

Chemistry

Administered May 2013

RELEASED

STAAR CHEMISTRY REFERENCE MATERIALS



ATOMIC STRUCTURE

Speed of light = (frequency)(wavelength)

$$c = f\lambda$$

Energy = (Planck's constant)(frequency)

$$E_{\text{photon}} = hf$$

Energy = $\frac{(\text{Planck's constant})(\text{speed of light})}{(\text{wavelength})}$

$$E_{\text{photon}} = \frac{hc}{\lambda}$$

BEHAVIOR OF GASES

Total pressure of a gas = $\left(\begin{array}{l} \text{sum of the partial pressures} \\ \text{of the component gases} \end{array} \right)$

$$P_T = P_1 + P_2 + P_3 + \dots$$

(Pressure)(volume) = (moles)(ideal gas constant)(temperature)

$$PV = nRT$$

$\frac{(\text{Initial pressure})(\text{initial volume})}{(\text{Initial moles})(\text{initial temperature})} = \frac{(\text{final pressure})(\text{final volume})}{(\text{final moles})(\text{final temperature})}$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

(Initial pressure)(initial volume) = (final pressure)(final volume)

$$P_1V_1 = P_2V_2$$

$\frac{(\text{Initial volume})}{(\text{Initial temperature})} = \frac{(\text{final volume})}{(\text{final temperature})}$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$\frac{(\text{Initial volume})}{(\text{Initial moles})} = \frac{(\text{final volume})}{(\text{final moles})}$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

SOLUTIONS

Molarity = $\frac{\text{moles of solute}}{\text{liter of solution}}$

$$M = \frac{\text{mol}}{\text{L}}$$

Ionization constant of water = $\left(\begin{array}{l} \text{hydrogen ion} \\ \text{concentration} \end{array} \right) \left(\begin{array}{l} \text{hydroxide ion} \\ \text{concentration} \end{array} \right)$

$$K_w = [\text{H}^+][\text{OH}^-]$$

$\left(\begin{array}{l} \text{Volume of} \\ \text{solution 1} \end{array} \right) \left(\begin{array}{l} \text{molarity of} \\ \text{solution 1} \end{array} \right) = \left(\begin{array}{l} \text{volume of} \\ \text{solution 2} \end{array} \right) \left(\begin{array}{l} \text{molarity of} \\ \text{solution 2} \end{array} \right)$

$$V_1M_1 = V_2M_2$$

pH = -logarithm (hydrogen ion concentration)

$$\text{pH} = -\log[\text{H}^+]$$

THERMOCHEMISTRY

Heat gained or lost = (mass) $\left(\begin{array}{l} \text{specific} \\ \text{heat} \end{array} \right) \left(\begin{array}{l} \text{change in} \\ \text{temperature} \end{array} \right)$

$$Q = mc_p\Delta T$$

Enthalpy of reaction = $\left(\begin{array}{l} \text{enthalpy} \\ \text{of products} \end{array} \right) - \left(\begin{array}{l} \text{enthalpy} \\ \text{of reactants} \end{array} \right)$

$$\Delta H = \Delta H_f^\circ(\text{products}) - \Delta H_f^\circ(\text{reactants})$$

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OTHER FORMULAS

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$D = \frac{m}{V}$$

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

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

CONSTANTS AND CONVERSIONS

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

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

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

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

$$\text{alpha particle } (\alpha) = {}_2^4\text{He} \quad \text{beta particle } (\beta) = {}_{-1}^0\text{e} \quad \text{neutron} = {}_0^1\text{n}$$

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

$$0^\circ\text{C} = 273 \text{ K}$$

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

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

$$1 \text{ atm} = 760 \text{ mm Hg} = 101.3 \text{ kPa}$$

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

$$1 \text{ calorie (cal)} = 4.18 \text{ joules (J)}$$

$$1000 \text{ calories (cal)} = 1 \text{ Calorie (Cal)} = 1 \text{ kilocalorie (kcal)}$$

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.

