BASIC CHEMISTRY C

WORKSHEET

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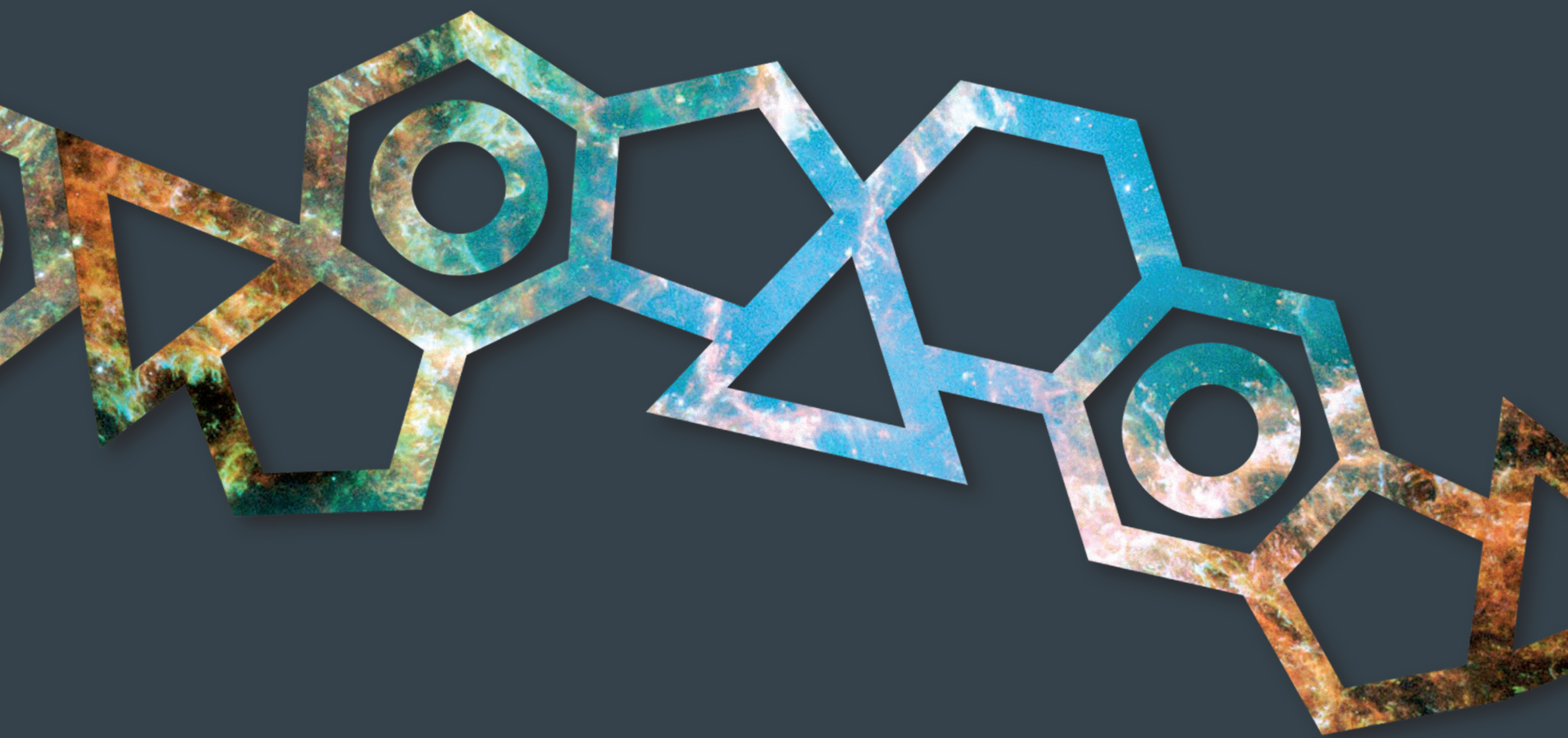

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About the worksheet

This file contains the worksheets for all eight chapters of *Basic Chemistry C*. Each chapter in the book finishes with a collection of new terms/concepts you are expected to learn and use in context when answering the 10 questions that follow.

These concepts should be clearly understood, and by working actively with the worksheets in this file, you will have the opportunity one more time to train and embed these new concepts. A collection of all 16 completed worksheets at the end of the school year will serve as an overview of the basic material presented in this first-year chemistry class, what is fundamental for further study and what you are expected to know on your exams.

This collection might also be used as part of your classroom study—you could be asked to prepare the concepts at home to use when answering related questions in class. Class work could come in the form of matrix-group discussions, presentations, and cooperative learning structures such as ”Ask Someone Who” and other related forms.

To get the most out of these worksheets, couple your written answers with in-depth discussions. This will strengthen both your written and oral competences.

