Chemistry

Name: Date:
Teacher: Class/Period:

1) Which property of an apple is different on Earth than it is on the Moon?

A. Density
B. Mass
C. Volume
D. Weight

2) What is the volume, in mL, of a sample of glycerol with a density of 1.20 g/mL and a mass of 43.7 g ?

A. 36.4
B. 42.5
C. 44.9
D. 52.4

3) Which statement is always true for a compound?

A. It is homogeneous.
B. It contains only 1 element.
C. Its chemical composition varies.
D. It decomposes by physical means.

4) Chemists add ammonium lauryl sulfate ($CH_3(CH_2)_{11}SO_4NH_4$) to shampoo to reduce the surface tension of water. How many hydrogen (H) atoms are in 1 molecule of ammonium lauryl sulfate?

A. 9
B. 20
C. 25
D. 29

5) Which representation is a structural formula?

A. O
B. HO
C. H_2O_2
D. H−O−O−H

6) Which statement correctly describes 1 mole of iodine (I_2) ?

A. Its mass is 126.9 g.
B. Its mass is 380.7 g.
C. It contains 6.02×10^{23} atoms.
D. It contains 6.02×10^{23} molecules.

7) What is the gram formula mass, in g/mol, of aluminum nitrate ($Al(NO_3)_3$) ?

A. 88.99
B. 151.00
C. 165.01
D. 213.01

8) What is the name given to anything that takes up space and has mass?

A. Compound
B. Matter
C. Mixture
D. Substance

9) At standard atmospheric pressure, Terell heats a sample of caffeine. At 178°C, the solid converts directly into a gas. What is the name of this phase change?

A. Sublimation
B. Evaporation
C. Crystallization
D. Condensation

10) At 22°C, the air pressure in a car tire is 1293 torr. Convert this pressure to atmospheres (atm).

A. 12.76
B. 5.262
C. 1.701
D. 1.293

11) Which statement accurately compares solids, liquids, and gases at the molecular level?

A. Liquid molecules move at the highest speeds.
B. Solid molecules move at the slowest speeds.
C. Gas molecules are the closest together.
D. Solid molecules are the farthest apart.

12) At constant temperature, Kelly increases the volume of a fixed amount of a gas. Use the kinetic-molecular theory to explain how increasing the volume affects the pressure of the gas.

A. The pressure decreases because there are fewer collisions between gas molecules and the container walls.

B. The pressure decreases because there are more collisions between gas molecules and the container walls.

C. The pressure increases because there are fewer collisions between gas molecules and the container walls.

D. The pressure increases because there are more collisions between gas molecules and the container walls.

13) Luis prepares a carbonated beverage using carbon dioxide gas (CO_2), solid sucrose ($C_{12}H_{22}O_{11}$), and liquid water (H_2O). Identify only the solute(s).

A. CO_2

B. H_2O

C. CO_2 and $C_{12}H_{22}O_{11}$

D. $C_{12}H_{22}O_{11}$ and H_2O

14) A chemist dissolves potassium chloride (KCl) in water until no more KCl dissolves. How would the chemist most accurately classify this solution?

A. Dilute

B. Saturated

C. Unsaturated

D. Supersaturated

15) Which substance is a solution?

A. Sand

B. Molten gold

C. Graphite

D. Brass

16) A chemistry student has 4 empty cubes. Two of the cubes have 1 cm sides and masses of 0.5 g. The other two cubes have 2 cm sides and masses of 1.0 g. The student adds 1 or more balls to each cube, as shown in this table.

Cube Experiment

Cube	Side length (cm)	Mass of empty cube (g)	Number of balls added
A	1	0.5	1
B	1	0.5	2
C	2	1.0	8
D	2	1.0	11

The mass of each ball is 1.0 g. After the addition of the ball(s), which cube has the greatest density?

A. Cube A

B. Cube B

C. Cube C

D. Cube D

17) Deuterium (^2H) is an isotope of hydrogen (H). During a chemistry experiment, a student observes that both of these reactions occur.

$$H_2(g) + Cl_2(g) \rightarrow 2\ HCl(g)$$

$$^2H_2(g) + Cl_2(g) \rightarrow 2\ ^2HCl(g)$$

Which statement best explains the student's observations?

A. Isotopes have different chemical properties.

B. Isotopes have similar chemical properties.

C. Isotopes have different physical properties.

D. Isotopes have similar physical properties.

18) What is the chemical formula of calcium cyanide?

A. CaCN

B. $CaCN_2$

C. $Ca(CN)_2$

D. $Ca(CN)_3$

19) A sample of a compound containing only nickel (Ni) and oxygen (O) has a mass of 24.6 g. Analysis of the sample shows that 10.4 g is Ni and the remaining 14.2 g is O. What is the percent composition of Ni in this sample?

A. 26.8%

B. 42.3%

C. 57.7%

D. 73.2%

20) What is the correct chemical formula for iron(III) sulfide?

A. Fe_2S_3

B. Fe_3S_2

C. $Fe_2(SO_4)_3$

D. $Fe_3(SO_4)_2$

21) A chemist purchases a small gas cylinder containing 150.0 g of phosphorus trifluoride (PF_3) gas. How many molecules of PF_3 are in the gas cylinder?

