right) = 0.05 \text{ mol}$$

20. Complete the following table, including mass and atomic numbers on symbols. (6 points each)

| Symbol                      | No. of Protons | No. of Neutrons | No. of electrons | Net Charge |
|-----------------------------|----------------|-----------------|------------------|------------|
| $^{206}_{82}\text{Pb}$      | 82             | 124             | 82               | 0          |
| $^{69}_{31}\text{Ga}^{3+}$  | 31             | 38              | 28               | 3+         |
| $^{127}_{52}\text{Te}^{2-}$ | 52             | 75              | 54               | 2-         |
| $^{54}_{25}\text{Mn}^{2+}$  | 25             | 29              | 23               | 2+         |

b. Classify Koolaid as matter. Completely list evidence for each category in which you place it and, where appropriate, include experimental procedures which would support your classification.

homogenous solution (mixture)  
 one could boil off  $H_2O$  to give solid sugar  
 plus other solutes (dyes, e.g.)

Part C. Multiple Choice (2 points each) Circle the answer of your *best* choice .

21. In 1928, 1.0 g of a new element was isolated from 660 kg of the ore molybdenite. The percent by mass of this element in the ore was:

- a. 6.6 %
- b. 1.5 %
- c. 1.0 %
- d.  $3.5 \times 10^{-3}$  %
- e.  $1.5 \times 10^{-4}$  %

22. Which of the following metric relationships is incorrect?

- a. 1 microliter =  $10^{-6}$  liters
- b. 1 gram =  $10^3$  kilograms
- c.  $10^3$  milliliters = 1 liter
- d. 1 gram =  $10^2$  centigrams
- e. 10 decimeters = 1 meter

23. Which of the following is *not* a unit in the SI system?
- ampere
  - calorie
  - candela
  - Kelvin
  - meter
24. The statement "The total mass of materials is not affected by a chemical change in those materials" is called a(n)
- experiment.
  - measurement.
  - natural law.
  - observation.
  - theory.
25. The amount of uncertainty in a measured quantity is determined by:
- both the skill of the observer and the limitations of the measuring instrument.
  - neither the skill of the observer nor the limitations of the measuring instrument.
  - the limitations of the measuring instrument only.
  - the skill of the observer only.
  - none of these
26. A scientist obtains the number 0.045006700 on a calculator. If this number actually has four (4) significant figures, how should it be written?
- 0.4567
  - 0.4501
  - 0.04501
  - 0.045
  - 0.04500
27. Which of the following statements from Dalton's atomic theory is no longer true, according to modern atomic theory?
- All atoms of a given element are identical.
  - Atoms are indivisible in chemical reactions.
  - Atoms are not created or destroyed in chemical reactions.
  - Elements are made up of tiny particles called atoms.
  - All of these statements are true according to modern atomic theory.
28. All of the following are true *except*:
- An ion has a positive or negative charge.
  - Ions are formed by adding electrons to a neutral atom.
  - Ions are formed by changing the number of protons in an atom's nucleus.
  - Ions are formed by removing electrons from a neutral atom.
  - Metals tend to form positive ions.
29. Which among the following represent a set of isotopes? Atomic nuclei containing:
- I. 20 protons and 20 neutrons    II. 21 protons and 19 neutrons    III. 22 neutrons and 18 protons  
IV. 20 protons and 22 neutrons    V. 21 protons and 20 neutrons
- I, II, III
  - III, IV
  - I, V
  - I, IV and II, V
  - No isotopes are indicated.

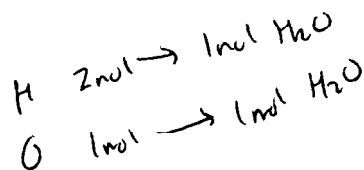
30. The average mass of a carbon atom is 12.011. Assuming you were able to pick up only one carbon atom, the chances that you would randomly get one with a mass of 12.011 is
- 0%.
  - 0.011%.
  - about 12%.
  - 12.011%.
  - greater than 50%.

