Chemistry 11 – Course Review

KEY

Unit 2—Introduction to Chemistry

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
9-40	Hand-In #1—Unit Conversions Hand-In #2—Significant Digits Experiment 3-A - Determining the Mass/Volume Relation for 3 Liquids	p.21, p.26, p.33-34, p.39, p.40

1. 0.0006 mm = ? µm

$6\times10^{-4}\ mm \times \frac{10^{-3}\ m}{1\ mm} \times \frac{1\ \mu m}{10^{-6}\ m} = 6\times10^{-1}\ \mu m = 0.6\ \mu m$

Answer 0.6 µm

2. 0.054 mL = ? nL

$5.4\times10^{-2}\ mL \times \frac{10^{-3}\ L}{1\ mL} \times \frac{1\ nL}{10^{-9}\ L} = 5.4\times10^{4}\ nL$

Answer 5.4×10^{4} nL

3. 3.5 µg/L = ? mg/mL

$\frac{3.5\ \mu g}{L} \times \frac{10^{-6}\ g}{1\ \mu g} \times \frac{1\ mg}{10^{-3}\ g} \times \frac{10^{-3}\ L}{1\ mL} = 3.5\times10^{-6}\ \frac{mg}{mL}$

Answer 3.5×10^{-6} mg/mL

4. The density of iron is 7860 g/L. Calculate the mass of a 3.2 mL sample of iron.

M / D | V

$M = D \times V$

$M = 0.0032\ L \times \frac{7860\ g}{L} = 25.152\ g$

Answer 25.2 g

5. Manganese has a density of 7.20 g/mL. Calculate the volume occupied by a 4.0 kg piece of manganese.

= 4000 g

$V = \frac{M}{D} = \frac{4000\ g}{7.20\ g/mL} = 555.56\ mL$

Answer 556 mL

6. A 0.0460 L piece of copper has a mass of 410.32 g. Calculate the density of copper in g/mL.

$D = \frac{M}{V} = \frac{410.32\ g}{46.0\ mL} = 8.92\ \frac{g}{mL}$

Answer 8.92 g/mL

7. Give the number of significant digits in each of the following. Assume they are all measurements.

a) 0.0023 2
b) 3953 000 4
c) 1.0200×10^5 5
d) 3.2×10^{-4} 2
e) 50020.000 8
f) 3450 3

8. Perform the following calculations and round the answers off to the correct number of significant digits as justified by the data. Assume all numbers are measurements.

a) (5) (2) 2.1500×0.31 ..... 0.67
b) 2 dp 4 dp $0.05 + 394.7322$ ..... (2 dp) 394.78
c) (4) (1) $4.905 \times 10^6 \div 4 \times 10^{-2}$ ... 1×10^8
d) (3) (3) $(3.33 \times 9.52) + 13.983$ .. 45.7
31.7016 + 13.983
(35D = 1 dp) (3 dp)
e) 3.813 + 98.98 + 2.669 .. 105.46
3 dp 2 dp 3 dp
f) (3) (4) $8.90 \times 10^3 \div 4.400 \times 10^{-6}$ ..... 2.02×10^9
g) (4) (5) $83.00 \div 1.2300 \times 10^2$ 0.6748
h) 4 dp 3 dp 98.0076 - 2.195 ..... 95.813
i) (3) (6) 0.00000200 x 245.912 ..... 4.92×10^{-4}
j) (4) (3) (3) (5) $(5.802 \div 6.21) + (2.41 \div 9.2565)$ .. 1.195 (3 dp)
0.9342995 0.260358
(35D = 3 dp) (35D = 3 dp)

9. Round the following numbers to 2 significant digits. (4 marks)

a) 2 000 000 000..... 2.0×10^9
b) 106 000 ..... 1.1×10^5 (110 000)
c) 3.88945×10^{28} ..... 3.9×10^{28}
d) 0.000 000 7895 ..... 7.9×10^{-7}