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PERIODIC TABLE OF THE ELEMENTS

Atomic number _____ 14																	
Symbol _____ Si																	
Atomic mass _____ 28.086																	
Silicon _____ Name																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1A	2A	3B	4B	5B	6B	7B	8B	9	10	11B	12B	3A	4A	5A	6A	7A	8A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H 1.008 Hydrogen	He 4.003 Helium	Li 6.941 Lithium	Be 9.012 Beryllium	B 10.812 Boron	C 12.011 Carbon	N 14.007 Nitrogen	O 15.999 Oxygen	F 18.998 Fluorine	Ne 20.180 Neon	Na 22.990 Sodium	Mg 24.305 Magnesium	Al 26.982 Aluminum	Si 28.086 Silicon	P 30.974 Phosphorus	S 32.066 Sulfur	Cl 35.453 Chlorine	Ar 39.948 Argon
K 39.098 Potassium	Ca 40.078 Calcium	Sc 44.956 Scandium	Ti 47.867 Titanium	V 50.942 Vanadium	Cr 51.996 Chromium	Mn 54.938 Manganese	Fe 55.845 Iron	Co 58.933 Cobalt	Ni 58.693 Nickel	Cu 63.546 Copper	Zn 65.38 Zinc	Ga 69.723 Gallium	Ge 72.64 Germanium	As 74.922 Arsenic	Se 78.96 Selenium	Br 79.904 Bromine	Kr 83.798 Krypton
Rb 85.468 Rubidium	Sr 87.62 Strontium	Y 88.906 Yttrium	Zr 91.224 Zirconium	Nb 92.906 Niobium	Mo 95.96 Molybdenum	Tc (98) Technetium	Ru 101.07 Ruthenium	Rh 102.906 Rhodium	Pd 106.42 Palladium	Ag 107.868 Silver	Cd 112.412 Cadmium	In 114.818 Indium	Sn 118.711 Tin	Sb 121.760 Antimony	Te 127.60 Tellurium	I 126.904 Iodine	Xe 131.294 Xenon
Cs 132.905 Cesium	Ba 137.328 Barium	Lu 174.967 Lutetium	Hf 178.49 Hafnium	Ta 180.948 Tantalum	W 183.84 Tungsten	Re 186.207 Rhenium	Os 190.23 Osmium	Ir 192.217 Iridium	Pt 195.085 Platinum	Au 196.967 Gold	Hg 200.59 Mercury	Tl 204.383 Thallium	Pb 207.2 Lead	Bi 208.980 Bismuth	Po (209) Polonium	At (210) Astatine	Rn (222) Radon
Fr (223) Francium	Ra (226) Radium	Lr (262) Lawrencium	Rf (267) Rutherfordium	Db (268) Dubnium	Sg (271) Seaborgium	Bh (272) Bohrium	Hs (270) Hassium	Mt (276) Meitnerium	Ds (281) Darmstadtium	Rg (280) Roentgenium	Mass numbers in parentheses are those of the most stable or most common isotope.						
87	88	103	104	105	106	107	108	109	110	111							

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

Chemistry

DIRECTIONS

Read each question carefully. For a multiple-choice question, determine the best answer to the question from the four answer choices provided. For a griddable question, determine the best answer to the question. Then fill in the answer on your answer document.

1 What is the formula of the ion hydrogen sulfite, which has a charge of -1 ?



2 What is the pH of a substance that has a hydrogen ion concentration of $1.2 \times 10^{-2} M$?

F 2.08

G 1.92

H 1.00

J 0.080

- 3** Which of the following includes an example of a chemical property of an element?
- A** Aluminum is a solid at room temperature and is a poor thermal insulator.
 - B** Sulfur is not shiny and is not malleable.
 - C** Sodium is a solid at room temperature and reacts with other elements.
 - D** Silicon is shiny and is a poor conductor of electricity.

-
- 4** Elements in a group of the periodic table are described below.

