Virginia

Standards of Learning Assessments

Blueprint

End-Of-Course

Chemistry Test

for the

2003 Science Standards of Learning

This revised blueprint will be effective with the 2005-2006 administration of the Standards of Learning Tests.

Chemistry Blueprint

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Standards of Learning (SOL) Test Blueprint

Introduction

What is a test blueprint?

A test blueprint is a guide for test construction and use. The Standards of Learning (SOL) test blueprints serve a number of purposes. They serve as a guide to test developers as they write test questions and construct the SOL tests. These blueprints also serve as a guide to educators, parents, and students in that they show:

(a) SOL covered by the test and which, if any, have been excluded;
(b) which SOL are assigned to each reporting category;
(c) the number of test items in each reporting category and on the total test;
(d) general information about how the test questions were constructed; and
(e) the materials that students are allowed to use while taking the test.

How is the test blueprint organized?

The blueprint contains the following information:

1. **Test Development Guidelines:** guidelines used by the testing contractor and the members of the Content Review Committees in developing the SOL tests. This section contains two parts:

   A. General Considerations — lists general considerations that were used in developing the test as well as considerations specific to a particular content area.

   B. Ancillary Materials — lists any materials that students are allowed to use while taking the test.

2. **Blueprint Summary Table:** — a summary of the blueprint which displays the following information:

   - reporting categories for the test;
   - number of test items in each reporting category;
   - Standards of Learning (SOL) included in each reporting category. SOL are identified by numbers and letters that correspond to the original SOL document;
   - SOL which are excluded from the SOL test;
   - number of operational items on the test;
   - number of field-test items on the test; and
   - total number of items (operational and field-test items) on the test.

3. **Expanded Blueprint:** provides the same information as the Blueprint Summary Table except that the full text of each SOL is included.

What is a reporting category?

Each test assesses a number of SOL. In the test blueprint, SOL are grouped into categories that represent related content or skills. These categories are labeled *Reporting Categories*. For example, a reporting category for the chemistry test is "Atomic Structure and Periodic Relationships." Each of the SOL in this reporting category addresses understanding of the structure of atoms and the organization of the periodic table. When the results of the SOL tests are reported, the scores will be presented in terms of scores for each reporting category and a total test score.

Are some SOL assigned to more than one reporting category?

Letters under a particular SOL are sometimes coded to different reporting categories. For example, the SOL CH.4a which deals with the Avogadro's principle is assigned to the reporting category "Molar Relationships" in the test. However, SOL CH 4.c which deals with the partial pressure in chemical reactions is assigned to the reporting category "Phases of Matter and Kinetic Molecular Theory." Each lettered SOL is assigned to only one reporting category.

Will all SOL listed in the blueprint be assessed each time the SOL tests are given?

Each SOL will not be assessed on every SOL test form. To keep the length of a test reasonable, the test will measure a selection of the SOL within a reporting category. However, every SOL that is not excluded in the blueprint is eligible for inclusion on each form of an SOL test. Over time all SOL in a reporting category will be assessed.

Chemistry Test Development Guidelines

A. General Considerations

1. All items included in this test will address the knowledge and skills specified in the 2003 Virginia Standards of Learning in Chemistry.

2. Items will be examined for any content or context that stereotypes, offends, or unfairly penalizes students based on age, gender, economic status, race, ethnicity, religion, or geographic region.

3. The test will be untimed.

4. There is no penalty for guessing. Students will be scored on the number of correct answers out of the total number of operational items on the test.

5. The questions will be appropriate in terms of understandings and experiences that accompany an active science program.

6. Information will be presented through written text or through visual materials such as graphs, tables, models, or other illustrations.

7. Questions will require students to apply previously acquired knowledge and/or to use information that is provided in a prompt.

8. Measurements will be given in SI (metric), or English units where appropriate.

9. Students will be permitted scratch paper at any time during the test.

10. Four-function, scientific, or graphing calculators may be used on the test.

11. Students will be permitted to use standard (e.g., inches) and metric rulers during the test.

12. Students will be permitted to use a Periodic Table of Elements during the test. A reduced copy of this table follows the expanded blueprint. Students will be provided a larger version for use during the test.

B. Ancillary Materials

Refer to the current examiner's manual or the Department of Education's Web site for ancillary materials that may be used.

Chemistry Test
Blueprint Summary Table

Reporting Categories	Number of Items	Chemistry SOL
Scientific Investigation	10	CH.1a-i
Atomic Structure and Periodic Relationships	8	CH.2a-i
Nomenclature, Chemical Formulas, and Reactions	16	CH.3a-f
Molar Relationships	8	CH.4a, b, e-g
Phases of Matter and Kinetic Molecular Theory	8	CH.4c, d CH.5a-f
SOL Excluded From This Test		None
Total Number of Operational Items	50	
Field-Test Items*	10	
Total Number of Items	60	

The topics of organic and biochemistry may appear in context in other questions, but will *not* be tested or reported separately from the categories above.

