Question #: 1

After some fact or facts have been observed, a scientist would like to find an explanation for what is observed. What is the next step of the scientific method?

A. A law is established that is an explanation of the fact(s).
B. An experiment is designed to explain the fact(s).
C. A hypothesis is proposed as an initial explanation of the fact(s).
D. A theory is adopted which explains the fact(s).

Question #: 2

A substance that cannot be chemically broken down into simpler substances is

A. a homogeneous mixture.
B. an element.
C. a heterogeneous mixture.
D. a compound.

Question #: 3

Fill in each blank with the word physical or chemical.

The temperature that ice melts is a __1__ property.
The fact that an iron nail will rust is a __2__ property.
When coal (mainly carbon) will burn in the presence of oxygen to produce carbon dioxide. This is an example of a __3__ property.

1. __________
2. __________
3. __________
Question #: 4

Which two options express correct relationships for prefix multipliers?

A. 1 mL = 10^{-3} L  
B. 1 cm = 10^{2} m  
C. 1 kg = 10^{3} g  
D. 1 ns = 10^{9} s

Question #: 5

Select the two answers that show the same number in both scientific and standard notation.

A. 1,200,000; 1.2 \times 10^{-6}  
B. 426; 4.26 \times 10^{2}  
C. 0.000045; 4.5 \times 10^{-5}  
D. 0.010; 1.0 \times 10^{2}

Question #: 6

What is the density of a block of a metal alloy with a volume of 2.3 cm^3 and a mass of 19.3 grams? Report your answer with two significant figures. Do NOT include units in your answer. Do NOT use scientific notation.

density = \underline{1} g/cm^3
Question #: 7

The Niagara Falls official website states that Horseshoe Falls allows 6 million cubic feet of water over the crestline every minute. A student is asked to convert 6 ×10⁶ ft³ to cubic centimeters and gets the answer 16,990,107,955,200 cm³. While their math is correct, what is wrong with the answer?

A. Nothing. If the math is correct, the answer is correct.
B. It would be impossible to know the volume to the nearest 100 cm³ if it is only known to the nearest 1,000,000 ft³.
C. The student should have reported the answer in scientific notation for it to be correct.
D. It is not possible for the number of cm³ to be a larger number than the number of ft³.

Question #: 8

What answer should be reported with the correct number of significant figures for the following calculation?

\[
\frac{249.362 + 41}{63.498} =
\]

A. 4.6
B. 4.57
C. 4.573
D. 4.5728

Question #: 9

The manufacturing specifications of a metal rod used in a general chemistry lab was determined to be 6.550 cm. Students in the lab were asked to measure the length of the rod by whatever means they had at their disposal. Which set of data is very precise, but not accurate?

A. 6.0 cm, 6.2 cm, 6.6 cm, 6.1 cm
B. 6.551 cm, 6.498 cm, 6.552 cm, 6.551 cm
C. 7.446 cm, 7.450 cm, 7.448 cm, 7.449 cm
D. 5.2 cm, 6.6 cm, 5.3 cm, 4.8 cm
**Question #**: 10

The top speed of a Formula 1 race car is 340. kilometers per hour. What is the speed in miles per hour? Report your answer with three significant figures. Do NOT include units in your answer.

\[1\text{ mi/h}\]

1. 

**Question #**: 11

A Honda Civic Hybrid has an EPA gas mileage rating of 46 mi/gal on the highway. How many kilometers can the Civic travel on 4.0 L of gasoline? Distance traveled = \[1\text{ km}\] Report your answer with three significant figures. Do NOT include units in your answer.

1. 

**Question #**: 12

Dalton's Atomic Theory states that

A. an element is composed of several isotopes.
B. matter is composed of small indestructible particles.
C. there is a very large amount of empty space in an atom.
D. that energy is neither created nor destroyed during a chemical reaction.
Question #: 13

Select the statement that is **consistent** with Rutherford's theory of the atom, proposed after observing the scattering of α particles shown in the experiment below.

A. The positive charge of the atom is concentrated in a small core called the nucleus.
B. Protons are evenly distributed throughout an atom.
C. There are only positive particles in the atom.
D. Atoms have an overall positive charge.

---

Question #: 14

The atomic number determines the number of ___1___ [electrons, neutrons, protons] in an atom or ion. The atomic number of sodium is ___2___.

1. __________
2. __________
Question #: 15

An isotope has 15 protons and 16 neutrons. What are the values (numbers or letters) for A, Z and X?

\[ \frac{AX}{Z} \]

\[ A = 1 \] (enter a whole number)
\[ Z = 2 \] (enter a whole number)
\[ X = 3 \] (enter an element symbol)

1. _________
2. _________
3. _________

Question #: 16

Gallium exists as two isotopes, \(^{69}\text{Ga}\) and \(^{71}\text{Ga}\). The mass of \(^{69}\text{Ga}\) is 68.9256 with a 60.11% abundance. What is the mass of \(^{71}\text{Ga}\)?

