Question #: 1

How many moles of beryllium are in 15.0 grams of Be?

A. 1.66  
B. 135.15  
C. 9.01  
D. 0.601

Question #: 2

Vanillin, C₈H₆O₃, is the molecule responsible for the vanilla flavor in food. What is the molar mass of vanillin? Report your answer with **two** decimal places. Do **NOT** include units in your answer.

\[ \text{g/mol} \]

1. 

Question #: 3

What is the mass of 0.335 mol of sodium oxide?

\[ \text{g} \]

Report your answer with **three** significant figures. Do **NOT** include units with your answer.

1. 

**Question #: 4**

Determine the number of molecules of methane (CH₄) in 5.00 moles of methane gas.

A. 80.2 molecules of methane  
B. 4.82 x 10²⁵ molecules of methane  
C. 3.01 x 10²⁴ molecules of methane  
D. 8.30 x 10⁻²⁴ molecules of methane

**Question #: 5**

How many grams of K are in 56.0 g of potassium sulfide (K₂S)?  
Report answer with **three** significant figures. Do **NOT** include units in your answer.

1. ________ g

**Question #: 6**

How many moles of hydrogen atoms are contained in 15.0 g of glucose (C₆H₁₂O₆)?

A. 12 moles  
B. 6 moles  
C. 1 mole  
D. 3 moles
Question #: 7

A 5.25 g sample of a compound, composed only of manganese and oxygen, was analyzed and determined to contain 2.60 g Mn. What is the empirical formula of the compound? Report each answer as a whole number. Do NOT include chemical symbols in your answer.

1. __________
2. __________

Question #: 8

What volume (in mL) of a 2.00 M aqueous solution of NaOCl contains 5.50 grams of dissolved solid sodium hypochlorite (NaOCl)? Report your answer with three significant figures. Do NOT include units in your answer.

1. __________

Question #: 9

What volume of concentrated sulfuric acid (18.0 M H₂SO₄) is needed to prepare 2.50 L of a 1.00 M solution?

A. 7.20 mL
B. 14.4 mL
C. 69.4 mL
D. 139 mL
**Question #**: 10

Which solution has the **highest** concentration of NaCl?

A. 0.500 mol NaCl in 200. mL of solution  
B. 0.400 mol NaCl in 150. mL of solution  
C. 0.300 mol NaCl in 125. mL of solution  
D. 0.800 mol NaCl in 400. mL of solution

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**Question #**: 11

Which expression correctly defines mass percent of the solute?

A. \[ \frac{\text{mass of solute}}{\text{mass of solvent}} \times 100 \]

B. \[ \frac{\text{mass of solute}}{\text{mass of solution}} \times 100 \]

C. \[ \frac{\text{mass of solvent}}{\text{mass of solution}} \times 100 \]

D. \[ \frac{\text{mass of solvent}}{\text{mass of solute}} \times 100 \]
Question #: 12

What is the oxidation number of hydrogen in each substance? Report your answer as a sign (+ or −) and a whole number. You must include both the correct sign and number to receive credit except when the oxidation number is zero.

\[ \text{H}_2 \quad 1\]
\[ \text{H}_2\text{SO}_4 \quad 2\]
\[ \text{NaH} \quad 3\]

1. 
2. 
3. 

Question #: 13

Determine the molarity of a solution containing 1.56 moles of LiCl in 1.50 L of solution.

A. 1.04 M LiCl  
B. 0.962 M LiCl  
C. 44.1 M LiCl  
D. 2.34 M LiCl

Question #: 14

If 2.5 grams of CaCl\(_2\) are dissolved in 353 grams of water, what is the molality of the calcium chloride solution?

A. 0.70 m  
B. 7.1 m  
C. 6.4 \times 10^{-5} m  
D. 6.4 \times 10^{-2} m
Question #: 15

A 1.65 \times 10^4 \text{ g} \text{ water sample contains } 0.0096 \text{ g of Pb}^{2+} \text{ ions. What is the concentration of lead in ppb?}

A. 582 ppb  
B. 726 ppb  
C. 361 ppb  
D. 1,890 ppb

Question #: 16

A solution is 22.5\% by mass methanol in ethanol. What mass of methanol (CH}_3\text{OH}) is present in 500.0 \text{ mL of solution? The density of the solution is 0.789 g/mL. Report your answer to three significant figures. Do NOT include units in your answer.}

_1_ \text{ mL}

1. __________

Question #: 17

What is the mole fraction of CH}_3\text{OH} in an aqueous solution that is 12.0 \text{ m in CH}_3\text{OH?}

A. 0.178  
B. 0.216  
C. 0.400  
D. 0.667
**Question #**: 18

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \text{1. } \text{CaO} + \text{2. } \text{C} \rightarrow \text{3. } \text{CaC}_2 + \text{4. } \text{CO}_2 \]

1. 
2. 
3. 
4. 