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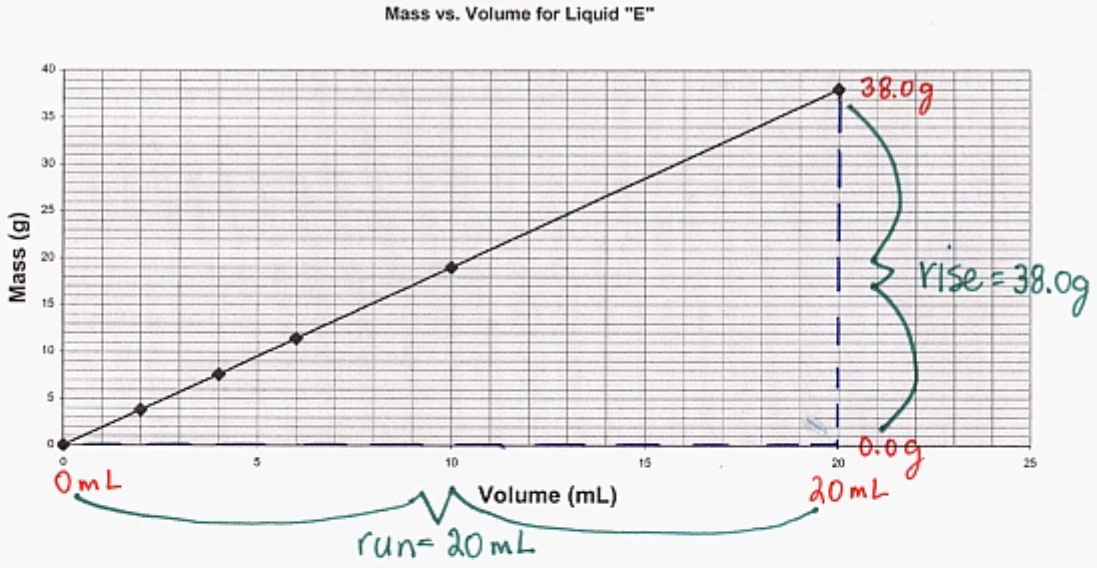
10. Given the following graph of Mass (g) vs. Volume (mL) for Liquid "E", answer the questions below it:



a) Calculate the slope of the line and express it in the correct units.

$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{38.0\text{ g}}{20.0\text{ mL}} = 1.9\text{ g/mL}$

b) What is the Y-Intercept for the line? 0.0 g

c) Write a ~~mathematical equation~~ for the line in terms of Mass and Volume.

Mass(g) = 1.9 g/mL x Volume(mL)

d) Predict the mass of 150 mL of Liquid "E". (Use the equation from (c))

$M = 1.9V$

$= 1.9\text{ g/mL} \times 150\text{ mL} = 285\text{ g}$

e) Predict the volume occupied by a 240 g sample of Liquid "E"

$V = \frac{M}{1.9} = \frac{240\text{ g}}{1.9\text{ g/mL}} = 126\text{ mL}$

f) What is the density of Liquid "E" in g/mL? D = slope = 1.9 g/mL

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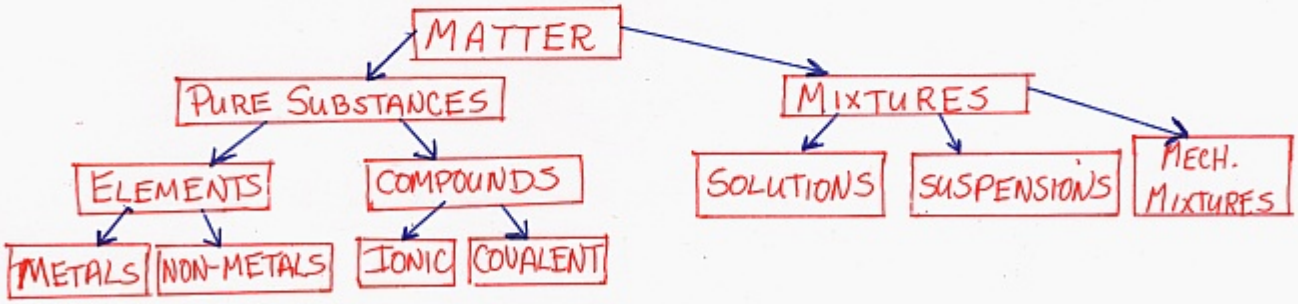
Unit 3—Properties of Matter

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
41- 61	Experiment 2C – Elements, Compounds & Mixtures Experiment on Methods of Physical Separation of Mixtures Experiment 2A-Warming Behavior of Solid Paradichlorobenzene	p.43, p.52, p.58-59

1. Define: Observation, Interpretation, Qualitative, Quantitative, Data, Experiment, Hypothesis, Theory, Laws, Matter, Chemistry, Physical and Chemical Properties, Malleability, Ductility, Lustre, Viscosity and Diffusion. Review the Phases of Matter.

See page 41-46 of S.W.

2. Draw the diagram from your notes outlining the Classification of Matter. Make sure you can define each classification.



see S.W. p 49-52

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3. Review p.53-58. Answer the following:

a) Explain how distillation can be used to separate the substances in a solution.