A. 70.520 amu  
B. 70.925 amu  
C. 69.875 amu  
D. 71.125 amu

Question #: 17

How many protons and electrons are in an atom of selenium that has a \(-2\) charge? Report each answer as a whole number. Do NOT include units in your answer.

Number of protons = 1  
Number of electrons = 2

1. _________
2. _________
Question #: 18

Which one represents a possible molecular formula for the empirical formula of C_3H_5ClO? 

A. C_6H_{10}ClO_2  
B. C_5H_{10}Cl_2O_2  
C. C_6H_{10}Cl_2O_2  
D. C_6H_{12}Cl_2O_2

Question #: 19

Fill in the missing element symbol or name.

<table>
<thead>
<tr>
<th>Element Symbol</th>
<th>Element Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>potassium</td>
</tr>
<tr>
<td>2</td>
<td>silver</td>
</tr>
<tr>
<td>Hg</td>
<td>3</td>
</tr>
<tr>
<td>Ar</td>
<td>4</td>
</tr>
</tbody>
</table>

1. __________
2. __________
3. __________
4. __________
**Question #: 20**

Classify each element as a **main group metal**, **transition metal**, **nonmetal**, or **metalloid**.

<table>
<thead>
<tr>
<th>Element</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>1</td>
</tr>
<tr>
<td>Sr</td>
<td>2</td>
</tr>
<tr>
<td>Se</td>
<td>3</td>
</tr>
</tbody>
</table>

1. ________
2. ________
3. ________

**Question #: 21**

Provide the **name** of each polyatomic ion.

<table>
<thead>
<tr>
<th>Polyatomic Ion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO$_3^{2-}$</td>
<td>1</td>
</tr>
<tr>
<td>NO$_2^-$</td>
<td>2</td>
</tr>
</tbody>
</table>

Provide the **charge** of each polyatomic ion. Report your answers as a number **and** a sign (+ or –). Do **NOT** include the name or formula of the ion.

<table>
<thead>
<tr>
<th>Polyatomic Ion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>phosphate: PO$_4^{3-}$</td>
<td>3</td>
</tr>
<tr>
<td>ammonia: NH$_4^+$</td>
<td>4</td>
</tr>
</tbody>
</table>

1. ________
2. ________
3. ________
4. ________
Question #: 22

What is the name of Na₂SO₄?

A. sodium sulfite  
B. sodium(II) sulfate  
C. sodium(I) sulfate  
D. sodium sulfate

Question #: 23

What is the chemical formula of sulfur hexafluoride?  
Enter the formula without subscripts or spaces. Use parentheses if needed, e.g., C₄H₄O₂ or (NH₄)₂S.

1. __________

Question #: 24

What is the mass of 1.35 moles of aluminum?  
Report your answer with three significant figures. Do NOT include units in your answer.

1. __________

Question #: 25

How many atoms of nitrogen are in 15 grams of calcium nitrate, Ca(NO₃)₂?  

A. 2.0 atoms  
B. 9.0 atoms  
C. 5.4 ×10²² atoms  
D. 1.1 ×10²³ atoms
Question #: 26

What is the mass percent of Na in Na$_2$SO$_4$?

A. 22.57%
B. 32.37%
C. 16.19%
D. 45.07%

Question #: 27

A compound is 61.7% germanium, 30.6% carbon and 7.7% hydrogen by mass. Put symbols in order of GeCH. Enter the formula without subscripting the numbers, add no spaces, and use parentheses if needed, e.g., C$_4$H$_4$O$_2$ or (NH$_4$)$_2$S. Its empirical formula is ___1___.

1. __________

Question #: 28

Choose from the following words to complete the sentence: solute, solvent, solution, molarity, dilution.
A ___1___ is a homogeneous mixture made of a ___2___ (substance in the lesser quantity) and a ___3___ (substance in the greater quantity).

1. __________
2. __________
3. __________
Question #: 29

What is the molarity of a solution formed by dissolving 0.475 g of NaCl in enough water to yield 25.0 mL of solution? The molar mass of NaCl = 58.44 g/mol.

A. 0.00815 M  
B. 0.00325 M  
C. 0.255 M  
D. 0.325 M

Question #: 30

If 32.50 mL of 5.05 M NaH₂PO₄ solution is diluted to 100.0 mL, what is the final concentration of NaH₂PO₄? Report your answer with three significant figures. Do NOT include units in your answer.

1. _________
Question #: 1

After some fact or facts have been observed, a scientist would like to find an explanation for what is observed. What is the next step of the scientific method?

A. A law is established that is an explanation of the fact(s).
B. An experiment is designed to explain the fact(s).
✓ C. A hypothesis is proposed as an initial explanation of the fact(s).
D. A theory is adopted which explains the fact(s).

