Student Name _____

Teacher Name _____

School _____

System _____

CHEMISTRY

ITEM SAMPLER

Tennessee End of Course Assessment

Chemistry

Chemistry

PEARSON

Chemistry Reference Sheet

Periodic Table of the Elements

Key

11	Atomic Number
Na	Element Symbol
Sodium	Element Name
22.990	Average Atomic Mass *

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.008																	2 He Helium 4.003
2	3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.409	31 Ga Gallium 69.723	32 Ge Germanium 72.610	33 As Arsenic 74.922	34 Se Selenium 78.960	35 Br Bromine 79.904	36 Kr Krypton 83.800
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.620	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.940	43 Tc Technetium (98)	44 Ru Ruthenium 101.070	45 Rh Rhodium 102.906	46 Pd Palladium 106.420	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.600	53 I Iodine 126.904	54 Xe Xenon 131.290
6	55 Cs Cesium 132.905	56 Ba Barium 137.327	57 La Lanthanum 138.905	72 Hf Hafnium 178.490	73 Ta Tantalum 180.948	74 W Tungsten 183.840	75 Re Rhenium 186.207	76 Os Osmium 190.230	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.967	80 Hg Mercury 200.590	81 Tl Thallium 204.383	82 Pb Lead 207.200	83 Bi Bismuth 208.980	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Cn Copernicium (285)	113 Uut ?	114 Fl Flerovium (289)	115 Uup ?	116 Lv Livermorium (292)	117 Uus ?	118 Uuo ?

58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.360	63 Eu Europium 151.964	64 Gd Gadolinium 157.250	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.040	71 Lu Lutetium 174.967
90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.

Turn over for Formulas, Constants, and Unit Conversions

Chemistry Reference Page
Formulas, Constants, and Unit Conversions

Formulas

Change in Enthalpy (Heat): $Q = m(\triangle T)c_p$

Heat of Fusion: $Q = m\triangle H_{fus}$

Ideal Gas Law: $PV = nRT$

Heat of Vaporization: $Q = m\triangle H_{vap}$

Density: $d = \frac{m}{V}$

Molarity (M) = $\frac{\text{mol of solute}}{\text{L of solution}}$

Combined Gas Law: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Molality (m) = $\frac{\text{mol of solute}}{\text{kg of solvent}}$

Boiling Point Elevation: $\triangle T_b = k_b \times m$

Freezing Point Depression: $\triangle T_f = k_f \times m$

Constants

Universal Gas Constant (R): $0.0821 \frac{\text{atm} \times \text{L}}{\text{mol} \times \text{K}}$, or equal to $8.31 \frac{\text{kPa} \times \text{L}}{\text{mol} \times \text{K}}$

Molar Volume at STP: $22.4 \frac{\text{L}}{\text{mol}}$

Avogadro's Number (1 mole): 6.02×10^{23}

Specific Heat Capacity of Liquid Water: c_p (H_2O) = $1.00 \frac{\text{cal}}{\text{g} \times °\text{C}} = 4.18 \frac{\text{J}}{\text{g} \times °\text{C}}$

Unit Conversions

1 atm = 760 mm Hg = 760 Torr = 101.3 kPa = $14.7 \frac{\text{lb}}{\text{in.}^2}$ = 29.92 in. Hg

K = °C + 273

1.000 calorie = 4.184 Joules

1 mL = 1 cm^3

1 L = 1,000 mL = 1,000 cm^3

giga (G) = 10^9, mega (M) = 10^6, kilo (k) = 10^3, hecto (h) = 10^2, deka (da) = 10^1

deci (d) = 10^{-1}, centi (c) = 10^{-2}, milli (m) = 10^{-3}, micro (μ) = 10^{-6}, nano (n) = 10^{-9}

