Example Items

Chemistry

Chemistry Example Items are a **representative set** of items for the ACP. Teachers may use this set of items along with the test blueprint as guides to prepare students for the ACP. On the last page, the correct answer, content SE and SE justification are listed for each item.

The specific part of an SE that an Example Item measures is NOT necessarily the only part of the SE that is assessed on the ACP. None of these Example Items will appear on the ACP.

Teachers may provide feedback regarding Example Items.

(1) Download the Example Feedback Form and email it. The form is located on the homepage of the Assessment website: https://assessment.dallasisd.org.

OR

(2) To submit directly, click "Example Feedback – online form" **after** you click the Example Items link under ACP Resources on the ACP tab on the Assessment website.

Second Semester

2020–2021

Code #: 3101

STAAR CHEMISTRY
REFERENCE MATERIALS

ATOMIC STRUCTURE

Speed of light = (frequency)(wavelength)	$c = f\lambda$
Energy = (Planck's constant)(frequency)	$E_{\text{photon}} = hf$
$\text{Energy} = \dfrac{\text{(Planck's constant)(speed of light)}}{\text{(wavelength)}}$	$E_{\text{photon}} = \dfrac{hc}{\lambda}$

BEHAVIOR OF GASES

$\text{Total pressure of a gas} = \left(\begin{array}{c}\text{sum of the partial pressures}\\ \text{of the component gases}\end{array}\right)$	$P_T = P_1 + P_2 + P_3 + \ \ldots$
(Pressure)(volume) = (moles)(ideal gas constant)(temperature)	$PV = nRT$
$\dfrac{\text{(Initial pressure)(initial volume)}}{\text{(Initial moles)(initial temperature)}} = \dfrac{\text{(final pressure)(final volume)}}{\text{(final moles)(final temperature)}}$	$\dfrac{P_1V_1}{n_1T_1} = \dfrac{P_2V_2}{n_2T_2}$
(Initial pressure)(initial volume) = (final pressure)(final volume)	$P_1V_1 = P_2V_2$
$\dfrac{\text{(Initial volume)}}{\text{(Initial temperature)}} = \dfrac{\text{(final volume)}}{\text{(final temperature)}}$	$\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$
$\dfrac{\text{(Initial volume)}}{\text{(Initial moles)}} = \dfrac{\text{(final volume)}}{\text{(final moles)}}$	$\dfrac{V_1}{n_1} = \dfrac{V_2}{n_2}$

SOLUTIONS

$\text{Molarity} = \dfrac{\text{moles of solute}}{\text{liter of solution}}$	$M = \dfrac{\text{mol}}{\text{L}}$
$\text{Ionization constant of water} = \left(\begin{array}{c}\text{hydrogen ion}\\ \text{concentration}\end{array}\right)\left(\begin{array}{c}\text{hydroxide ion}\\ \text{concentration}\end{array}\right)$	$K_w = [H^+][OH^-]$
$\left(\begin{array}{c}\text{Volume of}\\ \text{solution 1}\end{array}\right)\left(\begin{array}{c}\text{molarity of}\\ \text{solution 1}\end{array}\right) = \left(\begin{array}{c}\text{volume of}\\ \text{solution 2}\end{array}\right)\left(\begin{array}{c}\text{molarity of}\\ \text{solution 2}\end{array}\right)$	$V_1M_1 = V_2M_2$
pH = –logarithm (hydrogen ion concentration)	$\text{pH} = -\log[H^+]$

THERMOCHEMISTRY

$\text{Heat gained or lost} = \text{(mass)}\left(\begin{array}{c}\text{specific}\\ \text{heat}\end{array}\right)\left(\begin{array}{c}\text{change in}\\ \text{temperature}\end{array}\right)$	$Q = mc_p\Delta T$
$\begin{array}{c}\text{Enthalpy of}\\ \text{reaction}\end{array} = \left(\begin{array}{c}\text{enthalpy}\\ \text{of products}\end{array}\right) - \left(\begin{array}{c}\text{enthalpy}\\ \text{of reactants}\end{array}\right)$	$\Delta H = \Delta H_f^o\text{(products)} - \Delta H_f^o\text{(reactants)}$

