



## To the Student:

After your registration is complete and your proctor has been approved, you may take the Credit by Examination for Chemistry 1A.

## WHAT TO BRING

- several sharpened No. 2 pencils
- lined notebook paper
- calculator (standard or scientific are allowed)

## ABOUT THE EXAM

The examination for the first semester of Chemistry consists of 31 questions: 21 multiple choice, 9 problem-solving, and 1 fill-in based on the Periodic Table of Elements. The exam is based on the Texas Essential Knowledge and Skills (TEKS) for this subject. The full list of TEKS is included in this document (it is also available online at the Texas Education Agency website, <http://www.tea.state.tx.us/>). The TEKS outline specific topics covered in the exam, as well as more general areas of knowledge and levels of critical thinking. Use the TEKS to focus your study in preparation for the exam. A copy of the Periodic Table of Elements is also included in this document and in the exam.

The examination will take place under supervision, and the recommended time limit is three hours. You may not use any notes or books. A percentage score from the examination will be reported to the official at your school.

In preparation for the examination, review the TEKS for this subject. All TEKS are assessed. A list of Study Topics is included in this document to focus your studies. It is important to prepare adequately. Since questions are not taken from any one source, you can prepare by reviewing any of the state-adopted textbooks that are used at your school. The textbook used with our CHEM 1A course is:

Phillips, John S., Victor S. Strozak, and Cheryl Wistrom (2000). *Chemistry: Concepts and Applications*. Westerville, OH: Glencoe/McGraw-Hill. ISBN 0-02-828209-4.

Good luck on your examination!

## CHEM 1A Study Topics

To successfully complete the CBE, you should study and understand the following topics:

- Classify matter according to its composition.
- Distinguish among elements, compounds, homogeneous mixtures, and heterogeneous mixtures.
- Relate the properties of matter to its structure.
- Distinguish between physical and chemical properties.
- Apply the law of conservation of matter to chemical changes.
- Distinguish between physical and chemical properties.
- Contrast chemical and physical changes.
- Apply the law of conservation of matter to chemical changes.
- Relate historic experiments to the development of the modern model of the atom.
- Illustrate the modern model of an atom.
- Interpret the information available in an element block of the periodic table.
- Relate the electron to modern atomic theory.
- Compare electron energy levels in an atom.
- Illustrate valence electrons by Lewis electron dot structures.
- Outline the steps in the historical development of the periodic table.
- Predict similarities in properties of the elements by using the periodic table.
- Relate an element's valence electron structure to its position in the periodic table.
- Use the periodic table to classify an element as a metal, nonmetal, or metalloid.
- Compare the properties of metals, nonmetals, and metalloids.
- Distinguish the properties of compounds from those of the elements of which they are composed.
- Compare and contrast the properties of sodium chloride, water, and carbon dioxide.
- Analyze evidence to conclude that differences exist in the ways compounds form.
- Model two types of compound formation, ionic and covalent, at the atomic level.
- Compare, using examples, the effect of covalent and ionic bonding on the physical properties of compounds.
- Apply ionic charge to writing formulas for ionic compounds.
- Apply formulas to name ionic compounds.
- Interpret the information in a chemical formula.
- Compare the properties of molecular and ionic substances.
- Distinguish among allotropes of an element.
- Apply formulas to name molecular compounds.

- Relate chemical changes and macroscopic properties.
- Demonstrate how chemical equations describe chemical reactions.
- Illustrate how to balance chemical reactions by changing coefficients.
- Distinguish among the five major types of chemical reactions.
- Classify a reaction as belonging to one of five major types.
- Demonstrate factors that influence the direction of a reaction.
- Classify factors that influence the rate of a reaction.
- Relate the position of any main group element in the periodic table to its electron configuration.
- Predict chemical behavior of the main group elements.
- Relate chemical behavior to electron configuration and atomic size.
- Relate the chemical and physical properties of the transition elements to their electron configurations.
- Predict the chemical behavior of transition elements from their positions in the periodic table.
- Predict the type of bond that forms between atoms by using electronegativity values.
- Compare and contrast characteristics of ionic, covalent, and polar covalent bonds.
- Interpret the sea of electrons model of metallic bonding.
- Diagram electron dot structures for molecules.
- Formulate three-dimensional geometry of molecules from electron dot structures.
- Predict molecular polarity from three-dimensional geometry and bond polarity.
- Use kinetic theory to model the effects on a gas when the mass, temperature, pressure, volume, or number of particles is changed.
- Measure atmospheric pressure.
- Demonstrate the ability to use the factor label method to convert pressure units.
- Analyze data that relate temperature, pressure, and volume of a gas.
- Use kinetic theory to model Boyle's law and Charles' law.
- Predict the effect of changes in pressure and temperature on the volume of a gas.
- Relate how volumes of gases react in terms of the kinetic theory of gases.

