To the Student:

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

WHAT TO BRING

- lined notebook paper
- sharpened No. 2 pencils
- a **non-programmable** calculator

ABOUT THE EXAM

The examination for the first semester of Integrated Physics and Chemistry 1A consists of 85-91 multiple choice questions, which will make up 75% of the final exam grade; the other 25% will be skills and essay questions. You will be provided with a bubble answer sheet for the objective questions; you will answer the skills and essay questions on your own paper. Skills questions will cover such things as measuring, calculating, graphing, designing an experiment, etc.

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.

The examination will take place under supervision, and the recommended time limit is three hours. You may not use any notes or books. You may use a **non-programmable** calculator. 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. It is important to prepare adequately. Since questions are not taken from any one course, you can prepare by reviewing any of the state-adopted textbooks that are used at your school. The textbook used with our IPC 1A course is:

McLaughlin, Charles William, et al. (2005). *Physical Science.* New York: Glencoe McGraw Hill. ISBN 9780078600517.

The practice exam included in this document will give you a model of the types of questions that will be asked on your examination. It is *not* a duplicate of the actual examination. It is provided to illustrate the format of the exam, not to serve as a review sheet. In order to be successful on the examination, you must study and review all of the concepts of Integrated Physics and Chemistry. These concepts are listed on pages that follow this letter.

Good luck on your examination!

IPC 1A CBE—Study Sheet

Before taking this exam, you should be able to:

- plan and implement an investigation using scientific method, formulate hypotheses, select appropriate equipment and technology, draw inferences, and communicate valid conclusions;
- make wise choices in the use and conservation of resources, disposal or recycling of materials (especially as they apply to substances studied, such as petrochemicals and polymers);
- demonstrate safe practices for lab investigations;
- collect data and make measurements with precision;
- identify tools to measure length, volume, mass and temperature;
- identify metric units and explain the importance of a universal system of measurement;
- use dimensional analysis to convert units;
- organize, analyze, evaluate, make inferences and predict trends from data (using skills such as reading data charts, tables, and the periodic table);
- define matter, describe properties of each class of matter, list the general properties of matter, describe the relationship between mass and weight (gravity), and calculate density;
- identify and describe four phases of matter, phase changes, and energy changes that take place during phase changes;
- define chemical and physical changes, and recognize and identify those changes;
- list the contributions of major scientists such as Archimedes, Rutherford, Thomson, Bohr, the Curies, Einstein, Dalton, amd Becquerel;
- describe the historical development of the atomic theory; analyze, critique, review, and compare atomic theories; and explain how indirect evidence has led to understanding of atom;
- identify three subatomic particles, relate charges of each, relative sizes, placement in atom, and role in bonding, nuclear fusion, and nuclear fission;
- identify properties of fluids, such as density, viscosity, and buoyancy;

- classify substances as elements and compounds or mixtures (heterogeneous or homogeneous);
- describe the general properties of elements and relate the chemical behavior of elements, including bonding (ionic, covalent, or metallic), to their placement on the periodic table;
- analyze energy changes that accompany chemical changes as exothermic or endothermic;
- identify or be able to draw atoms, ions, and isotopes;
- define radioactivity;
- identify and describe the law of conservation of mass;
- describe types of nuclear reactions such as fission and fusion and know some of their applications in medicine, energy production, tracing, etc.
- relate the structure of water to its role as universal solvent;
- evaluate the environmental and economic impact of end products of chemical reactions;
- recognize and understand reading of chemical equations, understand the function of coefficients and subscripts, recognize balanced chemical equations, and identify the type of chemical reaction as synthesis, decomposition, single replacement, or double replacement;
- relate concentration of ions in a solution to physical and chemical properties such as pH;
- state the properties of acids and bases, have a general knowledge of the placement of some common acids and bases on the pH scale, and relate acid rain to the pH scale;
- recognize how various factors affect solubility (including temperature, pressure, particle size, nature of solute, and solvent);
- explain how petroleum products are separated from crude oil, explain what petrochemicals and polymers are, and describe the economic and environmental impact of oil spills and of disposing or recycling such materials.

