General Chemistry Chapter 1 & 2 Pre-Test Key

Essays

1.) (20 pts total, 2-2.5 pts each) 8-10 Briefly answer each of the following essay questions. (The actual test will contain 8 to 10 of these questions.)

a) Explain the difference between qualitative and quantitative data? What are the uses or advantages of both?

Qualitative - general observations
Quantitative - measurable
Qualitative general terms such as big, tall, small. Quantitative more exact measurement 45kg 312m

Quantitative more objective and replicable.

b) What is a hypothesis? What is an important determinant of a good hypothesis? Describe the transition from hypothesis to theory.

Hypothesis - educated guess. A good hypothesis must have a clearly defined premise and be testable. Over time and repeated experiments by different scientists, a hypothesis becomes a theory, a reflection of our current understanding.

c) What is the difference between a substance and a mixture? Give an example of each.

Substance - definite, distinct, and inseparable by physical means. It is the same no matter where the sample is taken. Ex: water, H_2O
Mixture - indefinite, separable by physical means. Ex: salt water.

d) What is the difference between a homogeneous mixture and a heterogeneous mixture? Give an example of both.

(Estimed)

Homogeneous mixture - uniform Ex: dissolved sugar water
Heterogeneous mixture - not uniform. Ex: sand on the beach.

e) What are the three states of matter? Describe the three states of matter with respect to the proximity and movement of particles.

Solid - particles close, particles unable to move much relative to each other. (Though vibrates)
Liquid - particles slightly further apart - better able to move relative to each other.
Gas - particles relatively far apart - little restriction in movement.

f) What is the fundamental difference between a chemical and physical property? Give at least one example of both.

chemical: combustion
physical: density

Chemical property - observations require a chemical change, a change in bond configuration. A chemical property irreversibly changes the substance. Physical property can be observed without breaking bonds or irreversibly change.

g) What is the difference between an extensive property and an intensive property? Provide examples of each. Which presents a better way to identify a substance?

Extensive - depends on amount (mass, volume)
Intensive - does not depend on amount (density, melting point)

h) What is the difference between mass and weight?

Mass is a measurement of the amount of matter in an object. Weight is a force that is proportional to mass (and gravity). Weight can vary by location, while mass cannot.

i) What does temperature actually measure?

The movement (or kinetic energy) of particles within a system. Specifically, temperature is the average movement of a system of particles.

j) What is the basis of the celsius temperature scale? What is the basis of the kelvin temperature scale?

Celsius temperature is base on the freezing point (0°C) and boiling point (100°C) of water. Kelvin is based on movement - where absolute zero describes a complete lack of movement.

k) Describe the three main tenets of the Dalton's atomic theory.

- Elements are composed of atoms
- All atoms of the same element retain similar properties. All elements have different properties.
- Matter cannot be created or destroyed.

l) In Rutherford's experiment, why did most of the positively charged alpha particles travel through the thin gold foil sheet? What two main characteristics of an atom did these experiments prove?

The atom is mostly empty space!
Space and the concentration of mass and positive charge in the nucleus.

m) Why are the atomic masses of some elements non-whole numbers?

Isotopes – some elements have versions with different numbers of neutrons (affects stability)

n) Which subatomic particle contributes most to the reactivity of an atom or compound? What do we specifically call this location?

Electrons in the outer or valence shell.

o) Describe what is meant by the "octet rule".

The electron configuration of relatively small atoms are stable when their valence shell contains an octet (or 8) electrons. Makes it less reactive.

2.) (4 pts total, 0.5 pts each) Complete the following table

Base Quantity	Name of Unit	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
temperature	Kelvin	K

3.) (6 pts total, 2 pts each) Solve each of the following density problems.

a) If the density of a compound is 8.62 g/mL and the volume is 12.2 mL, find its mass? (Be mindful of significant digits)

$D = \frac{m}{V}$ $\quad m = DV$

$= (8.629/mL)(12.2mL)$

105g

b) If the volume of a compound is 84.3 mL and the mass is 36.8 g, what is the density of the compound? (Be mindful of significant digits)

$D = \frac{M}{V}$ $\frac{36.8\,g}{84.3\,mL} = 0.437\,g/mL$

c) If the mass of a compound is 48.7 g and its density is 13.6 g/mL, what is the volume of the sample? (Be mindful of significant digits)

$D = \frac{M}{V}$ $V = \frac{M}{D} = \frac{48.7\,g}{13.6\,g/mL} = 3.58\,mL$

4.) (8 pts total, 2 pts each) Convert the following temperatures:

a) 350 K into °C (Be mindful of significant digits)

$350\,K \rightarrow {}^\circ C$ $(350 - 273)\,^\circ C = 77\,^\circ C$

b) 104 °F into °C (Be mindful of significant digits)