STAAR CHEMISTRY REFERENCE MATERIALS

OTHER FORMULAS

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \qquad D = \frac{m}{V}$$

$$\text{Percent error} = \left(\frac{\text{accepted value} - \text{experimental value}}{\text{accepted value}}\right)(100)$$

$$\text{Percent yield} = \left(\frac{\text{actual yield}}{\text{theoretical yield}}\right)(100)$$

CONSTANTS AND CONVERSIONS

Avogadro’s number $= 6.02 \times 10^{23}$ particles per mole

h = Planck’s constant $= 6.63 \times 10^{-34}\ \text{J} \cdot \text{s}$

c = speed of light $= 3.00 \times 10^{8}\ \frac{\text{m}}{\text{s}}$

K_w = ionization constant of water $= 1.00 \times 10^{-14} \left(\frac{\text{mol}}{\text{L}}\right)^2$

alpha particle (α) $= {}^{4}_{2}\text{He}$ beta particle (β) $= {}^{0}_{-1}\text{e}$ neutron $= {}^{1}_{0}\text{n}$

standard temperature and pressure (STP) = 0°C and 1 atm

0°C = 273 K

volume of ideal gas at STP $= 22.4\ \frac{\text{L}}{\text{mol}}$

$1\ \text{cm}^3 = 1\ \text{mL} = 1\ \text{cc}$

1 atm = 760 mm Hg = 101.3 kPa

R = ideal gas constant $= 0.0821\ \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} = 8.31\ \frac{\text{L} \cdot \text{kPa}}{\text{mol} \cdot \text{K}} = 62.4\ \frac{\text{L} \cdot \text{mm Hg}}{\text{mol} \cdot \text{K}}$

1 calorie (cal) = 4.18 joules (J)

1000 calories (cal) = 1 Calorie (Cal) = 1 kilocalorie (kcal)

RULES FOR SIGNIFICANT FIGURES

1. Non-zero digits and zeros between non-zero digits are always significant.
2. Leading zeros are not significant.
3. Zeros to the right of all non-zero digits are only significant if a decimal point is shown.
4. For values written in scientific notation, the digits in the coefficient are significant.
5. In a common logarithm, there are as many digits after the decimal point as there are significant figures in the original number.

STAAR CHEMISTRY REFERENCE MATERIALS

POLYATOMIC IONS

Acetate	$C_2H_3O_2^-$, CH_3COO^-
Ammonium	NH_4^+
Carbonate	CO_3^{2-}
Chlorate	ClO_3^-
Chlorite	ClO_2^-
Chromate	CrO_4^{2-}
Cyanide	CN^-
Dichromate	$Cr_2O_7^{2-}$
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Hypochlorite	ClO^-
Nitrate	NO_3^-
Nitrite	NO_2^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Phosphate	PO_4^{3-}
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY OF COMMON IONIC COMPOUNDS IN WATER

Soluble compounds contain	**Common exceptions**
$C_2H_3O_2^-$, CH_3COO^-	None
NH_4^+	None
NO_3^-	None
CN^-	None
ClO^-	None
ClO_2^-	None
ClO_3^-	None
ClO_4^-	None
Br^-	Compounds of Ag^+, Pb^{2+}, and Hg_2^{2+}
Cl^-	Compounds of Ag^+, Pb^{2+}, and Hg_2^{2+}
I^-	Compounds of Sr^{2+}, Ba^{2+}, Pb^{2+}, and Hg_2^{2+}
SO_4^{2-}	Compounds of Sr^{2+}, Ba^{2+}, Pb^{2+}, and Hg_2^{2+}

Insoluble compounds contain	**Common exceptions**
CO_3^{2-}	Compounds of NH_4^+ and the alkali metal cations
PO_4^{3-}	Compounds of NH_4^+ and the alkali metal cations
CrO_4^{2-}	Compounds of NH_4^+ and the alkali metal cations
$Cr_2O_7^{2-}$	Compounds of NH_4^+ and the alkali metal cations
OH^-	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}
S^{2-}	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}

ACTIVITY SERIES

Metal

Lithium
Potassium
Barium
Calcium
Sodium
Magnesium
Aluminum
Manganese
Zinc
Chromium
Iron
Cobalt
Nickel
Tin
Lead
(Hydrogen)
Copper
Mercury
Silver
Platinum
Gold