IPC 1A Practice Exam

The following practice exam will help prepare you for the CBE. The questions are similar to those on the CBE, though not identical, and the format is similar. The practice exam is presented to help you study for the CBE. Work straight through the practice exam as if you were actually taking the proctored test. When you encounter a question you don't know at all or a topic that isn't fresh in your memory, mark that question so that you will know to go back and study the topic more thoroughly.

Multiple Choice

Circle the letter of the response that *best* answers the question or completes the statement.
A periodic table of elements is included for reference at the end of this document.

1. The best type of graph to show parts of a whole would be a

   A. line graph.
   B. bar graph.
   C. pie chart.
   D. histogram.

2. When trying to decide whether to wear black or white clothing on a winter day, which of the following would be a hypothesis?

   A. Black clothing should be worn when the temperature dips below 50° Fahrenheit.
   B. Most people at school wore white yesterday.
   C. Black clothing is the correct choice for a winter day.
   D. I think black clothing would be most comfortable to wear on a winter day like today.

3. In a science lab, the mass of a person would probably be measured in

   A. grams.
   B. kilograms.
   C. milligrams.
   D. pounds.

4. In a science lab, the tool most likely used to measure the mass of a large crystal of copper sulfate would be a

   A. graduated cylinder.
   B. ruler.
   C. balance.
   D. scale.

5. Before any lab activity is begun, investigators should

   A. read through all instructions.
   B. study any applicable safety rules.
   C. ask any questions about any part of the procedure they don't understand.
   D. All of the above.

6. A light bulb is an example of

   A. a dependent variable.
   B. an independent variable.
   C. pure science.
   D. technology.

7. A scientific theory that has been tested many times and is generally accepted as true is called a

   A. law.
   B. hypothesis.
   C. fact.
   D. prediction.

8. If the mass of an object is 300 g and its volume is 150 mL, its density is

   A. 0.5 g/mL.
   B. 2.0 g/mL.
   C. 5 g/mL.
   D. 0.2 g/mL.

9. How many degrees are between the freezing point and the boiling point on the Celsius temperature scale?

   A. 10
   B. 100
   C. 180
   D. 273

10. A meter is slightly larger than a(n)

    A. foot.
    B. inch.
    C. yard.
    D. mile.

11. Which of the following is a physical property of matter?

    A. density
    B. flammability
    C. reactivity
    D. beauty

12. Viscosity describes substances in the _____ state of matter.

    A. solid
    B. liquid
    C. gas
    D. plasma

13. The mathematical formula for density is

A. $D = m \times v$
B. $D = m / v$
C. $D = v / m$
D. $D = m + v$

14. Of the following items, the one with the **most** thermal energy would be

A. a glass of ice water.
B. a glass of tap water.
C. a large glacier.
D. a cubic meter of steam.

15. Burning a piece of paper is an example of a

A. phase change.
B. physical change.
C. chemical change.
D. mass change.

16. When two or more substances are mixed together but not chemically combined, the resulting combination is called a(n)

A. element.
B. mixture.
C. compound.
D. phase change.

17. Which of the following is **not** a mixture?

A. colloid
B. compound
C. suspension
D. solution

18. A property or properties that might be used to separate substances in a mixture could include which of the following?

A. magnetism
B. melting point
C. solubility
D. All of the above.

19. A substance that cannot be changed into simpler substances by a chemical change is called a(n)

A. element.
B. liquid.
C. solid.
D. mixture.

20. Which of the following has a definite volume and shape?

A. solid
B. liquid
C. gas
D. plasma

21. As a result of his experiment, Rutherford proposed that an atom has a

A. dense, positively charged nucleus.
B. dense, negatively charged nucleus.
C. neutral nucleus surrounded by negatively charged electrons.
D. neutral nucleus surrounded by positively charged particles.

22. Mendeleev arranged an early "periodic table" in order by

A. increasing atomic number.
B. increasing atomic mass.
C. increasing electron orbitals.
D. decreasing atomic number.

23. In the chemical equation $2H_2 + O_2 \rightarrow 2H_2O$,

A. water combines with oxygen.
B. water is produced.
C. hydrogen and oxygen are produced.
D. a compound is changed into the elements of which it is made.

