Unit 1 · Topic 1 · Atomic Structure & Properties

Moles & Molar Mass

Complete AP Chemistry Study Guide

📊 This topic represents 7-9% of the AP Exam

📖 What's Inside

AP Chemistry Rescue · Created by Mr. Hisham Mahmoud

✓ Aligned with College Board 2025 Curriculum

📚 Concept 1: What is a Mole?

Understanding the fundamental counting unit of chemistry

🎯 Learning Objectives

- Define the mole as a counting unit in chemistry
- Understand why chemists need the mole concept
- Explain the relationship between moles and Avogadro's number
- Compare the mole to everyday counting units

What is a Mole?

A **mole** (abbreviated "mol") is a counting unit in chemistry, just like a dozen is a counting unit for eggs. However, instead of counting 12 items, one mole represents a much larger number: **6.022×10^{23}** items. This number is called **Avogadro's number** (N_A), named after Italian scientist Amedeo Avogadro.

💡 Why Do We Need the Mole?

Atoms and molecules are incredibly tiny. A single drop of water contains approximately **1.67×10^{21} molecules**! Working with such enormous numbers would be impractical. The mole allows chemists to work with manageable numbers while still accounting for the astronomical quantities of atoms and molecules in chemical reactions.

Real-World Analogy

Counting Unit	Number of Items	Common Use
1 pair	2 items	Shoes, socks
1 dozen	12 items	Eggs, donuts
1 gross	144 items	Pencils in bulk
1 mole	**6.022×10^{23}**	**Atoms, molecules, ions**

Understanding the Magnitude of Avogadro's Number

Money: If you had 6.022×10^{23} dollars and spent 1 billion dollars per second, it would take you over **19 million years** to spend it all!

Time: Counting to Avogadro's number at one number per second would take approximately **1.9×10^{16} years**—over a million times the age of the universe!

✅ Key Takeaways

- The mole is a **counting unit** for extremely small particles
- **1 mole = 6.022×10^{23} particles** (Avogadro's number)
- The mole bridges the gap between the **atomic scale and laboratory scale**
- Any type of particle can be counted in moles: atoms, molecules, ions, electrons
- The mole is one of the **seven SI base units** in science

⚖️ Concept 2: Molar Mass

Connecting atomic mass to measurable quantities

🎯 Learning Objectives

- Define molar mass and its units (g/mol)
- Calculate molar mass from atomic masses on the periodic table
- Determine molar mass for elements, compounds, and hydrates

What is Molar Mass?

Molar mass is the mass of one mole of a substance, expressed in grams per mole (g/mol). It's numerically equal to the atomic or molecular mass, but the units change from amu to grams.

🔑 The Magic Connection

• **One carbon-12 atom** has a mass of 12 amu → **One mole of carbon-12 atoms** has a mass of 12 grams
This 1:1 numerical relationship works for ALL elements and compounds!

How to Calculate Molar Mass

Step 1: Identify all atoms in the chemical formula | **Step 2:** Find the atomic mass of each element

Step 3: Multiply each atomic mass by the subscript | **Step 4:** Add all values together

📊 Example 1: Water (H_2O)

Atoms: 2 H, 1 O | Atomic masses: H = 1.01, O = 16.00 g/mol
H: 2 × 1.01 = 2.02 | O: 1 × 16.00 = 16.00
Total molar mass = 2.02 + 16.00 = 18.02 g/mol

📊 Example 2: Calcium Carbonate ($CaCO_3$)

Atoms: 1 Ca, 1 C, 3 O | Ca: 40.08 | C: 12.01 | O: 3 × 16.00 = 48.00
Total molar mass = 40.08 + 12.01 + 48.00 = 100.09 g/mol

📊 Example 3: Magnesium Nitrate $Mg(NO_3)_2$

Atoms: 1 Mg, 2 N, 6 O *(The subscript 2 multiplies everything inside parentheses!)*
Mg: 24.31 | N: 2 × 14.01 = 28.02 | O: 6 × 16.00 = 96.00
Total molar mass = 24.31 + 28.02 + 96.00 = 148.33 g/mol

✅ Key Takeaways

- Molar mass is expressed in **g/mol** (grams per mole)
- Molar mass is **numerically equal to atomic/molecular mass**
- For compounds, **multiply atomic mass by subscripts**, then add all together
- Watch for parentheses! Subscripts outside multiply everything inside

