KEY

Advanced Placement Chemistry Review Assignment

Topic 1: Significant Figures & Scientific Notation

1. Count the number of significant figures in the following measurements.

   a. 2.71 g 3 b. 0.00047 kg 2 c. 7.0×10^5 m 2 d. 1,030 L 3

   e. 150 pencils exact f. 37500 µg 3 g. 0.1010 cm 4

2. Express each of the following in proper scientific notation (Pay attention to sig figs and units).

   a. 0.000125 m 1.25×10^{-4} m b. 155.0 mL 1.550×10^2 mL

   c. 123,030,000 ng 1.2303×10^8 ng d. 481.9 x 10^{-9} cm 4.819×10^{-7} cm

3. Calculate the correct answer with proper units and significant figures for each of the following:

   a. 12 g + 0.677 g + 86.33 g = 99 g

   b. (355.78 g) / (0.056 g) = 6400 OR 6.4×10^3

   c. 97.34 mL – 34.1 mL = 63.2 mL

   d. 14.68 x 5 = 70 OR 7×10^1

4. Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

   a. 0.14 x (6.02×10^{23}) = 8.4×10^{22}

   b. $\frac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4} \times 100\ \%$ = 0.81% (assume 100 is exact)

   c. $\frac{(3.8 \times 10^{-12} \times 4.0 \times 10^{-13})}{(4 \times 10^{12} \times 6.3 \times 10^{13})}$ = 6×10^{-51}

Topic 2: Dimensional Analysis

Show work using dimensional analysis. No work = no credit even if answer is correct. Follow significant figures and rounding rules unless the number of significant figures is specified. Include units where appropriate.

5. How many hours are in a week? Report your answer to three significant figures.

$$\frac{1\ \text{wk}}{1} \times \frac{7\ \text{d}}{1\ \text{wk}} \times \frac{24\ \text{hr}}{1\ \text{d}} = 168\ \text{hr}$$

6. Find the number of centimeters in 1.00×10^2 yards. (1 yd = 3 ft, 1 ft = 12 in, 2.54 cm = 1 in)

$$\frac{1.00 \times 10^2\ \text{yd}}{1} \times \frac{3\ \text{ft}}{1\ \text{yd}} \times \frac{12\ \text{in}}{1\ \text{ft}} \times \frac{2.54\ \text{cm}}{1\ \text{in}} = 9.14 \times 10^3\ \text{cm}\ \text{OR}\ 9140\ \text{cm}$$

7. If Jules Verne expressed the title of his famous book, Twenty Thousand Leagues under the Sea in basic SI units, what would the title be? Round your answer to three significant figures.
   (1 league = 3.45 mi, 1 mi = 1609 m)

$$\frac{20{,}000\ \text{leagues}}{1} \times \frac{3.45\ \text{mi}}{1\ \text{league}} \times \frac{1609\ \text{m}}{1\ \text{mi}} = 111{,}000{,}000\ \text{m}\ \text{OR}\ 1.11 \times 10^8\ \text{m}$$

8. How many µL are present in 250 mL of H_2O?

$$\frac{250\,mL}{1} \times \frac{1\,L}{1000\,mL} \times \frac{1{,}000{,}000\,\mu L}{1\,L} = \boxed{250{,}000\,\mu L \text{ OR } 2.5\times10^{5}\,\mu L}$$

9. Wavelengths are often represented in nm. What is the diameter of a helium (He) atom in nm if it is equivalent to 1.0×10^{-13} km?

$$\frac{1.0\times10^{-13}\,km}{1} \times \frac{1000\,m}{1\,km} \times \frac{10^{9}\,nm}{1\,m} = \boxed{.10\,nm \text{ OR } 1.0\times10^{-1}\,nm}$$

10. The area of a rectangular room has a length of 10.5 m and a width of 4.50 m. What is this area in m^2? In cm^2?

$$A = (10.5\,m)(4.50\,m) = \boxed{47.3\,m^2}$$

$$\frac{47.3\,m^2}{1} \times \frac{(100\,cm)^2}{(1\,m)^2} = \boxed{4730\,cm^2 \text{ OR } 4.73\times10^{3}\,cm^2}$$

11. The acceleration of a sphere is determined to be 9.52 m/s^2. What is the acceleration in km/min^2?

$$\frac{9.52\,m}{s^2} \times \frac{1\,km}{1000\,m} \times \left(\frac{60\,s}{1\,min}\right)^2 = \boxed{34.3\,\frac{km}{min^2}}$$

Topic 3: Density and Temperature

Show all work. No work = no credit even if answer is correct. Follow significant figures and rounding rules. Include units where appropriate.