*These field-test items will *not* be used to compute students' scores on the test.

Expanded Blueprint

Reporting Category: Scientific Investigation
Number of Items: 10

Chemistry SOL in This Reporting Category:

CH.1 The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data. Key concepts include

a) designated laboratory techniques;
b) safe use of chemicals and equipment;
c) proper response to emergency situations;
d) manipulation of multiple variables, using repeated trials;
e) accurate recording, organization, and analysis of data through repeated trials;
f) mathematical and procedural error analysis;
g) mathematical manipulations (SI units, scientific notation, linear equations, graphing, ratio and proportion, significant digits, dimensional analysis);
h) use of appropriate technology including computers, graphing calculators, and probeware, for gathering data and communicating results; and
i) construction and defense of a scientific viewpoint (the nature of science).

Reporting Category: Atomic Structure and Periodic Relationships
Number of Items: 8

Chemistry SOL in This Reporting Category:

CH.2 The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure. The periodic table is a tool used for the investigations of

a) average atomic mass, mass number, and atomic number;
b) isotopes, half lives, and radioactive decay;
c) mass and charge characteristics of subatomic particles;
d) families or groups;
e) series and periods;
f) trends including atomic radii, electronegativity, shielding effect, and ionization energy;
g) electron configurations, valence electrons, and oxidation numbers;
h) chemical and physical properties; and
i) historical and quantum models.

Reporting Category: Nomenclature, Chemical Formulas, and Reactions
Number of Items: 16

Chemistry SOL in This Reporting Category:

CH.3 The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations. Key concepts include

a) nomenclature;
b) balancing chemical equations;
c) writing chemical formulas (molecular, structural, and empirical; and Lewis diagrams);
d) bonding types (ionic and covalent);
e) reaction types (synthesis, decomposition, single and double replacement, oxidation-reduction, neutralization, exothermic, and endothermic); and
f) reaction rates and kinetics (activation energy, catalysis, and degree of randomness).

Reporting Category: Molar Relationships
Number of Items: 8

Chemistry SOL in This Reporting Category:

CH.4 The student will investigate and understand that quantities in a chemical reaction are based on molar relationships. Key concepts include

a) Avogadro's principle and molar volume;
b) stoichiometric relationships;
e) solution concentrations;
f) chemical equilibrium; and
g) acid/base theory: strong electrolytes, weak electrolytes, and nonelectrolytes; dissociation and ionization; pH and pOH; and the titration process.

Reporting Category: Phases of Matter and Kinetic Molecular Theory
Number of Items: 8

Chemistry SOL in This Reporting Category

CH.4 The student will investigate and understand that quantities in a chemical reaction are based on molar relationships. Key concepts include
- c) partial pressure; and
- d) gas laws;

CH.5 The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include
- a) pressure, temperature, and volume;
- b) vapor pressure;
- c) phase changes;
- d) molar heats of fusion and vaporization;
- e) specific heat capacity; and
- f) colligative properties.

Periodic Table of the Elements

Atomic mass — Symbol — Atomic number — Electron configuration — Selected Oxidation States — Name

28.0855 | - 4, + 2, + 4 | **Si** | 14 | *[Ne]*3s²3p²* | Silicon

* The bracketed area represents the electron configuration of a noble gas.

Group 1 … 18 | Period 1 … 7

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00794 +1 -1 **H** 1 *1s* Hydrogen																	4.00260 **He** 2 *1s²* Helium
2	6.941 +1 **Li** 3 *1s²2s¹* Lithium	9.01218 +2 **Be** 4 *1s²2s²* Beryllium	Transition Elements										10.81 +3 **B** 5 *1s²2s²2p¹* Boron	12.0111 -4 +2 +4 **C** 6 *1s²2s²2p²* Carbon	14.0067 -3 -2 -1 +1 +2 +3 +4 +5 **N** 7 *1s²2s²2p³* Nitrogen	15.9994 -2 **O** 8 *1s²2s²2p⁴* Oxygen	18.998403 -1 **F** 9 *1s²2s²2p⁵* Fluorine	20.179 0 **Ne** 10 *1s²2s²2p⁶* Neon
3	22.98977 +1 **Na** 11 *[Ne]3s¹* Sodium	24.305 +2 **Mg** 12 *[Ne]3s²* Magnesium	3	4	5	6	7	8	9	10	11	12	26.98154 +3 **Al** 13 *[Ne]3s²3p¹* Aluminum	28.0855 -4 +2 +4 **Si** 14 *[Ne]3s²3p²* Silicon	30.97376 -3 +3 +5 **P** 15 *[Ne]3s²3p³* Phosphorus	32.06 -2 +4 +6 **S** 16 *[Ne]3s²3p⁴* Sulfur	35.453 -1 +1 +3 +5 +7 **Cl** 17 *[Ne]3s²3p⁵* Chlorine	39.948 0 **Ar** 18 *[Ne]3s²3p⁶* Argon
4	39.0983 +1 **K** 19 *[Ar]4s¹* Potassium	40.08 +2 **Ca** 20 *[Ar]4s²* Calcium	44.9559 +3 **Sc** 21 *[Ar]3d¹4s²* Scandium	47.88 +2 +3 +4 **Ti** 22 *[Ar]3d²4s²* Titanium	50.9415 +2 +3 +4 +5 **V** 23 *[Ar]3d³4s²* Vanadium	51.996 +2 +3 +6 **Cr** 24 *[Ar]3d⁵4s¹* Chromium	54.9380 +2 +3 +4 +6 +7 **Mn** 25 *[Ar]3d⁵4s²* Manganese	55.847 +2 +3 **Fe** 26 *[Ar]3d⁶4s²* Iron	58.9332 +2 +3 **Co** 27 *[Ar]3d⁷4s²* Cobalt	58.69 +2 +3 **Ni** 28 *[Ar]3d⁸4s²* Nickel	63.546 +1 +2 **Cu** 29 *[Ar]3d¹⁰4s¹* Copper	65.39 +2 **Zn** 30 *[Ar]3d¹⁰4s²* Zinc	69.72 +3 **Ga** 31 *[Ar]3d¹⁰4s²4p¹* Gallium	72.59 +2 +4 **Ge** 32 *[Ar]3d¹⁰4s²4p²* Germanium	74.9216 -3 +3 +5 **As** 33 *[Ar]3d¹⁰4s²4p³* Arsenic	78.96 -2 +4 +6 **Se** 34 *[Ar]3d¹⁰4s²4p⁴* Selenium	79.904 -1 +1 +5 **Br** 35 *[Ar]3d¹⁰4s²4p⁵* Bromine	83.80 0 +2 **Kr** 36 *[Ar]3d¹⁰4s²4p⁶* Krypton
5	85.4678 +1 **Rb** 37 *[Kr]5s¹* Rubidium	87.62 +2 **Sr** 38 *[Kr]5s²* Strontium	88.9059 +3 **Y** 39 *[Kr]4d¹5s²* Yttrium	91.224 +4 **Zr** 40 *[Kr]4d²5s²* Zirconium	92.9064 +3 +5 **Nb** 41 *[Kr]4d⁴5s¹* Niobium	95.94 +3 +6 **Mo** 42 *[Kr]4d⁵5s¹* Molybdenum	(98) +4 +6 +7 **Tc** 43 *[Kr]4d⁶5s¹* Technetium	101.07 +3 **Ru** 44 *[Kr]4d⁷5s¹* Ruthenium	102.906 +3 **Rh** 45 *[Kr]4d⁸5s¹* Rhodium	106.42 +2 +4 **Pd** 46 *[Kr]4d¹⁰5s⁰* Palladium	107.868 +1 **Ag** 47 *[Kr]4d¹⁰5s¹* Silver	112.41 +2 **Cd** 48 *[Kr]4d¹⁰5s²* Cadmium	114.82 +3 **In** 49 *[Kr]4d¹⁰5s²5p¹* Indium	118.71 +2 +4 **Sn** 50 *[Kr]4d¹⁰5s²5p²* Tin	121.75 -3 +3 +5 **Sb** 51 *[Kr]4d¹⁰5s²5p³* Antimony	127.60 -2 +4 +6 **Te** 52 *[Kr]4d¹⁰5s²5p⁴* Tellurium	126.905 -1 +1 +5 +7 **I** 53 *[Kr]4d¹⁰5s²5p⁵* Iodine	131.29 0 +2 +4 +6 **Xe** 54 *[Kr]4d¹⁰5s²5p⁶* Xenon
6	132.905 +1 **Cs** 55 *[Xe]6s¹* Cesium	137.33 +2 **Ba** 56 *[Xe]6s²* Barium	138.906 +3 **La** 57 *[Xe]5d¹6s²* Lanthanum	178.49 +4 **Hf** 72 *[Xe]4f¹⁴5d²6s²* Hafnium	180.948 +5 **Ta** 73 *[Xe]4f¹⁴5d³6s²* Tantalum	183.85 +6 **W** 74 *[Xe]4f¹⁴5d⁴6s²* Tungsten	186.207 +4 +6 +7 **Re** 75 *[Xe]4f¹⁴5d⁵6s²* Rhenium	190.2 +3 +4 **Os** 76 *[Xe]4f¹⁴5d⁶6s²* Osmium	192.22 +3 +4 **Ir** 77 *[Xe]4f¹⁴5d⁷6s²* Iridium	195.08 +2 +4 **Pt** 78 *[Xe]4f¹⁴5d⁹6s¹* Platinum	196.967 +1 +3 **Au** 79 *[Xe]4f¹⁴5d¹⁰6s¹* Gold	200.59 +1 +2 **Hg** 80 *[Xe]4f¹⁴5d¹⁰6s²* Mercury	204.383 +1 +3 **Tl** 81 *[Xe]4f¹⁴5d¹⁰6s²6p¹* Thallium	207.2 +2 +4 **Pb** 82 *[Xe]4f¹⁴5d¹⁰6s²6p²* Lead	208.980 +3 +5 **Bi** 83 *[Xe]4f¹⁴5d¹⁰6s²6p³* Bismuth	(209) +2 +4 **Po** 84 *[Xe]4f¹⁴5d¹⁰6s²6p⁴* Polonium	(210) **At** 85 *[Xe]4f¹⁴5d¹⁰6s²6p⁵* Astatine	(222) 0 **Rn** 86 *[Xe]4f¹⁴5d¹⁰6s²6p⁶* Radon
7	(223) +1 **Fr** 87 *[Rn]7s¹* Francium	226.025 +2 **Ra** 88 *[Rn]7s²* Radium	227.028 +3 **Ac** 89 *[Rn]6d¹7s²* Actinium	(261) **Rf** 104 *[Rn]5f¹⁴6d²7s²* Rutherfordium	(262) **Db** 105 *[Rn]5f¹⁴6d³7s²* Dubnium	(263) **Sg** 106 *[Rn]5f¹⁴6d⁴7s²* Seaborgium	(262) **Bh** 107 *[Rn]5f¹⁴6d⁵7s²* Bohrium	(265) **Hs** 108 *[Rn]5f¹⁴6d⁶7s²* Hassium	(266?) **Mt** 109 *[Rn]5f¹⁴6d⁷7s²* Meitnerium	(269?) 110									

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

Metals ◄ ► Nonmetals

Lanthanoid Series	140.12 +3 +4 **Ce** 58 *[Xe]4f¹5d¹6s²* Cerium	140.908 +3 **Pr** 59 *[Xe]4f³6s²* Praseodymium	144.24 +3 **Nd** 60 *[Xe]4f⁴6s²* Neodymium	(145) +3 **Pm** 61 *[Xe]4f⁵6s²* Promethium	150.36 +2 +3 **Sm** 62 *[Xe]4f⁶6s²* Samarium	151.96 +2 +3 **Eu** 63 *[Xe]4f⁷6s²* Europium	157.25 +3 **Gd** 64 *[Xe]4f⁷5d¹6s²* Gadolinium	158.925 +3 **Tb** 65 *[Xe]4f⁹6s²* Terbium	162.50 +3 **Dy** 66 *[Xe]4f¹⁰6s²* Dysprosium	164.930 +3 **Ho** 67 *[Xe]4f¹¹6s²* Holmium	167.26 +3 **Er** 68 *[Xe]4f¹²6s²* Erbium	168.934 +3 **Tm** 69 *[Xe]4f¹³6s²* Thulium	173.04 +2 +3 **Yb** 70 *[Xe]4f¹⁴6s²* Ytterbium	174.967 +3 **Lu** 71 *[Xe]4f¹⁴5d¹6s²* Lutetium
Actinoid Series	232.038 +4 **Th** 90 *[Rn]6d²7s²* Thorium	231.036 +4 +5 **Pa** 91 *[Rn]5f²6d¹7s²* Protactinium	238.029 +3 +4 +5 +6 **U** 92 *[Rn]5f³6d¹7s²* Uranium	237.048 +3 +4 +5 +6 **Np** 93 *[Rn]5f⁴6d¹7s²* Neptunium	(244) +3 +4 +5 +6 **Pu** 94 *[Rn]5f⁶7s²* Plutonium	(243) +3 +4 +5 +6 **Am** 95 *[Rn]5f⁷7s²* Americium	(247) +3 **Cm** 96 *[Rn]5f⁷6d¹7s²* Curium	(247) +3 +4 **Bk** 97 *[Rn]5f⁹7s²* Berkelium	(251) +3 **Cf** 98 *[Rn]5f¹⁰7s²* Californium	(252) **Es** 99 *[Rn]5f¹¹7s²* Einsteinium	(257) **Fm** 100 *[Rn]5f¹²7s²* Fermium	(258) **Md** 101 *[Rn]5f¹³7s²* Mendelevium	(259) **No** 102 *[Rn]5f¹⁴7s²* Nobelium	(260) **Lr** 103 *[Rn]5f¹⁴6d¹7s²* Lawrencium

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