Worksheet C1a · Explain the concepts

proton	
neutron	
electron	
atom	
periodic table (groups and periods)	
isotope	
element	
shell model	
electron structure	
octet rule	
atomic mass	
reactant	
product	
(balanced) equation	
state	

Worksheet C1b · Use the concepts

1. Explain the connection between an element's atomic number (*Z*), its nucleon number (*A*) and its atomic structure:

2. Explain the difference between the concepts atom, isotope and element:

3. Explain the difference between an element and a compound:

4. Calculate the atomic mass of an element given the percentage composition and masses of the isotopes:

5. Identify groups, main groups and periods in the periodic table, and explain what is common among elements in the same main group, and among elements in the same period:

6. Write down the electron structure for the first 20 elements and relate this to the shell model:

7. Explain why the octet rule is also called the noble gas rule, and explain the importance of the octet rule for making compounds:

8. Explain the difference between coefficients, in front of a chemical formula, and subscripts, written inside the formula, using $2H_2O$ as an example:

9. Balance an equation for a reaction with given reactants and products, using the following equation as example: $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$:

10. Determine and indicate if a substance exists as a solid, a liquid, a gas or is dissolved in water:

Worksheet C2a · Explain the concepts

ion	
ionic bond	
formula unit	
ionic lattice	
ionic compound	
polyatomic ion	
water of crystallization	
hazard pictogram	
macroscopic	
solubility	
exothermic	
endothermic	
precipitation	
spectator ion	

Worksheet C2b · Use the concepts

1. Explain the difference between the structure of an atom and an ion (for example, the element oxygen):

2. Construct a formula unit for a given positive ion and a given negative ion (for example, Al^{3+} and SO_4^{2-}):

3. Name ionic compounds made of monatomic ions as well as polyatomic ions, and explain the meaning of $\cdot 7H_2O$ in the formula $FeSO_4 \cdot 7H_2O$:

4. Explain why ionic compounds have high melting and boiling points:

5. Give both a microscopic and a macroscopic description of the process in which an ionic compound is dissolved in water (for example, KCl):

6. Using Table 8, explain if an ionic compound is soluble or insoluble/slightly soluble (for example, $ZnSO_4$):

7. Write a balanced equation for a precipitation reaction (for example, the formation of calcium phosphate):

8. Using Table 8, find two soluble compounds that when mixed produce a given insoluble/slightly soluble compound like $BaSO_4$; write the equation for the precipitation using compound formulas; identify the spectator ions in the solution:

9. Explain if a chemical reaction is exothermic or endothermic from a measured change of temperature of the reaction:

10. Given labelling rules, find the relevant hazard pictogram and H- and P-statements. Use Table 6 and Tables E and F in the appendix:

Worksheet C3a · Explain the concepts

covalent bond	
electron dot formula	
structural formula	
tetrahedron	
molecule	
solid	
liquid	
melting	
evaporation	
sublimation	
electronegativity	
polar/non-polar	
hydrophilic/ hydrophobic	
non-bonding pair	

Worksheet C3b · Use the concepts

1. Explain how to name molecules made of two non-metals, such as I_2O_5:

2. Explain what is meant by a covalent bond:

3. Draw electron dot formulas for molecules, such as CH_4, NH_3, H_2O and Cl_2:

4. Explain the difference between single bonds, double bonds and triple bonds:

5. Point out the difference between molecular bonds and ionic bonds:

6. Explain the difference between the solid, liquid and gaseous states of molecules, and know the terms used to describe the transition from one state to another:

7. Explain the difference between the structures of diamond and graphite:

8. Explain what is meant by electronegativity, and use Figure 61 (p. 68) to figure out if a bond is polar or non-polar, for example, the bonds N–H and N–P:

9. Explain what determines the polar or non-polar nature of a molecule:

10. Explain the significance of the content of hydrophilic and hydrophobic groups for a molecule's solubility in water:

Worksheet C4a · Explain the concepts

density	
formula mass	
molecular mass	
amount	
mole	
molar mass	
Avogadro's constant	
equivalent amounts	
ratio of amounts	
limiting reactant	
theoretical yield	
practical yield	
absolute temperature	
the ideal gas equation	

Worksheet C4b · Use the concepts

1. Express the relationship between density, mass and volume, and explain why densities of gases in general are much smaller than densities of solids:

2. Explain what is meant by formula mass and molecular mass:

3. State the number of formula units contained in 1 mol of a substance:

4. Calculate the molar mass of a compound, such as $FeSO_4 \cdot 7H_2O$:

5. Write down the relationship between mass, amount and molar mass; and state the units for the three concepts:

6. Calculate the amount of a substance given the mass and the molar mass:

7. Calculate the mass of a substance given the amount and the molar mass:

8. Explain how the equivalent amounts of compounds are calculated in a balanced equation, such as $C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$, when the mass of one of the compounds is given:

9. Explain the difference between the theoretical yield and the practical yield of a compound produced by a chemical reaction

10. Write the ideal gas equation and use it to calculate the volume of, for example, 2 mol $O_2(g)$ at pressure 1.0 bar and temperature 100 °C:

Worksheet C5a · Explain the concepts

homogeneous	
heterogeneous	
% by mass	
% by volume	
molar concentration	
volumetric flask	
burette	
pipette	
dilution	
saturated solution	
equilibrium	
formal molar calculation	
actual molar concentration	
titration	
indicator	

