VIRGINIA STANDARDS OF LEARNING

TEST ITEM SET

CHEMISTRY

2010 Science Standards of Learning

Released Spring 2015

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SAMPLE A

Which of the following is a balanced equation?

- **A** $H_2 + Br_2 \rightarrow 2HBr$
- **B** $H_2 + Br_2 \rightarrow HBr$
- **C** $H_2 + 2Br_2 \rightarrow 2HBr$
- **D** $2H_2 + Br_2 \rightarrow HBr$

Directions: Click and drag a term into each box. Each term may be used more than once.

SAMPLE B

A student conducted an investigation to determine the effect of water temperature on the amount of sugar that dissolves in a beaker of water. Identify components for trial 1 of this investigation.

Trial 1

Beaker Number	Amount of Water (mL)	Temperature of Sugar (°C)	Temperature of Water (°C)	Amount of Sugar Dissolved (g)
1	100	20	5	185
2	100	20	10	189
3	100	20	15	194
4	100	20	20	204

Terms

- **Variable**
- **Constant**

A student measures the mass of a 1.00 g aluminum rod as 0.99 g. The best estimate of the percent error associated with this measurement is —

- **A** 0.01%
- **B** 0.1%
- **C** 1%
- **D** 10%

The most efficient way to determine whether a reaction is an exothermic chemical reaction is to use —

- **A** an oxygen probe
- **B** a temperature probe
- **C** a pressure probe
- **D** a pH probe

$$2Al(C_2H_3O_2)_3 + 3BaSO_4 \rightarrow Al_2(SO_4)_3 + 3Ba(C_2H_3O_2)_2$$

Which type of chemical reaction does this equation represent?

- **A** Synthesis
- **B** Neutralization
- **C** Oxidation-reduction
- **D** Double-replacement

Directions: Type your answer in the box. Use "+" or "-" for the electrical charge.

What is the oxidation number of an oxide ion?

What is the molarity of a solution with 0.2 moles of potassium permanganate ($KMnO_4$) dissolved in enough water to make a 500.0 mL solution?

- **A** 0.0004 M
- **B** 0.1 M
- **C** 0.4 M
- **D** 100 M

When 92.0 g of ethanol (C_2H_5OH) are vaporized at its boiling point of 78.3°C, it requires 78.6 kJ of energy. What is the approximate molar heat of vaporization of ethanol in kJ/mol?

- **A** 0.854
- **B** 1.17
- **C** 39.3
- **D** 78.3

Directions: Type your answer in the box. Your answer must use significant digits.

What is the density of an aqueous solution that has a mass of 10.081 g and 12.5 mL?

[ ] **g/mL**

Which element has 16 neutrons, 15 protons, and 15 electrons?

- **A** Sulfur (S)
- **B** Phosphorus (P)
- **C** Gallium (Ga)
- **D** Zinc (Zn)

$$\mathrm{Al}(s) + 3\mathrm{AgNO_3}(aq) \rightarrow \mathrm{Al(NO_3)_3}(aq) + 3\mathrm{Ag}(s)$$

This equation represents which type of chemical reaction?

- **A** Single-replacement
- **B** Double-replacement
- **C** Decomposition
- **D** Synthesis

In the formula for barium chloride, ($BaCl_2$), barium (Ba) is written first because it is —

- **A** a single atom
- **B** a larger atom
- **C** the positive ion
- **D** the negative ion

Which of these laboratory techniques is best to separate a solid from a liquid to recover the liquid?

- **A** Titration
- **B** Chromatography
- **C** Filtering
- **D** Vaporization

Which of these is NOT required to ensure that stock solutions are free of contamination?

- **A** Store all solutions in brown bottles
- **B** Do not place dropping pipettes in stock solution bottles
- **C** Never return excess chemicals to stock bottles
- **D** Replace tops on reagent bottles after use

Which of these values is most responsible for changing the boiling and freezing points of a solvent?

- **A** Molar mass of the solvent
- **B** Electronegativity of the solvent
- **C** Weight of the solute particles
- **D** Number of the solute particles

What is the name of the compound with the formula NH_4NO_3 ?