24. Hydrogen is grouped with alkali metals because it

A. is a gas.
B. has one electron in its outer energy level.
C. does not readily form compounds.
D. is a metal.

25. An element with an atomic number of 6 and a mass number of 14 contains _____ neutrons in its nucleus.

A. 20
B. 12
C. 8
D. 6

26. A family of elements with two electrons in its outer energy level is the

A. actinides.
B. alkali metals.
C. alkaline earth metals.
D. halogens.

27. When the temperature of a solution of a solid in a liquid is raised, the solubility usually

A. increases.
B. decreases.
C. remains the same.
D. cannot be determined.

28. In the early 1900s, experimentation done in Rutherford's lab

A. resulted in the proposal that most mass and all positive charges are concentrated in the nucleus of the atom.
B. explained the presence of small, negatively charged particles in atoms.
C. explained the orbital paths of electrons around the nucleus.
D. determined that paths of electrons cannot be precisely predicted.

29. The radioactive isotope nickel-63 has a half-life of 100 years. How much of a 10.0-g sample of nickel-63 is left after 300 years?

A. 10 g.
B. 5 g
C. 2.5 g
D. 1.25 g
E. 0.625 g

30. The modern periodic law states that the physical and chemical properties of elements are periodic functions of their

A. atomic mass.
B. atomic number.
C. phase.
D. energy content.

31. Which of the following describes an isotope's half-life?

A. a constant time interval
B. a varied time interval
C. an increasing time interval
D. a decreasing time interval

32. For which of the following could carbon-14 dating be used?

A. a bone fragment
B. a marble column
C. dinosaur fossils
D. rocks

continued →

33. Elements that have 5, 6, 7, or 8 electrons in their outermost energy level are

A. metals.
B. nonmetals.
C. metalloids.
D. alloys.

34. Which of the following is an atom that has gained an electron?

A. negative ion
B. positive ion
C. polar molecule
D. nonpolar molecule

35. If heat must be added to a chemical reaction for the reaction to continue to completion, the reaction is

A. balanced.
B. endothermic.
C. exothermic.
D. reactant.

36. The transfer of electrons occurs during

A. metallic bonding.
B. covalent bonding.
C. ionic bonding.
D. the formation of molecules.

37. An atom with an oxidation number of 2–

A. has two valence electrons.
B. will form an ion with a charge of 2+.
C. will form an ion with a charge of 6–.
D. has six valence electrons.

38. The formula for zinc iodide is ZnI_2. What is the oxidation number of zinc in zinc iodide?

A. 1–
B. 1+
C 2–
D. 2+

39. A chemical reaction in which two or more substances combine to form another substance is called a

A. reactant.
B. decomposition reaction.
C. synthesis reaction.
D. product.

40. According to the law of conservation of mass, if two atoms of hydrogen are used as a reactant, how many atoms of hydrogen must be part of the product?

A. None would be required.
B. 1
C. 2
D. 4

41. Which of the following represents a correctly balanced double-replacement reaction?

A. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
B. $MgCO_3 + HCl \rightarrow MgCl_2 + H_2CO_3$
C. $Ba(NO_3)_2 + K_2SO_4 \rightarrow BaSO_4 + 2KNO_3$
D. $C_3H_8 + O_2 \rightarrow 3CO_2 + 4H_2O$
E. None of the above.

42. Which of the following is an endothermic reaction?

A. cooling water nearly to the freezing point
B. iron rusting
C. burning wood
D. exploding dynamite

43. In an exothermic reaction,

A. some energy is destroyed.
B. energy is released.
C. energy is taken from the surroundings.
D. energy is stored in one or more of the products.