$(104\,^\circ F - 32\,^\circ F)\frac{5}{9} = \overset{8}{\cancel{72}}\left(\frac{5}{\cancel{9}}\right) = \boxed{40.0\,^\circ C}$

c) 85.0 °C into °F (Be mindful of significant digits)

$\overset{17}{\cancel{85}}.0\,^\circ C * \frac{9}{\cancel{5}} + 32$ $153 + 32 = \boxed{185\,^\circ F}$

d) 53 °C into K (Be mindful of significant digits)

$53 + 273 = \boxed{326\,K}$ with significant digits → $\boxed{330\,K}$

5.) (9 pts total, 3 pts each) Use your knowledge of dimensional analysis and life to answer the following related questions:

a) The longest home run hit in major league baseball this season was 486 feet. Approximately how many centimeters did the ball travel?

$$486\ ft * \frac{12\ in}{1\ ft} * \frac{2.54\ cm}{1\ in} = 14,813.28$$

$14,800\ cm$ or $1.48 * 10^4\ cm$

b) According to its website, Netflix contains approximately 125,000,000 hours of programming at any given time. How many years would it take an individual to watch the current Netflix library of content?

$$125,000,000\ h * \frac{1\ day}{24\ h} * \frac{1\ yr}{365\ days} = 14,269\ years$$

- Doesn't this make you feel hopeless — there's so much to binge watch — .

$14,300$ years
or
$1.43 * 10^4$ years

c) Nate has a problem. Recently, Nate (and the rest of the country) discovered the Popeye's chicken sandwich. According to nutritional data offered on the website, a chicken sandwich and fries combo meal contains 1004 calories. While Nate wants to fend off excess weight gain until the holiday season, he cannot help but eat five of these combo meals a day. If he burns 363 calories for every 30 minutes of running, how long will he need to run every day to keep his slim physique?

$$\frac{1004\ cals}{combo} * \frac{5\ combos}{1\ day} * \frac{30\ min}{363\ cals} = 415\ min$$

or nearly 7 hours...

∴

6.) (10 pts total, 0.5 pts each) Using the periodic table, provide the atomic mass, atomic number, and complete profile of subatomic particles for each. Please round to the nearest whole number when necessary.

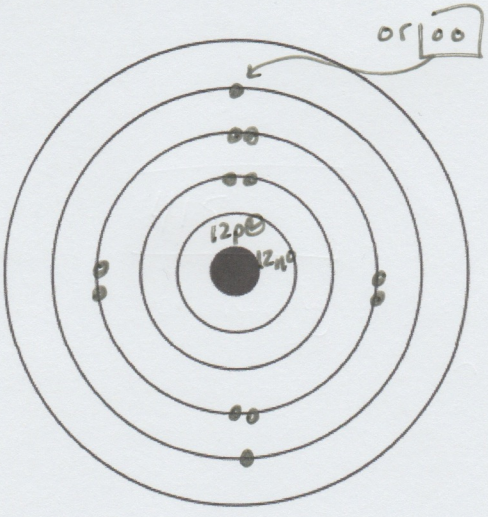
Atom	Atomic Mass	Atomic Number	Protons (p^+)	Neutrons (n^0)	Electrons (e^-)
Potassium	39.098	19	19	≈20	19
Iron	55.845	26	26	≈30	26
Cadmium	112.41	48	48	≈64	48
Arsenic	74.922	33	33	≈42	33

7.) (2 pts total) The structure of deoxyribonucleic acid (DNA) utilizes an extended phosphodiester backbone about its vertical axis. If a scientist wanted to replace the central phosphorous in the backbone with another element, which one could he potentially use? Explain your reasoning.

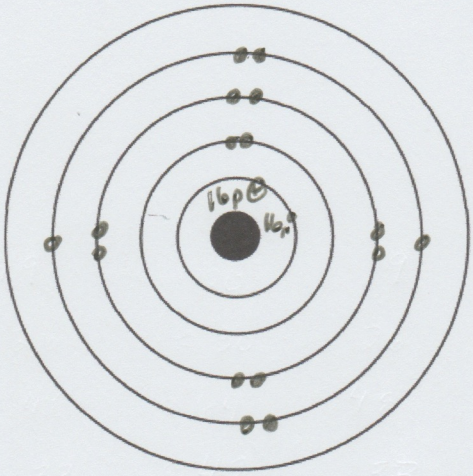
Arsenic — it has the same number of valence electrons and could form the same number of covalent bonds. In fact... this actually happens — at least, arsenic can take the place of phosphorous — it's called arsenic poisoning.