- **A** Ammonium nitrate
- **B** Nitrogen nitrate
- **C** Nitrogen hydrogen oxide
- **D** Ammonium nitrogen trioxide

Directions: Type your answer in the box.

Calculate the number of moles of Li_3PO_4 in 2.2 L of a 0.60 M Li_3PO_4 solution.

_____ **moles**

$$N_2(g) + 3F_2(g) \rightleftarrows 2NF_3(g)$$

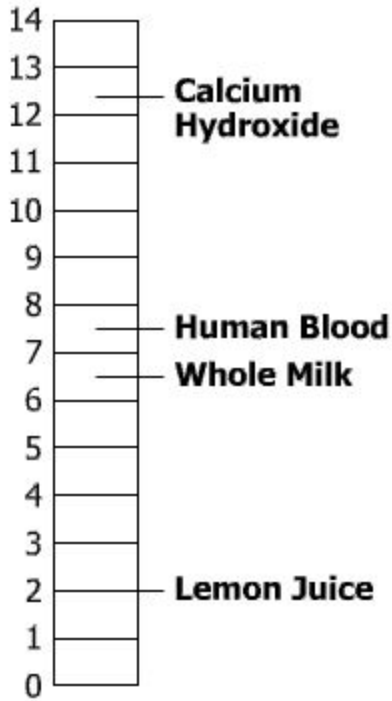
Equilibrium has been reached for the reaction shown. Which conclusion is correct?

- **A** The N_2 and F_2 together will form at a faster rate than the NF_3.
- **B** The partial pressures of N_2, F_2, and NF_3 will stay constant.
- **C** The NF_3 will form at a faster rate than the N_2 and F_2 together.
- **D** The partial pressure of NF_3 will keep changing.

If 89.6 joules of heat are needed to heat 20.0 grams of iron from 30.0°C to 40.0°C, what is the specific heat of the iron in $\frac{J}{g \cdot °C}$?

- **A** 0.448
- **B** 2.23
- **C** 8.96
- **D** 896

pH Scale of Various Substances



Which of the four substances on this pH scale is slightly basic?

- **A** Calcium hydroxide
- **B** Human blood
- **C** Whole milk
- **D** Lemon juice

Which element will most likely form covalent bonds with fluorine?

- **A** Carbon
- **B** Potassium
- **C** Neon
- **D** Tin

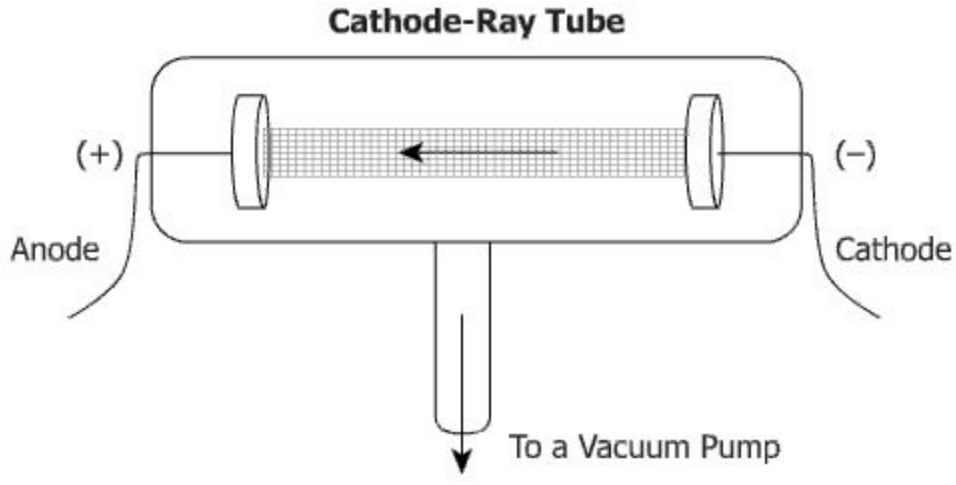
The physical process of evaporation involves —

- **A** ion formation
- **B** electron sharing
- **C** transferring valence electrons
- **D** overcoming intermolecular forces

$$\_\_\_\ C_2H_4 + \_?\_\ O_2 \rightarrow \_\_\_\ CO_2 + \_\_\_\ H_2O$$

How many moles of O_2 are in the chemical equation when balanced using the lowest whole numbers?