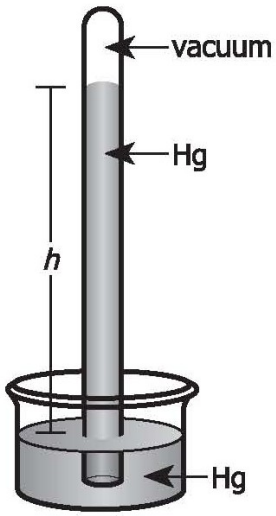
A. 3.531×10^{23}

B. 1.026×10^{24}

C. 3.734×10^{25}

D. 1.433×10^{26}

22) This diagram shows a closed-end mercury (Hg) barometer.



When atmospheric pressure is 1.30 atm, what is the height (h), in millimeters, of the Hg in the barometer?

A. 132

B. 585

C. 760

D. 988

23) At 1.00 atm, a sealed weather balloon contains 20.0 L of helium (He) gas at 25.0°C. Assume that none of the He escapes and the pressure is constant. What is the volume, in liters, of He in the weather balloon at 35.0°C ?

A. 40.0

B. 28.0

C. 20.7

D. 14.3

24) What is the wavelength, in m, of red light with a frequency of 5.80×10^{14} Hz ?

A. 3.85×10^{-19}

B. 5.17×10^{-7}

C. 1.93×10^{6}

D. 1.74×10^{23}

25) Cobalt-60 ($^{60}_{27}Co$) is an isotope of elemental Co. How many protons and neutrons are in the nucleus of a neutral $^{60}_{27}Co$ atom?

A. 27 protons and 33 neutrons

B. 27 protons and 60 neutrons

C. 33 protons and 27 neutrons

D. 33 protons and 60 neutrons

26) A pharmacist prepared a liquid medication and gave instructions to shake the medication well before using. How did the pharmacist most likely formulate the medicine?

A. As a suspension with particles that settled to the bottom of the container

B. As a true solution with particles that settled to the bottom of the container

C. As a colloid with particles that remain unevenly distributed throughout the container

D. As a homogeneous mixture with particles that remain unevenly distributed throughout the container

27) A technician dissolves 20.0 g of magnesium bromide ($MgBr_2$) in 100.0 g of water (H_2O). What is the percent composition of $MgBr_2$ in the solution?

A. 10.9%

B. 13.0%

C. 16.7%

D. 20.0%

28) In chemistry class, a student studies this reaction.

$$A(g) + B(g) \rightarrow C(g)$$

The student performs the reaction 3 times in a sealed 2.5 L vessel at 25°C. The student uses different amounts of Reactants A and B in each reaction. The student measures the rate of each reaction and records the results in this table.

Reaction Rates			
Reaction	A (mol)	B (mol)	Rate of reaction (M/sec)
1	0.018	0.018	0.026
2	0.025	0.025	0.038
3	0.032	0.032	0.052

According to the kinetic theory, which statement provides the best explanation for the data in the table?

A. The reaction rate decreases at higher concentrations of reactants because fewer collisions occur between the reactants.

B. The reaction rate decreases at lower concentrations of reactants because more collisions occur between the reactants.

C. The reaction rate increases at higher concentrations of reactants because more collisions occur between the reactants.

D. The reaction rate increases at lower concentrations of reactants because fewer collisions occur between the reactants.

29) A student in the chemistry club must send 25 invitations to chemists for the school's career day. Which action is the rate-determining step in sending the invitations?

A. Placing the letters in the envelopes

B. Putting stamps on the envelopes

C. Writing the letters

D. Signing the letters

30) What is the percent by mass of chlorine (Cl) in $BaCl_2 \cdot 2\ H_2O$?

A. 14.5%

B. 17.0%

C. 29.0%

D. 34.1%

31) This table shows the percent composition data for an unknown organic compound.

Element	% Composition
C	70.54
H	10.66
O	18.80

What is the empirical formula of this compound?

A. C_5H_9O

B. $C_6H_{11}O$

C. $C_7H_{10}O_2$

D. $C_8H_8O_2$

32) At 83.7 kPa and 35.0°C, what is the density, in g/L, of phosphorus hydride (PH_3) ?

A. 0.528

B. 1.11

C. 1.52

D. 2.39

33) Sylvia heats 2.28 g of a liquid until it completely vaporizes. The boiling point of the liquid is 56.3°C. She collects all of the gas in a 750.0 mL vessel. The pressure of the gas is 1.41 atm at 56.3°C. What is the molar mass, in g/mol, of the liquid?

A. 9.97

B. 22.3

C. 58.3

D. 121

34) Calcium chloride ($CaCl_2$) reacts with sodium phosphate (Na_3PO_4) to produce calcium phosphate ($Ca_3(PO_4)_2$) and sodium chloride (NaCl).

$$3\ CaCl_2(aq) + 2\ Na_3PO_4(aq) \rightarrow Ca_3(PO_4)_2(s) + 6\ NaCl(aq)$$

When a chemist adds 200.0 mL of 0.150 M $CaCl_2(aq)$ to 115.0 mL of 0.250 M $Na_3PO_4(aq)$, what is the maximum number of moles of $Ca_3(PO_4)_2$ that the reaction can produce?