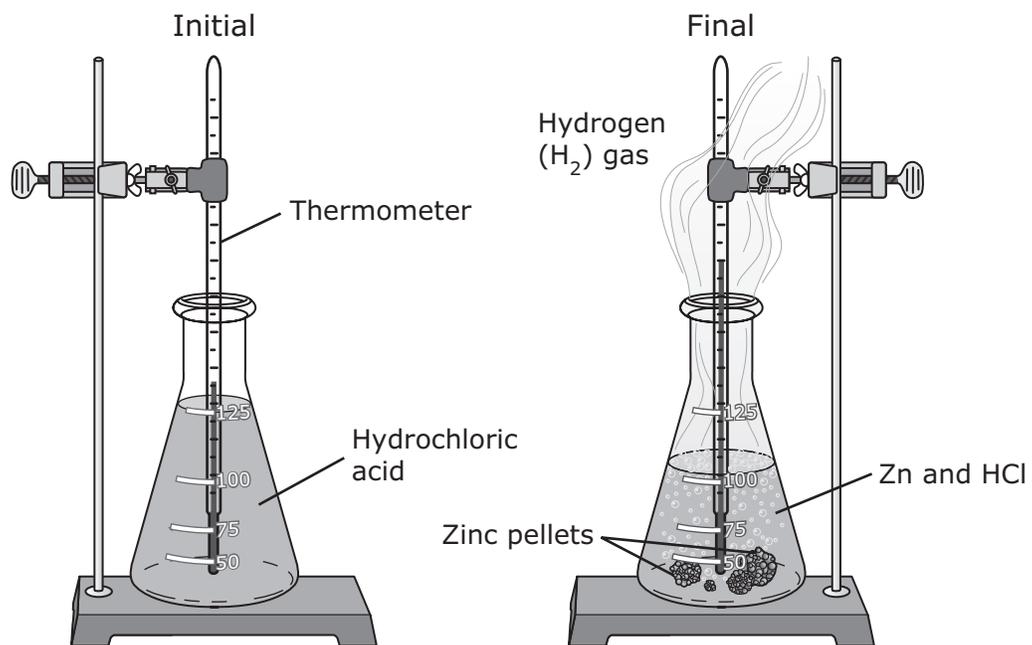
Some Properties of a Certain Group of Elements

- Soft silvery-white color
- Good conductor of thermal energy
- Good conductor of electricity
- Atoms contain a single valence electron

These elements most likely belong to which group?

- F** Alkali metals
- G** Alkaline earth metals
- H** Halogens
- J** Noble gases

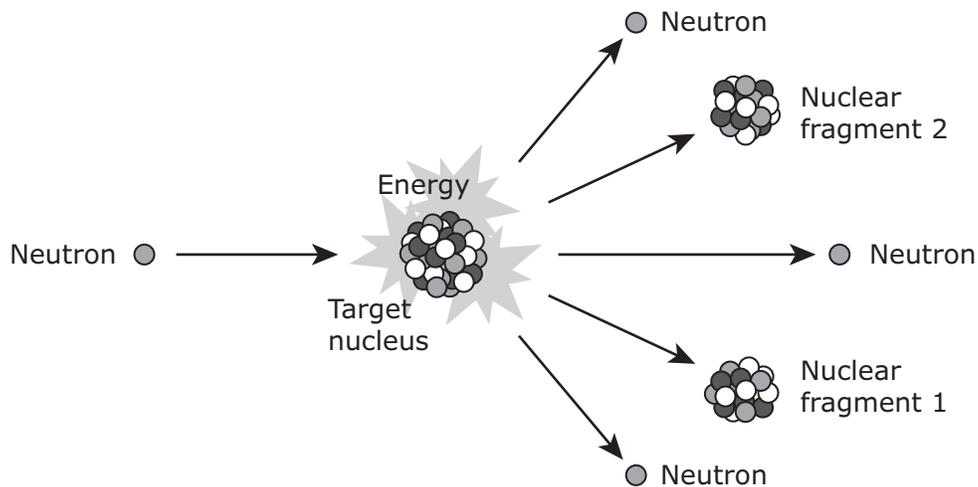
- 5 The diagram below shows what happens when zinc reacts with hydrochloric acid.



Which of these best describes the energy transformation that occurs during this reaction?

- A** Thermal energy \rightarrow kinetic energy **C** Chemical energy \rightarrow thermal energy
B Kinetic energy \rightarrow potential energy **D** Potential energy \rightarrow chemical energy

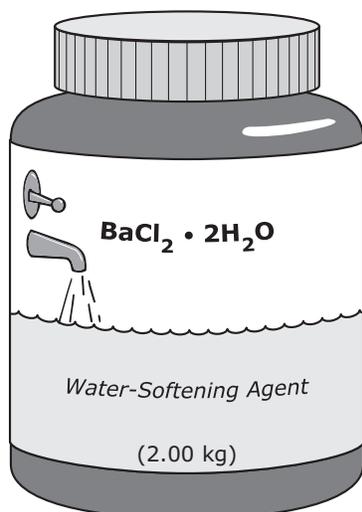
6 The diagram below represents a nuclear reaction.