- **A** 5
- **B** 4
- **C** 3
- **D** 2

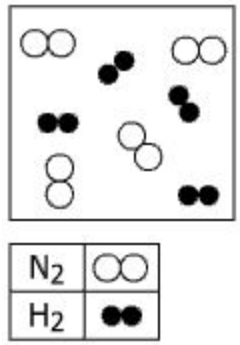


While English physicist J. J. Thomson was carrying out experiments on cathode rays, he was able to determine that the rays consisted of particles he called "corpuscles." These particles were later named —

- **A** protons
- **B** electrons
- **C** gamma rays
- **D** neutrons

In the Haber process, nitrogen (N_2) and hydrogen (H_2) are directly combined to form ammonia (NH_3). Which illustration contains the stoichiometric quantities of the reactants for this reaction?

A



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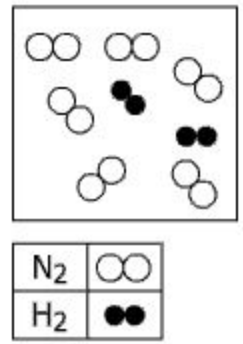
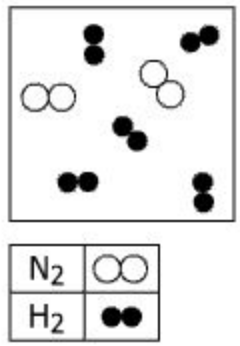
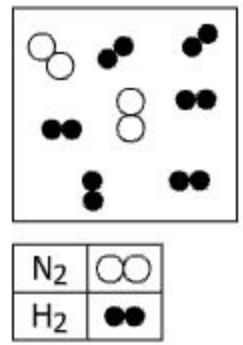


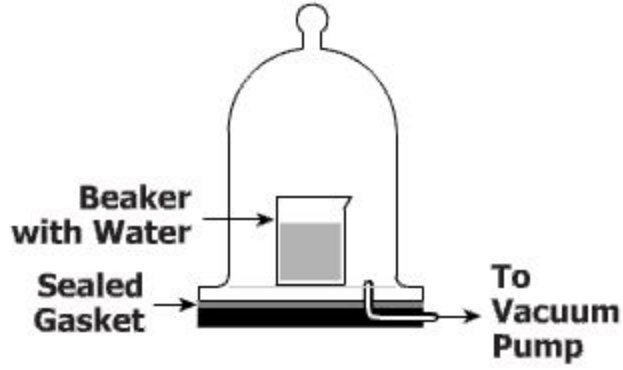
B



D



Thick-Walled Vacuum Jar

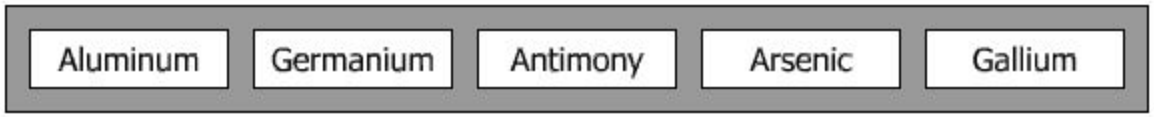


A beaker of water is placed in a large sealed jar that is attached to a vacuum pump. As air is pumped out of the jar, the water begins to boil because —

- **A** the temperature of the water decreases as the surrounding pressure decreases
- **B** the lower pressure inside the jar causes the water to contract
- **C** the air pressure in the jar has been lowered until it is equal to the vapor pressure of the water
- **D** the pressure on the water is insufficient to hold the hydrogen and oxygen atoms together, resulting in a decomposition reaction

Directions: Click on the correct answers.