The components of the solution have different boiling points. The temperature is gradually increased so that only one of the substances boils. The vapor from the boiling substance is condensed to a liquid in the condenser. The other substance(s) remain(s) in the flask

b) What types of mixtures does paper chromatography work best for?

- small amounts like ink, leaf pigments etc.

see diagram p.54 S.W.

c) What is the simplest, most economical method of separating suspensions?

filtration

d) Solvent extraction involves using two different solvents which are (*miscible/immiscible*) immiscible. A device called a separatory funnel is used.

e) Explain how a centrifuge separates the components of a suspension.

It spins fast and the more dense materials are forced outward move (toward bottom of test-tube)

see diagram p. 56 of S.W.

4. Define a physical change – a change in which the chemical composition of materials don't change

Give some examples of physical changes.

- phase changes - freezing, melting, boiling, condensation etc.
- physical mixing
- grinding etc.

5. Define a chemical change – a change in which new chemical substances are formed

Give some examples of chemical changes.

burning (combustion)
cooking
cellular respiration
photosynthesis
neutralization etc.

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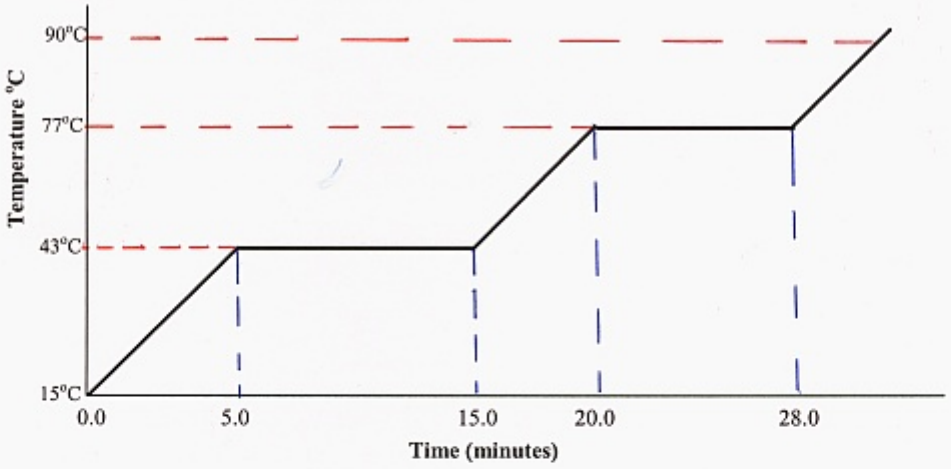
6. Given the following graph of Temperature vs. Time for warming substance "X" which starts out as a solid, answer the questions below:



a) During time 0.0 – 5.0 minutes, the added heat energy is being used to
increase the temperature of the solid

b) During time 5.0 – 15.0 minutes, the added heat energy is being used to
melt the solid.

c) During time 15.0 – 20.0 minutes, the added heat energy is being used to
warm up the liquid substance "X"

d) During time 20.0 – 28.0 minutes, the added heat energy is being used to
boil the liquid

e) The melting point of substance "X" is 43°C.

f) The boiling point of substance "X" is 77°C

g) If a greater amount of substance "X" was used, the melting point would be
1. a lower temperature
2. a higher temperature
3. the same temperature Answer (3)

h) What phase is substance "X" at 90°C? gaseous

i) Explain WHY the curve levels off between 5.0 min. and 15.0 min.
All of the added heat energy is being used for the process of melting the solid (phase change), so none is available the warm the substance until melting is complete.

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Unit 4— Names and Formulas for Compounds

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
65 - 76	Hand-In Assignment #3 - Formulas and Names for Ionic Compounds	p.75-76