8.) (8 pts total, 4 pts each) Draw the electron distribution for each of the following neutral atoms. Include the number of protons and neutrons in the appropriate place. Draw an arrow where the atom could form a bond.

a) Magnesium

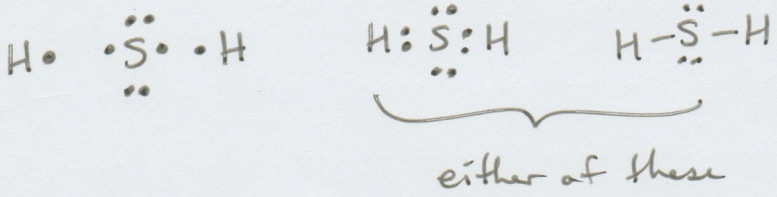


b) Sulfur

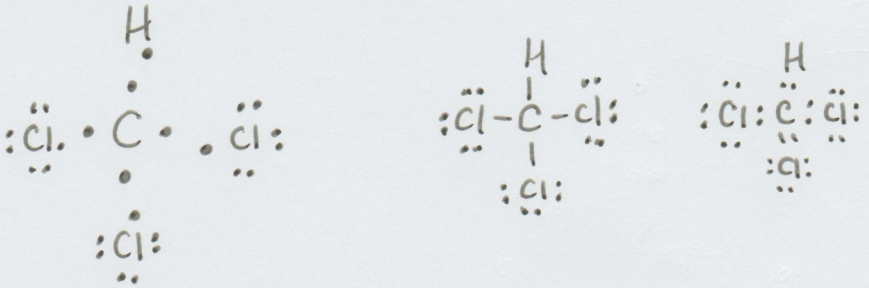


9.) (6 pts total, 3 pts each) Draw the structural form of each molecule, starting first with individual electron distribution diagrams (Lewis Structures).

a) H_2S



b) $CHCl_3$



10.) (4 pts total, 2 pts each) Write the empirical formula for each of the following:

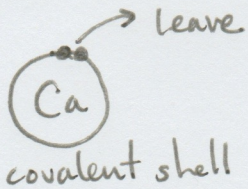
a) $C_5H_{10}O_5$ $\quad CH_2O$

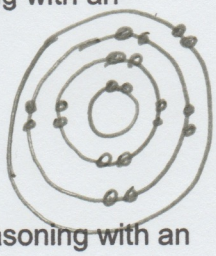
b) $C_8H_{14}O_2$ $\quad C_4H_7O$

11.) (6 pts total, 2 pts each) Answer each of the following.

a) What is the charge of a calcium ion? Demonstrate your reasoning with an electron distribution diagram.

Ca^{+2}

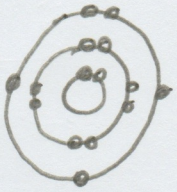




b) What is the charge of a phosphorous ion? Demonstrate your reasoning with an electron distribution diagram.

P^{-3}

covalent shell



c) Write the ionic formula for calcium phosphide.

Ca^{+2} P^{-3} $\quad \boxed{Ca_3P_2}$

12.) (8 pts total, 2 pts each) Write the ionic formula for each of the following:

a) Potassium sulfide

K^+ S^{-2} $\quad \boxed{K_2S}$

b) Sodium bromide

Na^+ Br^- $\quad \boxed{NaBr}$

c) Magnesium fluoride

Mg^{+2} F^- $\quad \boxed{MgF_2}$

d) Barium nitride

Ba^{+2} N^{-3} Ba_3N_2

13.) (4 pts total, 0.5 pts each) Provide the molecular or ionic formula for each of the following compounds:

a) nitrogen tribromide

NBr_3

b) aluminum sulfate

$Al_2(SO_4)_3$

c) trihydrogen monophosphide

H_3P

d) magnesium hydroxide

$Mg(OH)_2$

e) mercury (II) nitrate

$Hg(NO_3)_2$

f) dinitrogen trioxide

N_2O_3

g) iodine pentafluoride

IF_5

h) sodium bicarbonate

$NaHCO_3$

14.) (5 pts total, 0.5 pts each) Provide the proper name for each of the following molecular formulas.

a) $(NH_4)_2SO_4$

ammonium sulfate

b) Si_2Br_6

disilicon hexabromide
↑ sorry ☺

c) P_4S_5

tetraphosphorous pentasulfide

d) $MgCO_3$

Magnesium carbonate

e) Li_3PO_4

lithium phosphate

f) NO_5

mononitrogen pentoxide

g) $Mg(NO_3)_2$

Magnesium nitrate

h) $FeCl_3$

Iron (III) ← careful chloride

i) NF_3

mononitrogen trifluoride

j) $Cu(OH)_2$

Copper (II) ← careful hydroxide