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**Question #**: 19

Which one is the correct net ionic equation for the reaction between aqueous solutions of sodium chloride and silver nitrate?

A. \( \text{Ag}^+ (aq) + \text{Cl}^- (aq) \rightarrow \text{AgCl(s)} \)
B. \( \text{NaCl(aq)} + \text{AgNO}_3(aq) \rightarrow \text{AgCl(s)} + \text{NaNO}_3(aq) \)
C. \( \text{Na}^+(aq) + \text{Cl}^-(aq) + \text{Ag}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{AgCl(s)} + \text{Na}^+(aq) + \text{Cl}^-(aq) \)
D. \( \text{Na}^+(aq) + \text{Cl}^-(aq) + \text{Ag}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{Ag}^+(aq) + \text{Cl}^-(aq) + \text{Na}^+(aq) + \text{Cl}^-(aq) \)

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**Question #**: 20

Which two ionic compounds are considered insoluble in water?

A. manganese(III) acetate
B. lead(II) iodide
C. ammonium phosphate
D. nickel(II) sulfide
Question #: 21

When added to water, a weak acid will 1 [partially, completely] ionize in solution and generate a 2 [small, large] amount of hydronium ions.

1. __________
2. __________

Question #: 22

Fill in the blanks with either hydroxide or hydronium. An acid, when dissolved in water, yields 1 ions. A base, when dissolved in water, yields 2 ions.

1. __________
2. __________

Question #: 23

Select the two redox reactions.

A. 2H₂(g) + O₂(g) → 2H₂O(l)

B. Zn(s) + Cu(NO₃)₂(aq) → Cu(s) + Zn(NO₃)₂(aq)

C. MgSO₄(aq) + Ba(NO₃)₂(aq) → BaSO₄(s) + Mg(NO₃)₂(aq)

D. H₂SO₄(aq) + 2NaOH(aq) → Na₂SO₄(aq) + 2H₂O(l)
The rechargeable nickel-cadmium battery commonly used in battery-operated devices, uses the following redox reaction to generate electricity:

\[ \text{Cd(s)} + \text{NiO}_2(s) + 2\text{H}_2\text{O(l)} \rightarrow \text{Cd(OH)}_2(s) + \text{Ni(OH)}_2(s) \]

Identify the substances that are oxidized and reduced, and indicate which is the oxidizing agent and which is the reducing agent.

Enter a chemical formula or symbol for each answer. Report chemical formulas with numbers but without subscripts (for example, \( \text{H}_2\text{O} \) would be entered as \( \text{H}_2\text{O} \)).

1. \( \text{__________} \)
2. \( \text{__________} \)
3. \( \text{__________} \)
4. \( \text{__________} \)

Which one is not a strong acid in aqueous solution?

A. HI
B. HNO\(_2\)
C. HClO\(_4\)
D. HCl
**Question #**: 26

How many grams of carbon dioxide (CO$_2$) are produced when 454 grams of propane (C$_3$H$_8$) reacts with excess oxygen?

C$_3$H$_8$(g) + 5O$_2$(g) → 3CO$_2$(g) + 4H$_2$O(l)

A. 1360 grams  
B. 453 grams  
C. 151 grams  
D. 0.702 grams

**Question #**: 27

If 20.0 grams of magnesium are added to a solution containing 1.00 mole of hydrochloric acid, how many grams of hydrogen gas are produced?

Mg(s) + 2 HCl(aq) → H$_2$(g) + MgCl$_2$(aq)

A. 0.829 g  
B. 1.008 g  
C. 1.659 g  
D. 2.106 g

**Question #**: 28

What mass of the *excess* reactant remains after 7.50 grams of Zn react with 7.25 grams of HCl?

Zn(s) + 2HCl(aq) → ZnCl$_2$(aq) + H$_2$(g)

A. 0.25 g  
B. 1.0 g  
C. 0.87 g  
D. 0.75 g
Question #: 29

Fe₂O₃ reacts with excess CO at a high temperature according to the equation below.
Fe₂O₃(s) + 3CO(g) → 2Fe(s) + 3CO₂(g)
If 6.50 g of Fe₂O₃ yields 3.85 g of Fe, what is the percent yield of the reaction?