Which of the following best describes this reaction?

- F** Nuclear fusion is occurring because many smaller nuclei are being fused.
- G** Nuclear fission is occurring because large amounts of energy are being absorbed.
- H** Nuclear fusion is occurring because many energetic neutrons are being emitted.
- J** Nuclear fission is occurring because a nucleus is being split into smaller nuclei.

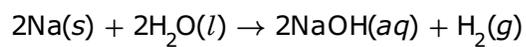
- 7 A detail from a label on a bottle of a water-softening agent is shown below.



Which inference about the contents of the bottle can best be drawn?

- A They consist of barium chloride anhydrous.
 - B They consist of barium chloride dihydrate.
 - C They consist of barium chloride hexahydrate.
 - D They consist of barium chloride heptahydrate.
-
- 8 Heart cells require a certain balance of sodium and potassium ions to function. The blood, which is approximately 83% water, carries these two types of ions to the heart. The property of water that allows it to carry ions to the heart is its —
- F molecular mass
 - G specific heat
 - H polarity
 - J density

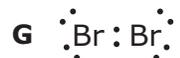
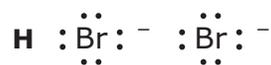
- 9 The equation below represents a chemical reaction that produces a gas.



What is the theoretical yield in liters of H_2 gas if 5.00 g of Na are completely reacted and the H_2 gas is collected at STP?

- A 0.109 L
- B 2.44 L
- C 4.88 L
- D 5.09 L

-
- 10 Which of these is the electron-dot diagram for $\text{Br}_2(l)$?



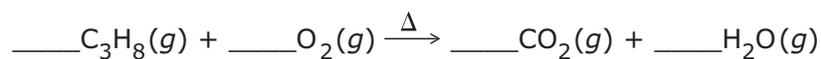
11 The table below lists some properties of a sample of lauric acid.

Property	Value
Volume	79.6 mL
Mass	70.022 g
Boiling point	222°C
Number of moles	0.350

Which of these is an intensive property of this sample?

- A** Volume
- B** Mass
- C** Boiling point
- D** Number of moles

12 When the equation below is balanced, what is the coefficient for oxygen?



Record your answer and fill in the bubbles on your answer document.

- 13** Which mixture can be separated through filtration because one of the substances is insoluble in water?
- A** NaClO_3 and $\text{Pb}(\text{ClO}_3)_2$
 - B** Na_2SO_4 and SrSO_4
 - C** NaNO_3 and $\text{Pb}(\text{NO}_3)_2$
 - D** $\text{NaC}_2\text{H}_3\text{O}_2$ and $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$
-

- 14** Some students used a variety of procedures to investigate four liquid samples. The students recorded the following information.

- When Sample W was cooled, solid particles settled out of the liquid.
- The mass and volume of Sample X were measured, and the density of Sample X was calculated to be 1.6 g/mL.
- Sample Y was heated, and the temperature was recorded. All the liquid boiled away at the same temperature and left no residue in the container.
- When a dilute acid was added to Sample Z, gas bubbles formed and rapidly rose to the surface of the liquid.

Based on these observations, which sample was clearly identifiable as a pure substance?

- F** Sample W
- G** Sample X
- H** Sample Y
- J** Sample Z

15 What is the electron configuration for an atom of germanium at ground state?

- A** $[\text{Ar}]4s^23d^{10}4p^2$
 - B** $[\text{Ar}]4s^24d^{10}4p^2$
 - C** $[\text{Kr}]4s^23d^{10}4p^2$
 - D** $[\text{Kr}]4s^24d^{10}4p^2$
-

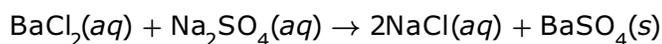
16 Which of the following correctly matches a compound with its molecular geometry?