🔄 Concept 3: Mass-Mole Conversions

Converting between grams and moles

🎯 Learning Objectives

- Use molar mass as a conversion factor between mass and moles
- Convert from mass (grams) to moles and from moles to mass (grams)
- Apply dimensional analysis to solve conversion problems

$$n = \text{mass} / \text{molar mass}$$

n = moles (mol) · **mass** = grams (g) · **molar mass** = g/mol

🎯 Two Types of Conversions

Grams → Moles: n = mass ÷ molar mass | **Moles → Grams:** mass = n × molar mass

📊 Example 1: Grams to Moles

How many moles are in 50.0 g of water (H_2O)? (Molar mass = 18.02 g/mol)

n = mass / molar mass = 50.0 g / 18.02 g/mol = **2.77 mol**

📊 Example 2: Moles to Grams

What is the mass of 3.5 moles of NaCl? (Molar mass = 58.44 g/mol)

mass = n × molar mass = 3.5 mol × 58.44 g/mol = **204.5 g**

📊 Example 3: Multi-Step Problem

What mass of $CuSO_4$ is needed to have 0.250 moles? (Cu=63.55, S=32.07, O=16.00)

Step 1: Molar mass = 63.55 + 32.07 + (4 × 16.00) = 159.62 g/mol
Step 2: mass = 0.250 mol × 159.62 g/mol = **39.9 g**

✅ Key Takeaways

- **Always calculate molar mass first** before doing conversions
- **Check units!** They should cancel to give you the desired unit
- **Grams to moles: divide** | **Moles to grams: multiply**

🔬 Concept 4: Mole-Particle Conversions

Converting between moles and individual particles

🎯 Learning Objectives

- Use Avogadro's number to convert between moles and particles
- Calculate the number of atoms, molecules, or ions from moles
- Distinguish between molecules and individual atoms in compounds

Types of Particles

• **Atoms** (in elements like He, Fe, C) • **Molecules** (in compounds like H_2O, CO_2, CH_4)

• **Formula units** (in ionic compounds like NaCl) • **Ions** (in solutions like Na^+, Cl^-)

$$\text{Particles} = n \times (6.022 \times 10^{23})$$

OR: $n = \text{Particles} / (6.022 \times 10^{23})$

⚠️ Important Distinction

1 mole of H_2O contains: 6.022×10^{23} **molecules** of H_2O

BUT: 1.806×10^{24} **atoms** total (each molecule has 3 atoms: 2 H + 1 O)

📊 Example 1: Moles to Molecules

How many molecules are in 2.5 moles of glucose?

Molecules = 2.5 mol × 6.022×10^{23} = **1.51×10^{24} molecules**

📊 Example 2: Counting Individual Atoms

How many hydrogen atoms are in 1.5 moles of H_2O?

Step 1: Molecules = 1.5 × 6.022×10^{23} = 9.033×10^{23} molecules

Step 2: Each H_2O has 2 H atoms → H atoms = 9.033×10^{23} × 2 = **1.81×10^{24}**

📊 Example 3: Mass to Atoms

How many atoms are in 27.0 g of aluminum? (Al = 26.98 g/mol)

Step 1: n = 27.0 g / 26.98 g/mol = 1.00 mol

Step 2: Atoms = 1.00 × 6.022×10^{23} = **6.02×10^{23} atoms**

✅ Key Takeaways

- **Be specific:** Are you counting molecules, atoms, or formula units?
- **Multi-step problems:** Often go grams → moles → particles
- **Subscripts matter:** H_2O has 2 H atoms per molecule!

📊 Concept 5: Percent Composition

Determining the percentage of each element in a compound

🎯 Learning Objectives

- Calculate the percent composition by mass of each element in a compound
- Use percent composition to verify compound purity
- Apply percent composition in empirical formula determination

$$\% \text{ element} = (\text{mass of element} / \text{total mass}) \times 100\%$$

📐 Step-by-Step Method

Step 1: Calculate the molar mass of the compound
Step 2: Find the total mass contribution of each element
Step 3: Divide each element's mass by total molar mass, multiply by 100
Step 4: Check that all percentages add up to 100%

📊 Example 1: Water (H_2O)

Molar mass: H: 2 × 1.01 = 2.02 | O: 16.00 | Total = 18.02 g/mol

% H = (2.02 / 18.02) × 100% = 11.2% | % O = (16.00 / 18.02) × 100% = 88.8%

Check: 11.2% + 88.8% = 100% ✓

📊 Example 2: Glucose ($C_6H_{12}O_6$)