Common Ions

Element Name	Charges	Ions	Charges	Ions	Charges
Silver (Ag^{1+})	1+	Ammonium (NH_4^+)	1+	Oxide (O^{2-})	2–
Zinc (Zn^{2+})	2+	Nitrate (NO_3^-)	1–	Sulfide (S^{2-})	2–
Scandium (Sc^{3+})	3+	Nitrite (NO_2^-)	1–	Sulfate (SO_4^{2-})	2–
Copper (Cu^{1+}, Cu^{2+})	1+, 2+	Hydrogen Carbonate (HCO_3^-)	1–	Sulfite (SO_3^{2-})	2–
Gold (Au^{1+}, Au^{3+})	1+, 3+	Perchlorate (ClO_4^-)	1–	Carbonate (CO_3^{2-})	2–
Cobalt (Co^{2+}, Co^{3+})	2+, 3+	Chlorate (ClO_3^-)	1–	Peroxide (O_2^{2-})	2–
Nickel (Ni^{2+}, Ni^{3+})	2+, 3+	Chlorite (ClO_2^-)	1–	Chromate (CrO_4^{2-})	2–
Lead (Pb^{2+}, Pb^{4+})	2+, 4+	Hypochlorite (ClO^-)	1–	Dichromate ($Cr_2O_7^{2-}$)	2–
Tin (Sn^{2+}, Sn^{4+})	2+, 4+			Phosphate (PO_4^{3-})	3–
Mercury (Hg^{1+}, Hg^{2+})	1+, 2+				
Iron (Fe^{2+}, Fe^{3+})	2+, 3+				
Titanium (Ti^{2+}, Ti^{3+}, Ti^{4+})	2+, 3+, 4+				
Chromium (Cr^{2+}, Cr^{3+})	2+, 3+				
Vanadium (V^{2+}, V^{3+}, V^{4+})	2+, 3+, 4+				
Manganese (Mn^{2+}, Mn^{3+}, Mn^{4+})	2+, 3+, 4+				

Turn over for Periodic Table of the Elements

Contents

Introduction to Chemistry

Content of tests

The testing program titled the *Tennessee End of Course Assessment* was established to meet the Tennessee mandate for end of course assessments in Tennessee secondary schools. These tests measure the Tennessee State Performance Indicators. Subject areas covered by the end of course assessments include Mathematics, Language Arts, History, and Science.

Test development

For the *Tennessee End of Course Assessment*, a staff of writers—composed of both teachers and professional test developers experienced in each of the content areas—researched and wrote the items. Professional editors and content specialists carefully reviewed all items and test directions for content and accuracy. To provide a large pool of items for final test selection, the test developers created approximately twice as many items as were needed in the final editions of the tests.

After items were field tested, student responses were analyzed. Professional content editors and researchers carefully reviewed items, their data, and test directions for content, suitability, and accuracy before including particular items and test directions in operational tests.

Test administration

Tennessee End of Course Assessments are given to students as they near the end of courses that are included in the program. Tests may be given midyear for block schedules or near the end of the school year.

This test contains 65 multiple-choice questions.

You will have ample time to read and answer each of the questions. The Chemistry test has been designed to be administered in one session and is not timed. The first 15 minutes are set aside to complete identifying data on the answer sheet.

A reference page, similar to the one located in this Item Sampler, will be in the front of the actual test. This page includes the periodic table, formulas, constants, and unit conversions for use during testing.

Calculator use is recommended. Sharing calculators during testing is not permitted.

The following types of calculators/devices may **NOT** be used during the test:

- pocket organizers
- electronic writing pads or input devices
- Some examples of prohibited calculators are:
  - Casio models: CFX-9970G, Algebra FX 2.0
  - Hewlett-Packard models: HP-40G, HP-49G
  - Texas Instruments models: TI-89, TI-92, Voyage 200, TI-NSPIRE - the CAS version (The non-CAS version of TI-NSPIRE is allowable.)
- calculators that can communicate (transfer data or information) wirelessly with other student calculators/devices
- cell phones, PSPs, and/or iPods

Students may use any four-function, scientific, or graphing calculator that does not have any of the above features. The use of devices that have a Computer Algebra System (CAS) is NOT allowed.

Tips for Taking the Test

Preparing for the test

- Review this Tennessee End of Course Item Sampler for Chemistry carefully and thoroughly.
- Acquire a Tennessee End of Course Practice Test for Chemistry located at http://www.state.tn.us/education/assessment/sec_samplers.shtml.
- Take the Tennessee End of Course Practice Test for Chemistry several times.
- Become familiar with the correct way to mark answers on the answer sheet. There is a sample answer sheet in the Tennessee End of Course Practice Test.