Question #: 2

A substance that cannot be chemically broken down into simpler substances is
A. a homogeneous mixture. ✓
B. an element.
C. a heterogeneous mixture.
D. a compound.

Question #: 3

Fill in each blank with the word **physical** or **chemical**.
The temperature that ice melts is a **1** property.
The fact that an iron nail will rust is a **2** property.
When coal (mainly carbon) will burn in the presence of oxygen to produce carbon dioxide. This is an example of a **3** property.

1. physical
2. chemical
3. chemical

Question #: 4

Which two options express correct relationships for prefix multipliers?

✓ A. 1 mL = 10^{-3} L
   B. 1 cm = 10^2 m
✓ C. 1 kg = 10^3 g
   D. 1 ns = 10^9 s

Question #: 5

Select the two answers that show the same number in both scientific and standard notation.

A. 1,200,000; 1.2 \times 10^{-6}
✓ B. 426; 4.26 \times 10^2
✓ C. 0.000045; 4.5 \times 10^{-5}
   D. 0.010; 1.0 \times 10^2
Question #: 6

What is the density of a block of a metal alloy with a volume of 2.3 cm³ and a mass of 19.3 grams?
Report your answer with two significant figures. Do NOT include units in your answer. Do NOT use scientific notation.
density = 1 g/cm³

1. 8.4

Question #: 7

The Niagara Falls official website states that Horseshoe Falls allows 6 million cubic feet of water over the crestline every minute. A student is asked to convert $6 \times 10^6$ ft³ to cubic centimeters and gets the answer 16,990,107,955,200 cm³. While their math is correct, what is wrong with the answer?

A. Nothing. If the math is correct, the answer is correct.
✓B. It would be impossible to know the volume to the nearest 100 cm³ if it is only known to the nearest 1,000,000 ft³.
C. The student should have reported the answer in scientific notation for it to be correct.
D. It is not possible for the number of cm³ to be a larger number than the number of ft³.

Question #: 8

What answer should be reported with the correct number of significant figures for the following calculation?

$$\frac{249.362 + 41}{63.498} =$$

A. 4.6
✓B. 4.57
C. 4.573
Question #: 9

The manufacturing specifications of a metal rod used in a general chemistry lab was determined to be 6.550 cm. Students in the lab were asked to measure the length of the rod by whatever means they had at their disposal. Which set of data is very precise, but not accurate?

A. 6.0 cm, 6.2 cm, 6.6 cm, 6.1 cm
B. 6.551 cm, 6.498 cm, 6.552 cm, 6.551 cm
✓ C. 7.446 cm, 7.450 cm, 7.448 cm, 7.449 cm
D. 5.2 cm, 6.6 cm, 5.3 cm, 4.8 cm

Question #: 10

The top speed of a Formula 1 race car is 340. kilometers per hour. What is the speed in miles per hour?
Report your answer with three significant figures. Do NOT include units in your answer.

1 mi/h

1. 211

Question #: 11

A Honda Civic Hybrid has an EPA gas mileage rating of 46 mi/gal on the highway. How many kilometers can the Civic travel on 4.0 L of gasoline?
Distance traveled = 1 km
Report your answer with three significant figures. Do NOT include units in your answer.

1. 78

Question #: 12

Dalton’s Atomic Theory states that
A. an element is composed of several isotopes.
✓B. matter is composed of small indestructible particles.
C. there is a very large amount of empty space in an atom.
D. that energy is neither created nor destroyed during a chemical reaction.

**Question #: 13**

Select the statement that is **consistent** with Rutherford’s theory of the atom, proposed after observing the scattering of α particles shown in the experiment below.

✓A. The positive charge of the atom is concentrated in a small core called the nucleus.
B. Protons are evenly distributed throughout an atom.
C. There are only positive particles in the atom.
D. Atoms have an overall positive charge.

**Question #: 14**

The atomic number determines the number of 1 [electrons, neutrons, protons] in an atom or ion. The atomic number of sodium is 2 .

1. protons
2. 11|eleven|Eleven|

**Question #: 15**
An isotope has 15 protons and 16 neutrons. What are the values (numbers or letters) for A, Z and X?

\[
\begin{array}{c}
A = 1 \\
Z = 2 \\
X = 3
\end{array}
\]

Question #: 16

Gallium exists as two isotopes, \(^{69}\text{Ga}\) and \(^{71}\text{Ga}\). The mass of \(^{69}\text{Ga}\) is 68.9256 with a 60.11% abundance. What is the mass of \(^{71}\text{Ga}\)?

A. 70.520 amu
✓ B. 70.925 amu
C. 69.875 amu
D. 71.125 amu

Question #: 17

How many protons and electrons are in an atom of selenium that has a \(-2\) charge? Report each answer as a whole number. Do NOT include units in your answer.