A. 59.2%
B. 84.7%
C. 76.3%
D. 69.9%

Question #: 30

A 50.0 mL sample of an unknown Sr(OH)₂ solution requires titration with 75.0 mL of 0.150 M HBr to reach the equivalence point. What is the concentration of the unknown Sr(OH)₂ solution? __________ M

Hint: Write a balanced equation for the reaction.
Report your answer with three significant figures. Do NOT include units in your answer.
Question #1:

How many moles of beryllium are in 15.0 grams of Be?

✓ A. 1.66
   B. 135.15
   C. 9.01
   D. 0.601

Question #2:

Vanillin, $C_8H_8O_3$, is the molecule responsible for the vanilla flavor in food. What is the molar mass of vanillin?

Report your answer with two decimal places. Do NOT include units in your answer.
Question #: 3

What is the mass of 0.335 mol of sodium oxide?

Report your answer with three significant figures. Do NOT include units with your answer.

1. 20.8

Question #: 4

Determine the number of molecules of methane (CH₄) in 5.00 moles of methane gas.

A. 80.2 molecules of methane
B. 4.82 x 10²⁵ molecules of methane
✓C. 3.01 x 10²⁴ molecules of methane
D. 8.30 x 10⁻²⁴ molecules of methane

Question #: 5

How many grams of K are in 56.0 g of potassium sulfide (K₂S)?

Report answer with three significant figures. Do NOT include units in your answer.

1. 39.7

Question #: 6

How many moles of hydrogen atoms are contained in 15.0 g of glucose (C₆H₁₂O₆)?
Question #: 7

A 5.25 g sample of a compound, composed only of manganese and oxygen, was analyzed and determined to contain 2.60 g Mn. What is the empirical formula of the compound?

\[ \text{Mn} \quad 1 \quad \text{O} \quad 2 \]

Report each answer as a whole number. Do NOT include chemical symbols in your answer.

1. 2
2. 7

Question #: 8

What volume (in mL) of a 2.00 M aqueous solution of NaOCl contains 5.50 grams of dissolved solid sodium hypochlorite (NaOCl)?

Report your answer with three significant figures. Do NOT include units in your answer.

\[ 1 \text{ mL} \]

1. 36.9

Question #: 9

What volume of concentrated sulfuric acid (18.0 M H₂SO₄) is needed to prepare 2.50 L of a 1.00 M solution?

A. 7.20 mL
B. 14.4 mL
C. 69.4 mL
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Question #: 10

Which solution has the **highest** concentration of NaCl?

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✓ B. 0.400 mol NaCl in 150. mL of solution
C. 0.300 mol NaCl in 125. mL of solution
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Which expression correctly defines mass percent of the solute?

A. \[
\frac{\text{mass of solute}}{\text{mass of solvent}} \times 100
\]
✓ B. \[
\frac{\text{mass of solute}}{\text{mass of solution}} \times 100
\]
C. \[
\frac{\text{mass of solvent}}{\text{mass of solution}} \times 100
\]
D. \[
\frac{\text{mass of solvent}}{\text{mass of solute}} \times 100
\]

Question #: 12

What is the oxidation number of **hydrogen** in each substance? Report your answer as a sign (+ or –) and a whole number. You must include **both** the correct sign and number to receive credit except when the oxidation number is zero.

\[H_2\] 1
\[ \text{H}_2\text{SO}_4 \quad \frac{2}{\text{NaH}} \quad \frac{3}{\text{NaH}} \]

1. 0
2. +1
3. -1

**Question #**: 13

Determine the molarity of a solution containing 1.56 moles of LiCl in 1.50 L of solution.

✓ A. 1.04 M LiCl
   B. 0.962 M LiCl
   C. 44.1 M LiCl
   D. 2.34 M LiCl

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A. 0.70 m
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C. \(6.4 \times 10^{-5}\) m
✓ D. \(6.4 \times 10^{-2}\) m

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A \(1.65 \times 10^4\) g water sample contains 0.0096 g of Pb²⁺ ions. What is the concentration of lead in ppb?

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   C. 361 ppb
**Question #: 16**

A solution is 22.5% by mass methanol in ethanol. What mass of methanol (CH\(_3\)OH) is present in 500.0 mL of solution? The density of the solution is 0.789 g/mL.

Report your answer to **three** significant figures. Do **NOT** include units in your answer.

1 mL

1. 88.8

**Question #: 17**

What is the mole fraction of CH\(_3\)OH in an aqueous solution that is 12.0 m in CH\(_3\)OH?