Before the test

- Get a good night's sleep. To do your best, you need to be rested.

During the test

- Relax. It is normal to be somewhat nervous before the test. Try to relax and not worry.
- Listen. Listen to and read the test directions carefully. Ask for an explanation of the directions if you do not understand them.
- Plan your time. Do not spend too much time on any one question. If a question seems to take too long, skip it and return to it later. Answer all questions you are sure of first.
- Think. If you are not sure how to answer a question, read it again and try your best to answer the question. Rule out answer choices that you know are incorrect and choose from those that remain.

Directions for Using the Item Sampler

This Item Sampler for Chemistry provides specific information to students and teachers. It contains examples of different item types for each Performance Indicator that may be tested in any given end of course test administration. Performance Indicators have been grouped under Reporting Categories. These Reporting Categories will be used to report information regarding performance on the end of course tests to students, teachers, schools, and systems.

The items in this Item Sampler will not be found in the end of course tests. The number of items in this Item Sampler does not reflect the emphasis of content on the test. In order to identify the emphasis of content, the End of Course Assessment Practice Test for Chemistry should be used. The Practice Test gives a better representation of content emphasis across Reporting Categories and Performance Indicators.

An Answer Key is located on Page 36. Use it to check your answers. Review items that you get wrong.

Reporting Category: Embedded Inquiry, Technology & Engineering, Mathematics
Numbers 1 through 11

Performance Indicator: Select a description or scenario that reevaluates and/or extends a scientific finding.

1 **Mendeleev compiled a periodic table of 63 known elements according to increasing atomic weight based on the properties of known elements. Moseley and other scientists modified the periodic table based on increasing atomic number. Which statement regarding the modern periodic table is correct?**

A Moseley and other scientists included new elements in the existing periodic table.

B Moseley and other scientists disregarded Mendeleev's classification of the periodic table.

C Moseley and other scientists rearranged the periodic table based on the availability of elements on Earth's surface.

D Moseley and other scientists concluded that atomic mass has the least relevance in arranging elements on the periodic table.

Go On ▶

Performance Indicator: Analyze the components of a properly designed scientific investigation.

2 **A student performed an experiment to analyze the freezing point depression in salt water. The table shows the data from the experiment.**

Freezing Point Depression Data

Sample	Salt Concentration (molality)	Freezing Point (°C)
1	0.00	0.00
2	0.50	–0.93
3	1.00	–1.85
4	1.50	–2.78

Sample 1 contained no salt and had a normal freezing point. Why did the student most likely include this sample in the experiment?

F so the thermometer could be calibrated

G so a graph of the data could begin at the origin

H so the effect of the experimental variable could be determined

J so more reliable results could be obtained by including more data

Performance Indicator: Determine appropriate tools to gather precise and accurate data.

3 **Which tools should a student use to create a 20% sodium chloride solution by mass?**

A graduated cylinder and beaker
B beaker and balance
C balance and thermometer
D thermometer and graduated cylinder

Performance Indicator: Evaluate the accuracy and precision of data.

4 **During an investigation, a student determines that a copper sample has a density of 8.10 g/mL. What is the student's percent error if the accepted density for copper is 8.96 g/mL?**

F 0.7%
G 8.6%
H 9.6%
J 11.0%

Go On ▶

Performance Indicator: Defend a conclusion based on scientific evidence.

5 **A student is given an unknown metal sample that she speculates is zinc (Zn). The table represents some properties of zinc.**

Zinc Properties

Color	Blueish-white
Malleability	Brittle at room temperature; malleable at 100 – 150°C
Electrical Conductivity	Moderately good
Density	7.140 g/mL
Chemical Properties	Combusts to form zinc oxide (ZnO); reacts with iodine to form zinc iodide (ZnI_2) in an exothermic reaction

Which procedure would best help the student to confirm the identity of the sample?

A examining the color of the sample

B measuring the electrical conductivity of the sample

C hitting the sample with a mallet at room temperature

D adding liquid iodine to the sample in a closed container

Performance Indicator: Determine why a conclusion is free of bias.