Worksheet C5b · Use the concepts

1. Explain what is meant by homogeneous and heterogeneous solutions, and give examples of each:

2. Give examples of how to calculate the content of a compound in a solution in terms of % by mass and % by volume, respectively:

3. Write down the relationship between amount, volume and molar concentration, and state the units for all three quantities:

4. Calculate the amount of a compound for which the molar concentration and the volume are known:

5. Calculate the molar concentration of a compound for which the amount and the volume of the solution are known:

6. Explain how in practice to make, for example, a 500 mL 0.150 M $MgCl_2$ solution from the pure compound:

7. Explain how to use the formula for dilution: $c_{initial} \times V_{initial} = c_{final} \times V_{final}$:

8. Explain what is meant by an unsaturated solution and a saturated solution, respectively, and explain the relationship between the two concepts saturated solution and equilibrium:

9. Explain how to calculate the actual molar concentrations of the ions in 0.100 M solutions of, for example, the compounds NaCl and $Ca(NO_3)_2$:

10. Explain how to do an endpoint titration in which a solution of NaCl is titrated with a solution of $AgNO_3$:

Worksheet C6a · Explain the concepts

alkane	
isomerism	
alkyl group	
naming rules	
combustion	
substitution reaction	
alkene	
cis/*trans*-isomerism	
elimination reaction	
addition reaction	
unsaturated hydrocarbon	
alkyne	
cyclic hydrocarbon	
aromatic hydrocarbon	
alcohol	
carboxylic acid	
threshold limit value	

Worksheet C6b · Use the concepts

1. Explain the molecular structure of alkanes and name two examples (chosen by you), including some isomeric molecules:
2. Explain the molecular structure of alkenes and how to name alkenes, including the meaning of *cis*/*trans* isomerism:
3. Explain the molecular structure and how to name alkynes:
4. Write a balanced equation for a combustion reaction, and explain the difference between complete and incomplete combustion:
5. Describe the following types of reaction: substitution, elimination and addition, and state an example of each:
6. Give examples of the molecular structure of cyclic hydrocarbons, and explain the special molecular structure of benzene:
7. Give some examples of the use of hydrocarbons:
8. Give examples of the molecular structure of alcohols and carboxylic acids:
9. Explain the physical properties of hydrocarbons, such as boiling points, melting points and solubility in water:
10. Explain the meaning of threshold limit values and the influence these have for the handling of compounds in the workplace:

Worksheet C7a · Explain the concepts

hydron	
acid	
base	
conjugate acid–base pairs	
amphoteric	
auto-ionization	
ion product of water	
acid solution	
basic solution	
neutral solution	
pH value	
indicator	
titration curve	
equivalence point	

Worksheet C7b · Use the concepts

1. Explain the difference between an acid and an acidic solution and the difference between a base and a basic solution:

2. Explain why a base must have a non-bonding pair:

3. Write a balanced equation for the reaction between an acid and water, for example, HNO_3 and water, and name the products:

4. Write a balanced equation for the reaction of a base with water, for example NH_3 and water, and name the products:

5. Give examples of conjugate acid–base pairs:

6. Give examples of compounds that are amphiprotic:

7. Explain the difference between a strong acid and a weak acid, and explain the difference between a strong base and a weak base:

8. Write the equation for the auto-ionization of water, and explain how the ion product of water is calculated:

9. Explain how to calculate the pH value of a strong acid and how to measure pH of a solution:

10. Explain how to calculate the formal molar concentration from a colorimetric titration or from a titration curve:

Worksheet C8a · Explain the concepts

oxidation	
reduction	
redox reaction	
activity series	
noble metal	
oxidation number	
electron transfer	
partial electron transfer	
rules for balancing redox reactions	
redox titration	

Worksheet C8b · Use the concepts

1. Explain what happens during an oxidation and a reduction:

2. Explain the meaning of the activity series, and explain what happens if a piece of iron is placed in a solution of magnesium chloride or if a piece of iron is placed in a solution of copper(II) chloride:

3. Explain why hydrogen is placed in the activity series:

4. Explain how oxidation numbers are assigned to hydrogen in H_2, H_2O and OH^-:

5. Explain how oxidation numbers are assigned to oxygen in O_2, O^{2-}, SO_2 and H_2O_2:

6. Explain how oxidation numbers are assigned to the atoms in SO_3^{2-}, NH_4^+, $Cr_2O_7^{2-}$, Zn and MnO_4^-:

7. Explain how the concepts oxidation and reduction relate to changes in oxidation numbers in a chemical reaction, for example, $Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$:

8. Explain why the total increase in oxidation numbers must equal the total decrease in oxidation numbers:

9. Explain step-by-step how to balance a redox reaction that takes place in an acidic solution: for example, $Fe^{2+}(aq) + NO_3^-(aq) \rightarrow Fe^{3+}(aq) + NO(g)$:

10. Explain step-by-step how to balance a redox reaction that takes place in a basic solution: for example, $SO_3^{2-}(aq) + MnO_4^-(aq) \rightarrow SO_4^{2-}(aq) + MnO_4^{2-}(aq)$:

