

Introducing the

Virginia Standards of Learning

*End
of
Course*

The complete set of items that appeared on the Spring 2000 Standards of Learning test taken by most public school students in Virginia is presented in the following pages. The intent of this release of these test questions is to provide parents and teachers additional information to accompany the Student Performance Report and/or the Parent Report.

The information accompanying each test question is broken into several components:

Reporting Category: Matches the score report and allows for identification of strengths and weaknesses indicated by student scores.

Standard of Learning: Presents the SOL used in developing the assessment question.

Builds On: Indicates what the student has studied in previous course work.

Instruction: Provides information for teachers to use as the SOL is incorporated into instruction.

The answer to each question can be found in the back of the booklet.

Virginia
Standards of Learning Assessments

Chemistry

End of Course

Reporting Category: Scientific Investigation

A. Standard of Learning: 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.

Builds On: Work with variables begins in the fifth grade SOL and increases in complexity throughout the study of the science SOL.

A

1 The following data are obtained in the laboratory:

- (a) The mass of a clean, dry 250 mL beaker
- (b) The mass of the same beaker containing an unknown quantity of magnesium sulfate

The mass of the magnesium sulfate is obtained by subtracting (a) from (b). Which of the following will provide the most accurate results?

- A Measurements should be taken using the same balance.
- B The temperature of the room must remain constant.
- C The barometric pressure should be recorded.
- D A calculator should be used to subtract (a) from (b).

Instruction: Provide students an opportunity to determine the mass of a substance container such as a beaker or cup.

B. Standard of Learning: 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:

b) safe use of chemicals and equipment.

Builds On: Work with variables begins in the fifth grade SOL and increases in complexity throughout the study of the science SOL.

B

2 Many reactions are taken to completion by heating the reaction mixture in a test tube. Each of the following would be a safe practice *except* —

- F heating the test tube gently to prevent the solution from boiling over
- G pointing the test tube away from others so that no one is injured
- H placing a stopper in the test tube to prevent gas from escaping
- J holding the test tube with test tube clamps to avoid touching hot objects

Instruction: Provide students information to understand proper safety procedures for heating a reaction mixture in a test tube.

Chemistry

End of Course

A. Standard of Learning: 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:

d) multiple variables are manipulated with repeated trials.

Builds On: Work with repeated trials with variables begins with the sixth grade SOL and increases in complexity throughout the study of the science SOL.

A

3

Trial	Volume	Pressure	Temperature
1	100 mL	250 mm Hg	298 K
2	300 mL	83 mm Hg	298 K
3	500 mL	50 mm Hg	298 K

A student wants to study the effects of volume on gas pressure. During his experiment, he recorded the above data. How could he now study the effects of temperature on gas pressure?

A Vary the temperature but keep the gas volume constant
 B Vary the volume of the gas only
 C Vary the pressure and temperature of the gas
 D Vary the temperature and volume of the gas

Instruction: Provide students an opportunity to analyze the results of an experiment and to determine how to change the experiment to study another variable.

B. Standard of Learning: 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:

e) accurate recording, organizing, and analysis of data through repeated trials.

Builds On: Work with recording, organizing, and analyzing data begins with the second grade SOL and increases in complexity throughout the study of the science SOL.

B

4

Which salt's solubility in water is least affected by temperature?

F NaClO_3
 G KNO_3
 H KBr
 J NaCl

5

$$\text{A} + \text{B} \xrightarrow{\text{catalyst}} \text{AB}$$

A student conducted an experiment to study the effects of temperature on this chemical reaction. The student's experimental conditions are shown below.

	Trial Number			
	1	2	3	4
Temperature	17°C	18°C	20°C	16°C
Amount of catalyst	1 mg	2 mg	3 mg	4 mg
Amount of A	5g	5g	5g	5g
Amount of B	7g	7g	7g	7g
Time for reaction to complete (min)	10	8	5	3

Which of the following would improve the student's experimental design?

A Use the same amount of catalyst in all trials
 B Keep all tubes at 18°C
 C Keep the reaction time constant
 D Decrease the quantity of reactants

Instruction: Provide students an opportunity to analyze the graph of results for an experiment to determine how one variable affects the other; and to analyze a table of results for an experiment to determine how to improve the experimental design.

Chemistry

End of Course

A. Standard of Learning: 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:

f) mathematical and procedural error analysis.

Builds On: Work with identifying numerical data that are contradictory or unusual in experimental results begins in the fourth grade SOL and increases in complexity throughout the study of science.

A

6 A student massed a piece of iron on a balance. The most sensitive beam was marked off in 0.1 g intervals. The student reported the iron's mass as 12.34 g. Which of the digits in the measurement is estimated?

- F 1
- G 2
- H 3
- J 4

7 A student measured the temperature of a boiling solution and found it to be 56.0°C at standard pressure. The theoretical temperature of that boiling solution is 55.0°C. What is the percent of error in the student's measurement?

- A 18%
- B 1.8%
- C 0.18%
- D 0.018%

Instruction: Provide students an opportunity to analyze and report the weight of an object on a decigram balance and to determine the percent of error between the experimental and theoretical temperatures.

Chemistry

End of Course

A. Standard of Learning: 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:

g) mathematical manipulations (SI units, scientific notation, linear equations, graphing, ratio and proportion, significant digits, dimensional analysis, use of scientific calculator).

Builds On: Work with gathering, charting, and graphing data begins with the third grade SOL and increases in complexity through the study of science.

A

8 How many significant digits are in 0.003450?

F 3
G 4
H 6
J 7

9 A 0.500 L solution of 6 M HCl has to be made. How much 12 M HCl is needed?

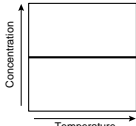
A 0.250 L
B 2.50 L
C 25.0 L
D 2500 L

10

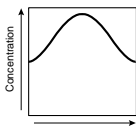
Generalization: As temperature increases, the solubility of a gas in a liquid usually decreases.

Which graph best represents the above generalization?

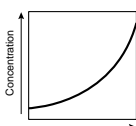
F



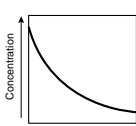
G



H



J



Instruction: Provide students an opportunity to determine the number of significant digits in a number; to determine how to dilute a substance to a desired concentration; and to represent generalizations with graphs.

Chemistry

End of Course

Reporting Category: Atomic Structure and Periodic Relationships

A. Standard of Learning: 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

b) isotopes/half-lives/nuclear particles.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

A

11

	Protons	Neutrons	Electrons
Substance A	8	8	8
Substance B	8	9	8

The data above indicate that —

A A and B are isotopes of the same element
 B A and B are different elements
 C A has a greater charge than B
 D A is more reactive than B

Instruction: Provide students an opportunity to analyze information about two elements to determine if they are isotopes of the same element.

B. Standard of Learning: 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

c) particle/mass charge.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

B

12 A neutral atom of calcium has 20 electrons. Calcium forms a 2+ ion. How many electrons does a calcium ion have?

F 2
 G 18
 H 20
 J 22

Instruction: Provide students an opportunity to identify the composition of an ion based on the number of electrons in a neutral atom.

Chemistry

End of Course

A. Standard of Learning: 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

d) families/groups.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

<p>A</p> <p>13 According to their placement on the periodic table, which elements would have the most similar atomic structures?</p> <p>A Sodium and scandium B Sodium and barium C Sodium and potassium D Sodium and aluminum</p>	<p>14 Oxygen and sulfur are in the same group (16) in the periodic table. This means that, in general, oxygen and sulfur —</p> <p>F will react only with each other G undergo similar reactions with other elements H can only react with elements in group 16 J combine only with elements in periods of 4 or higher</p>
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Instruction: Provide students an opportunity to investigate similarities between elements in the same group and to identify elements for similar atomic structure.

B. Standard of Learning: 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

f) trends/patterns: atomic/nuclear radii, electronegativity, shielding effect.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

<p>B</p>	<p>15 According to the periodic table, which of the following series of elements is ordered according to decreasing reactivity?</p> <p>A He, Cs, Si, Mg B Cs, Mg, Si, He C Si, He, Cs, Mg D Mg, Si, Cs, He</p>
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Instruction: Provide students an opportunity to arrange elements in order of decreasing reactivity using the periodic table.

Chemistry

End of Course

A. Standard of Learning: 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

g) electron configurations/oxidation numbers.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

A

16 With n representing the outermost energy level, the electron configuration for that level for elements in Group 14 is —

F $ns^2 np^1$

G $ns^2 np^2$

H $ns^2 np^3$

J $ns^2 np^4$

Instruction: Provide students an opportunity to represent the electron configuration for the outermost energy level of elements in the same group.

B. Standard of Learning: 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

h) chemical/physical properties.

Builds On: Work with the properties of materials begins with the sixth grade SOL and increases in complexity throughout the study of science.

B

17 An alkali metal will most readily react with —

A another alkali metal

B an alkaline earth metal

C a halogen

D a noble gas

Instruction: Provide students an opportunity to investigate what reacts with alkali metals.

Chemistry

End of Course

A. Standard of Learning: 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

i) historical/quantum models.

Builds On: Work with atoms and their structures begins with the sixth grade SOL and increases in complexity throughout the study of science.

A

18 Neils Bohr's contribution to modern atomic theory was the proposition that —

- F each atom has a specific number of positive charges
- G an atom has electrons in discrete energy levels
- H electrons have a definite mass that can be computed
- J atomic mass is determined by the number of protons and neutrons in an atom

Instruction: Provide students an opportunity to investigate Neil Bohr's contribution to modern atomic theory.

Reporting Category: Nomenclature, Chemical Formulas, and Reactions

B. Standard of Learning: 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.

Builds On: Work with mixtures, compounds, and elements begins with the sixth grade SOL and continues to increase in complexity throughout the study of science.

B

19 O_2 , N_2 , Cl_2 , and I_2 are examples of —

- A diatomic molecules
- B compounds
- C ionic compounds
- D atoms

20 Which of these is the correct name for KBr ?

- F Potassium bromine
- G Potassium bromide
- H Potassium bromate
- J Potassium bromite

Instruction: Provide students an opportunity to understand how to write chemical formula.

Chemistry

End of Course

A. Standard of Learning: 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:

b) balancing chemical equations.

Builds On: Work with mixtures, compounds, and elements begins with the sixth grade SOL and continues to increase in complexity throughout the study of science.

A

21 Which of the following is a balanced equation?

- A $C_2H_6(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$
- B $C_2H_6(g) + O_2(g) \rightarrow 3CO_2(g) + H_2O(g)$
- C $C_2H_6(g) + 2O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$
- D $C_2H_6(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

22

iron (III) chloride + sodium carbonate \rightarrow iron (III) carbonate + sodium chloride

Which of these is the balanced equation for the reaction described above?

- F $FeCl_3 + Na_2CO_3 \rightarrow Fe_2(CO_3)_3 + NaCl$
- G $2FeCl_3 + 2Na_2CO_3 \rightarrow 3Fe_2(CO_3)_3 + 3NaCl$
- H $2FeCl_3 + 3Na_2CO_3 \rightarrow Fe_2(CO_3)_3 + 6NaCl$
- J $3FeCl_3 + 2Na_2CO_3 \rightarrow 3Fe_2(CO_3)_3 + 6NaCl$

Instruction: Provide students an opportunity to translate from reaction written in words to a balanced chemical equation and to balance chemical equations.

Chemistry

End of Course

A. Standard of Learning: 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:

c) writing chemical formulas—molecular, structural, empirical, and Lewis diagrams.

Builds On: Work with mixtures, compounds, and elements begins with the sixth grade SOL and continues to increase in complexity throughout the study of science.

A

23 How many different elements are in ammonium hydroxide (NH_4OH)?

- A 2
- B 3
- C 4
- D 7

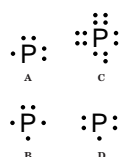
26 The name for NH_4F is —

- F ammonia fluoride
- G ammonium fluoride
- H nitrogen tetrahydrogen fluoride
- J ammonium fluorine

24 Which of the following best represents the reaction between sulfuric acid and calcium hydroxide?

- F $\text{H}_2\text{SO}_4 + \text{Ca}(\text{OH})_2 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$
- G $\text{HSO}_4 + \text{CaOH} \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$
- H $\text{H}_2\text{SO}_4 + \text{Ca}(\text{OH})_2 \rightarrow \text{CaSO}_4 + 2\text{H}_2\text{O}$
- J $\text{H}_2\text{SO}_4 + 2\text{Ca}(\text{OH})_2 \rightarrow 2\text{CaSO}_4 + 3\text{H}_2\text{O}$

27 The electron configuration for phosphorous is $1s^2 2s^2 2p^6 3s^2 3p^3$. What is the Lewis electron dot diagram for phosphorous?



25 $:\text{N}::\text{N}:$

According to the Lewis diagram, a nitrogen molecule has a —

- A bent structure and a double bond
- B linear structure and a triple bond
- C polar structure and a triple bond
- D circular structure and an ionic bond

28 Cobalt, a transition metal, can have an oxidation number of either 2+ or 3+.

Which of these represents the two possible chemical formulas for the chemical combination of cobalt with oxygen?

- F CoO , Co_2O_3
- G Co_2O_3 , Co_3O_2
- H Co_2O_3 , Co_3O_2
- J CoO , Co_3O_2

Instruction: Provide students an opportunity to describe a molecular shape and bond type based on the Lewis electron dot diagram, to analyze a Lewis diagram, to write the chemical equation for a given reaction, to determine the number of elements in a chemical formula, to identify a compound given its formula, and to identify possible chemical formulas based on a given oxidation number.

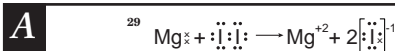
Chemistry

End of Course

A. Standard of Learning: 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:

d) bonding types—ionic, covalent.

Builds On: Work with mixtures, compounds, and elements begins with the sixth grade SOL and continues to increase in complexity throughout the study of science.



Which statement describes the above equation?

- A Magnesium transfers an electron to each atom of the iodine molecule.
- B The iodine molecule transfers two protons to magnesium.
- C Magnesium shares an electron with iodine.
- D Iodine becomes a free monatomic element.

30 Sodium iodide exhibits what type of bond?

- F Covalent
- G Ionic
- H Hydrogen
- J Metallic

Instruction: Provide students an opportunity to identify the bonding type in simple compounds and to identify a description of an ionic equation.

B. Standard of Learning: 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:

e) reaction types—synthesis, decomposition, single and double replacement, oxidation-reduction, neutralization, nuclear, exothermic and endothermic, spontaneous/non-spontaneous, dissociation ionization.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

B **31** Which of the following reactions is a decomposition reaction?

- A $\text{S}_8 + 8\text{O}_2 \rightarrow 8\text{SO}_2$
- B $\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{O}_2$
- C $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
- D $2\text{Na} + 2\text{AgCl} \rightarrow 2\text{NaCl} + 2\text{Ag}$

32 Which of the following reactions is a neutralization reaction?

- F $2\text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$
- G $\text{KOH} + \text{HNO}_3 \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$
- H $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- J $4\text{Fe}(\text{OH})_2 + 2\text{H}_2\text{O}_2 \rightarrow 4\text{Fe}(\text{OH})_3$

33 Which of the following reactions is an example of a single-replacement reaction?

- A $2\text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$
- B $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- C $\text{CO}_2 \rightarrow \text{C} + \text{O}_2$
- D $4\text{Fe}(\text{OH})_2 + \text{O}_2 \rightarrow 4\text{Fe}(\text{OH})_3$

Instruction: Provide students an opportunity to identify a decomposition reaction from a chemical equation; to identify a single-replacement reaction from a chemical equation; and to identify a neutralization reaction from a chemical equation.

Chemistry

End of Course

A. Standard of Learning: 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:

g) reaction rates and kinetics: activation energy, catalysis, degree of randomness.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

A

34 When seltzer tablets are placed in a glass of water, they fizz as they release a gas. To increase the speed that gas is released from each tablet, it would be best to increase the —

- F volume of the glass
- G temperature of the water
- H amount of water
- J hardness of the water

Instruction: Provide students an opportunity to investigate variables that increase reaction rates.

Reporting Category: Molar Relationships

B. Standard of Learning: 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, molar volume.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

B

35 What is the mass of one mole of S_8 ?

- A 32.1 mg
- B 32.1 g
- C 257 g
- D 4.8×10^{24} g

36 What is the mass of 2 moles of HgO ?

- F 108 g
- G 217 g
- H 323 g
- J 433 g

37 One mole of which of these compounds contains two moles of hydrogen atoms?

- A CH_4
- B H_2S
- C $NaOH$
- D NH_3

Instruction: Provide students an opportunity to determine the mass of a mole of an element; to determine the mass of two moles of a compound; and to determine when a mole of a compound contains two moles of an atom.

Chemistry

End of Course

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

b) stoichiometric relationships.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

<p>A</p> <p>38 A student has one mole of an unknown compound in a test tube. The mass of the compound is 58.5 g. The compound could be —</p> <p>F CaCl_2 G NaCl H AgNO_3 J CuCl</p>	<p>39 $2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$</p> <p>To produce 12 moles of water, how many moles of oxygen gas are needed?</p> <p>A 2 B 7 C 9 D 14</p>
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Instruction: Provide students an opportunity to determine a possible unknown compound, knowing its mole quantity and its given mass; and to determine the number of moles of oxygen gas needed to produce 12 moles of water in a given chemical equation.

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

f) chemical equilibrium.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

<p>B</p>	<p>40 $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$</p> <p>Ten moles of hydrogen and ten moles of iodine were put into a sealed 1-liter container at 490°C and allowed to react. After a while, there were still small amounts of unreacted hydrogen and iodine, but the hydrogen iodide concentration became constant. This is because —</p> <p>F there was not enough hydrogen to react with all of the iodine G the hydrogen iodide was reacting with the container H iodine loses its reactivity at high temperatures J the reaction reached a state of equilibrium</p>
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Instruction: Provide students an opportunity to investigate a reaction that reaches a state of chemical equilibrium.

Chemistry

End of Course

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

g) acid/base theory: strong/weak electrolytes, dissociation/ionization (pH, pOH), and titration.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

A

41 The pH Ranges of Common Indicators

Indicator	pH range	Color it turns if pH below range	Color it turns if pH above range
cresol red	0.2 - 1.8	red	yellow
methyl orange	3.2 - 4.4	red	yellow
methyl red	4.8 - 6.0	red	yellow
litmus	5.5 - 8.0	red	blue
bromothymol blue	6.0 - 7.6	yellow	blue
phenol red	6.6 - 8.0	yellow	red
thymol blue	8.0 - 9.6	yellow	blue
phenolphthalein	8.2 - 10.6	colorless	red

A solution of unknown pH was tested with two indicators. Methyl orange turned yellow and methyl red turned red. Which of these could be the pH of the solution?

A 3.0
B 4.0
C 4.6
D 6.2

42 Which of the following is *not* a base?

F $\text{Al}(\text{OH})_3$
G $\text{Ca}(\text{OH})_2$
H CaSO_4
J KOH

Instruction: Provide students an opportunity to determine possible pH values for a solution using a chart of common indicators and to identify compounds as bases or acids based on their formula.

Reporting Category: Phases of Matter and Kinetic Molecular Energy

B. Standard of Learning: 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.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

B

43 A sample of nitrogen gas is collected over water at 20°C . The vapor pressure of water at 20°C is 18 mmHg. What is the partial pressure of the nitrogen if the total pressure is 765 mmHg?

A 18 mmHg
B 747 mmHg
C 765 mmHg
D 783 mmHg

Instruction: Provide students an opportunity to determine partial pressure for nitrogen gas collected over water.

Chemistry

End of Course

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

d) gas laws.

Builds On: Work with changes in chemical composition begins with the sixth grade SOL and increases in complexity throughout the study of science.

B. Standard of Learning: 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:

d) phase changes.

Builds On: Work with the kinetic theory begins in Physical Science in the eighth grade and increases in complexity throughout the study of science.

A

- 44 A gas has a volume of 50.0 cm^3 at a temperature of -73°C . What volume would the gas occupy at a temperature of -123°C if the pressure stays constant?

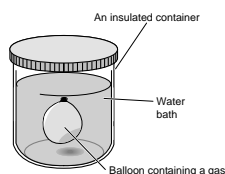
F 3.75 cm^3
G 5.0 cm^3
H 37.5 cm^3
J 50.0 cm^3

- 45 Ideal Gas Law constant = $8.31 \frac{\text{dm}^3 \cdot \text{kPa}}{\text{K} \cdot \text{mol}}$

How many moles of CO_2 are there in a 50.0 dm^3 sample of the gas at a pressure of 100.0 kPa and a temperature of 50°C ?

A 1.20 moles
B 1.86 moles
C 2.0 moles
D 12.0 moles

46



One way to increase the volume of the gas in the balloon in the diagram above is to —

F cool the gas in the balloon only
G increase the temperature of the water
H push the balloon farther down into the water bath
J seal the top of the water bath

B

- 47 Which phase change involves the absorption of heat?

A Gas to liquid
B Liquid to solid
C Liquid to gas
D Gas to solid

Instruction: Provide students an opportunity to investigate the phase change that involves the absorption or release of heat.

Instruction: Provide students an opportunity to apply the formula for Ideal Gas Law constant; to determine how to increase the volume of gas in a balloon submerged in water; and to determine change in volume when temperature decreases and pressure is constant.

Chemistry

End of Course

A. Standard of Learning: 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:

e) molar heats of fusion and vaporization.

Builds On: Work with vaporization and heat transfer begins in Physical Science in eighth grade and increases in complexity through the study of science.

A

48

Substance	Heat of Vaporization at the Boiling Point
Water (H ₂ O)	539 calories per gram
Alcohol (CH ₃ CH ₂ OH)	204 calories per gram
Chloroform (CHCl ₃)	59 calories per gram

What probably causes chloroform to have the lowest heat of vaporization?

F Smallest size of the molecules listed
 G Smallest mass of the molecules listed
 H Smallest intermolecular forces of attraction
 J Fewest number of bonds

Instruction: Provide students an opportunity to interpret a chart with information about vaporization and determine why one substance has the lowest heat of vaporization.

B. Standard of Learning: 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:

f) specific heat capacity.

Builds On: Work with heat transfer begins in Physical Science in eighth grade and increases in complexity through the study of science.

B

49 How many calories are required to raise the temperature of 105 g of water from 30.0°C to 70.0°C?

A 1.05×10^3
 B 2.10×10^3
 C 4.20×10^3
 D 8.40×10^3

Instruction: Provide students an opportunity to calculate the number of calories needed to raise the temperature of a given mass of water by a given number of degrees.

Chemistry

End
of
Course

A. Standard of Learning: 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:

g) solutions.

Builds On: Work with solubility begins in Physical Science in eighth grade and increases in complexity through the study of science.

A

50

	Molecular Weight	Density	Polar	Melting Point (°C)	Boiling Point (°C)
Benzene	78.11	.878	No	5.5	80
Methanol	32.04	.791	Yes	-97	65
Hexane	86.18	.659	No	-95	98
Octane	114.23	.702	No	-57	126
Water	18.0	1.0	Yes	0.0	100

A student needed to dissolve a substance that she knew was soluble in water. According to the chart, which other solvent would most likely dissolve the substance?

- F Benzene
- G Methanol
- H Hexane
- J Octane

Instruction: Provide students an opportunity to determine a solvent for a given substance based on a chart of information.