6 **A technician was given several objects that were found in the ruins of an ancient human settlement. The objects included bones, wood, and pottery. The technician determined the ages of the objects by analyzing radioisotopes of carbon-14. What did the technician most likely do to keep the analysis free from bias?**

F compared the color and texture of the objects from the ruins with modern-day objects

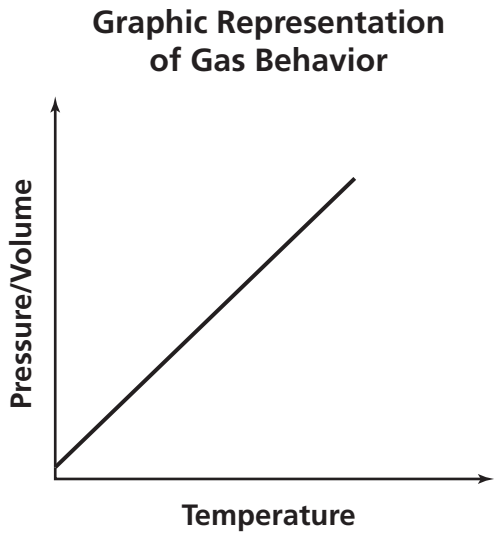
G compared the amount of carbon in the objects from the ruins with modern-day objects

H used the experiences of a group of scientists to determine the ages of the objects from the ruins

J used data from multiple experiments to determine the ages of the objects from the ruins

Performance Indicator: Compare conclusions that offer different but acceptable explanations for the same set of experimental data.

7 **A student is studying the behavior of gas in relation to pressure/volume and temperature, as shown in the graph.**



The student suggests that a rise in temperature leads to an increase in pressure. Which other statement is also consistent with the graph?

A A rise in temperature leads to an increase in volume.

B A rise in temperature leads to a decrease in molar mass.

C A rise in temperature leads to a decrease in energy.

D A rise in temperature leads to an increase in density.

Performance Indicator: Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.

8 **Students in a chemistry laboratory are testing an unknown colorless solution to determine whether the solution is an acid or a base. Which procedure will produce the most valid conclusion?**

F adding phenolphthalein to the solution and observing the color change

G stirring the solution using a glass rod until the solid particles settle to the bottom of the test tube

H tasting the unknown solution to decide whether the solution is bitter or sour

J heating the solution until the color of the solution changes to pink

Performance Indicator: Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.

9 **Nonstick aluminum cookware had several problems during its original development. One problem was that the chemical of the nonstick surface did not adhere to anything, including the aluminum pan. The manufacturers first tried to attach the compound to the pan by blasting the surface of the pan with sand. This produced small pits on the surface to which the compound could adhere. However, when utensils were scraped against the pan, the nonstick compound fell off.**

What did the manufacturers most likely do next in the engineering-design process?

A retested by blasting the pan surface with another abrasive

B redesigned the compound to better adhere to the surface

C brainstormed other possible methods to attach the compound to the surface

D conducted more research to see which other solutions had been tried

Go On ▶

Performance Indicator: Evaluate the overall benefit to cost ratio of a new technology.

10 **Recent scientific research suggests that the long-term use of alternative energy resources, such as solar and wind power, will have a large impact in minimizing human causes of climate change. Which best describes a benefit to cost ratio of alternative energy resources?**

F Initially building wind turbines will be expensive, but in the long term, the atmosphere will be less polluted.

G Solar panels need greater efficiency improvement and, in the long term, will be expensive to use.

H Alternative energy resources are more expensive to maintain and will be expensive in the long term.

J Alternative energy resources are inexpensive, but studying the long-term environmental effects will be expensive.

Performance Indicator: Use design principles to determine if a new technology will improve the quality of life for an intended audience.

11 **Scientists have tested a design for a fast-charging nickel-iron battery that is intended to provide stronger and safer batteries for electric cars. Which action best describes the next step to investigate whether the battery designed serves the intended purpose?**

A marketing the fast-charging nickel-iron batteries for use in electric cars

B replacing all the current electric car batteries with fast-charging nickel-iron batteries

C designing an electric car model to pilot test the fast-charging nickel-iron batteries

D comparing the gas mileage of an electric car that uses the fast-charging nickel-iron battery with the gas mileage of a gasoline-powered car

Go On ▶

Reporting Category: Atomic Structure
Numbers 12 through 16

Performance Indicator: Compare and contrast the major models of the atom (i.e., Bohr, and the quantum mechanical model).