STAAR CHEMISTRY
REFERENCE MATERIALS

STAAR
State of Texas Assessments of Academic Readiness

PERIODIC TABLE OF THE ELEMENTS

Atomic number — 14
Symbol — **Si**
Atomic mass — 28.086
Silicon — Name

	1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 **H** 1.008 Hydrogen																	2 **He** 4.003 Helium
2	3 **Li** 6.941 Lithium	4 **Be** 9.012 Beryllium											5 **B** 10.812 Boron	6 **C** 12.011 Carbon	7 **N** 14.007 Nitrogen	8 **O** 15.999 Oxygen	9 **F** 18.998 Fluorine	10 **Ne** 20.180 Neon
3	11 **Na** 22.990 Sodium	12 **Mg** 24.305 Magnesium											13 **Al** 26.982 Aluminum	14 **Si** 28.086 Silicon	15 **P** 30.974 Phosphorus	16 **S** 32.066 Sulfur	17 **Cl** 35.453 Chlorine	18 **Ar** 39.948 Argon
4	19 **K** 39.098 Potassium	20 **Ca** 40.078 Calcium	21 **Sc** 44.956 Scandium	22 **Ti** 47.867 Titanium	23 **V** 50.942 Vanadium	24 **Cr** 51.996 Chromium	25 **Mn** 54.938 Manganese	26 **Fe** 55.845 Iron	27 **Co** 58.933 Cobalt	28 **Ni** 58.693 Nickel	29 **Cu** 63.546 Copper	30 **Zn** 65.38 Zinc	31 **Ga** 69.723 Gallium	32 **Ge** 72.64 Germanium	33 **As** 74.922 Arsenic	34 **Se** 78.96 Selenium	35 **Br** 79.904 Bromine	36 **Kr** 83.798 Krypton
5	37 **Rb** 85.468 Rubidium	38 **Sr** 87.62 Strontium	39 **Y** 88.906 Yttrium	40 **Zr** 91.224 Zirconium	41 **Nb** 92.906 Niobium	42 **Mo** 95.96 Molybdenum	43 **Tc** (98) Technetium	44 **Ru** 101.07 Ruthenium	45 **Rh** 102.906 Rhodium	46 **Pd** 106.42 Palladium	47 **Ag** 107.868 Silver	48 **Cd** 112.412 Cadmium	49 **In** 114.818 Indium	50 **Sn** 118.711 Tin	51 **Sb** 121.760 Antimony	52 **Te** 127.60 Tellurium	53 **I** 126.904 Iodine	54 **Xe** 131.294 Xenon
6	55 **Cs** 132.905 Cesium	56 **Ba** 137.328 Barium	71 **Lu** 174.967 Lutetium	72 **Hf** 178.49 Hafnium	73 **Ta** 180.948 Tantalum	74 **W** 183.84 Tungsten	75 **Re** 186.207 Rhenium	76 **Os** 190.23 Osmium	77 **Ir** 192.217 Iridium	78 **Pt** 195.085 Platinum	79 **Au** 196.967 Gold	80 **Hg** 200.59 Mercury	81 **Tl** 204.383 Thallium	82 **Pb** 207.2 Lead	83 **Bi** 208.980 Bismuth	84 **Po** (209) Polonium	85 **At** (210) Astatine	86 **Rn** (222) Radon
7	87 **Fr** (223) Francium	88 **Ra** (226) Radium	103 **Lr** (262) Lawrencium	104 **Rf** (267) Rutherfordium	105 **Db** (268) Dubnium	106 **Sg** (271) Seaborgium	107 **Bh** (272) Bohrium	108 **Hs** (270) Hassium	109 **Mt** (276) Meitnerium	110 **Ds** (281) Darmstadtium	111 **Rg** (280) Roentgenium							

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

Lanthanide Series	57 **La** 138.905 Lanthanum	58 **Ce** 140.116 Cerium	59 **Pr** 140.908 Praseodymium	60 **Nd** 144.242 Neodymium	61 **Pm** (145) Promethium	62 **Sm** 150.36 Samarium	63 **Eu** 151.964 Europium	64 **Gd** 157.25 Gadolinium	65 **Tb** 158.925 Terbium	66 **Dy** 162.500 Dysprosium	67 **Ho** 164.930 Holmium	68 **Er** 167.259 Erbium	69 **Tm** 168.934 Thulium	70 **Yb** 173.055 Ytterbium
Actinide Series	89 **Ac** (227) Actinium	90 **Th** 232.038 Thorium	91 **Pa** 231.036 Protactinium	92 **U** 238.029 Uranium	93 **Np** (237) Neptunium	94 **Pu** (244) Plutonium	95 **Am** (243) Americium	96 **Cm** (247) Curium	97 **Bk** (247) Berkelium	98 **Cf** (251) Californium	99 **Es** (252) Einsteinium	100 **Fm** (257) Fermium	101 **Md** (258) Mendelevium	102 **No** (259) Nobelium