31. Which of the following are incorrectly paired?
- Ba, alkaline earth metal
  - K, alkali metal
  - Ne, noble gas
  - Ni, transition metal
  - O, halogen

32. Gallium consists of two isotopes of masses 68.95 amu and 70.95 amu with abundances of 60.16% and 39.84%, respectively. What is the atomic weight of gallium?
- 69.55
  - 69.75
  - 69.95
  - 70.15
  - 71.95

33. A sample of ammonia has a mass of 56.6 g. How many molecules are in this sample?
- 3.32 molecules
  - $6.78 \times 10^{23}$  molecules
  - $1.78 \times 10^{24}$  molecules
  - $2.00 \times 10^{24}$  molecules
  - $17.03 \times 10^{24}$  molecules

34. What is the molar mass of  $\text{Ca}_3(\text{PO}_4)_2$ ?
- 310.18 g/mol
  - 166.02 g/mol
  - 135.05 g/mol
  - 118.02 g/mol
  - 87.05 g/mol



yuck!  
tough question!

35. You take an aspirin tablet (a compound consisting solely of carbon, hydrogen, and oxygen) with a mass of 1.00 g, burn it in air, and collect 2.20 g of carbon dioxide and 0.400 g water. The molar mass of aspirin is between 170 and 190 g/mol. The molecular form of aspirin is
- $\text{C}_6\text{H}_8\text{O}_5$  160 g/mol
  - $\text{C}_8\text{H}_{10}\text{O}_5$  186
  - $\text{C}_9\text{H}_8\text{O}_4$  180
  - $\text{C}_{10}\text{H}_8\text{O}_4$  180
  - none of these
- $(2.20 \text{ g CO}_2) \left( \frac{1 \text{ mol}}{44.0 \text{ g}} \right) = 0.0500$        $\frac{0.0500}{0.022} = 2.25 \times 4 = 9$   
 $(0.400 \text{ g H}_2\text{O}) \left( \frac{1 \text{ mol}}{18.0 \text{ g}} \right) = 0.0222$        $\frac{0.022}{0.022} = 1 \times 4 = 4$   
 $(1.00 \text{ g}) \left( \frac{1 \text{ mol}}{180 \text{ g}} \right) = 0.0055 \text{ mol}$       from H & O

36. The limiting reactant in a reaction
- is the reactant for which there is the least amount in grams. *no*
  - is the reactant which has the lowest coefficient in a balanced equation. *no*
  - is the reactant for which there is the most amount in grams. *no*
  - is the reactant for which there is the fewest number of moles. *not always*
  - none of these *the one that runs out first. not always*

37. A piece of indium with a mass of 16.6 g is submerged in 46.3 cm<sup>3</sup> of water in a graduated cylinder. The water level increases to 48.6 cm<sup>3</sup>. The correct value for the density of indium from these data is:

- a. 7.217 g/cm<sup>3</sup>  
b. 7.2 g/cm<sup>3</sup>  
c. 0.14 g/cm<sup>3</sup>  
d. 0.138 g/cm<sup>3</sup>  
e. more than 0.1 g/cm<sup>3</sup> away from any of these values.

$$\frac{16.6 \text{ g}}{48.6 - 46.3 \text{ cm}^3} = 7.21739$$

48.6 - 46.3 = 2.3  
so 2 SF better answer  
than 2.21739

38. Express 165,000 in exponential notation.

- a.  $1.65000 \times 10^5$   
b.  $1.65 \times 10^5$   
c.  $165 \times 10^3$   
d.  $1.6500 \times 10^{-5}$   
e.  $1.65 \times 10^{-5}$

39. 100 seconds contain this many nanoseconds:

- a.  $1 \times 10^{12}$   
b.  $1 \times 10^{11}$   
c.  $1 \times 10^{10}$   
d.  $1 \times 10^8$   
e.  $1 \times 10^7$