12 **Which statement describes the quantum mechanical model of the atom?**

F Electrons exhibit both wave and particle properties.

G Electrons move along set orbits around the nucleus.

H The exact positions and momentums of electrons in an atom are always known.

J An atom is mostly positively charged with electrons scattered through it.

Go On ▶

Performance Indicator: Interpret the periodic table to describe an element's atomic makeup.

13 **A table containing isotopes with atomic particles is shown.**

Data Table of Isotopes

Set	Number of Protons	Number of Neutrons	Number of Electrons
1	16	16	16
2	15	16	15
3	16	16	15
4	15	15	16

Which set of values is correct for a neutral phosphorus atom?

A 1
B 2
C 3
D 4

Performance Indicator: Describe the trends found in the periodic table with respect to atomic size, ionization energy, or electronegativity.

14 **Which of these elements has the greatest attraction for electrons?**

F copper (Cu)

G oxygen (O)

H potassium (K)

J nitrogen (N)

Performance Indicator: Determine the Lewis electron-dot structure or number of valence electrons for an atom of any main-group element from its atomic number or position in the periodic table.

15 **Which Lewis electron-dot structure represents a neutral atom of iodine (I)?**

A

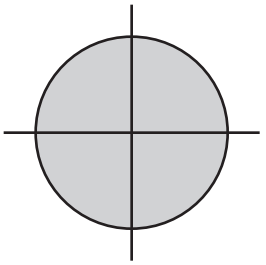
B

C

D

Performance Indicator: Represent an electron's location in the quantum mechanical model of an atom in terms of the shape of electron clouds (*s* and *p* orbitals in particular), relative energies of orbitals, and the number of electrons possible in the *s*, *p*, *d* and *f* orbitals.

16 **Which illustration best represents a probable location of a single electron in a *p* orbital of a neutral neon atom?**



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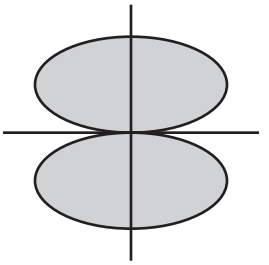

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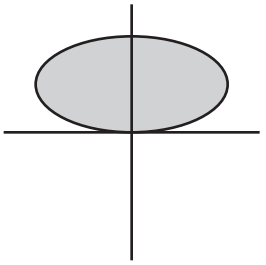

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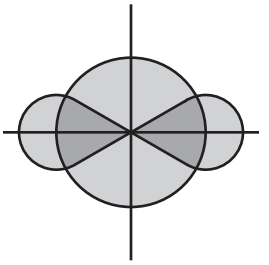


J

Reporting Category: Matter and Energy
Numbers 17 through 23

Performance Indicator: Distinguish among elements, compounds, and mixtures.

17 **Which statement best describes sulfuric acid (H_2SO_4)?**

A Sulfuric acid is a compound.
B Sulfuric acid is a mixture.
C Sulfuric acid is an element.
D Sulfuric acid is a suspension.

Performance Indicator: Identify properties of a solution: solute and solvent in a solid, liquid or gaseous solution: procedure to make or determine the concentration of a solution in units of ppm, ppb, molarity, percent composition, factors that affect the rate of solution.

18 **A chemist wants to make 100.0 mL of a 4.0 M sodium hydroxide (NaOH) solution. Approximately what mass of NaOH is required to make the solution?**