Molar mass: C: 72.06 | H: 12.12 | O: 96.00 | Total = 180.18 g/mol

% C = 40.0% | % H = 6.7% | % O = 53.3%

📊 Example 3: Ammonia (NH_3)

Molar mass: N: 14.01 | H: 3.03 | Total = 17.04 g/mol

% N = (14.01 / 17.04) × 100% = 82.2% | % H = 17.8%

✅ Key Takeaways

- Percent composition shows the **mass percentage** of each element
- Always calculate **molar mass first**
- All percentages should **add up to 100%**
- Useful for **identifying compounds** and checking purity

📋 Quick Reference Summary

Essential formulas and concepts for Unit 1 Topic 1

Essential Formulas

Conversion	Formula	Units
Grams to Moles	**n = mass / molar mass**	mol = g / (g/mol)
Moles to Grams	**mass = n × molar mass**	g = mol × (g/mol)
Moles to Particles	**particles = n × 6.022 × 10^{23}**	particles
Particles to Moles	**n = particles / 6.022 × 10^{23}**	mol
Percent Composition	**% = (element mass / total) × 100**	%

Key Numbers to Remember

Value	Name	Meaning
6.022 × 10^{23}	Avogadro's Number (N_a)	Particles in 1 mole
1 mol	One Mole	6.022 × 10^{23} particles
g/mol	Molar Mass Units	Grams per mole

Common Atomic Masses (Rounded)

Element	Symbol	Mass	Element	Symbol	Mass
Hydrogen	H	1.01	Sulfur	S	32.07
Carbon	C	12.01	Chlorine	Cl	35.45
Nitrogen	N	14.01	Calcium	Ca	40.08
Oxygen	O	16.00	Iron	Fe	55.85
Sodium	Na	22.99	Copper	Cu	63.55
Magnesium	Mg	24.31	Zinc	Zn	65.38

🎯 **Conversion Map**

Mass (g) ←——→ Moles (mol) ←——→ Particles (atoms/molecules)

Use **molar mass** for mass ↔ moles | Use **Avogadro's number** for moles ↔ particles

🟢 EASY QUESTIONS (1-10)

Direct application questions - Build your foundation

E1

What is Avogadro's number?

- A 6.022×10^{22}
- B 6.022×10^{23}
- C 6.022×10^{24}
- D 6.022×10^{25}

Answer: B - Avogadro's number is 6.022×10^{23} particles per mole.

E2

What are the units for molar mass?

- A grams (g)
- B moles (mol)
- C grams per mole (g/mol)
- D particles per gram

Answer: C - Molar mass is expressed in grams per mole (g/mol).

E3

What is the molar mass of O_2 (oxygen gas)? (O = 16.00 g/mol)

- A 8.00 g/mol
- B 16.00 g/mol
- C 32.00 g/mol
- D 48.00 g/mol

Answer: C - O_2 has 2 oxygen atoms: 2 × 16.00 = 32.00 g/mol

E4

How many moles are in 18.02 g of water? (Molar mass of H_2O = 18.02 g/mol)

- A 0.5 mol
- B 1.0 mol
- C 2.0 mol
- D 18.02 mol

🟢 EASY QUESTIONS (11-15)

Direct application questions - continued

E11

What is the molar mass of carbon (C)?

- A 6.02 g/mol
- B 12.01 g/mol
- C 14.01 g/mol
- D 16.00 g/mol

Answer: B - The molar mass of carbon equals its atomic mass: 12.01 g/mol

E12

How many moles are in 44.0 g of CO_2? (Molar mass = 44.01 g/mol)

- A 0.5 mol
- B 1.0 mol
- C 2.0 mol
- D 44.0 mol

Answer: B - n = 44.0 g / 44.01 g/mol ≈ 1.0 mol

E13

What is the percent composition formula?

