Chemistry B

Credit by Exam Study Guide

This EA/CBE Study Guide can help you prepare for the exam by giving you an idea of what you need to study, review, and learn. To succeed, you should be thoroughly familiar with the subject matter before you attempt to take the exam.

Every question that appears on the EA/CBE is grounded in the knowledge and skills statements and student expectations within the state-mandated standards, the Texas Essential Knowledge and Skills (TEKS). It should be noted that the exam will not test every student expectation. However, it is important that students study and know the entire scope of the TEKS so that they can develop a complete understanding of the content. The EA/CBEs are global exams grounded in the TEKS and are not designed to be a final exam for the University of Texas high school courses. You can view the TEKS for this exam online at **http://www.tea.state.tx.us/teks/**. Since questions are not taken from any one source, you can prepare by reviewing any of the state-adopted textbooks.

About the Exam

The EA/CBE consists of 50 multiple-choice questions that are worth 1 point each. You will be provided the Formula Sheet and Periodic Table of the Elements shown at the end of this Study Guide. You will be allowed **3 hours** to take the exam.

Materials Given with the Exam

For paper-based exams, a formula sheet and periodic table will be provided with your test. For computer-based exams, the proctor will provide to you a paper copy of the formula sheet and periodic table immediately prior to testing. You will return the sheet after the exam. The formula sheet and periodic table can be found at the end of this study guide.

Concepts and Objectives

The bulleted lists and sample questions below may not refer to all the material that will be on the exam. This list only provides additional information for some of the student expectations tested in the Chemistry, Second Semester EA/CBE. Ultimately, you should use the TEKS to guide your exam preparation.

Chemical Reactions

- identify and determine whether a chemical reaction or a physical change has taken place;
- write and understand chemical equations, word equations and formula equations;
- write a formula equation from a word equation;
- balance a chemical equation;
- interpret a balanced chemical equation;
- identify the five types of chemical reactions;
- predict the reactants or products of a chemical reaction;

- understand the importance of classifying chemical reactions.

Stoichiometry

- describe the concept of the mole and identify the numerical value of the mole;
- use Avogadro's number to calculate the number of molecules in a sample;
- perform stoichiometric calculations to perform various conversions;
- write mole ratios;
- use mole to mole conversions to predict the limiting reagent of a reaction;
- determine the efficiency of a chemical reaction by doing mass to mass conversions and calculating the percent yield.

Thermochemistry

- define *energy*, *heat, temperature*, *enthalpy*, *entropy* and *free energy*;
- determine the direction of heat flow in a system;
- identify whether a system has potential and/or kinetic energy;
- explain the relationship between energy, heat, and work;
- calculate the amount of energy converted into heat and the amount converted into work;
- identify a reaction as *endothermic* or *exothermic*;
- calculate the specific heat capacity of a substance;
- calculate the change in temperature of a substance using its specific heat;
- perform bomb calorimetric calculations;
- use Hess's Law to manipulate chemical equations and calculate enthalpy changes;
- define *molar heat of formation* and use it to calculate enthalpy change in a reaction;
- determine the change in entropy of a chemical reaction;
- calculate the change in free energy for a reaction;
- predict whether a reaction will proceed spontaneously.

States of Matter

- explain the difference between the strength of intermolecular forces in solids, liquids, and gasses;
- explain the different forces of attraction between molecules;
- predict the type of bond in a compound and the intermolecular force of attraction between those molecules;
- explain how a barometer works and predict its behavior at different pressures;
- correlate intermolecular forces of attraction and the physical properties for that substance;
- interpret and extrapolate information from a graph of the boiling points of different substances and information from a phase diagram;
- understand the concept of the triple point and the critical point in a phase diagram;
- define *latent heat* and distinguish between latent heat of fusion and latent heat of vaporization;
- calculate the amount of heat gained/lost as substance goes from one temperature to another.

Behavior of Gasses

- understand how a manometer works;
- predict the change in a manometer with relation to a change the in pressure of a gas;
- explain the four main factors that affect the behavior of a gas;
- know the formal mathematical expressions that define relationships between the pressure, volume, temperature, and moles of a gas;
- calculate the pressure, volume, temperature, and number of moles of a gas;
- calculate the total pressure and partial pressures of a mixture of gasses;
- calculate the partial pressure of gasses from the number of moles of these gasses.

Water

- explain why water circulates in a lake during winter and how this benefits the marine life in the lake;
- define *surface tension* and explain why water has a strong surface tension;
- explain the spherical shape a drop of water assumes when it is released from a dropper;
- discuss hydrogen bonding and explain how it contributes to the physical characteristics of water;
- discuss the role that hydrogen bonds play in determining the structure of ice crystals and why ice is less dense than liquid water;
- correlate the structure of ice crystals and the physical characteristics and properties of ice;
- explain how water behaves as a solvent;
- discuss polarity and the role polarity plays in the solvation process;
- explain why like dissolves like.