- A. 0.178
- B. 0.216
- C. 0.400
- D. 0.667

**Question #: 18**

Balance the following chemical equation with the smallest possible whole numbers by filling in each blank with the proper coefficient. If the coefficient is 1, fill in 1.

\[ \text{1} \text{ CaO} + \text{2} \text{ C} \rightarrow \text{3} \text{ CaC}_2 + \text{4} \text{ CO}_2 \]

1. 2
2. 5
3. 2
4. 1

**Question #: 19**
Which one is the correct **net ionic** equation for the reaction between aqueous solutions of sodium chloride and silver nitrate?

✓ A. \( \text{Ag}^+ (aq) + \text{Cl}^- (aq) \rightarrow \text{AgCl} (s) \)
B. \( \text{NaCl}(aq) + \text{AgNO}_3(aq) \rightarrow \text{AgCl}(s) + \text{NaNO}_3(aq) \)
C. \( \text{Na}^+(aq) + \text{Cl}^-(aq) + \text{Ag}^+(s) + \text{Cl}^-(aq) \rightarrow \text{AgCl}(s) + \text{Na}^+(aq) + \text{Cl}^-(aq) \)
D. \( \text{Na}^+(aq) + \text{Cl}^-(aq) + \text{Ag}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{Ag}^+(aq) + \text{Cl}^-(aq) + \text{Na}^+(aq) + \text{Cl}^-(aq) \)

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Which **two** ionic compounds are considered insoluble in water?

A. manganese(III) acetate
✓ B. lead(II) iodide
C. ammonium phosphate
✓ D. nickel(II) sulfide

**Question #: 21**

When added to water, a weak acid will **1** [partially, completely] ionize in solution and generate a **2** [small, large] amount of hydronium ions.

1. partially
2. small

**Question #: 22**

Fill in the blanks with either hydroxide or hydronium.
An acid, when dissolved in water, yields **1** ions.
A base, when dissolved in water, yields **2** ions.

1. hydronium
2. hydroxide

**Question #: 23**
Select the **two** redox reactions.

✓ A. $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(l)$

✓ B. $\text{Zn}(s) + \text{Cu(NO}_3\text{)}_2(\text{aq}) \rightarrow \text{Cu}(s) + \text{Zn(NO}_3\text{)}_2(\text{aq})$

C. $\text{MgSO}_4(\text{aq}) + \text{Ba(NO}_3\text{)}_2(\text{aq}) \rightarrow \text{BaSO}_4(s) + \text{Mg(NO}_3\text{)}_2(\text{aq})$

D. $\text{H}_2\text{SO}_4(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(l)$

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**Question #: 24**

The rechargeable nickel-cadmium battery commonly used in battery-operated devices, uses the following redox reaction to generate electricity:

$\text{Cd}(s) + \text{NiO}_2(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{Cd(OH)}_2(s) + \text{Ni(OH)}_2(s)$

Identify the substances that are oxidized and reduced, and indicate which is the oxidizing agent and which is the reducing agent.

Enter a **chemical formula or symbol** for each answer. Report chemical formulas with numbers but without subscripts (for example, $\text{H}_2\text{O}$ would be entered as $\text{H}_2\text{O}$).

1. is oxidized.
2. is reduced.
3. is the oxidizing agent.
4. is the reducing agent.

1. $\text{Cd}$
2. $\text{Ni}[/\text{NiO}_2]$  
3. $\text{Ni}[/\text{NiO}_2]$  
4. $\text{Cd}$
Question #: 25

Which one is **not** a strong acid in aqueous solution?

A. HI  ✓
B. HNO₂
C. HClO₄
D. HCl

Question #: 26

How many grams of carbon dioxide (CO₂) are produced when 454 grams of propane (C₃H₈) reacts with excess oxygen?

\[ C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \]

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\[ Mg(s) + 2\text{ HCl}(aq) \rightarrow \text{H}_2(g) + \text{MgCl}_2(aq) \]

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D. 2.106 g

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If 6.50 g of Fe\textsubscript{2}O\textsubscript{3} yields 3.85 g of Fe, what is the percent yield of the reaction?

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A 50.0 mL sample of an unknown Sr(OH)\textsubscript{2} solution requires titration with 75.0 mL of 0.150 M HBr to reach the equivalence point. What is the concentration of the unknown Sr(OH)\textsubscript{2} solution?

\[ 1 \text{ M} \]

Hint: Write a balanced equation for the reaction.

Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. 0.113