# Texas Essential Knowledge and Skills

## CHEM 1 – Chemistry

### §112.35. Chemistry, Beginning with School Year 2010-2011 (One Credit).

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Required prerequisites: one unit of high school science and Algebra I. Suggested prerequisite: completion of or concurrent enrollment in a second year of math. This course is recommended for students in Grade 10, 11, or 12.

(b) Introduction.

(1) Chemistry. In Chemistry, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include characteristics of matter, use of the Periodic Table, development of atomic theory and chemical bonding, chemical stoichiometry, gas laws, solution chemistry, thermochemistry, and nuclear chemistry. Students will investigate how chemistry is an integral part of our daily lives.

(2) Nature of Science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

**(1) Scientific processes.** The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including the appropriate use of safety showers, eyewash fountains, safety goggles, and fire extinguishers;

(B) know specific hazards of chemical substances such as flammability, corrosiveness, and radioactivity as summarized on the Material Safety Data Sheets (MSDS); and

(C) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

**(2) Scientific processes.** The student uses scientific methods to solve investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology, including graphing calculators, computers and probes, sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, safety goggles, and burettes, electronic balances, and an adequate supply of consumable chemicals;

(F) collect data and make measurements with accuracy and precision;

(G) express and manipulate chemical quantities using scientific conventions and mathematical procedures, including dimensional analysis, scientific notation, and significant figures;

(H) organize, analyze, evaluate, make inferences, and predict trends from data; and

(I) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphs, journals, summaries, oral reports, and technology-based reports.

**(3) Scientific processes.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment;

(E) describe the connection between chemistry and future careers; and

(F) research and describe the history of chemistry and contributions of scientists.

**(4) Science concepts.** The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties. The student is expected to:

(A) differentiate between physical and chemical changes and properties;

(B) identify extensive and intensive properties;

(C) compare solids, liquids, and gases in terms of compressibility, structure, shape, and volume; and

(D) classify matter as pure substances or mixtures through investigation of their properties.

**(5) Science concepts.** The student understands the historical development of the Periodic Table and can apply its predictive power. The student is expected to:

(A) explain the use of chemical and physical properties in the historical development of the Periodic Table;

(B) use the Periodic Table to identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals; and

(C) use the Periodic Table to identify and explain periodic trends, including atomic and ionic radii, electronegativity, and ionization energy.

**(6) Science concepts.** The student knows and understands the historical development of atomic theory. The student is expected to:

(A) understand the experimental design and conclusions used in the development of modern atomic theory, including Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, and Bohr's nuclear atom;

(B) understand the electromagnetic spectrum and the mathematical relationships between energy, frequency, and wavelength of light;

(C) calculate the wavelength, frequency, and energy of light using Planck's constant and the speed of light;

(D) use isotopic composition to calculate average atomic mass of an element; and

(E) express the arrangement of electrons in atoms through electron configurations and Lewis valence electron dot structures.

**(7) Science concepts.** The student knows how atoms form ionic, metallic, and covalent bonds. The student is expected to:

(A) name ionic compounds containing main group or transition metals, covalent compounds, acids, and bases, using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;

(B) write the chemical formulas of common polyatomic ions, ionic compounds containing main group or transition metals, covalent compounds, acids, and bases;

(C) construct electron dot formulas to illustrate ionic and covalent bonds;

(D) describe the nature of metallic bonding and apply the theory to explain metallic properties such as thermal and electrical conductivity, malleability, and ductility; and

(E) predict molecular structure for molecules with linear, trigonal planar, or tetrahedral electron pair geometries using Valence Shell Electron Pair Repulsion (VSEPR) theory.