12. A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?

$$V = (2.9\,cm)(3.5\,cm)(10.0\,cm) = \boxed{102\,cm^3}$$

$$d = \frac{615.0\,g}{102\,cm^3} = \boxed{6.03\,g/cm^3}$$

13. The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

$$V_{Ag} = \frac{5.25\,g}{10.5\,g/mL} = .500\,mL$$

$$V_{Ag + H_2O} = 11.2\,mL + .500\,mL = \boxed{11.7\,mL}$$

14. You can figure out whether a substance floats or sinks if you know its density and the density of the liquid. In which of the liquids listed below will high-density polyethylene, HDPE, float? HDPE, a common plastic, has a density of 0.97 g/cm^3. It does not dissolve in any of the following liquids.

Substance	Density (g/cm^3)	
ethylene glycol	1.1088	float
water	0.9997	float
ethanol	0.7893	
methanol	0.7914	
acetic acid	1.0492	float
glycerol	1.2613	float

15. Mercury is found as a liquid at room temperature. If it has a boiling point of 630. K, what is this boiling point in degrees Celsius?

630. K - 273 = 357 °C

Topic 4: Precision and Accuracy

16. The density of ethanol was determined experimentally at 25°C in a series of trials to be 0.608 g/mL, 0.705 g/mL, and 0.689 g/mL. The accepted density of ethanol is reported to be 0.789 g/mL.
    a. Are the experimental densities precise? Why/Why not?

no - the range is .097 g/mL, which is 14.5% of the mean density

    b. Calculate % error for this experiment. Use the average experimental density in your calculation and report your answer to 0.1%. Show your work.

$$\%\text{error} = \frac{|.789\ g/mL - .667\ g/mL|}{.789\ g/mL} \times 100 = 15.4\%$$

    c. Are the experimental densities accurate? Why/Why not?

no - the % error is more than 10%

Topic 5: Properties and Changes

17. Categorize each of the following as an element, a compound, or a mixture:
    a. carbonated water — mixture
    b. tungsten — element
    c. aspirin (acetylsalicylic acid) — compound
    d. air — mixture
    e. lye (sodium hydroxide) — compound
    f. fluorine — element

18. Iron pyrite, also known as fool's gold, has a shiny golden metallic appearance. Crystals are often in the form of perfect cubes. A cube of iron pyrite measuring 0.40 cm on each side has a mass of 0.064 g.

a. Which of these observations are qualitative and which are quantitative?

qualitative - shiny golden metallic cubic

quantitative - .40cm side length .064g mass

b. Which of these observations are extensive (dependent on the amount of substance present) and which are intensive (independent of the amount of substance present)?

intensive: all qualitative observations

extensive: all quantitative observations

19. Identify the following as a physical property, physical change, chemical property, or chemical change:

a. Ethanol has a density of 0.697 g/mL. — phys property

b. The solution turns blue upon mixing water and food coloring. — phys change

c. Wood burns in an oven. — chem change

d. Methyl alcohol is highly flammable. — chem property

e. Ice melts in a beaker. — phys change

f. Methyl ethanoate smells like apples. — phys property

g. Iron rusts on a car. — chem change

h. Alkali metals react strongly in hydrochloric acid. — chem property

Topic 6: Atom Structure & History

20. How many protons and neutrons are contained in the nucleus of each of the following atoms? How many electrons are present in each of these neutral atoms?

a. $^{13}_{6}C$ — 6 protons, 7 neutrons, 6 electrons

b. $^{208}_{82}Pb$ — 82 protons, 126 neutrons, 82 electrons

21. Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium-70	70	31	31	39	31	$^{70}_{31}Ga$
Phosphorus-31	31	15	15	16	18	$^{31}_{15}P^{-3}$
Strontium-80	80	38	38	42	36	$^{80}_{38}Sr^{+2}$
Manganese-55	55	25	25	30	23	$^{55}_{25}Mn^{+2}$

22. The natural abundance for boron isotopes is 19.9% boron-10 (exact mass 10.013 amu) and 80.1% boron-11 (exact mass 11.009 amu). Calculate the average atomic mass of boron using the exact masses instead of mass numbers in your calculations. Show your work. Follow significant figures and rounding rules. Include appropriate units.