F 1.60 g

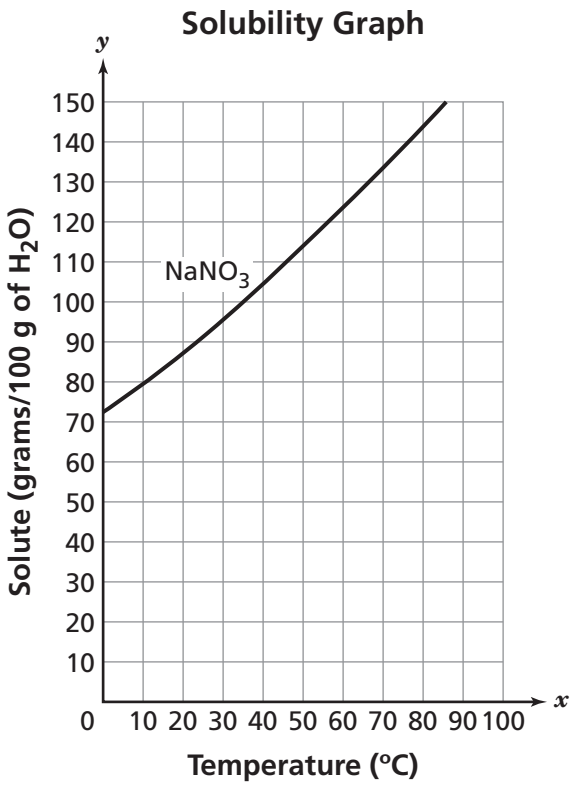
G 100. g

H 16.0 g

J 40.0 g

Performance Indicator: Classify a solution as saturated, unsaturated, or supersaturated based on its composition and temperature and a solubility graph.

19 **The graph shows the solubility of sodium nitrate ($NaNO_3$) dissolved in 100 g of water (H_2O).**



How many grams of $NaNO_3$ are needed to prepare a saturated solution in 100 g of water at 40°C?

A 40 g
B 80 g
C 90 g
D 105 g

Performance Indicator: Identify properties of matter (e.g., physical: density, boiling point, melting point, or chemical: ability to rust or tarnish, be sour) or changes in matter (e.g., physical: phase change, shape, color, or chemical: formation of a gas or precipitate).

20 **Which of these correctly identifies two processes with the types of changes that occur?**

F combustion – physical change; boiling – chemical change

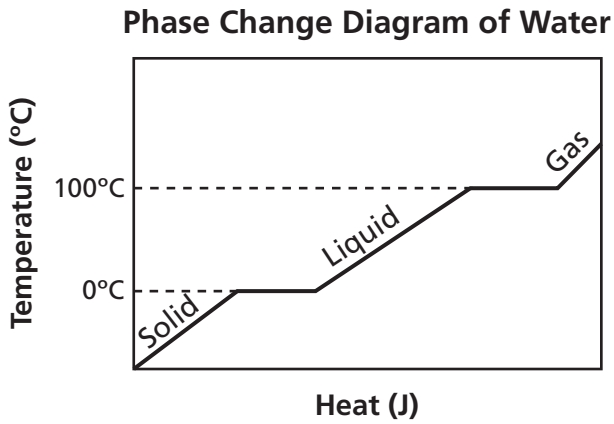
G boiling – physical change; combustion – chemical change

H melting – physical change; sublimation – chemical change

J sublimation – physical change; melting – chemical change

Performance Indicator: Compare and contrast heat and temperature changes (endothermic/exothermic) in chemical (e.g., combustion) or physical (e.g., phase transformations) processes.

21 **A phase change diagram of water is shown.**



Which statement best explains what causes the phase change from ice to liquid water?

A Heat is released as ice turns into liquid water.

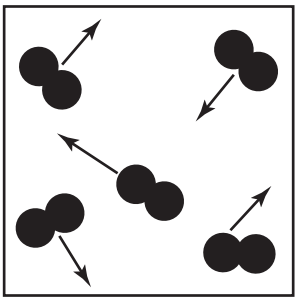
B Heat is absorbed as ice turns into liquid water.

C The mass increases when ice turns into liquid water.

D The hydrogen bonds prevent the absorption of heat.

Performance Indicator: Investigate similarities and differences among solids, liquids and gases in terms of energy and particle spacing.

22 **Which illustration best shows the energy of motion and the particle spacing of a diatomic liquid?**



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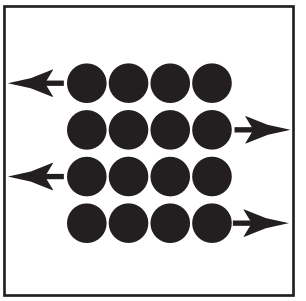

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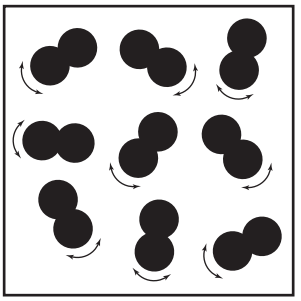

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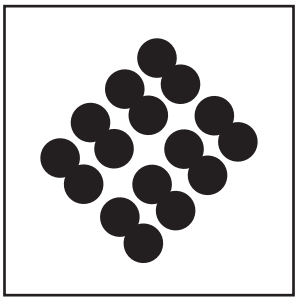

J

Performance Indicator: Predict how changes in volume, temperature, and pressure affect the behavior of a gas.