**(8) Science concepts.** The student can quantify the changes that occur during chemical reactions. The student is expected to:

(A) define and use the concept of a mole;

(B) use the mole concept to calculate the number of atoms, ions, or molecules in a sample of material;

(C) calculate percent composition and empirical and molecular formulas;

(D) use the law of conservation of mass to write and balance chemical equations; and

(E) perform stoichiometric calculations, including determination of mass relationships between reactants and products, calculation of limiting reagents, and percent yield.

**(9) Science concepts.** The student understands the principles of ideal gas behavior, kinetic molecular theory, and the conditions that influence the behavior of gases. The student is expected to:

(A) describe and calculate the relations between volume, pressure, number of moles, and temperature for an ideal gas as described by Boyle's law, Charles' law, Avogadro's law, Dalton's law of partial pressure, and the ideal gas law;

(B) perform stoichiometric calculations, including determination of mass and volume relationships between reactants and products for reactions involving gases; and

(C) describe the postulates of kinetic molecular theory.

**(10) Science concepts.** The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in chemical and biological systems;

(B) develop and use general rules regarding solubility through investigations with aqueous solutions;

(C) calculate the concentration of solutions in units of molarity;

(D) use molarity to calculate the dilutions of solutions;

(E) distinguish between types of solutions such as electrolytes and nonelectrolytes and unsaturated, saturated, and supersaturated solutions;

(F) investigate factors that influence solubilities and rates of dissolution such as temperature, agitation, and surface area;

(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid base reactions that form water;

(H) understand and differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions;

(I) define pH and use the hydrogen or hydroxide ion concentrations to calculate the pH of a solution; and

(J) distinguish between degrees of dissociation for strong and weak acids and bases.

**(11) Science concepts.** The student understands the energy changes that occur in chemical reactions. The student is expected to:

(A) understand energy and its forms, including kinetic, potential, chemical, and thermal energies;

(B) understand the law of conservation of energy and the processes of heat transfer;

(C) use thermochemical equations to calculate energy changes that occur in chemical reactions and classify reactions as exothermic or endothermic;

(D) perform calculations involving heat, mass, temperature change, and specific heat; and

(E) use calorimetry to calculate the heat of a chemical process.

**(12) Science concepts.** The student understands the basic processes of nuclear chemistry. The student is expected to:

(A) describe the characteristics of alpha, beta, and gamma radiation;

(B) describe radioactive decay process in terms of balanced nuclear equations; and

(C) compare fission and fusion reactions.

*Source: The provisions of this §112.35 adopted to be effective August 4, 2009, 34 TexReg 5063.*