According to the periodic table of the elements, which elements belong to the same period?



How many moles are in 2.04×10^{24} molecules of H_2O?

- **A** 0.295 mol
- **B** 3.39 mol
- **C** 1.13×10^{24} mol
- **D** 1.44×10^{48} mol

What is the name for $FeCl_3$ using the IUPAC nomenclature rules?

- **A** Iron chloride
- **B** Iron(II) chloride
- **C** Iron trichloride
- **D** Iron(III) chloride

Directions: Type your answer in the box.

An expandable container of oxygen gas has a volume of 125 mL at a temperature of 25.0°C. What volume will the gas occupy at 55.0°C ?

_____ **mL**

Which of these correctly describes how organic catalysts operate in biological reactions?

- **A** They are used up in the reactions.
- **B** They lower the overall energy of the reactions.
- **C** They lower the activation energy of the reactions.
- **D** They keep the temperature of the reactions constant.

What volume will 35.9 g of hydrogen gas (H_2) occupy at STP?

- **A** 399 L
- **B** 798 L
- **C** 804 L
- **D** 1,620 L

$$\_\_\_Ca(NO_3)_2 + \_?\_H_3PO_4 \rightarrow \_\_\_Ca_3(PO_4)_2 + \_\_\_HNO_3$$

When this equation is balanced, the coefficient in front of H_3PO_4 is —

- **A** 1
- **B** 2
- **C** 3
- **D** 4

Increasing the volume of a sealed container will cause the gas particles within the container to —

- **A** form a liquid
- **B** collide more frequently
- **C** increase in molecular attraction
- **D** exhibit lower pressure

Melting Point Results (°C)

Trial	Group 1	Group 2	Group 3	Group 4
1	113	114	116	110
2	111	115	113	111
3	110	111	114	111
4	110	110	113	110

Each of four groups of students determined and recorded the melting point of a solid compound. If the actual melting point is 113°C, which group had the best precision?

- **A** Group 1
- **B** Group 2
- **C** Group 3
- **D** Group 4

Consider any set of three adjacent elements in the same period on the periodic table. For which characteristic is the average for the three elements always equal to the value of the middle element?

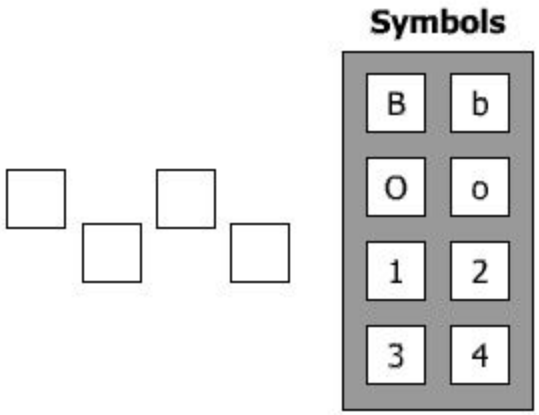
- **A** Atomic number
- **B** Atomic mass
- **C** Number of neutrons
- **D** Number of isotopes

A substance has a molecular formula of $C_8H_{10}N_4O_2$. The empirical formula is —

- **A** $C_2H_6N_2O$
- **B** $C_4H_5N_2O$
- **C** $C_9H_7N_3O$
- **D** CHNO

Directions: Click and drag the correct answers to the boxes.

Create the formula for diboron trioxide using the symbols provided.



What is the name for the compound AlI_3 ?

- **A** Aluminum(I) iodide
- **B** Aluminum triiodide
- **C** Aluminum(III) iodide
- **D** Aluminum iodide

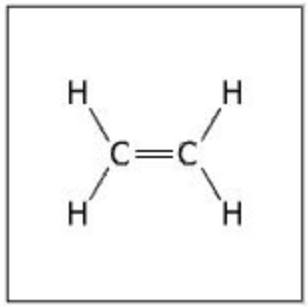
$$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$$

How many moles of carbon dioxide (CO_2) are produced when reacting 6.00 moles of butane (C_4H_{10}) in excess oxygen (O_2)?