- F** Water (H_2O): linear
 - G** Carbon dioxide (CO_2): tetrahedral
 - H** Ammonia (NH_3): trigonal planar
 - J** Methane (CH_4): tetrahedral
-

17 A sample of a compound is added to distilled water in a clean beaker. A reaction occurs, and the water temperature drops rapidly. Which of the following statements is best supported by this observation?

- A** An endothermic reaction occurred.
- B** A dehydration reaction occurred.
- C** The water was originally warmer than the compound.
- D** The beaker was contaminated by another compound.

18 Use the equation below to answer the following question.



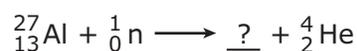
The theoretical yield of BaSO_4 is 58.35 g. If 44.34 g of BaSO_4 are produced from the reaction shown above, what is the percent yield of BaSO_4 ?

- F 31.67%
- G 52.03%
- H 75.99%
- J 85.17%

19 When zinc is exposed to air, zinc oxide is produced. What happens in this reaction?

- A Zinc is oxidized, and oxygen is reduced.
- B Zinc is reduced, and oxygen is oxidized.
- C Both zinc and oxygen are oxidized.
- D Both zinc and oxygen are reduced.

20 The equation below represents a nuclear reaction.



What is the mass number of the missing particle in this reaction?

Record your answer and fill in the bubbles on your answer document.

23 The following table lists some properties of copper and sulfur.

Property	Copper	Sulfur
Color	Reddish	Pale yellow
Conductor of electricity	Yes	No
State of matter at room temperature	Malleable solid	Brittle solid
Metal or nonmetal	Metal	Nonmetal
Luster	Metallic	Dull
Ductile	Yes	No
Density (g/cm ³)	8.96	2.07

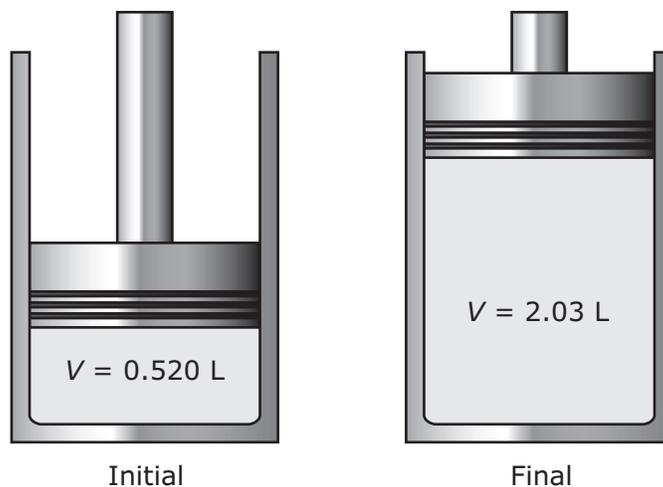
Samples of copper metal and sulfur powder are placed in the same test tube and heated over a Bunsen burner. The resulting substance has the following properties.

- Does not conduct electricity
- Has a density of 5.6 g/cm³
- Has a metallic luster
- Is a black brittle crystalline solid

This black substance is classified as —

- A** a heterogeneous mixture **C** a compound
- B** an element **D** a homogeneous mixture

- 24** The diagram below shows a gas with an initial pressure of 3060 mm Hg in a cylinder at a constant temperature. The gas expands inside the cylinder and pushes the piston up.



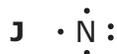
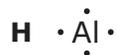
What is the final pressure of the gas after the expansion?

- F** 544 mm Hg
- G** 784 mm Hg
- H** 1830 mm Hg
- J** 6212 mm Hg

-
- 25** Which of these statements is an accurate description of the ionization energies of elements in the periodic table?

- A** The ionization energy of lithium is greater than that of potassium.
- B** The ionization energy of iodine is greater than that of fluorine.
- C** The ionization energy of magnesium is greater than that of sulfur.
- D** The ionization energy of krypton is greater than that of neon.

26 Which of the following shows a correct Lewis dot structure?



27 What is the volume of 2.00 moles of chlorine (Cl_2) at STP, to the nearest tenth of a liter?

Record your answer and fill in the bubbles on your answer document.

28 In a famous experiment conducted by Ernest Rutherford, positively charged alpha particles were scattered by a thin gold foil. Which of the following is a conclusion that resulted from this experiment?