# PERIODIC TABLE OF THE ELEMENTS

PERIOD	GROUP NUMBERS IUPAC RECOMMENDATION (1985)		GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)		GROUP NUMBERS IUPAC RECOMMENDATION (1985)		GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)		GROUP NUMBERS IUPAC RECOMMENDATION (1985)		GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)		GROUP NUMBERS IUPAC RECOMMENDATION (1985)		GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)		GROUP NUMBERS IUPAC RECOMMENDATION (1985)		GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1 <b>H</b> HYDROGEN	2 <b>He</b> HELIUM																		
2	3 <b>Li</b> LITHIUM	4 <b>Be</b> BERYLLIUM																		
3	11 <b>Na</b> SODIUM	12 <b>Mg</b> MAGNESIUM																		
4	19 <b>K</b> POTASSIUM	20 <b>Ca</b> CALCIUM	21 <b>Sc</b> SCANDIUM	22 <b>Ti</b> TITANIUM	23 <b>V</b> VANADIUM	24 <b>Cr</b> CHROMIUM	25 <b>Mn</b> MANGANESE	26 <b>Fe</b> IRON	27 <b>Co</b> COBALT	28 <b>Ni</b> NICKEL	29 <b>Cu</b> COPPER	30 <b>Zn</b> ZINC	31 <b>Ga</b> GALLIUM	32 <b>Ge</b> GERMANIUM	33 <b>As</b> ARSENIC	34 <b>Se</b> SELENIUM	35 <b>Br</b> BROMINE	36 <b>Kr</b> KRYPTON		
5	37 <b>Rb</b> RUBIDIUM	38 <b>Sr</b> STRONTIUM	39 <b>Y</b> YTRORIUM	40 <b>Zr</b> ZIRCONIUM	41 <b>Nb</b> NOBIUM	42 <b>Mo</b> MOLYBDENUM	43 <b>Tc</b> TECHNETIUM	44 <b>Ru</b> RUTHENIUM	45 <b>Rh</b> RHODIUM	46 <b>Pd</b> PALLADIUM	47 <b>Ag</b> SILVER	48 <b>Cd</b> CADMIUM	49 <b>In</b> INDIUM	50 <b>Sn</b> TIN	51 <b>Sb</b> ANTIMONY	52 <b>Te</b> TELLURIUM	53 <b>I</b> IODINE	54 <b>Xe</b> XENON		
6	55 <b>Cs</b> CAESIUM	56 <b>Ba</b> BARIUM	57-71 <b>La-Lu</b> Lanthanide	72 <b>Hf</b> HAFNIUM	73 <b>Ta</b> TANTALUM	74 <b>W</b> TUNGSTEN	75 <b>Re</b> RHENIUM	76 <b>Os</b> OSMIUM	77 <b>Ir</b> IRIDIUM	78 <b>Pt</b> PLATINUM	79 <b>Au</b> GOLD	80 <b>Hg</b> MERCURY	81 <b>Tl</b> THALLIUM	82 <b>Pb</b> LEAD	83 <b>Bi</b> BISMUTH	84 <b>Po</b> POLONIUM	85 <b>At</b> ASTATINE	86 <b>Rn</b> RADON		
7	87 <b>Fr</b> FRANCIUM	88 <b>Ra</b> RADIUM	89-103 <b>Ac-Lr</b> Actinide	104 <b>Rf</b> RUTHERFORDIUM	105 <b>Db</b> DUBNIUM	106 <b>Sg</b> SEABORGIUM	107 <b>Bh</b> BOHRRIUM	108 <b>Hs</b> HASSIUM	109 <b>Mt</b> MEITNERIUM	110 <b>Uu</b> UNUNILLIUM	111 <b>Uuu</b> UNUNUNIUM	112 <b>Uub</b> UNUNBIUM	114 <b>Uuq</b> UNUNQUADIUM							

## LANTHANIDE

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
<b>La</b>	<b>Ce</b>	<b>Pr</b>	<b>Nd</b>	<b>Pm</b>	<b>Sm</b>	<b>Eu</b>	<b>Gd</b>	<b>Tb</b>	<b>Dy</b>	<b>Ho</b>	<b>Er</b>	<b>Tm</b>	<b>Yb</b>	<b>Lu</b>
LANTHANUM	CERIUM	PRASEODYMIUM	NEODYMIUM	PROMETHIUM	SAMARIUM	EUROPIUM	GADOLINIUM	TERBIUM	DYSPROSIUM	HOLMIUM	ERBIUM	THULIUM	YTTERRIUM	LUTETIUM

## ACTINIDE

89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
<b>Ac</b>	<b>Th</b>	<b>Pa</b>	<b>U</b>	<b>Np</b>	<b>Pu</b>	<b>Am</b>	<b>Cm</b>	<b>Bk</b>	<b>Cf</b>	<b>Es</b>	<b>Fm</b>	<b>Md</b>	<b>No</b>	<b>Lr</b>
ACTINIUM	THORIUM	PROTACTINIUM	URANIUM	NEPTUNIUM	PLUTONIUM	AMERICIUM	CURIUM	BERKELIUM	CALIFORNIUM	EINSTEINIUM	FERMIUM	MEINDELEVIUM	NOBELIUM	LAWRENCIUM