Updated Spring 2011

1 The equation shown represents a gas-producing reaction.

$$2KNO_3 \rightarrow 2KNO_2 + O_2$$

After 55.551 grams of solid KNO_3 (molar mass = 101.102 g/mol) completely decomposes, what volume of oxygen gas, O_2, is produced at Standard Temperature and Pressure (STP)?

A 6.154 liters

B 8.000 liters

C 12.31 liters

D 22.40 liters

2 Which statement correctly compares nuclear fusion and nuclear fission?

A Fission requires a high density and high temperature environment, while fusion requires high speed neutrons to initiate.

B Fission requires little energy to split the atoms, while fusion takes extremely high energy to bring two or more atoms together.

C Fusion is the union of two or more lighter atoms into a larger one, while fission is the splitting of a large atom into two or more smaller ones.

D Fission is the union of two or more lighter atoms into a larger one, while fusion is the splitting of a large atom into two or more smaller ones.

3 What is the pH of a solution with hydrogen ion concentration of 1×10^{-6} M?

A -6

B 10^{-6}

C 6

D $\log(-6)$

4 Which substance is soluble in water?

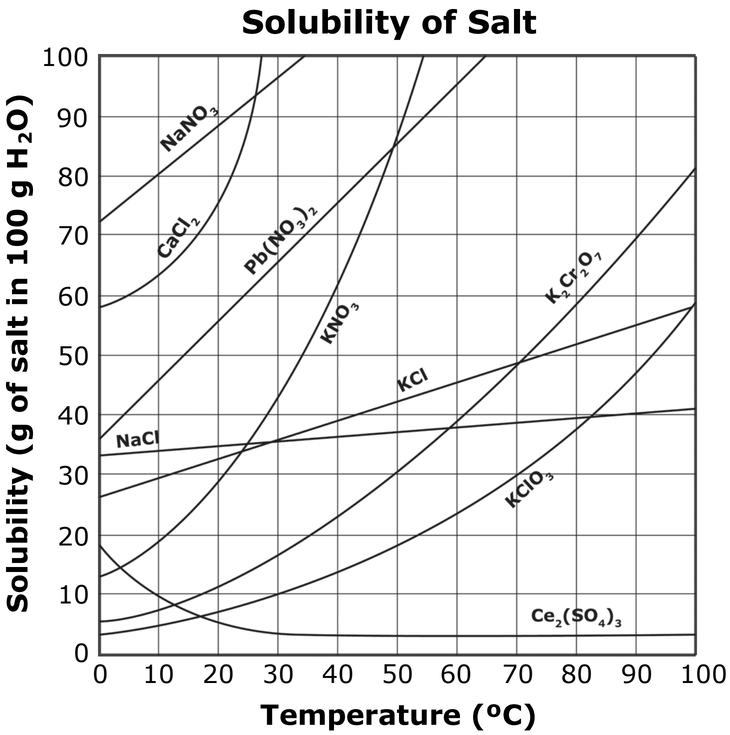
A $Pb(CO_3)_2$

B Ag_3PO_4

C $Sn(CrO_4)_2$

D NH_4Cl

Use the solubility curves to answer the next question.



5 Seventy grams of four substances are added to 100 grams of water in four separate beakers. The water in all four beakers is held at 50 °C. Which substance makes an unsaturated solution?

A KNO_3

B NaCl

C $KClO_3$

D $K_2Cr_2O_7$

6 The unbalanced reaction shown represents the decay of ${}^{238}_{92}U$.

$$ {}^{238}_{92}U \rightarrow {}^{234}_{90}Th + ? $$

What kind of particle must be emitted to balance this equation?

A Alpha

B Beta

C Neutron

D Positron

7 A student used calorimetry to determine the heat lost by a piece of candy as it cools. She placed the candy in a beaker of water. The table shows the measurements she made during her experiment and the known value she used for the specific heat of water.

