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 (assessment.dallasisd.org).

OR

(2) To submit directly: Login to the Assessment website. Under "News" in the left-hand column, click on "Sem 2 Example Items Download." Above the subjects, click on "Example Feedback Form."

Second Semester
2017–2018
Code #: 3101

STAAR CHEMISTRY REFERENCE MATERIALS

STAAR™ State of Texas Assessments of Academic Readiness

ATOMIC STRUCTURE

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

BEHAVIOR OF GASES

Total pressure of a gas = $\left(\begin{array}{c}\text{sum of the partial pressures}\\ \text{of the component gases}\end{array}\right)$	$P_T = P_1 + P_2 + P_3 + \ . \ . \ .$
(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

Molarity = $\dfrac{\text{moles of solute}}{\text{liter of solution}}$	$M = \dfrac{\text{mol}}{\text{L}}$
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

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

STAAR CHEMISTRY REFERENCE MATERIALS

OTHER FORMULAS

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

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

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

CONSTANTS AND CONVERSIONS

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

h = Planck's constant $= 6.63 \times 10^{-34}$ J · s

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

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

alpha particle (α) $= {}^{4}_{2}\text{He}$ $\qquad$ beta particle (β) $= {}^{0}_{-1}\text{e}$ $\qquad$ 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 $= 22.4 \dfrac{\text{L}}{\text{mol}}$

1 cm^3 = 1 mL = 1 cc

1 atm = 760 mm Hg = 101.3 kPa

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

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 Ag^+, 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 (Increasing Activity ↑)

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

PERIODIC TABLE OF THE ELEMENTS

Key: Atomic number — 14; Symbol — Si; Atomic mass — 28.086; Name — Silicon

Period	1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	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 10^{-6} moles/L?

A -6

B 10^{-6}

C 6

D $\log(-6)$

4 Which substance is soluble in water?

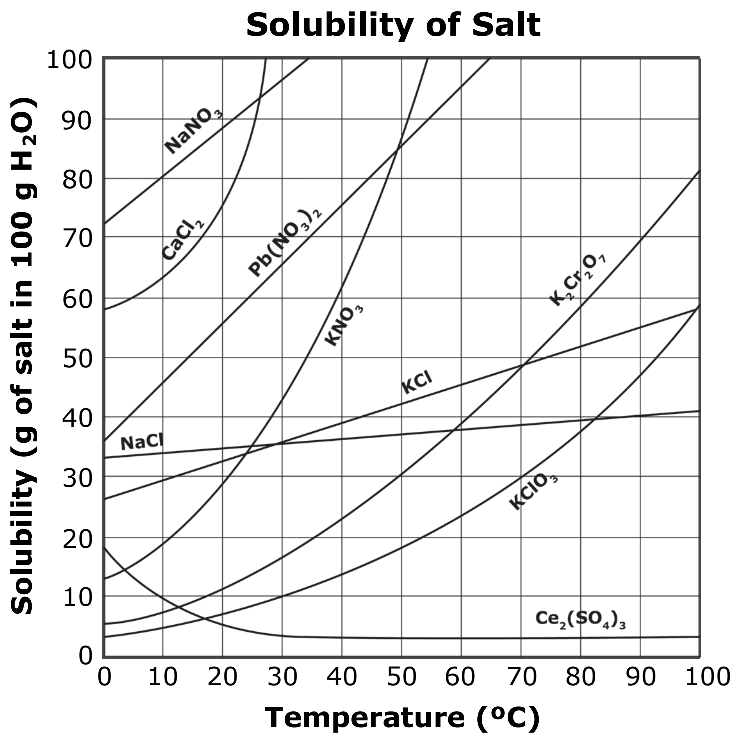
A $Pb(CO_3)_2$

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 Position

7 The balanced chemical reaction equation for the production of ammonia is shown.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

How many moles of ammonia, NH_3, are produced by reacting 5 moles of nitrogen gas, N_2, with excess hydrogen gas, H_2?

A 4 moles

B 5 moles

C 8 moles

D 10 moles

8 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

9 A 5.0 gram piece of steel is heated from 11 ºC to 21 ºC. Given that the specific heat of steel is 0.45 J/(g•°C), how much heat is absorbed during the rise in temperature?

A 12.5 Joules

B 22.5 Joules

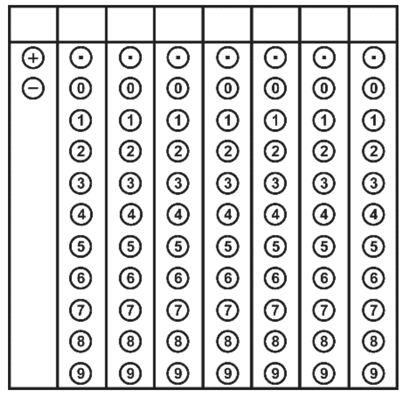
C 25.5 Joules

D 47.5 Joules

10 An expandable (V is not constant) container holds 15.0 liters of a gas at a pressure of 2.50 atm and at a temperature of 325 K. The volume of the container is then increased to a new volume of 25.0 liters while the temperature is held constant at 325 K. Calculate the new pressure in the container?

(Express the answer to 3 significant figures.)

Record the answer and fill in the bubbles on the grid provided. Be sure to use the correct place value.



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

$$2C + H_2 + 228.2\ kJ \rightarrow C_2H_2$$

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.

12 What type of radioactive decay particle causes an increase in the atomic number but leaves the mass number unaffected?