Properties of Solutions

- calculate the molar mass of elements and compounds;
- calculate the number of moles of solute from the concentration of a solution;
- express the concentration of a solution in percent by mass, molarity, and molality;
- explain the factors that affect solubility;
- interpret a solubility vs. temperature graph to determine whether a solution is unsaturated, saturated, or supersaturated;
- explain the effect that adding a solute has on the boiling point and freezing point of water;
- discuss the relationship between the solubility of a gas and the temperature of a solution;
- explain how non-polar gasses are kept in solution in a polar solvent.

Factors Affecting Reaction Rates

- explain the three criteria of the collision theory of chemical reactions;
- identify the factors that influence the rate of a reaction;
- discuss what it means for a reaction to be at equilibrium;
- distinguish between an endothermic and an exothermic reaction in terms of the heat and energy of the systems and discuss the effect that adding heat to each reaction would have on the reactants and the products;
- define *activation energy*;

- interpret an energy diagram;
- identify whether a reaction is endothermic or exothermic from the reactions energy diagram;
- describe the role that catalysts play in a chemical reaction and how the effect of a catalyst is expressed in an energy diagram;
- describe a process in terms of enthalpy, entropy, and Gibbs Free Energy;
- use Gibbs Free Energy equation to predict whether a reaction will be spontaneous or non-spontaneous;
- write equilibrium expressions for chemical reactions;
- explain the idea of dynamic equilibrium;
- use LeChatelier's principle to predict how a reaction will adjust to the stress/change applied to the system.

Acids and Bases

- recognize the general properties of both acids and bases;
- write the correct chemical formulas and names for acids and bases;
- name common uses of acids in industry;
- define and identify Arrehnius, Brønsted-Lowry, and Lewis acids and bases;
- differentiate between the three major acid-base theories;
- discuss the autionization of water;
- calculate the pH and/or pOH of a solution;
- calculate the $[H^+]$ and/or $[OH^-]$ of a solution;
- write and identify the conjugate base of an acid and the conjugate acid of a base;
- define and recognize *amphiprotic* acids and/or bases;
- identify acid-base neutralization reactions;
- write the correct chemical formulas for the products of acid-base neutralization reactions;
- write the equilibrium reaction for acid-base neutralization reactions;
- predict and calculate the pH of a solution after a neutralization reaction is completed;
- identify substances in the atmosphere that contribute to acid rain;
- write chemical equations for reactions between an acid and a carbonate.

Oxidation and Reduction Reactions

- define *oxidation* and *reduction*;
- determine and assign the oxidation state of each element within a compound;
- identify a chemical reaction as a redox reaction;
- identify the element that is being oxidized and the element that is being reduced in a redox reaction;
- balance oxidation-reduction equations using the half-reaction method;
- calculate the potential of an electrochemical cell;
- determine whether a cell/redox reaction is spontaneous or non-spontaneous.

Electrochemistry

- define and identify the components of a *galvanic cell* and a *voltaic cell*;
- determine the ideal amount of energy in an electrochemical cell;
- identify the cathode and anode and calculate the cell potential of an electrochemical cell;
- explain the structure of the different dry cells and identify the components of these electrochemical cells;
- calculate the amount of electrical energy the different dry cells produce;
- identify the redox reactions that take place in different dry cells;
- identify hazards that may be associated with dry cells;
- describe the major difference between wet and dry cell batteries;
- define and identify an *electrolytic cell*;
- differentiate between electrolytic cells and voltaic cells;
- describe uses of electrolytic cells;
- discuss the process of electroplating;
- explain the structure of a car battery and how these batteries are recharged.

Sample Questions

These sample questions will give you a better idea of the types of questions you can expect on the EA/CBE. These are provided to illustrate the format of the exam. They are not the actual exam. In order to be successful on the exam, you must study the TEKS and all of the concepts previously listed.

1. When burning methane gas to heat a home, what is the limiting reactant for this chemical reaction?

   A Methane
   B Carbon dioxide
   C Oxygen
   D Water vapor

2. Which assumption of the kinetic-molecular theory of gases is the most applicable to hot-air balloons?

   A Gases consist of large numbers of small particles far apart relative to their size.
   B Gas particles are in constant random motion and collisions between them are 100% elastic.
   C There are no forces of attraction between gas particles.
   D The average kinetic energy and density of gas particles depends on the temperature of the gas.

3. An ionic compound in an aqueous solution is able to conduct an electric current. This compound is considered to be

   A an alloy.
   B a cation.
   C an electrolyte.
   D an oxyanion.

4. The table shows data from an investigation designed to find a liquid solution that is both an acid and a strong electrolyte. Based on the data, which solution is both an acid and a strong electrolyte?

Properties of Some Solutions

Solution	Electrical Conductivity of Solution	Original Color of Litmus Paper	Color of Litmus Paper After Dipping in Solution	pH
1	Very high	Red	Blue	10.0
2	Low	Blue	Red	6.5
3	Moderate	Red	Red	5.4
4	Very high	Blue	Red	2.0

   A Solution 1
   B Solution 2
   C Solution 3
   D Solution 4

5. Calcium ions play an important role in the function of neurons in the brain. Elements that are chemically similar to calcium can interfere with the function of neurons. Which of the following is most likely to imitate calcium's role in the function of neurons?