1. Write the correct formula for the following compounds:

a) ammonium chlorate ..... NH_4ClO_3

b) copper (II) sulphite ..... $CuSO_3$

c) zinc carbonate tetrahydrate ..... $ZnCO_3 \cdot 4H_2O$

d) nitric acid ..... HNO_3

e) phosphorus pentaiodide ....(covalent)..... PI_5

f) iron (III) thiocyanate ..... $Fe(SCN)_3$

g) sulphuric acid ..... H_2SO_4

h) dinitrogen tetrafluoride ....(covalent)..... N_2F_4

2. Write the correct names for the following compounds:

a) $Mn(SO_4)_2$ ..... manganese (IV) sulphate

b) $PbCrO_4 \cdot 6H_2O$ ..... lead(II) chromate hexahydrate

c) As_2O_3 ....(covalent)..... diarsenic trioxide

d) CH_3COOH ..... acetic acid

e) $Ni_2(C_2O_4)_3$ ..... nickel (III) oxalate

f) NF_3 ....(covalent)..... nitrogen trifluoride

g) $(NH_4)_2HPO_4$ ..... ammonium monohydrogen phosphate

h) $Ba(OH)_2 \cdot 10H_2O$ ..... barium hydroxide decahydrate

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Unit 5— The Mole Concept

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
77 - 104	Experiment 4B—Moles of Iron and Copper Hand-In Assignment # 4 – Mass-Mole-Volume Conversions Do Experiment 7B—The Molar Volume of a Gas Hand-In Assignment #5 – Summary of Mole Conversions Tutorial 5-1 Do Experiment 5-1 - Percent Oxygen in $KClO_3$ Hand-In Assignment #6—Percent Composition, Empirical and Molecular Formulas, Molarity and Dilution Calculations	p.82, p.84, p.87, p.88-90, p.93, p.95, p.98, p.102, p.103-104

1. Make the following conversions, clearly showing your steps. Include proper units in all of your work and in your answer.

a) 133.44 grams of PCl_5 = ? moles

$133.44\ g\ PCl_5 \times \frac{1\ mol}{208.5\ g} = 0.64\ mol$

Answer 0.64 mol

b) 0.00256 moles of $Li_2Cr_2O_7$ = ? grams

$0.00256\ mol\ Li_2Cr_2O_7 \times \frac{229.8\ g}{1\ mol} = 0.588\ g$

Answer 0.588 g

c) 170.24 L of NO_2 at STP = ? moles

$170.24\ L \times \frac{1\ mol}{22.4\ L} = 7.6\ mol$

Answer 7.6 mol

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d) 570.625 g of PCl_3 gas = ? L (STP) g → mol → L

$$570.625\ g\ PCl_3 \times \frac{1\ mol}{137.5\ g} \times \frac{22.4\ L}{1\ mol} = 92.96\ L$$

Answer 92.96 L

e) 1030.4 mL of C_2H_6 gas at STP = ? g mL → L → mol → g

$$1.0304\ L \times \frac{1\ mol}{22.4\ L} \times \frac{30.0\ g}{1\ mol} = 1.38\ g$$

Answer 1.38 g

f) 5.00 kg of nitrogen gas = ? L (STP) Kg → g → mol → L

$$5000\ g\ N_2 \times \frac{1\ mol}{28.0\ g} \times \frac{22.4\ L}{1\ mole} = 4000.\ L$$

Answer 4.00×10^3 L (4000 L)

g) 0.5696 kg of $CH_{4(g)}$ = ? mL Kg → g → mol → L → mL

$$569.6\ g\ CH_4 \times \frac{1\ mol}{16.0\ g} \times \frac{22.4\ L}{1\ mole} \times \frac{1\ mL}{10^{-3}\ L} = 797440\ mL$$

Answer 7.97×10^5 mL (797440 mL)

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2. The density of liquid ethanol (C_2H_5OH) is 0.790 g/mL. Calculate the number of molecules in a 35.0 mL sample of liquid ethanol. (NOTE: You CAN'T use 22.4 L/mol since this is NOT a gas at STP!) First find Mass (M = DxV) then g → mol → molecules

M / DV

$M = D \times V = 0.790\ g/mL \times 35.0\ mL = 27.65\ g$

$27.65\ g\ C_2H_5OH \times \frac{1\ mol}{46.0\ g} \times \frac{6.02 \times 10^{23}\ molec.}{1\ mol}$

Answer 3.62×10^{23} molecules

3. A 100.0 mL sample of liquid mercury contains 6.78 moles. Calculate the density of liquid mercury from this data. First: mol → g then use D = M/V

$6.78\ mol\ Hg \times \frac{200.6\ g}{1\ mole} = 1360.068\ g\ Hg$ $D = \frac{M}{V} = \frac{1360.068\ g}{100.0\ mL} = 13.60\ g/mL$

Answer $D = 13.6\ g/mL$

4. Calculate the density of $PCl_{3(g)}$ at STP.

$D = \frac{M}{V} = \frac{\text{molar mass}}{\text{molar volume}} = \frac{MM}{22.4} = \frac{137.5\ g/mol}{22.4\ L/mol} = 6.138\ g/L$

Answer $D = 6.14\ g/L$

5. a) The density of a gas at STP is 4.955 g/L. Calculate the molar mass of this gas.