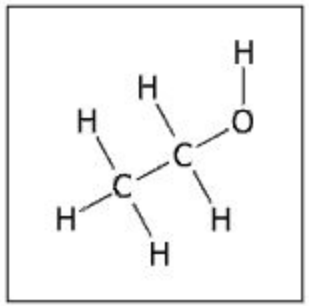
- **A** 1.50 mol
- **B** 24.0 mol
- **C** 66.0 mol
- **D** 1,060 mol

Which structure represents a nonpolar molecule?

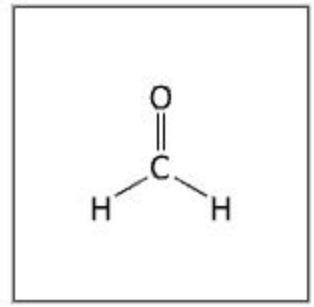
○ **A**



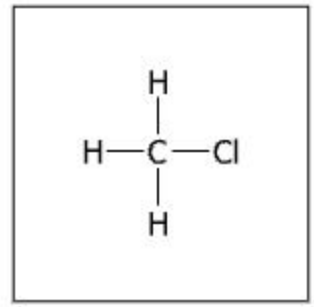
○ **B**



○ **C**



○ **D**



Using only one trial to collect data in an experiment —

- **A** makes it easier to determine a valid conclusion
- **B** reduces the percent error in the results
- **C** causes the conclusion to be less reliable
- **D** requires data with more significant figures

A common product of acid-base neutralization reactions is —

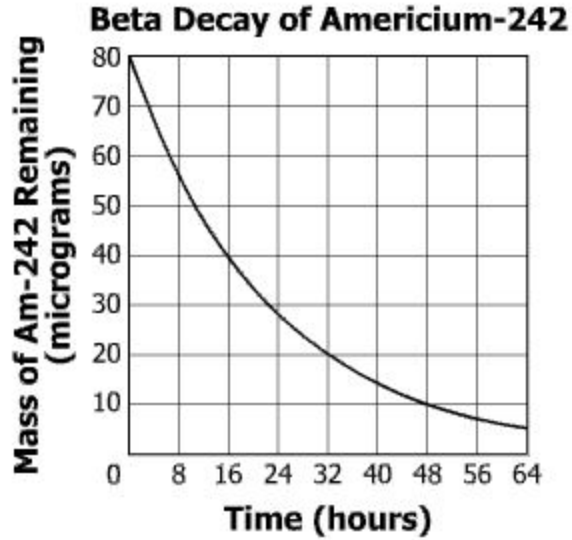
- **A** hydrogen
- **B** water
- **C** carbon dioxide
- **D** oxygen

Data Table

Solution	Brightness of Light Bulb	pH
$NaHCO_3$	Bright	8.4
HClO	Dim	3.7
$NaNO_3$	Bright	7.0
CH_3NH_2	Dim	8.0

Based on the information provided, which solution is a base and a weak electrolyte?

- **A** $NaHCO_3$
- **B** HClO
- **C** $NaNO_3$
- **D** CH_3NH_2



What is the half-life of Americium-242?

- **A** 11 hours
- **B** 16 hours
- **C** 32 hours
- **D** 64 hours

Two electrons are shared equally in bromine (Br_2). What type of bond is represented between the bromine atoms in this Lewis structure?

- **A** Nonpolar covalent bond
- **B** Polar covalent bond
- **C** Metallic bond
- **D** Ionic bond

A student is studying the effects of several solutions on the prevention of the browning of apples. The student used solutions having different pH values and immersed three apple slices in equal volumes of each of the solutions. Which of these is the independent variable in this investigation?

- **A** pH of solution
- **B** Shade of brown
- **C** Number of apple slices
- **D** Volume of solutions

An experiment produced 0.10 g CO_2 with a volume of 0.056 L at STP. If the accepted density of CO_2 at STP is 1.96 g/L, what is the approximate percent error?

- **A** 110%
- **B** 92%
- **C** 71%
- **D** 8.2%