44. What type of reaction is shown in the following chemical equation? $2H_20 \rightarrow 2H_2 + O_2$

A. decomposition.
B. double-displacement
C. single-displacement
D. synthesis

45. Which of the following is a property of acids?

A. Acids have a sour taste.
B. Acids affect indicators.
C. Acids neutralize bases.
D. All of the above.

continued →

46. Solutions can form with

A. solids in liquids.
B. liquids in gases.
C. gases in liquids.
D. All of the above.

47. An insoluble compound that forms during a chemical reaction is

A. aqueous.
B. a catalyst.
C. an inhibitor.
D. a precipitate.

48. Acids react with active metals to produce

A. hydrogen gas.
B. oxygen gas.
C. either hydrogen or oxygen gas.
D. different gases, depending on the acid.

49. Acetic acid is found in

A. battery acid.
B. citric acid.
C. stomach acid.
D. vinegar.

50. Of the following, the strongest base would have a pH of

A. 10.
B. 3.
C. 7.
D. 6.

51. A solution that contains a large amount of solute in the solvent could be described as

A concentrated.
B. diluted.
C. polar.
D. unsaturated.

52. In a chemical reaction between a strong acid and a strong base, the resulting solution should have a pH of

A. 2.
B. 7.
C. 0.
D. 12.

53. Fractional distillation is useful for petroleum because

A. it has a low boiling point.
B. it has a high boiling point.
C. its fractions boil and condense at different temperatures.
D. its fractions have different densities.

54. Which of the following is a chemical property?

A. density
B. solubility
C. flammability
D. hardness

55. The particles that make up a solid move _____ than do the particles that make up a gas.

A. in the same way
B. more quickly
C. more quickly and farther
D. more slowly

Read the following information, then answer questions 56-61.

Students wanted to know about the strength of a balloon under various temperature conditions. Four identical balloons were used for their experiment. Each balloon was filled with helium. One balloon was left in a room at normal room temperature. The second balloon was placed in a room with temperatures ten degrees higher than normal room temperature. The third balloon was placed in a warm oven. The fourth balloon was placed in an automobile in 100° weather.

56. In the experiment above, the balloons were a(n)

A. independent variable.
B. dependent variable.
C. constant.
D. control.

57. In the experiment, the balloon left at room temperature was a(n)

A. independent variable.
B. dependent variable.
C. constant.
D. control.

58. In the experiment, the different temperature environments were the

A. independent variable.
B. dependent variable.
C. constant.
D. control.

59. In the experiment, the helium in each of the balloons was a(n)

A. independent variable.
B. dependent variable.
C. constant.
D. control.

60. In the experiment, the time of failure for each balloon was the

A. independent variable.
B. dependent variable.
C. constant.
D. control.

61. The idea stating that matter is made of small particles that are in constant motion is

A. Boyle's law.
B. Charles's law.
C. the kinetic theory of matter.
D. Archimedes' principle.

Written Response

The following questions should be answered in complete sentences on your own paper. Writing must be neat and legible. Good writing skills should be used throughout.

62. The solubility of potassium chloride in water is 34 g per 100 g of water at 20°C. A warm solution containing 100 g of potassium chloride in 200 g of water is cooled to 20°C. How many grams of potassium chloride will come out of solution? Show your work and units.

63. Complete the chart below. For each substance, you have been given enough information to determine the values that are missing.

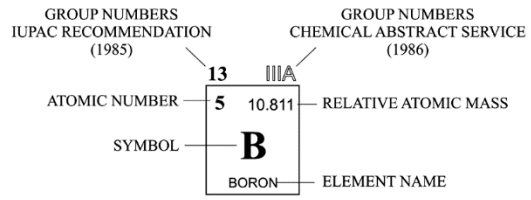
Substance	Symbol	Atomic No.	Mass No.	Protons	Neutrons	Electrons
Helium	He	2	4			
Magnesium	Mg	12			12	
Zinc	Zn	30	65			
Bromine	Br		80			35
Uranium	U				146	92

64. You have an opportunity to go into a science lab to perform flame tests. As part of the lab, you will be dipping a wire into chemical solutions and then holding the tip of the wire in a Bunsen burner flame. Your materials will include five beakers of solution, acid to clean the wire after you burn the chemical off each time, a Bunsen burner, and matches to start the burner. Make a comprehensive **list of safety rules** you should follow during this lab.