Mass of water	100.0 g
Mass of candy	7.0 g
Initial temperature of water	24.0 °C
Initial temperature of candy	100.0 °C
Final (highest) temperature of water	26.0 °C
Specific heat of water	4.18 J/(g•°C)

Based on the values in the table, how much heat was lost by the candy?

A 2170 J

B 836 J

C 518 J

D 58.5 J

8 An expandable (V is not constant) container holds 15 liters of a gas at a pressure of 2.5 atm and at a temperature of 320 K. The volume of the container is then increased to a new volume of 25 liters while the temperature is held constant at 320 K. What is the new pressure in the container?

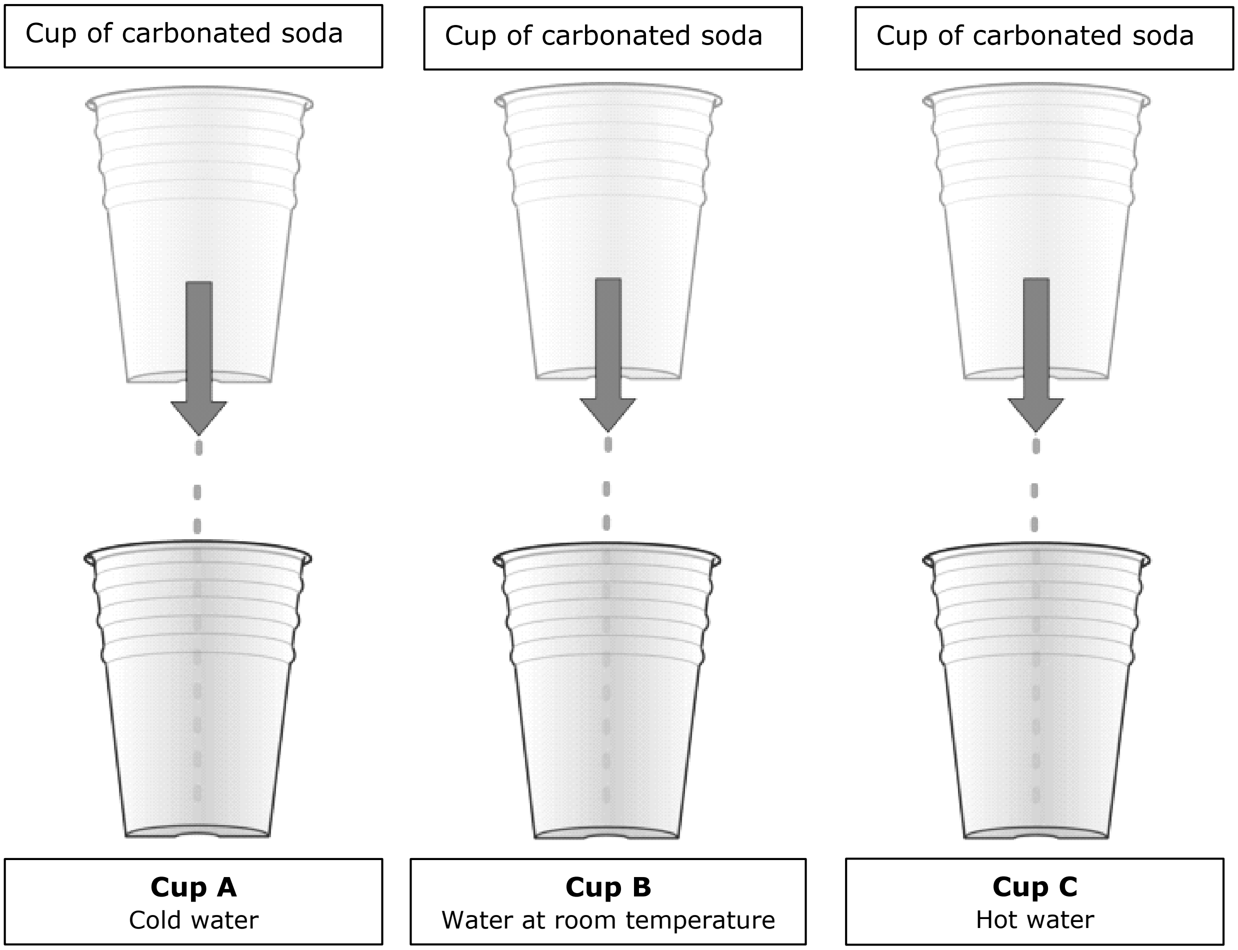
A 4.2 atm

B 2.5 atm

C 1.5 atm

D 0.7 atm

9 Three cups of carbonated soda are lowered into cups of water at varying temperatures.



All other factors being equal, in which cup does the greatest release of dissolved gas occur?