- A (total mass / element mass) × 100%
- B (element mass / total mass) × 100%
- C (moles / mass) × 100%
- D (mass / moles) × 100%

Answer: B - % = (mass of element / total molar mass) × 100%

E14

What is the mass of 0.5 moles of O_2? (O_2 = 32.00 g/mol)

- A 8.0 g
- B 16.0 g
- C 32.0 g
- D 64.0 g

🟡 MEDIUM QUESTIONS (1-8)

Multi-step problems requiring deeper understanding

M1

What is the molar mass of glucose ($C_6H_{12}O_6$)? (C=12.01, H=1.01, O=16.00)

- A 29.02 g/mol
- B 168.00 g/mol
- C 180.18 g/mol
- D 192.19 g/mol

Answer: C - C: 72.06 + H: 12.12 + O: 96.00 = 180.18 g/mol

M2

Calculate the molar mass of $Mg(NO_3)_2$. (Mg=24.31, N=14.01, O=16.00)

- A 86.33 g/mol
- B 102.33 g/mol
- C 148.33 g/mol
- D 164.33 g/mol

Answer: C - Mg: 24.31 + N: 28.02 + O: 96.00 = 148.33 g/mol (2N, 6O)

M3

How many moles are in 88.0 g of CO_2? (C=12.01, O=16.00)

- A 1.00 mol
- B 2.00 mol
- C 2.75 mol
- D 3.87 mol

Answer: B - Molar mass = 44.01 g/mol; n = 88.0/44.01 = 2.00 mol

M4

What is the mass of 0.750 moles of NH_3? (N=14.01, H=1.01)

- A 12.8 g
- B 17.0 g
- C 22.7 g
- D 51.0 g

🟡 MEDIUM QUESTIONS (9-15)

Multi-step problems - continued

M9

What is the mass of 4.50 moles of $CaCO_3$? (Molar mass = 100.09 g/mol)

- A 22.2 g
- B 45.0 g
- C 225 g
- D 450 g

Answer: D - mass = 4.50 × 100.09 = 450 g

M10

How many oxygen atoms are in 3.0 moles of Al_2O_3?

- A 1.8×10^{24}
- B 5.4×10^{24}
- C 9.0×10^{24}
- D 1.5×10^{25}

Answer: B - Each Al_2O_3 has 3 O; $3.0 \times 6.022 \times 10^{23} \times 3 = 5.4 \times 10^{24}$

M11

Calculate % carbon in methane (CH_4). (C=12.01, H=1.01)

- A 25.0%
- B 50.0%
- C 74.9%
- D 80.0%

Answer: C - Molar mass = 16.05; % C = (12.01/16.05) × 100% = 74.9%

M12

How many grams of Na are in 2.5 moles of NaCl? (Na = 22.99)

- A 22.99 g
- B 57.5 g
- C 88.6 g
- D 146 g

🔴 HARD QUESTIONS - AP EXAM STYLE (1-5)

Complex, multi-step problems similar to AP exam questions

H1

Which statement about the mole is correct?

- A One mole of any gas at STP occupies 22.4 L, but solids have different molar volumes
- B One mole of any substance contains the same number of particles, but different masses
- C One mole of different substances has different numbers of particles but same mass
- D One mole of a substance always has a mass of 1 gram

Answer: B - 1 mole always = 6.022×10^{23} particles, but mass varies by substance

H2

A compound is 40.0% C, 6.7% H, and 53.3% O. Which compound is it?

- A C_2H_6O (ethanol)
- B C_3H_8O (propanol)
- C $C_6H_{12}O_6$ (glucose)
- D $C_{12}H_{22}O_{11}$ (sucrose)

Answer: C - Glucose: %C=40.0%, %H=6.7%, %O=53.3% matches exactly

H3

Which compound has the highest % oxygen by mass?

- A CO (carbon monoxide)
- B CO_2 (carbon dioxide)
- C NO (nitrogen monoxide)
- D NO_2 (nitrogen dioxide)

Answer: B - CO: 57.1%, CO_2: 72.7%, NO: 53.3%, NO_2: 69.5%

H4

Which sample contains the greatest number of moles?

- A 10.0 g of He (4.00 g/mol)
- B 20.0 g of Ne (20.18 g/mol)
- C 30.0 g of Ar (39.95 g/mol)
- D 40.0 g of Kr (83.80 g/mol)

🔴 HARD QUESTIONS - AP EXAM STYLE (6-10)

Complex problems - continued

H6

What is the % water in $CuSO_4 \cdot 5H_2O$? (Cu=63.55, S=32.07, O=16.00, H=1.01)

- A 18.0%
- B 25.3%
- C 36.1%
- D 45.0%

Answer: C - $CuSO_4$: 159.62 + $5H_2O$: 90.10 = 249.72; %H_2O = 36.1%

H7

A gas has mass 5.60 g and 0.20 moles. What is the molar mass and identity?