$(.199)(10.013\ amu) + (.801)(11.009\ amu)$

$1.99\ amu + 8.82\ amu = \boxed{10.81\ amu}$

23. Europium has two stable isotopes, ^{151}Eu and ^{153}Eu, with masses of 150.9197 u and 152.9212 u, respectively. Calculate the percent abundances of these isotopes of europium to 0.1%. Hint: The percent abundances of these two isotopes must add to 100%. Show your work. Follow significant figures and rounding rules. Include appropriate units.

$x(150.9197u) + (1-x)(152.9212u) = 151.97u$

$152.9212u - (2.0015u)x = 151.97u \qquad x = .475$

^{151}Eu: 47.5%

^{153}Eu: 52.5%

24. Identify the scientist(s) noted for the following events in atomic history.
   a. identified the electron; noted for the plum pudding model Thomson
   b. noted for the first atomic theory of the atom; solid sphere model Dalton
   c. developed the planetary model; electrons in fixed orbits Bohr
   d. developed the quantum mechanical model; electrons are localized to orbitals Heisenberg Schrödinger deBroglie
   e. identified the proton and the nucleus; nuclear model Rutherford
   f. determined the charge of an electron Millikan
   g. described wave theory de Broglie
   h. known for the uncertainty principle Heisenberg
   i. developed quantum numbers Schrödinger

25. Identify the model of the atom described in the following statements.
   a. currently accepted model quantum mechanical
   b. model that first included a subatomic particle plum pudding
   c. model developed using the gold foil experiment nuclear
   d. original model of the atom; atom was thought to be "indivisible" solid sphere
   e. model that only showed the movement of hydrogen's electron accurately; involved "quantums" planetary

Topic 7: Periodic Table Structure

Identify by name the group or section of the periodic table noted for the following features.

26. a. group containing the most reactive nonmetals; all are diatomics; form -1 ions halogens
   b. group containing metals that only form +2 ions alkaline earth metals
   c. set of metals that often form colored ions in solution; the majority have multiple charges as ions transition metals
   d. group containing the most reactive metals; form +1 ions alkali metals
   e. group containing least reactive elements on periodic table, typically inert noble gases

27. These elements start with the letter B: B, Ba, Bk, Bi, and Br. Identify which of these elements match the following descriptions. You may use elements once, more than once, or not at all.
   a. Which are metals? Ba Bk Bi
   b. Which are liquids? Br
   c. Which are actinides? Bk
   d. Which are main block elements? B Ba Bi Br

Topic 8: Compound Nomenclature

28. Name or give the formula for the following compounds. All ions included in the summer letter are required to be memorized by name and by formula.

	Name	Formula
a.	lithium fluoride	LiF
b.	potassium oxide	K_2O
c.	calcium phosphate	$Ca_3(PO_4)_2$
d.	manganese (II) chloride	$MnCl_2$
e.	silver sulfide	Ag_2S
f.	copper (I) oxide	Cu_2O
g.	aluminum sulfate	$Al_2(SO_4)_3$
h.	zinc carbonate	$ZnCO_3$
i.	chromium (III) phosphide	CrP
j.	sulfur trioxide	SO_3
k.	lead (IV) hydroxide	$Pb(OH)_4$
l.	dinitrogen pentoxide	N_2O_5
m.	ammonium sulfite	$(NH_4)_2SO_3$
n.	barium dichromate	$BaCr_2O_7$
o.	sodium peroxide	Na_2O_2
p.	ammonia	NH_3 (use common names; see ppt/videos if necessary)
q.	nickel (II) hypochlorite	$Ni(ClO)_2$
r.	iron (III) cyanide	$Fe(CN)_3$
s.	rubidium chromate	Rb_2CrO_4
t.	magnesium phosphate	$Mg_3(PO_4)_2$

Topic 9: Equations

29. Balance the following equations using the lowest whole-number coefficients.

a. $6Fe + \_\_P_4 \rightarrow 2Fe_3P_2$

b. $\_\_Ca + 2H_2O \rightarrow \_\_Ca(OH)_2 + \_\_H_2$

c. $3Ba(OH)_2 + 2H_3PO_4 \rightarrow \_\_Ba_3(PO_4)_2 + 6H_2O$

d. $3(NH_4)_2CO_3 + 2Al(ClO_3)_3 \rightarrow \_\_Al_2(CO_3)_3 + 6NH_4ClO_3$

30. Write balanced chemical equations for the following word equations. Use the lowest possible whole-number coefficients to balance the equations.

a. Aqueous solutions of ammonium sulfate and barium nitrate form a precipitate of barium sulfate and aqueous ammonium nitrate.

$$\_(NH_4)_2SO_4 + \_Ba(NO_3)_2 \rightarrow \_BaSO_4 + \underline{2}NH_4NO_3$$

b. Elemental magnesium and oxygen gas combine to form solid magnesium oxide.