Number of protons = 1
Number of electrons = 2

1. 34
2. 36
Question #: 18

Which one represents a possible molecular formula for the empirical formula of $C_3H_5ClO$?

A. $C_6H_{10}ClO_2$
B. $C_5H_{10}Cl_2O_2$
✓ C. $C_6H_{10}Cl_2O_2$
D. $C_6H_{12}Cl_2O_2$

Question #: 19

Fill in the missing element symbol or name.

<table>
<thead>
<tr>
<th>Element Symbol</th>
<th>Element Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>potassium</td>
</tr>
<tr>
<td>2</td>
<td>silver</td>
</tr>
<tr>
<td>Hg</td>
<td>3</td>
</tr>
<tr>
<td>Ar</td>
<td>4</td>
</tr>
</tbody>
</table>

1. K
2. Ag
3. mercury
4. argon

Question #: 20

Classify each element as a **main group metal**, **transition metal**, **nonmetal**, or **metalloid**.

<table>
<thead>
<tr>
<th>Element</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>1</td>
</tr>
<tr>
<td>Sr</td>
<td>2</td>
</tr>
<tr>
<td>Se</td>
<td>3</td>
</tr>
</tbody>
</table>
1. transition metal
2. main group metal
3. nonmetal

Question #: 21

Provide the **name** of each polyatomic ion.

<table>
<thead>
<tr>
<th>Ion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO\textsubscript{3}^{2-}</td>
<td>1</td>
</tr>
<tr>
<td>NO\textsubscript{2}^-</td>
<td>2</td>
</tr>
</tbody>
</table>

Provide the **charge** of each polyatomic ion. Report your answers as a number **and** a sign (+ or –). Do **NOT** include the name or formula of the ion.

<table>
<thead>
<tr>
<th>Ion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>phosphate: PO\textsubscript{4}^{??}</td>
<td>?? = 3</td>
</tr>
<tr>
<td>ammonia: NH\textsubscript{4}^{??}</td>
<td>?? = 4</td>
</tr>
</tbody>
</table>

1. sulfite
2. nitrite
3. 3|-3|
4. +|+1|

Question #: 22

What is the name of Na\textsubscript{2}SO\textsubscript{4}?

A. sodium sulfite
B. sodium(II) sulfate
C. sodium(I) sulfate
D. sodium sulfate

✓ D. sodium sulfate

Question #: 23

What is the chemical formula of sulfur hexafluoride?
Enter the formula **without** subscripts or spaces. Use parentheses if needed, e.g., C\textsubscript{4}H\textsubscript{4}O\textsubscript{2} or (NH\textsubscript{4})\textsubscript{2}S.

1. SF\textsubscript{6}

**Question #: 24**

What is the mass of 1.35 moles of aluminum?
Report your answer with **three** significant figures. Do NOT include units in your answer.

1. 36.4 g

**Question #: 25**

How many atoms of nitrogen are in 15 grams of calcium nitrate, Ca(NO\textsubscript{3})\textsubscript{2}?

- A. 2.0 atoms
- B. 9.0 atoms
- C. 5.4 \times 10^{22} atoms
- **D. 1.1 \times 10^{23}** atoms

**Question #: 26**

What is the mass percent of Na in Na\textsubscript{2}SO\textsubscript{4}?

- A. 22.57%
- **B. 32.37%**
- C. 16.19%
- D. 45.07%

**Question #: 27**
A compound is 61.7% germanium, 30.6% carbon and 7.7% hydrogen by mass. Put symbols in order of GeCH. Enter the formula without subscripting the numbers, add no spaces, and use parentheses if needed, e.g., C\textsubscript{4}H\textsubscript{4}O\textsubscript{2} or (NH\textsubscript{4})\textsubscript{2}S. Its empirical formula is __1__.

1. GeC\textsubscript{3}H\textsubscript{9}

Question #: 28

Choose from the following words to complete the sentence: solute, solvent, solution, molarity, dilution. A __1__ is a homogeneous mixture made of a __2__ (substance in the lesser quantity) and a __3__ (substance in the greater quantity).

1. solution
2. solute
3. solvent

Question #: 29

What is the molarity of a solution formed by dissolving 0.475 g of NaCl in enough water to yield 25.0 mL of solution? The molar mass of NaCl = 58.44 g/mol.

A. 0.00815 M
B. 0.00325 M
C. 0.255 M
✓ D. 0.325 M

Question #: 30

If 32.50 mL of 5.05 M NaH\textsubscript{2}PO\textsubscript{4} solution is diluted to 100.0 mL, what is the final concentration of NaH\textsubscript{2}PO\textsubscript{4}?
Report your answer with three significant figures. Do NOT include units in your answer.

1. 1.64