65. Think of five different objects in your home that are made entirely or partially from a synthetic polymer. For each one, determine what was used before the synthetic polymer became available.

66. An archaeologist finds some ancient pottery. The pottery has only one-fourth of its original amount of carbon-14. If the half-life of carbon-14 is 5,730 years, how old is the pottery?

PERIODIC TABLE OF THE ELEMENTS



PERIOD	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 1.0079 **H** HYDROGEN																	2 4.0026 **He** HELIUM
2	3 6.941 **Li** LITHIUM	4 9.0122 **Be** BERYLLIUM											5 10.811 **B** BORON	6 12.011 **C** CARBON	7 14.007 **N** NITROGEN	8 15.999 **O** OXYGEN	9 18.998 **F** FLUORINE	10 20.180 **Ne** NEON
3	11 22.990 **Na** SODIUM	12 24.305 **Mg** MAGNESIUM											13 26.982 **Al** ALUMINIUM	14 28.086 **Si** SILICON	15 30.974 **P** PHOSPHORUS	16 32.065 **S** SULPHUR	17 35.453 **Cl** CHLORINE	18 39.948 **Ar** ARGON
4	19 39.098 **K** POTASSIUM	20 40.078 **Ca** CALCIUM	21 44.956 **Sc** SCANDIUM	22 47.867 **Ti** TITANIUM	23 50.942 **V** VANADIUM	24 51.996 **Cr** CHROMIUM	25 54.938 **Mn** MANGANESE	26 55.845 **Fe** IRON	27 58.933 **Co** COBALT	28 58.693 **Ni** NICKEL	29 63.546 **Cu** COPPER	30 65.39 **Zn** ZINC	31 69.723 **Ga** GALLIUM	32 72.64 **Ge** GERMANIUM	33 74.922 **As** ARSENIC	34 78.96 **Se** SELENIUM	35 79.904 **Br** BROMINE	36 83.80 **Kr** KRYPTON
5	37 85.468 **Rb** RUBIDIUM	38 87.62 **Sr** STRONTIUM	39 88.906 **Y** YTTRIUM	40 91.224 **Zr** ZIRCONIUM	41 92.906 **Nb** NIOBIUM	42 95.94 **Mo** MOLYBDENUM	43 (98) **Tc** TECHNETIUM	44 101.07 **Ru** RUTHENIUM	45 102.91 **Rh** RHODIUM	46 106.42 **Pd** PALLADIUM	47 107.87 **Ag** SILVER	48 112.41 **Cd** CADMIUM	49 114.82 **In** INDIUM	50 118.71 **Sn** TIN	51 121.76 **Sb** ANTIMONY	52 127.60 **Te** TELLURIUM	53 126.90 **I** IODINE	54 131.29 **Xe** XENON
6	55 132.91 **Cs** CAESIUM	56 137.33 **Ba** BARIUM	57-71 **La-Lu** Lanthanide	72 178.49 **Hf** HAFNIUM	73 180.95 **Ta** TANTALUM	74 183.84 **W** TUNGSTEN	75 186.21 **Re** RHENIUM	76 190.23 **Os** OSMIUM	77 192.22 **Ir** IRIDIUM	78 195.08 **Pt** PLATINUM	79 196.97 **Au** GOLD	80 200.59 **Hg** MERCURY	81 204.38 **Tl** THALLIUM	82 207.2 **Pb** LEAD	83 208.98 **Bi** BISMUTH	84 (209) **Po** POLONIUM	85 (210) **At** ASTATINE	86 (222) **Rn** RADON
7	87 (223) **Fr** FRANCIUM	88 (226) **Ra** RADIUM	89-103 **Ac-Lr** Actinide	104 (261) **Rf** RUTHERFORDIUM	105 (262) **Db** DUBNIUM	106 (266) **Sg** SEABORGIUM	107 (264) **Bh** BOHRIUM	108 (277) **Hs** HASSIUM	109 (268) **Mt** MEITNERIUM	110 (281) **Uun** UNUNNILIUM	111 (272) **Uuu** UNUNUNIUM	112 (285) **Uub** UNUNBIUM		114 (289) **Uuq** UNUNQUADIUM				