23 **A gas at 65.0°C occupies 4.22 L. If the pressure remains the same, at which Celsius temperature will the volume be 3.87 L?**

A 37.0°C

B 69.6°C

C 88.4°C

D 309°C

Reporting Category: Interactions of Matter
Numbers 24 through 31

Performance Indicator: Analyze ionic and covalent compounds in terms of their formation (electron transfer vs. sharing), names, chemical formulas (e.g., molecular: H_2O, CO_2, NH_3: empirical: NaCl, $CaBr_2$, $Al(NO_3)_3$), percent composition, and molar masses.

24 **Which statement accurately describes the formation of a covalent bond?**

F Protons are shared between atoms.
G Electrons are shared between atoms.
H Protons are transferred from one atom to another.
J Electrons are transferred from one atom to another.

Performance Indicator: Determine the reactants, products, and types of different chemical reactions: composition, decomposition, double replacement, single replacement, combustion.

25 **The balanced chemical equation represents a reaction between glucose ($C_6H_{12}O_6$) and oxygen (O_2).**

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$$

Which type of reaction does the equation represent?

A single replacement
B composition
C double replacement
D combustion

Go On ▶

Performance Indicator: Predict the products of a chemical reaction (e.g., composition and decomposition of binary compounds).

26 **The chemical equation represents the reaction between lithium (Li) and oxygen (O_2).**

$$4Li + O_2 \rightarrow \_\_\_$$

What is the product of this reaction?

F $2Li_2O$
G $2Li_2O_2$
H $2LiO$
J $2Li_2O_3$

Performance Indicator: Balance a chemical equation to determine molar ratios.

27 **The unbalanced chemical equation shows the reaction between potassium chloride (KCl) and oxygen (O_2).**

$$KCl + \_\_\_ O_2 \rightarrow \_\_\_ KClO_3$$

When the chemical equation is balanced, what is the molar ratio of O_2 to $KClO_3$?

A 1 : 1
B 1 : 3
C 2 : 3
D 3 : 2

Go On ▶

Performance Indicator: Convert among the following quantities of a substance: mass, number of moles, number of particles, molar volume at STP.

28 **How many atoms are present in 150 grams of copper (Cu)?**

F 2.3×10^{1}

G 6.0×10^{23}

H 1.4×10^{24}

J 3.1×10^{24}

Performance Indicator: Identify and solve stoichiometry problems which interconvert volume of gases at STP, moles, and mass.

29 **The balanced chemical equation represents the reaction between zinc (Zn) and hydrochloric acid (HCl).**

$$Zn + 2HCl \longrightarrow H_2 + ZnCl_2$$

At STP, how many liters of hydrogen gas (H_2) will be produced if 10.0 g of zinc is allowed to react with excess hydrochloric acid?

A 2.95 L

B 3.43 L

C 6.85 L

D 22.4 L

Go On ▶

Performance Indicator: Classify substances as acids or bases based on their formulas and how they react with litmus and phenolphthalein.

30 **A student adds phenolphthalein to a solution containing a base. What is the resulting color of the solution?**

F colorless
G red
H blue
J pink

Performance Indicator: Describe radioactivity through a balanced nuclear equation and through an analysis of the half-life concept.