A. 0.0100

B. 0.0144

C. 0.0288

D. 0.0300

35) Dr. Estevez developed Molecule X as a new biodegradable treatment for ice on roads. Molecule X is very soluble in water (H_2O), and it does not cause corrosion on automobiles. Molecule X is nonvolatile, and it is a nonelectrolyte. When Dr. Estevez dissolves 4.25 mol of Molecule X in 3.00 kg of H_2O, what is the freezing point of the resulting solution?

A. −1.31°C

B. −2.33°C

C. −2.64°C

D. −7.25°C

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Formulas and Constants for the QualityCore™ Chemistry I Formative Assessments

Atomic Structure

$E = h\nu$

$c = \lambda\nu$

$E_K = \frac{1}{2}mv^2$

$\lambda = \frac{h}{mv}$

E = energy
h = Planck's constant = 6.63×10^{-34} J•s
ν = frequency
c = speed of light = 3.0×10^8 m/s
λ = wavelength
E_K = kinetic energy
m = mass
v = velocity
N_A = Avogadro's number = 6.02×10^{23} mol^{-1}

Gases

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

$T(K) = °C + 273$

$P_{total} = P_A + P_B + P_C + \ldots$

$PV = nRT$

$n = \frac{m}{M}$

$d = \frac{PM}{RT}$

$P_1V_1 = P_2V_2$

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

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{Rate_A}{Rate_B} = \frac{\sqrt{M_B}}{\sqrt{M_A}}$

d = density (solids, liquids, and gases)
m = mass
V = volume
T = temperature
P = pressure
n = number of moles
R = gas constant = 0.0821 L•atm/mol•K
M = molar mass
Rate = rate of effusion
STP = 1.00 atm and 0.00°C
1 atm = 760 mm Hg = 760 torr = 101.3 kPa
1 mol of ideal gas = 22.4 L at STP

Percent Yield and Percent Error

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\% \text{ Error} = \frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100$$

continued

Liquids and Solutions

$$\text{Percent (mass/mass)} = \frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \times 100$$

$$M = \frac{\text{moles of solute}}{\text{L of solution}}$$

$$m = \frac{\text{moles of solute}}{\text{kg of solvent}}$$

$$X_A = \frac{\text{moles}_A}{\text{moles}_{total}}$$

$$M_1V_1 = M_2V_2$$

$$\Delta T_f = K_f \times m$$

$$\Delta T_b = K_b \times m$$

M = molarity
m = molality
X_A = mole fraction of component A
V = volume
ΔT = temperature change
K_f = molal freezing point depression constant
K_f (H_2O) = 1.86°C/m
K_b = molal boiling point elevation constant
K_b (H_2O) = 0.512°C/m

Calorimetry, Thermodynamics, and Electrochemistry

$$q = mC\Delta T$$

$$\Delta H^\circ_{rxn} = \Delta H^\circ_f(\text{products}) - \Delta H^\circ_f(\text{reactants})$$

$$\Delta S^\circ_{rxn} = S^\circ(\text{products}) - S^\circ(\text{reactants})$$

$$\Delta G^\circ = -nFE^\circ_{cell}$$

$$E^\circ_{cell} = E^\circ_{red} - E^\circ_{oxid}$$

q = heat
m = mass
C = specific heat capacity
C (H_2O) = 4.184 J/g·°C
ΔT = temperature change
ΔH° = standard enthalpy change
ΔS° = standard entropy change
ΔG° = standard free energy change
n = number of moles of electrons
F = Faraday's constant = 96,500 coulombs/mol of electrons
E°_{cell} = standard cell potential
E°_{red} = standard reduction potential of the half-cell where reduction occurs
E°_{oxid} = standard reduction potential of the half-cell where oxidation occurs

Acids, Bases, and Equilibrium

$$pH = -\log [H^+]$$

$$pOH = -\log [OH^-]$$

$$pH + pOH = 14$$

$$K_w = [H^+][OH^-]$$

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b} \text{ where } a\,A + b\,B \rightleftharpoons c\,C + d\,D$$

$$K_{sp} = [A^+]^a[B^-]^b \text{ where } A_aB_b(s) \rightleftharpoons a\,A^+(aq) + b\,B^-(aq)$$

$[H^+]$ = H^+ molarity
$[OH^-]$ = OH^- molarity
K_w = ion-product constant for water
$K_w = 1.0 \times 10^{-14}$ at 25°C
K_{eq} = equilibrium constant
K_{sp} = solubility product constant

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Periodic Table of the Elements

1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac†** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (264)	108 **Hs** (265)	109 **Mt** (268)	110 **Ds** (281)								

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
†	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

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Answer Key

1) D
2) A
3) A
4) D
5) D
6) D
7) D
8) B
9) A
10) C
11) B
12) A
13) C
14) B
15) D
16) B
17) B
18) C
19) B
20) A
21) B
22) D
23) C
24) B
25) A
26) A
27) C
28) C
29) C
30) C
31) A
32) B
33) C
34) A
35) C