LANTHANIDE

6	57 138.91 **La** LANTHANUM	58 140.12 **Ce** CERIUM	59 140.91 **Pr** PRASEODYMIUM	60 144.24 **Nd** NEODYMIUM	61 (145) **Pm** PROMETHIUM	62 150.36 **Sm** SAMARIUM	63 151.96 **Eu** EUROPIUM	64 157.25 **Gd** GADOLINIUM	65 158.93 **Tb** TERBIUM	66 162.50 **Dy** DYSPROSIUM	67 164.93 **Ho** HOLMIUM	68 167.26 **Er** ERBIUM	69 168.93 **Tm** THULIUM	70 173.04 **Yb** YTTERBIUM	71 174.97 **Lu** LUTETIUM

ACTINIDE

7	89 (227) **Ac** ACTINIUM	90 232.04 **Th** THORIUM	91 231.04 **Pa** PROTACTINIUM	92 238.03 **U** URANIUM	93 (237) **Np** NEPTUNIUM	94 (244) **Pu** PLUTONIUM	95 (243) **Am** AMERICIUM	96 (247) **Cm** CURIUM	97 (247) **Bk** BERKELIUM	98 (251) **Cf** CALIFORNIUM	99 (252) **Es** EINSTEINIUM	100 (257) **Fm** FERMIUM	101 (258) **Md** MENDELEVIUM	102 (259) **No** NOBELIUM	103 (262) **Lr** LAWRENCIUM

IPC 1A Practice Exam Answer Key

Multiple Choice

1. C
2. D
3. B
4. C
5. D
6. D
7. A
8. B
9. B
10. C
11. A
12. B
13. B
14. C
15. C
16. B
17. B
18. D
19. A
20. A
21. A
22. B
23. B
24. B
25. C
26. C
27. A
28. A
29. D
30. B
31. A
32. A
33. B
34. A
35. B
36. C
37. D
38. D
39. C
40. C
41. C
42. A
43. B
44. A
45. D
46. D
47. D
48. A
49. D
50. A
51. A
52. B
53. C
54. C
55. D
56. C
57. D
58. A
59. C
60. B
61. C

Written Response

62. The solution holds 100 g/200 g at 30 degrees. However, 100 g of water can hold only 34 g at 20 degrees. So, 2×34 g = 68 g. The cooler solution will drop 32 g of solute.

63. Some safety rules might include:
    - Know where safety equipment is.
    - Read all instructions.

- Never work alone.
- Follow all acid safety rules.
- Check glassware for cracks or nicks and don't use any damaged glassware.
- Wear an apron.
- Wear goggles.
- Tie hair and loose clothing securely back.
- Notify your instructor immediately of any accidents.
- Ask about safe disposal of materials.
- Never eat or drink anything in the lab.

64.

Substance	Symbol	Atomic No.	Mass No.	Protons	Neutrons	Electrons
Helium	He	2	4	2	2	2
Magnesium	Mg	12	12	12	12	12
Zinc	An	30	65	30	35	30
Bromine	Br	35	80	35	45	35
Uranium	U	92	238	92	146	92

65. Many, many answers would be acceptable. Yours might include some of the following: wooden objects replaced by plastic; cotton, linen, or wool items replaced by nylon or acrylics; paper replaced by plastic wrap; padding materials replaced by polymer foam.

66. After one half-life, the sample would be 5,730 years old and would have half of its original amount of carbon-14. After another half-life, the sample would be 11,460 years old and half of one half would be one-quarter of the original amount of carbon-14 in the sample. Therefore, the sample is 11,460 years old.

Texas Essential Knowledge and Skills
IPC 1 – Integrated Physics and Chemistry

§112.38. Integrated Physics and Chemistry, Beginning with School Year 2010-2011 (One Credit).

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisites: none. This course is recommended for students in Grade 9 or 10.

(b) Introduction.

(1) Integrated Physics and Chemistry. In Integrated Physics and Chemistry, students conduct laboratory and field investigations, use scientific methods during investigation, and make informed decisions using critical thinking and scientific problem solving. This course integrates the disciplines of physics and chemistry in the following topics: force, motion, energy, and matter.