A Cup A

B Cup B

C Cup C

D All cups will release an equal amount of gas, because temperature is not a factor.

10 Water is a molecule with slightly positive hydrogen atoms and a slightly negative oxygen atom. This unique arrangement gives water its —

A conductivity properties

B electrolytic properties

C nonpolarity

D polarity

11 Which term describes the substance that is completely consumed during a chemical reaction?

A Excess reactant

B Limiting reactant

C Percent yield

D Theoretical yield

12 Which statement is one of the assumptions of the kinetic molecular theory of gasses?

A Collisions between gas particles and container walls are inelastic.

B The temperature of a gas depends on the average potential energy of the gas particles.

C Gas particles are much larger than the distance between them.

D The volume of a gas is mostly empty space.

13 A large beaker has 2.75 L of a solution containing 5.25 moles of copper (II) sulfate in water. What is the molarity of the solution?

A 2 M

B 1.91 M

C 0.524 M

D 0.5 M

14 Ethyne, a fuel used in oxyacetylene torches, is produced from the reaction shown.

$$2C + H_2 + 228.2\ \text{kJ} \rightarrow C_2H_2$$

Based on the equation, what type of reaction is used to produce ethyne?

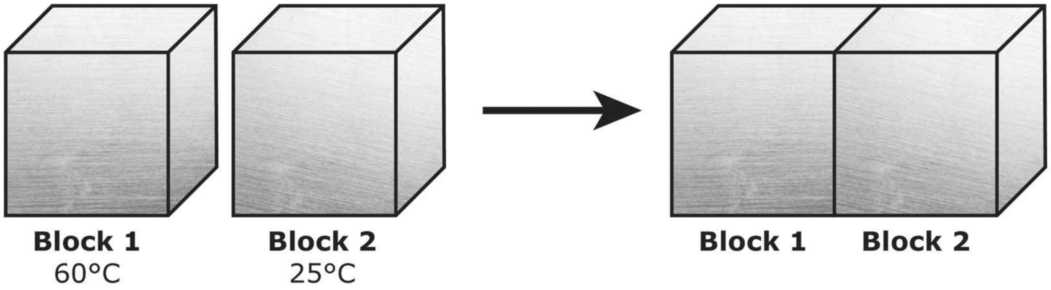
A Endothermic, because heat is absorbed.

B Exothermic, because heat is released.

C Endothermic, because heat is released.

D Exothermic, because heat is absorbed.

15 Two blocks of metal are separated and have different temperatures as shown. The blocks are then pushed together so that they touch.



Which statement describes the resulting heat flow?

A Heat flows from Block 1 to Block 2.

B Heat flows from Block 2 to Block 1.

C There is no heat flow.

D Heat flows back and forth from one block to the other.

EXAMPLE ITEMS Chemistry Key, Sem 2

Item#	Key	SE	Process Skills	SE Justification
1	A	C.8G	2G	Perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products.
2	C	C.12B	--	Compare fission and fusion reactions.
3	C	C.10H	2G	Calculate the pH of a solution using the hydrogen ion concentration.
4	D	C.10B	--	Apply the general rules regarding solubility through investigations with aqueous solutions.
5	A	C.10E	2H	Distinguish among types of solutions such as unsaturated and saturated solutions.
6	A	C.12A	2G	Describe radioactive decay processes in terms of balanced nuclear equations.
7	B	C.11D	2G	Perform calculations involving heat, mass, temperature change and specific heat.
8	C	C.9A	2G	Calculate the relationship between pressure and volume for an ideal gas as described by Boyle’s law.
9	C	C.10F	2H	Investigate factors that influence gas solubilities, such as temperature.
10	D	C.10A	--	Describe the unique role of water in solutions in terms of polarity
11	B	C.8H	--	Describe the concept of limiting reactants in a balanced chemical equation.
12	D	C.9B	3A	Describe the postulates of kinetic molecular theory.
13	B	C.10C	2G	Calculate the concentration of solutions in units of molarity.
14	A	C.11C	--	Classify reactions as exothermic or endothermic.
15	A	C.11B	2I	Describe the processes of heat transfer.