$MM = D \times 22.4$

$= 4.955\ \frac{g}{L} \times 22.4\ \frac{L}{mol} = 110.9\ g/mol$

b) The gas is an oxide of selenium. Determine the molecular formula.

SeO = 95 g/mol SeO_2 = 111.0 g/mole

Answer SeO_2

6. Find the percent composition (% by mass of each element) in the following compound: $Sr_3(PO_4)_2$. Show your work.

$MM = \underbrace{3(87.6)}_{Sr} + \underbrace{2(31.0)}_{P} + \underbrace{8(16.0)}_{O} = 452.8\ g/mol$

$\%\ of\ O = \frac{8(16.0)}{452.8} \times 100\% = 28.269\%$

$\%\ Sr = \frac{3(87.6)}{452.8} \times 100\% = 58.039\%$

$\%\ P = \frac{2(31.0)}{452.8} \times 100\% = 13.693\%$

Answer 58.04 %Sr, 13.69 %P, 28.27 %O

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7. A compound was analyzed and the following results were obtained:
Molar mass: 270.4 g/mol
Mass of sample: 162.24 g
Mass of potassium: 46.92 g
Mass of sulphur: 38.52 g
Mass of oxygen: the remainder of the sample is oxygen

a) Determine the mass of oxygen in the sample.

$162.24 - (46.92 + 38.52) = 76.8\ g$

Answer 76.8 g

b) Determine the empirical formula for this compound.

Element	Mass	Atomic Mass	Moles	Moles / Smallest Moles	S.R.
K	46.92	39.1	1.20	1.20 ÷ 1.20 = 1.00	1
S	38.52	32.1	1.20	1.20 ÷ 1.20 = 1.00	1
O	76.8	16.0	4.80	4.80 ÷ 1.20 = 4.00	4

Answer: Empirical Formula: KSO_4

c) Determine the molecular formula for this compound.

	Empirical	Molecular
Formula	KSO_4	$\xrightarrow{\times 2} K_2S_2O_8$
Mass	135.2	$\xrightarrow{\times 2}$ 270.4

Answer: Molecular Formula: $K_2S_2O_8$

8. 123.11 g of zinc nitrate, $Zn(NO_3)_2$ are dissolved in enough water to form 650.0 mL of solution. Calculate the $[Zn(NO_3)_2]$ Include proper units in your work and in your answers.

mol / M | L

$$123.11\ g\ Zn(NO_3)_2 \times \frac{1\ mol}{189.4\ g} = 0.65\ mol$$

$$M = \frac{mol}{L} = \frac{0.65\ mol}{0.650\ L} = 1.000\ M$$

Answer $[Zn(NO_3)_2] = 1.000\ M$

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9. Calculate the mass of potassium sulphite (K_2SO_3) needed to make 800.0 mL of a 0.200 M solution of K_2SO_3. Include proper units in your work and in your answers.

mol / M L

moles = 0.200 M × 0.8000 L = 0.160 mol

mass = 0.160 mol K_2SO_3 × $\frac{158.3\ g}{1\ mol}$ = 25.328 g

Answer 25.328 g

10. What volume of 2.50 M Li_2CO_3 would need to be evaporated in order to obtain 47.232 g of solid Li_2CO_3? Include proper units in your work and in your answers.

47.232 g Li_2CO_3 × $\frac{1\ mol}{73.8\ g}$ = 0.64 mol

mol / M L

$L = \frac{mol}{M} = \frac{0.64\ mol}{2.50\ M}$ = 0.256 L

Answer 0.256 L or 256 mL

11. 150.0 mL of water are added to 400.0 mL of 0.45 M HNO_3 . Calculate the final [HNO_3]. Include proper units in your work and in your answers. (Dilution)

$FC = IC \times \frac{IV}{FV}$ = 0.45 M × $\frac{400.0\ mL}{550.0\ mL}$ = 0.327 M

Answer Final [HNO_3] = 0.327 M

12. What volume of water needs to be added to 150.0 mL of 4.00 M H_2SO_4 in order to bring the concentration down to 2.50 M? Include proper units in your work and in your answers.

FC × FV = IC × IV

2.50 M × FV = 4.00 M × 150.0 mL

$FV_{(mL)} = \frac{4.00\ M \times 150.0\ mL}{2.50\ M}$ = 240.0 mL

Answer 90.0 mL

Water Added = FV − IV = 240.0 mL − 150.0 mL

= 90.0 mL