CHM151 Name:_____KEY_____

# Sample Exam 1 – Chapters 1-3

**SHOW ALL WORK FOR FULL CREDIT!!!!**

1. Give the symbol for each of the following elements:
   a. The semimetal in group IIIA. _____B_____
   b. The noble gas in period 6. _____Rn_____
   c. The halogen touching two semimetals. _____I_____

2. A piece of turquoise is a blue-green solid; it has a density of 0.0957 lb/in$^3$ and a mass of 2.5 g. Calculate the volume of the turquoise in mL.

   2.5 g (1 lb/453.59g)(1 in$^3$ / 0.0947 lb)(2.54 cm/ 1 in)$^3$(1 mL/1 cm$^3$) = 0.94 mL

3. Venus has a surface temperature of 730 K. What is this temperature in degrees Fahrenheit?

   850 $^o$F (2 s.f.)

4. The following are examples of chemical changes ***except***:
   a. Solid iron forms rust when combined with water and oxygen.
   b. Butane burns with air at 1970°C.
   c. Sodium bicarbonate reacts with vinegar to form carbon dioxide gas.
   d. Sodium chloride dissolves in water at room temperature.

5. What is the correct term for a gas turning into a solid? ____deposition___

6. What is the physical state for elemental chlorine, $Cl_2$, at room temperature and normal pressure?
   a. solid b. liquid c. gas

7. An oxygen molecule travels at 975 mph at room temperature. What is the de Broglie wavelength, in m, for an oxygen molecule if the mass of one oxygen molecule is 5.31 x 10$^{-23}$ g?
   (1 mi = 1.6093 km)
   Convert 975 mph into m/s first: 975 mi/hr(1 6093 km/mi)(1000m/km)(1 hr/3600 s) = 436 m/s
   $\lambda$ = h/mv = 6.626 x 10-34 kgm$^2$s$^{-1}$ / (5.31 x 10$^{-26}$ kg X 436 ms$^{-1}$) = 2.86 x 10$^{-11}$ m

8. Calculate the mass in grams of 4.73 x 10$^{25}$ formula units of calcium phosphate, $Ca_3(PO_4)_2$.
   4.73 x 10$^{25}$ formula units $Ca_3(PO_4)_2$ (1 mol/6.02214 x 10$^{23}$ formula units)( 310.178 g/ 1 mol) = 2.44 x 10$^4$ g units $Ca_3(PO_4)_2$

9. Consider the colors of the visible spectrum.

   a. Which color has the higher energy, yellow or red? _____Yellow_____

   b. Which color has the lower frequency, violet or green? ____green_____

   c. What is the frequency, in Hz, for orange light at 618 nm?

$c = \nu\lambda \quad \nu = c/\lambda = 2.998 \times 10^{8}\ ms^{-1}/(6.18 \times 10^{-7}\ m) = 4.85 \times 10^{14}\ s^{-1}$

10. When the Sojourner spacecraft landed on mars in 1997, the planet was approximately $7.8 \times 10^{7}$ km from earth.

   a. How many minutes did it take for the television signal (EM radiation) to reach Earth from Mars?

$7.8 \times 10^{7}\ km(1000\ m/km)(1\ sec/2.998 \times 10^{8}\ m)(1\ min / 60\ sec) = 4.3\ min$

   b. Calculate the energy, in kJ, of this transmission if the wavelength of the transmission was 71 m.

$$E = h\nu \quad \frac{(6.626 \times 10^{-34}\ Js)(2.998 \times 10^{8}\ ms^{-1})1\ kJ/1000J)}{71\ m} = 2.8 \times 10^{-30}\ kJ$$

11. Which of the following is an extensive property:

   a. boiling point  b. density  c. heat  d. color

12. Determine if the following are homogeneous or heterogeneous mixtures (circle one):

   a. soil  homogeneous  heterogeneous

   b. brass  homogeneous  heterogeneous

13. Complete the following table:

| Isotope | Mass Number, A | Atomic Number, Z | Neutrons, $n^0$ | Electrons, $e^-$ | Protons, $p^+$ |
|---|---|---|---|---|---|
| $^{117}Sb$ | 117 | 51 | 66 | 51 | 51 |
| $^{42}K^+$ | 42 | 19 | 23 | 18 | 19 |
| $^{6}Li$ | 6 | 3 | 3 | 3 | 3 |