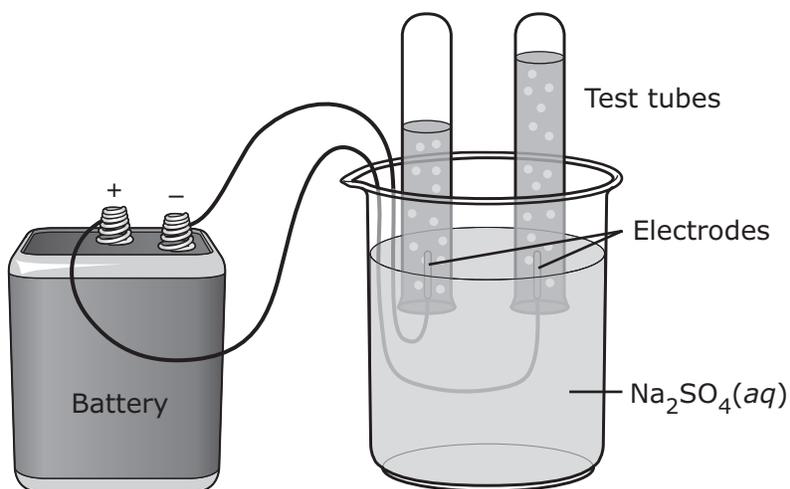
F The nucleus is negatively charged.

G The atom is a dense solid and is indivisible.

H The mass is conserved when atoms react chemically.

J The nucleus is very small and the atom is mostly empty space.

29 The diagram below shows a battery giving off a current producing bubbles in two test tubes.



Which of the following best shows that the investigation results in a chemical change?

- A** Liquid condenses on a cold glass rod when gas from the test tube on the left is released.
- B** A gas probe indicates that the water in the beaker contains dissolved nitrogen and oxygen.
- C** A burning wood splint placed above the mouth of the test tube on the right glows brighter when some gas is released from the test tube.
- D** The temperature of the wire connected to the battery increases.

30 A material safety data sheet (MSDS) for a chemical is shown below.

<p style="text-align: center;">MSDS $\text{H}_3\text{PO}_4(aq)$</p> <p style="text-align: center;">Section 9: Physical and Chemical Properties</p> <p>Physical state and appearance: Viscous liquid</p> <p>Odor: Odorless</p> <p>Color: Clear, colorless</p> <p>Boiling point: 158°C</p> <p>Melting point: 21°C</p> <p>Specific gravity: 1.685 at 25°C</p>

Which of these is the IUPAC name for $\text{H}_3\text{PO}_4(aq)$?

- F Trihydrogen phosphite
- G Phosphoric acid
- H Phosphorous hydroxide
- J Phosphorous acid

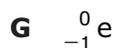
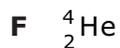
- 31** The diagram below shows part of Dmitri Mendeleev's original periodic table, with symbols of known elements and their atomic masses.

H = 1			Cu = 63.4
	Be = 9.4	Mg = 24	Zn = 65.2
	B = 11	Al = 27.1	X
	C = 12	Si = 28	Z
	N = 14	P = 31	As = 75
	O = 16	S = 32	Se = 79.4
	F = 19	Cl = 35.5	Br = 80

Mendeleev's arrangement of elements is different than that of the modern periodic table. Based on Mendeleev's arrangement, which elements should be placed in the shaded boxes labeled X and Z respectively?

- A** Indium (In), because it has a slightly higher atomic mass than aluminum (Al), and tin (Sn), because it has a slightly higher atomic mass than silicon (Si)
- B** Cadmium (Cd), because it has chemical properties similar to those of zinc (Zn), and mercury (Hg), because it has chemical properties similar to those of arsenic (As)
- C** Antimony (Sb), because it has a slightly higher atomic mass than zinc (Zn), and bismuth (Bi), because it also has a higher atomic mass than zinc (Zn)
- D** Gallium (Ga), because it has chemical properties similar to those of aluminum (Al), and germanium (Ge), because it has chemical properties similar to those of silicon (Si)

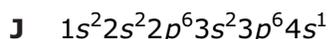
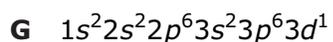
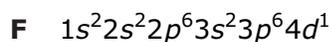
-
- 32** Which particle has the lightest mass?