(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 are 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 (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in 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; and

(B) 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 during laboratory and field investigations. 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) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(C) collect data and make measurements with precision;

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

(E) communicate valid conclusions.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions. 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 connections between physics and chemistry and future careers; and

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

(4) Science concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to:

(A) describe and calculate an object's motion in terms of position, displacement, speed, and acceleration;

(B) measure and graph distance and speed as a function of time using moving toys;

(C) investigate how an object's motion changes only when a net force is applied, including activities and equipment such as toy cars, vehicle restraints, sports activities, and classroom objects;

(D) assess the relationship between force, mass, and acceleration, noting the relationship is independent of the nature of the force, using equipment such as dynamic carts, moving toys, vehicles, and falling objects;

(E) apply the concept of conservation of momentum using action and reaction forces such as students on skateboards;

(F) describe the gravitational attraction between objects of different masses at different distances, including satellites; and

(G) examine electrical force as a universal force between any two charged objects and compare the relative strength of the electrical force and gravitational force.

(5) Science concepts. The student recognizes multiple forms of energy and knows the impact of energy transfer and energy conservation in everyday life. The student is expected to:

(A) recognize and demonstrate that objects and substances in motion have kinetic energy such as vibration of atoms, water flowing down a stream moving pebbles, and bowling balls knocking down pins;

(B) demonstrate common forms of potential energy, including gravitational, elastic, and chemical, such as a ball on an inclined plane, springs, and batteries;

(C) demonstrate that moving electric charges produce magnetic forces and moving magnets produce electric forces;

(D) investigate the law of conservation of energy;

(E) investigate and demonstrate the movement of thermal energy through solids, liquids, and gases by convection, conduction, and radiation such as in weather, living, and mechanical systems;

(F) evaluate the transfer of electrical energy in series and parallel circuits and conductive materials;

(G) explore the characteristics and behaviors of energy transferred by waves, including acoustic, seismic, light, and waves on water as they superpose on one another, bend around corners, reflect off surfaces, are absorbed by materials, and change direction when entering new materials;

(H) analyze energy conversions such as those from radiant, nuclear, and geothermal sources; fossil fuels such as coal, gas, oil; and the movement of water or wind; and

(I) critique the advantages and disadvantages of various energy sources and their impact on society and the environment.

(6) Science concepts. The student knows that relationships exist between the structure and properties of matter. The student is expected to:

(A) examine differences in physical properties of solids, liquids, and gases as explained by the arrangement and motion of atoms, ions, or molecules of the substances and the strength of the forces of attraction between those particles;

(B) relate chemical properties of substances to the arrangement of their atoms or molecules;

(C) analyze physical and chemical properties of elements and compounds such as color, density, viscosity, buoyancy, boiling point, freezing point, conductivity, and reactivity;

(D) relate the physical and chemical behavior of an element, including bonding and classification, to its placement on the Periodic Table; and

(E) relate the structure of water to its function as a solvent and investigate the properties of solutions and factors affecting gas and solid solubility, including nature of solute, temperature, pressure, pH, and concentration.

(7) Science concepts. The student knows that changes in matter affect everyday life. The student is expected to:

(A) investigate changes of state as it relates to the arrangement of particles of matter and energy transfer;

(B) recognize that chemical changes can occur when substances react to form different substances and that these interactions are largely determined by the valence electrons;

(C) demonstrate that mass is conserved when substances undergo chemical change and that the number and kind of atoms are the same in the reactants and products;

(D) analyze energy changes that accompany chemical reactions such as those occurring in heat packs, cold packs, and glow sticks and classify them as exothermic or endothermic reactions;

(E) describe types of nuclear reactions such as fission and fusion and their roles in applications such as medicine and energy production; and

(F) research and describe the environmental and economic impact of the end-products of chemical reactions such as those that may result in acid rain, degradation of water and air quality, and ozone depletion.

Source: The provisions of this §112.38 adopted to be effective August 4, 2009, 34 TexReg 5063.