- A 14 g/mol - nitrogen (N)
- B 28 g/mol - N_2 or CO
- C 32 g/mol - O_2
- D 44 g/mol - CO_2

Answer: B - Molar mass = 5.60/0.20 = 28 g/mol (matches N_2 or CO)

H8

In 2.0 moles of H_2SO_4, how many total atoms are present?

- A 6.02×10^{23}
- B 8.43×10^{24}
- C 1.20×10^{24}
- D 4.22×10^{24}

Answer: B - H_2SO_4 has 7 atoms; $2.0 \times 6.022 \times 10^{23} \times 7 = 8.43 \times 10^{24}$

H9

What mass of $KMnO_4$ for 0.100 moles? (K=39.10, Mn=54.94, O=16.00)

- A 11.0 g
- B 15.8 g
- C 18.2 g
- D 22.0 g

📝 FREE RESPONSE QUESTION 1 - EASY

Practice your written response skills with this foundational FRQ

FRQ 1: Molar Mass and Basic Conversions

10 Points

Context: A student is given a sample of sodium carbonate (Na_2CO_3) in the laboratory. The student needs to perform several calculations to understand the composition and quantity of the sample.

Atomic masses: Na = 22.99 g/mol, C = 12.01 g/mol, O = 16.00 g/mol

(a) Calculate the molar mass of Na_2CO_3. Show your work.
(3 points)

(b) The student has 21.2 g of Na_2CO_3. Calculate the number of moles present.
(3 points)

(c) How many formula units of Na_2CO_3 are in the sample from part (b)?
(2 points)

(d) How many individual sodium atoms are present in the sample?
(2 points)

✅ SCORING GUIDELINES & SAMPLE ANSWERS

(a) Molar mass calculation (3 points)

Na: 2 × 22.99 = 45.98 g/mol *(1 pt)*
C: 1 × 12.01 = 12.01 g/mol *(1 pt)*
O: 3 × 16.00 = 48.00 g/mol
Total = 45.98 + 12.01 + 48.00 = 105.99 g/mol *(1 pt for correct total)*

(b) Moles calculation (3 points)

n = mass / molar mass *(1 pt for correct setup)*
n = 21.2 g / 105.99 g/mol *(1 pt for substitution)*
n = 0.200 mol *(1 pt for correct answer with units)*

(c) Formula units calculation (2 points)

Formula units = n × Avogadro's number *(1 pt)*
= 0.200 mol × 6.022×10^{23}
= 1.20×10^{23} formula units *(1 pt)*

(d) Sodium atoms (2 points)

Each Na_2CO_3 has 2 Na atoms *(1 pt for recognizing this)*
Na atoms = $1.20 \times 10^{23} \times 2$
= 2.41×10^{23} sodium atoms *(1 pt)*

📝 FREE RESPONSE QUESTION 2 - MEDIUM

Multi-step problem requiring percent composition analysis

FRQ 2: Percent Composition and Compound Analysis

12 Points

Context: Iron can form two common oxides: iron(II) oxide (FeO) and iron(III) oxide (Fe_2O_3). A chemist analyzes a sample of an unknown iron oxide and finds it contains 72.4% iron by mass.

Atomic masses: Fe = 55.85 g/mol, O = 16.00 g/mol

(a) Calculate the percent composition of iron in FeO. Show your work.
(3 points)

(b) Calculate the percent composition of iron in Fe_2O_3. Show your work.
(3 points)

(c) Based on your calculations, identify the unknown iron oxide. Justify your answer.
(2 points)

(d) If the chemist has 25.0 g of the identified oxide, how many moles of iron atoms are present?
(4 points)

✅ SCORING GUIDELINES & SAMPLE ANSWERS

(a) Percent Fe in FeO (3 points)

Molar mass of FeO = 55.85 + 16.00 = 71.85 g/mol *(1 pt)*
% Fe = (55.85 / 71.85) × 100% *(1 pt)*
% Fe = 77.7% *(1 pt)*

(b) Percent Fe in Fe_2O_3 (3 points)

Molar mass of Fe_2O_3 = (2 × 55.85) + (3 × 16.00) = 159.70 g/mol *(1 pt)*
% Fe = (111.70 / 159.70) × 100% *(1 pt)*
% Fe = 69.9% *(1 pt)*

(c) Identification (2 points)

The unknown is **FeO (iron(II) oxide)** *(1 pt)*
Justification: The experimental value of 72.4% Fe is closer to the theoretical value for FeO (77.7%) than Fe_2O_3 (69.9%). The slight difference may be due to impurities or experimental error. *(1 pt)*