31 **The half-life of strontium-90 is about 29 years. How many half-lives have elapsed when 6.25% of a strontium-90 sample remains in the container?**

A 1
B 2
C 3
D 4

STOP

Answer Key with Reporting Category and Performance Indicator

Reporting Category 1: Embedded Inquiry, Technology & Engineering, Mathematics		
Item Number	**Correct Answer**	**Performance Indicator**
1	**A**	3221.Inq.1 Select a description or scenario that reevaluates and/or extends a scientific finding.
2	**H**	3221.Inq.2 Analyze the components of a properly designed scientific investigation.
3	**B**	3221.Inq.3 Determine appropriate tools to gather precise and accurate data.
4	**H**	3221.Inq.4 Evaluate the accuracy and precision of data.
5	**D**	3221.Inq.5 Defend a conclusion based on scientific evidence.
6	**J**	3221.Inq.6 Determine why a conclusion is free of bias.
7	**A**	3221.Inq.7 Compare conclusions that offer different but acceptable explanations for the same set of experimental data.
8	**F**	3221.TE.1 Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.
9	**C**	3221.TE.2 Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.
10	**F**	3221.TE.3 Evaluate the overall benefit to cost ratio of a new technology.
11	**C**	3221.TE.4 Use design principles to determine if a new technology will improve the quality of life for an intended audience.

Reporting Category 2: Atomic Structure		
Item Number	**Correct Answer**	**Performance Indicator**
12	**F**	3221.1.1 Compare and contrast the major models of the atom (i.e., Bohr, and the quantum mechanical model).
13	**B**	3221.1.2 Interpret the periodic table to describe an element's atomic makeup.
14	**G**	3221.1.3 Describe the trends found in the periodic table with respect to atomic size, ionization energy, or electronegativity.
15	**D**	3221.1.4 Determine the Lewis electron-dot structure or number of valence electrons for an atom of any main-group element from its atomic number or position in the periodic table.
16	**H**	3221.1.5 Represent an electron's location in the quantum mechanical model of an atom in terms of the shape of electron clouds (*s* and *p* orbitals in particular), relative energies of orbitals, and the number of electrons possible in the *s*, *p*, *d* and *f* orbitals.

Reporting Category 3: Matter and Energy		
Item Number	**Correct Answer**	**Performance Indicator**
17	**A**	3221.2.1 Distinguish among elements, compounds, and mixtures.
18	**H**	3221.2.2 Identify properties of a solution: solute and solvent in a solid, liquid or gaseous solution: procedure to make or determine the concentration of a solution in units of ppm, ppb, molarity, percent composition, factors that affect the rate of solution.
19	**D**	3221.2.3 Classify a solution as saturated, unsaturated, or supersaturated based on its composition and temperature and a solubility graph.
20	**G**	3221.2.4 Identify properties of matter (e.g., physical: density, boiling point, melting point, or chemical: ability to rust or tarnish, be sour) or changes in matter (e.g., physical: phase change, shape, color, or chemical: formation of a gas or precipitate).
21	**B**	3221.2.5 Compare and contrast heat and temperature changes (endothermic/exothermic) in chemical (e.g., combustion) or physical (e.g., phase transformations) processes.
22	**G**	3221.2.6 Investigate similarities and differences among solids, liquids and gases in terms of energy and particle spacing.
23	**A**	3221.2.7 Predict how changes in volume, temperature, and pressure affect the behavior of a gas.

Reporting Category 4: Interactions of Matter		
Item Number	**Correct Answer**	**Performance Indicator**
24	**G**	3221.3.1 Analyze ionic and covalent compounds in terms of their formation (electron transfer vs. sharing), names, chemical formulas (e.g., molecular: H_2O, CO_2, NH_3: empirical: NaCl, $CaBr_2$, $Al(NO_3)_3$), percent composition, and molar masses.
25	**D**	3221.3.2 Determine the reactants, products, and types of different chemical reactions: composition, decomposition, double replacement, single replacement, combustion.
26	**F**	3221.3.3 Predict the products of a chemical reaction (e.g., composition and decomposition of binary compounds).
27	**D**	3221.3.4 Balance a chemical equation to determine molar ratios.
28	**H**	3221.3.5 Convert among the following quantities of a substance: mass, number of moles, number of particles, molar volume at STP.
29	**B**	3221.3.6 Identify and solve stoichiometry problems which interconvert volume of gases at STP, moles, and mass.
30	**J**	3221.3.7 Classify substances as acids or bases based on their formulas and how they react with litmus and phenolphthalein.
31	**D**	3221.3.8 Describe radioactivity through a balanced nuclear equation and through an analysis of the half-life concept.