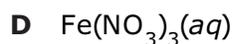
- 33** A 5.0 g sample of aluminum with a specific heat of $0.90 \text{ J}/(\text{g} \cdot ^\circ\text{C})$ was heated from 22.1°C to 32.1°C . How much heat, to the nearest joule, did the aluminum gain?

Record your answer and fill in the bubbles on your answer document.

- 34** Chemists can identify the composition of some unknown salts by conducting a flame test. When potassium salts are heated in a flame, a purple color is observed. This is due to the movement of electrons between energy levels. What is the electron configuration of a potassium atom at ground state?



- 35** Which product balances the chemical equation below?



36 Sodium, mercury, argon, and neon are used in the production of lamps. There are fewer safety guidelines regarding the handling of neon and argon than for mercury and sodium. Which of the following best describes the elements within the group of the periodic table that contains neon and argon gas?

- F** Gaseous at room temperature and highly reactive with metals
- G** Solid at room temperature and mildly reactive with strong acids
- H** Gaseous at room temperature and mostly unreactive with metals
- J** Solid at room temperature and mostly unreactive with strong acids

37 The table below shows the standard enthalpy of formation for each of three substances.

Compound	ΔH_f° (kJ/mol)
$\text{CaCO}_3(s)$	-1206.9
$\text{CaO}(s)$	-635.1
$\text{CO}_2(g)$	-393.5

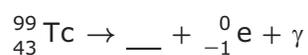
CaCO_3 decomposes according to the equation $\text{CaCO}_3(s) \xrightarrow{\Delta} \text{CaO}(s) + \text{CO}_2(g)$. What is the enthalpy of reaction?

- A** 178.3 kJ
- B** 571.8 kJ
- C** -1029 kJ
- D** -2236 kJ

38 What is the percentage by mass of sodium (Na) in a formula unit of sodium hydrogen carbonate (NaHCO_3)?

- F** 44.2%
 - G** 37.7%
 - H** 27.4%
 - J** 16.7%
-

39 A form of technetium-99 has a half-life of approximately 6 hours.



Which substance correctly completes the equation above?

- A** ${}_{42}^{99}\text{Mo}$
 - B** ${}_{43}^{94}\text{Te}$
 - C** ${}_{43}^{99}\text{Es}$
 - D** ${}_{44}^{99}\text{Ru}$
-

40 How many atoms are present in 179.0 g of iridium?

- F** 5.606×10^{23} atoms
- G** 6.464×10^{23} atoms
- H** 1.078×10^{26} atoms
- J** 1.157×10^{26} atoms

- 41** What volume of 1.0 *M* sodium phosphate, to the nearest tenth of a liter, must be used to make 4.0 L of 0.80 *M* sodium phosphate?

Record your answer and fill in the bubbles on your answer document.

-
- 42** X-ray crystallography is a technique that allows scientists to determine the ionic and atomic radii of elements. Which of these statements correctly describes a trend in ionic or atomic radii in the periodic table?

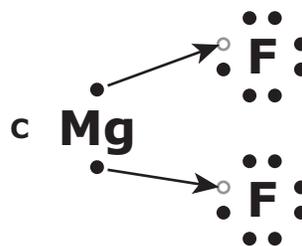
- F** The ionic radius decreases from top to bottom in a group.
- G** The atomic radius increases from left to right across a period.
- H** The ionic radius remains constant from right to left across a period.
- J** The atomic radius increases from top to bottom in a group.

-
- 43** Which of the following substances is a strong electrolyte when dissolved in water?

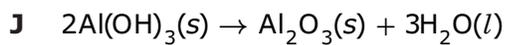
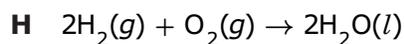
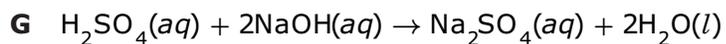
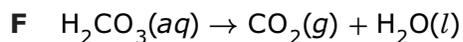
- A** NaNO_3
- B** $\text{C}_2\text{H}_5\text{OH}$
- C** S_2Cl_2
- D** $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

- 44 Which of the following best explains why doubling the temperature of an ideal gas in a closed vessel doubles the pressure?
- F Increasing the temperature increases the size of the gas molecules, which then can put more pressure on the vessel walls.
 - G Increasing the temperature decreases the volume, causing molecules to strike the vessel walls more frequently.
 - H Increasing the temperature causes gas molecules to collide more often and with enough force to displace electrons.
 - J Increasing the temperature causes gas molecules to move more rapidly, striking the vessel walls more frequently and with greater force.