(d) Moles of Fe atoms (4 points)

Moles of FeO = 25.0 g / 71.85 g/mol = 0.348 mol FeO *(2 pts)*
Each FeO has 1 Fe atom, so moles of Fe = moles of FeO *(1 pt)*
Moles of Fe = 0.348 mol *(1 pt)*

📝 FREE RESPONSE QUESTION 3 - HARD

AP Exam-level comprehensive problem

FRQ 3: Hydrate Analysis and Multi-Step Calculations

15 Points

Context: Hydrated magnesium sulfate ($MgSO_4 \cdot xH_2O$), commonly known as Epsom salt, is used in medicine and agriculture. A student heats 4.93 g of the hydrate until all water is removed, leaving 2.41 g of anhydrous $MgSO_4$.

Atomic masses: Mg = 24.31, S = 32.07, O = 16.00, H = 1.01 g/mol

(a) Calculate the mass of water lost during heating.
(1 point)

(b) Calculate the molar mass of anhydrous $MgSO_4$.
(2 points)

(c) Determine the number of moles of anhydrous $MgSO_4$ and the number of moles of H_2O lost.
(4 points)

(d) Determine the value of x in the formula $MgSO_4 \cdot xH_2O$. Show your reasoning.
(3 points)

(e) Calculate the percent by mass of water in the hydrated compound.
(2 points)

(f) How many hydrogen atoms were present in the original hydrated sample?
(3 points)

✅ SCORING GUIDELINES & SAMPLE ANSWERS

(a) Mass of water (1 point)

Mass of H_2O = 4.93 g - 2.41 g = **2.52 g**

(b) Molar mass of $MgSO_4$ (2 points)

$MgSO_4$ = 24.31 + 32.07 + (4 × 16.00) *(1 pt)*
= 120.38 g/mol *(1 pt)*

(c) Moles calculations (4 points)

Moles $MgSO_4$ = 2.41 g / 120.38 g/mol = **0.0200 mol** *(2 pts)*
Moles H_2O = 2.52 g / 18.02 g/mol = **0.140 mol** *(2 pts)*

(d) Value of x (3 points)

Ratio = moles H_2O / moles $MgSO_4$ *(1 pt)*
x = 0.140 / 0.0200 = 7 *(1 pt)*
x = 7, so the formula is $MgSO_4 \cdot 7H_2O$ *(1 pt)*

(e) Percent water (2 points)

% H_2O = (2.52 g / 4.93 g) × 100% *(1 pt)*
= 51.1% *(1 pt)*

(f) Hydrogen atoms (3 points)

📝 Complete Answer Key

Quick reference for all 40 multiple choice questions

🟢 Easy Questions (15 Questions)

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
E1	B	E4	B	E7	C	E10	C	E13	B
E2	C	E5	C	E8	C	E11	B	E14	B
E3	C	E6	C	E9	B	E12	B	E15	C

🟡 Medium Questions (15 Questions)

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
M1	C	M4	A	M7	B	M10	B	M13	A
M2	C	M5	D	M8	B	M11	C	M14	C
M3	B	M6	D	M9	D	M12	B	M15	B

🔴 Hard Questions - AP Exam Style (10 Questions)

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
H1	B	H3	B	H5	C	H7	B	H9	B
H2	C	H4	A	H6	C	H8	B	H10	D

📝 FRQ Point Summary

FRQ	Difficulty	Total Points	Key Topics
FRQ 1	🟢 Easy	10 points	Molar mass, moles, formula units, atoms
FRQ 2	🟡 Medium	12 points	Percent composition, compound identification
FRQ 3	🔴 Hard	15 points	Hydrate analysis, multi-step calculations

📊 Scoring Guide

MCQ: Easy 13-15 ✓ | Medium 12-15 ✓ | Hard 8-10 = AP Ready! 🌟
FRQ: Aim for 80%+ on each FRQ to demonstrate mastery

🎯 Study Tips for FRQs

- **Show all work** — Partial credit is awarded for correct setup even with calculation errors
- **Include units** — Always write units in your calculations and final answers
- **Box your final answers** — Make it easy for graders to find your answer

AP Chemistry Rescue

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✓ Aligned with College Board 2025 Curriculum

📚 COMING SOON

How NOT to Study AP Chemistry

The Ultimate Guide to Avoiding Common Mistakes and Actually Understanding Chemistry

Written by **Mr. Hisham Mahmoud**