   A Sodium
   B Potassium
   C Strontium
   D Rubidium

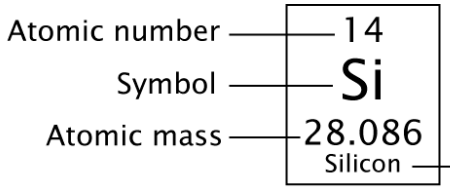
Answer Key

Item Number	Correct Answer	TEKS expectation
1	A	5A
2	D	11B
3	C	4D
4	D	12B
5	C	13C

Formula Sheet

General Formulas	
$D = \frac{m}{v}$, Density$= \frac{\text{mass}}{\text{volume}}$	Percent yield $= \frac{\text{actual yield}}{\text{theoretical yield}} \cdot 100\%$
$PV = nRT$, Pressure • Volume = moles • R • Temperature	
$Q = mc\Delta T$, Heat = mass • specific heat constant • change in temperature	
Charles's Law	
$\frac{V_1}{T_1} = \frac{V_2}{T_2}$, $\frac{\text{Volume}_1}{\text{Temperature}_1} = \frac{\text{Volume}_2}{\text{Temperature}_2}$	
The Combined Gas Law	
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$, $\frac{\text{Pressure}_1 \bullet \text{Volume}_1}{\text{Temperature}_1} = \frac{\text{Pressure}_2 \bullet \text{Volume}_2}{\text{Temperature}_2}$	
Specific Heats of Water	**Ideal Gas Constant** = $R = 8.31 \frac{\text{L} \bullet \text{kPa}}{\text{K} \bullet \text{mol}}$ or $0.0821 \frac{\text{L} \bullet \text{atm}}{\text{K} \bullet \text{mol}}$
Ice – 2090 J/kg^{o}C	273 K = 0^{o}C
Fusion – 333,000 J/kg	1 mL H_2O = 1 g of H_2O
Water – 4186 J/kg^{o}C	**Avogadro's number** = 6.02×10^{23}
Vaporization – 2,260,000 J/kg	1 mol of gas (at STP) = 22.4 L
Steam – 2010 J/kg^{o}C	101.3 kPa = 1 atmosphere = 760 mm Hg

Periodic Table of the Elements



Group	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIII	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 H 1.008 Hydrogen																	2 He 4.0026 Helium
2	3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998 Fluorine	10 Ne 20.179 Neon
3	11 Na 22.990 Sodium	12 Mg 24.305 Magnesium											13 Al 26.982 Aluminum	14 Si 28.086 Silicon	15 P 30.974 Phosphorus	16 S 32.066 Sulfur	17 Cl 35.453 Chlorine	18 Ar 39.948 Argon
4	19 K 39.098 Potassium	20 Ca 40.08 Calcium	21 Sc 44.956 Scandium	22 Ti 47.88 Titanium	23 V 50.942 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.847 Iron	27 Co 58.933 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.546 Copper	30 Zn 65.39 Zinc	31 Ga 69.72 Gallium	32 Ge 72.61 Germanium	33 As 74.922 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.80 Krypton
5	37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium	39 Y 88.906 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.906 Niobium	42 Mo 95.94 Molybdenum	43 Tc (98) Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.906 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.868 Silver	48 Cd 112.41 Cadmium	49 In 114.82 Indium	50 Sn 118.71 Tin	51 Sb 121.763 Antimony	52 Te 127.60 Tellurium	53 I 126.904 Iodine	54 Xe 131.29 Xenon
6	55 Cs 132.905 Cesium	56 Ba 137.33 Barium	57 La 138.906 Lanthanum	72 Hf 178.49 Hafnium	73 Ta 180.948 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.22 Iridium	78 Pt 195.08 Platinum	79 Au 196.967 Gold	80 Hg 200.59 Mercury	81 Tl 204.383 Thallium	82 Pb 207.2 Lead	83 Bi 208.980 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
7	87 Fr (223) Francium	88 Ra 226.025 Radium	89 Ac 227.028 Actinium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (263) Seaborgium	107 Bh (262) Bohrium	108 Hs (265) Hassium	109 Mt (266) Meitnerium	110 (269)								

Mass numbers in parentheses are those of the most stable or most common isotope.

Lanthanide Series	58 Ce 140.12 Cerium	59 Pr 140.908 Praseodymium	60 Nd 144.24 Neodymium	61 Pm (145) Promethium	62 Sm 150.36 Samarium	63 Eu 151.97 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.925 Terbium	66 Dy 162.50 Dysprosium	67 Ho 164.930 Holmium	68 Er 167.26 Erbium	69 Tm 168.934 Thulium	70 Yb 173.04 Ytterbium	71 Lu 174.967 Lutetium
Actinide Series	90 Th 232.038 Thorium	91 Pa 231.036 Protactinium	92 U 238.029 Uranium	93 Np 237.048 Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium	102 No (259) Nobelium	103 Lr (262) Lawrencium