- 45 Which of the following diagrams correctly represents the formation of a compound consisting of magnesium and fluorine?



46 Which equation represents a neutralization reaction?



47 A scientist filters a sample of river water. The data from this process are listed below.

Trial	1	2	3
Initial mass of dry filter paper (g)	2.05	2.06	2.04
Mass of filter paper after filtering river water and drying sample (g)	2.64	2.53	2.61

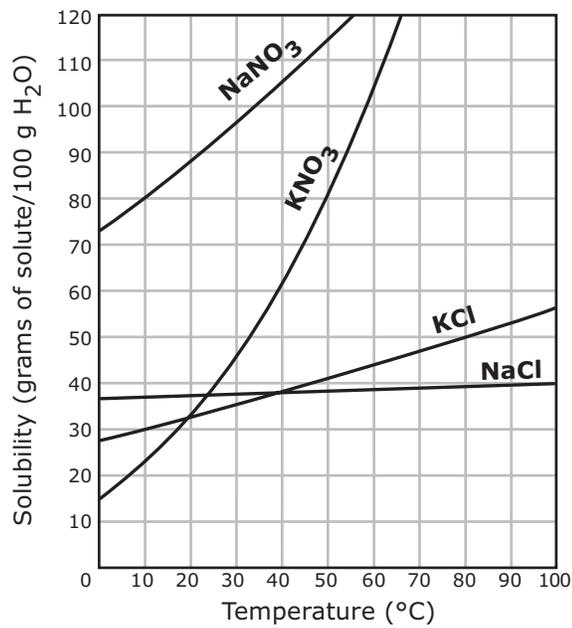
These data support which of the following descriptions of the sample?

- A It is a pure substance because solid particles cannot pass through the filter paper.
- B It is a pure substance because the river water is composed only of free elements.
- C It is a mixture because dissolved ions in the water pass through the filter paper.
- D It is a mixture because solid particles are separated from the river water.

- 48** As a distant star moves away from Earth, the light given off by the star has a measurably lower frequency. What happens to the wavelength and energy of the photons of light when the frequency becomes lower?
- F** The wavelength becomes longer, and the energy decreases.
 - G** The wavelength becomes shorter, and the energy decreases.
 - H** The wavelength becomes longer, and the energy increases.
 - J** The wavelength becomes shorter, and the energy increases.

-
- 49** Which of these is a postulate of kinetic molecular theory?
- A** Molecules of gases have a finite volume.
 - B** Molecules of gases attract and repel one another.
 - C** Collisions between gas molecules are inelastic.
 - D** The kinetic energy of gas molecules depends on temperature.

50 The solubility of an unknown substance was tested during an experiment.



Mass of Unknown Solute That Dissolves in 100 g Water

Trial	30°C	40°C	50°C
1	46.0 g	63.2 g	80.2 g
2	45.9 g	61.4 g	81.3 g
3	44.3 g	62.9 g	79.8 g
Average	45.4 g	62.5 g	80.4 g

Based on the solubility curve information and the results of the experiment, what is most likely the identity of this unknown solute?

- F NaCl
- G KCl
- H KNO₃
- J NaNO₃

- 51** Which of the following best explains why CO_2 gas is easily compressible but solid CO_2 (dry ice) is incompressible?
- A** The molecules of CO_2 gas are much closer together than the molecules in dry ice.
 - B** The molecules of solid CO_2 are much closer together than the molecules of CO_2 gas.
 - C** The molecules of CO_2 gas are much smaller than the molecules of solid CO_2 .
 - D** The molecules of CO_2 gas attract one another, while the molecules of the solid CO_2 repel one another.
-

52 What is the chemical formula for disulfur decafluoride?

- F** S_{10}F_2
- G** S_3F_9
- H** S_2F_{10}
- J** S_2F_8



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