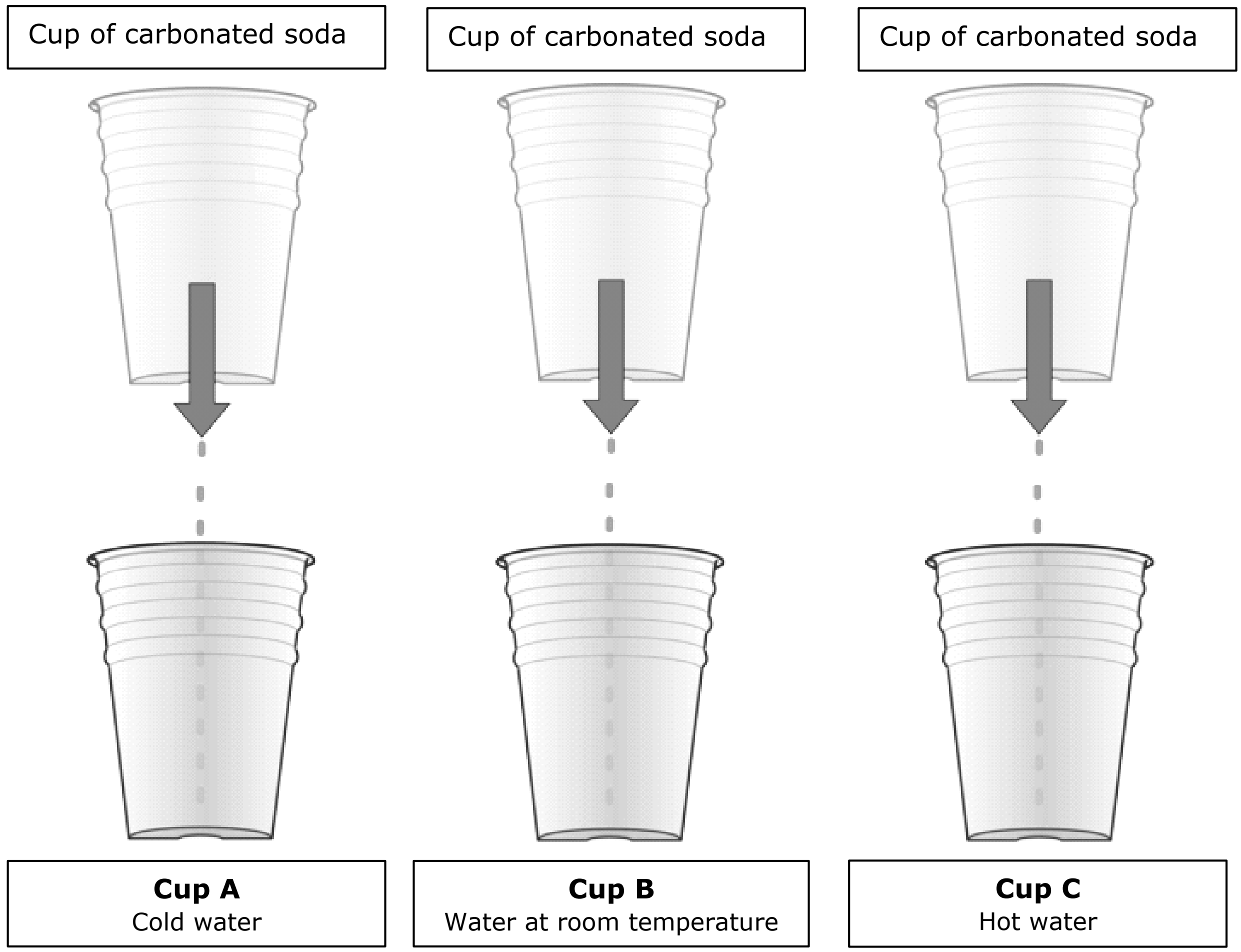
A Alpha

B Beta

C Gamma

D Positron

13 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.

14 Which equation represents an acid-base neutralization reaction?

A $2Mg + O_2 \rightarrow 2MgO$

B $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$

C $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

D $NaOH + HCl \rightarrow NaCl + H_2O$

15 Students performed a lab where they measured hydrogen ion concentration after pouring four different acids into separate beakers containing 200 mL of water. The table shows $[H^+]$ for each of the resulting solutions.

Solution	**$[H^+]$**
Solution A	5.9×10^{-5}
Solution B	2.2×10^{-8}
Solution C	3.3×10^{-10}
Solution D	1.5×10^{-4}

Based on the information in the table, which is the strongest acid?

A Solution A

B Solution B

C Solution C

D Solution D

EXAMPLE ITEMS Chemistry Key, Sem 2

Item#	Key	SE	Process Skills	SE Justification
1	A	C.9B	2G	Perform stoichiometric calculations, including determination of mass and volume relationships between reactants and products for reactions involving gases.
2	C	C.12C	--	Compare fission and fusion reactions.
3	C	C.10I	2G	Define pH and use the hydrogen ion concentration to calculate the pH of a solution.
4	D	C.10B	--	Use general rules regarding solubility through investigations with aqueous solutions.
5	A	C.10E	2H	Distinguish between unsaturated and saturated solutions.
6	A	C.12B	2G	Describe radioactive decay process in terms of balanced nuclear equations.
7	D	C.8E	2G	Perform stoichiometric calculations.
8	B	C.11E	2H	Use calorimetry to calculate the heat of a chemical process.
9	B	C.11D	2G	Perform calculations involving heat, mass, temperature change, and specific heat.
10	1.50	C.9A	2G	Calculate the relationship between pressure and volume for an ideal gas as described by Boyle’s law.
11	A	C.11C	--	Classify reactions as exothermic or endothermic.
12	B	C.12A	--	Describe the characteristics of beta radiation.
13	C	C.10F	2H	Investigate factors that influence solubilities, such as temperature.
14	D	C.10H	2G	Differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions.
15	D	C.10J	2H	Distinguish between degrees of dissociation for strong and weak acids.