14. The element copper, Cu, is a _____.

   a. metal  b. metalloid  c. nonmetal  d. gas

15. Which of the following is equal to one mole? (Look at the molar mass since it is g/ 1 mole)

   b. 55.85 g Fe  b. 98.90 g Sr  c. 14.35 g He  d. 10.15 g Mg

16. Match the scientist to their discovery

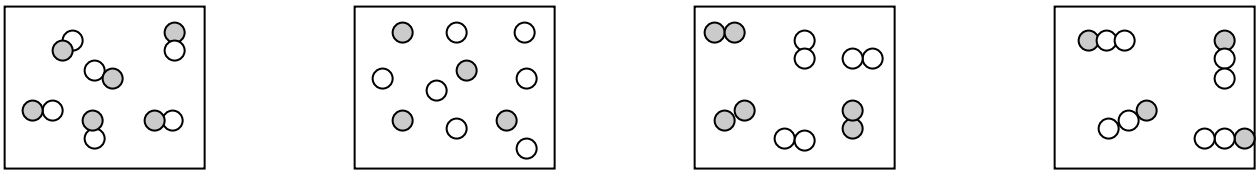
Dalton JJ Thomson Rutherford

JJ Thomson a. Identified the atom as a sphere of mainly positive charge with negatively charged particles dispersed throughout.

Dalton b. An element is composed very tiny particles that are indivisible called atoms.

Rutherford c. The atom consists of a tiny, dense, positively charged nucleus where nearly all of the mass resides.

17. If white and grey spheres represent atoms of different elements, which represents a mixture of diatomic elements?



a b c d

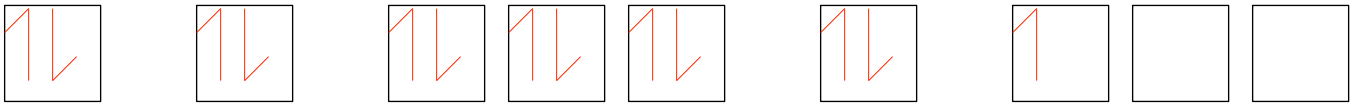
18. What is the symbol of the atom with the following short-hand electron configurations?

a. [Kr] $5s^2 4d^{10} 5p^2$ _____Sn_____

b. [Ar] $4s^1 3d^{10}$ _____Cu_____

c. [Xe] $6s^1$ _____Cs_____

19. Correctly complete the orbital filling diagram for a neutral aluminum atom:



1s 2s 2p 3s 3p

20. Write the full electron configuration from the ground state for the following:

a. Se $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

b. V $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

c. $Ni^{2+}$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$

21. Which set of quantum numbers is **NOT** allowed?

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

d. $n = 2, l = 1, m_l = 0, m_s = -\frac{1}{2}$

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

f. $n = 5, l = 0, m_l = 0, m_s = +\frac{1}{2}$

22. When n=5 and $l = 3$, what are the possible values for $m_l$? -3, -2, -1, 0, +1, +2, +3

23. Which quantum number represents the shape of an atomic orbital?
a. n b. $l$ c. $m_l$ d. $m_s$

24. Which one of the following alkali metal ions has the largest atomic radius?
a. $Rb^+$ b. $K^+$ c. $Na^+$ d. $Li^+$

25. Which of the following has the highest metallic character?
a. Sr b. Te c. Mo d. Rb

26. Which element has the lowest ionization energy?
a. F b. Cl c. Br d. I

27. Which ion is isoelectronic to a noble gas?
a. $Cr^{3+}$ b. $Sc^{2+}$ c. $Ga^{3+}$ d. $Ti^{4+}$

28. Which atom has the higher ionization energy, N or O?
a. N b. O

29. Energy is _____ when an electron changes from n = 5 to n = 2 in the hydrogen atom.
a. absorbed b. emitted c. negligible d. destroyed

30. What is the molar mass of calcium phosphate, $Ca_3(PO_4)_2$?
a. 430.42 g/mol b. 278.18 g/mol c. 310.18 g/mol d. 279.21g/mol

31. What value remains constant between different isotopes of the same element?
a. protons b. electrons c. neutrons d. mass number

32. What is the phase change associated with a substance changing from gas to liquid?
a. sublimation b. freezing c. vaporization d. condensation

33. How many carbon atoms are the in 10.0 g of propane, $C_3H_8$?

10.0 g $C_3H_8$( 1 mol $C_3H_8$ / 44.0962 g)(6.02214 x $10^{23}$ molecules/ 1 mol)(3 mol C/ 1 mole $C_3H_8$) = 4.10 x $10^{23}$ C atoms

34. What mass of oxygen gas occupies a 2.50 L container at STP?

2.50 L $O_2$ gas at STP$\frac{(1 \text{ mole } O_2)(32.00 \text{ g } O_2)}{(22.41 \text{ L})(1 \text{ mole})}$ = 3.57 g $O_2$

35. How many potassium ions are there in 8.99 moles of potassium nitride, $K_3N$?

8.99 mol $K_3N$(6.02214 x $10^{23}$/1 mol)(3 $K^+$ ions/1 mol $K_3N$) = 1.62 x $10^{25}$ $K^+$ ions