$$\underline{2}Mg + \_O_2 \rightarrow \underline{2}\,MgO$$

c. Chlorine gas and aqueous potassium bromide react to form bromine liquid and aqueous potassium chloride.

$$\_Cl_2 + \underline{2}KBr \rightarrow \_Br_2 + \underline{2}KCl$$

d. Solid copper (II) carbonate decomposes to form crystals of copper (II) oxide and carbon dioxide gas.

$$\_CuCO_3 \rightarrow \_CuO + \_CO_2$$

e. Sulfuric acid is neutralized by lithium hydroxide to form water and aqueous lithium sulfate.

$$\_H_2SO_4 + \underline{2}LiOH \rightarrow \underline{2}H_2O + \_Li_2SO_4$$

f. Liquid benzene, C_6H_6, undergoes combustion in oxygen gas, making carbon dioxide gas and steam.

$$\underline{2}C_6H_6 + \underline{15}O_2 \rightarrow \underline{12}CO_2 + \underline{6}H_2O$$

Topic 10: Mole Conversions & Stoichiometry

Show your work. No work = no credit. Follow significant figures and rounding rules. Include appropriate units.

31. a. Calculate the number of moles in 500. atoms of iron (Fe).

$$\frac{500.\ \text{atoms}}{1} \times \frac{1\ \text{mol}}{6.02\times10^{23}\ \text{atoms}} = 8.31\times10^{-22}\ \text{mol}$$

b. What is the molar mass of lead (IV) carbonate, $Pb(CO_3)_2$?

$$207.2 + 2(12.01) + 6(16.00) = 327.22\ g/mol$$

c. How many formula units are present in 87.2 grams of lead (IV) carbonate?

$$\frac{87.2\ g}{1} \times \frac{6.02\times10^{23}\ f.u.}{327.22\ g} = 1.60\times10^{23}\ f.u.$$

d. What percentage of oxygen is found in lead (IV) carbonate? Round your answer to 0.1%.

$$\%\,O = \frac{96.00\,g}{327.22\,g} \times 100 = 29.3\%$$

32. The reusable booster rockets of the U.S. space shuttle employed a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:

$\_3\_Al(s) + \_3\_NH_4ClO_4(s) \rightarrow \_\_ Al_2O_3(s) + \_\_ AlCl_3(s) + \_3\_NO(g) + \_6\_H_2O(g)$

a. Balance the above reaction using the lowest possible whole-number coefficients.

b. If 4.00 g of aluminum reacted completely, how many grams of aluminum oxide would be made?

$$\frac{4.00\text{ g Al}}{1} \times \frac{(1)\,101.96\text{ g } Al_2O_3}{(3)\,26.98\text{ g Al}} = 5.04\text{ g } Al_2O_3$$

c. If 4.18 g of aluminum chloride was produced, how many moles of ammonium perchlorate would be consumed?

$$\frac{4.18\text{ g } AlCl_3}{1} \times \frac{(3)\,1\text{ mol } NH_4ClO_4}{(1)\,133.33\text{ g } AlCl_3} = .0941\text{ mol } NH_4ClO_4$$

d. How many molecules of nitrogen monoxide would form if 6.3×10^{25} formula units of aluminum oxide were also produced?

$$\frac{6.3\times10^{25}\text{ f.u } Al_2O_3}{1} \times \frac{(3)\,6.02\times10^{23}\text{ molec NO}}{(1)\,6.02\times10^{23}\text{ f.u } Al_2O_3} = 1.9\times10^{26}\text{ molec NO}$$

33. The decomposition of ammonia is shown in the following equation: $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$.

a. 42.0 g of nitrogen has what volume in liters at STP?

$$\frac{42.0\text{ g } N_2}{1} \times \frac{22.4\text{ L}}{28.02\text{ g}} = 33.6\text{ L}$$

b. 150 L of NH_3 undergoes decomposition to form how many liters of hydrogen gas at STP?

$$\frac{150\text{ L } NH_3}{1} \times \frac{(3)\,22.4\text{ L } H_2}{(2)\,22.4\text{ L } NH_3} = 230\text{ L } H_2$$

c. How many liters of ammonia were decomposed at STP if 3.0×10^{23} nitrogen molecules were made?

$$\frac{3.0\times10^{23}\text{ molec } N_2}{1} \times \frac{(2)\,22.4\text{ L } NH_3}{(1)\,6.02\times10^{23}\text{ molec } N_2} = 22\text{ L } NH_3$$