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VCE Chemistry ½
Moles & Molar Mass [0.13]
Workshop

Error Logbook:

New Ideas/Concepts	Didn't Read Question
Pg / Q #: _____ Notes:	Pg / Q #: _____ Notes:
Algebraic/Arithmetic/ Calculator Input Mistake	**Working Out Not Detailed Enough**
Pg / Q #: _____ Notes:	Pg / Q #: _____ Notes:

Section A: Recap (5 Marks)

Learning Objective: [2.1.1] – Apply Avogadro's Number to Mole Calculations Using $n = N/Na$

- **Moles:**
  - **Definition:** The SI base unit for the _____ of substance in chemistry.

Denoted By	SI Units

  - **Definition:** A **constant/number** which relates the number of [particles]/[grams] to the number of moles.
  - N_A = _____

$$n = \_\_\_\_\_$$

  - When determining moles of **atoms** from a **molecule:** Ratios must be considered.

Learning Objective: [2.1.2] – Apply Molar Mass to Mole Calculations Using $n = m/M$

- **Molar Mass:**
  - **Definition:**
    - The ratio between the mass (in g) and the amount of substance present (in mol).
    - It tells how heavy an atom/molecule is per mole.

Denoted By	SI Units

  - Molar mass values can be found by considering the [atomic]/[mass] numbers of elements.

- **Molar Mass:**

$$n = \_\_\_\_\_$$

  - Where:

n	m	M
moles (in mol)	mass (in g)	molar mass (in g/mol)

Learning Objective: [2.1.3] – Apply Unit Conversions to Calculation Questions

- **Significant Figures:**

  - **Definition**: Significant figures tell us how _____ a measurement is.

$$\underbrace{0.00}_{\text{Leading zeroes}}\ \overbrace{61}^{\text{Non-zero}}\ \underbrace{00}_{\text{in-between zeroes}}\ \overbrace{34}^{\text{Non-zero}}\ \underbrace{00}_{\text{Trailing zeroes}}$$

  - **Rules:**
  - Non-zero digits: [significant]/[non-significant]
  - In-between zeros: [significant]/[non-significant]
  - Trailing zeros: [significant]/[non-significant]
  - Leading zeros: [significant]/[non-significant]
  - **When Answering:** Use the [smallest]/[greatest] number of significant figures in the question to express our answer.

- **Scientific Notation:**
  - **Expression:** One **non-zero digit** to the [left]/[right] of the decimal, multiplied by a power of ten.
  - When adding or subtracting multiple quantities, the final answer must be expressed to the lowest number of [significant figures]/[decimal places].
- **Non-SI Units:**
  - **Purpose:** To make more _____ measurements of quantities.
  - When going from a bigger to a smaller unit, there will be [more]/[less] of the same substance in the smaller unit, so we [multiply]/[divide] by the appropriate power of 10.

Question 1 (3 marks) **Walkthrough.**

a. Given that there are 2.83×10^{23} molecules of ammonia (NH_3), how many moles are present? (1 mark)

_____

b. How many moles of carbon atoms and oxygen atoms are present in total? (2 marks)

_____

_____

_____

Space for Personal Notes

Question 2 (2 marks) **Walkthrough.**

Sodium carbonate is investigated.

a. What is the molecular formula of sodium carbonate? (0.5 marks)

_____

b. Find the molar mass of sodium carbonate. (0.5 marks)

_____

c. Find the mass of 7.25 mol of sodium carbonate. (1 mark)

_____

Question 3 Walkthrough.

Find the amount (in mol) of chlorine in 210 μg of aluminium chloride.

_____

_____

_____

_____

_____

Space for Personal Notes

Section B: Warm Up (16 Marks)

INSTRUCTION: 16 Marks. 10 Minutes Writing.

Question 4 (3 marks)

For the following numbers, write the number of significant figures which are present:

a. 100. (0.5 marks)

b. 100.001. (0.5 marks)

c. 0.001. (0.5 marks)

d. 1.001. (0.5 marks)

e. 0.101. (0.5 marks)

f. 100.00. (0.5 marks)

Question 5 (3 marks)

a. Calculate the number of atoms in 1.52 mol of helium (He). (1 mark)

_____

_____

b. Calculate the number of atoms of in 8.20 mol of nitrogen (N_2). (1 mark)

_____

_____

c. Calculate the number of moles in 7.87×10^{24} atoms of neon. (1 mark)

_____

_____

Question 6 (2 marks)

For each of the following, figure out what the compound will look like and find its molar mass.

a. Ammonium sulphate. (1 mark)

_____

_____

b. Aluminum peroxide. (1 mark)

_____

_____

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Question 7 (2 marks)

For each of the following:

a. Find the mass of 0.582 mol of fluorine gas (F_2). (1 mark)

_____

_____

b. Find the mass of 8.50 mol of phosphoric acid (H_3PO_4). (1 mark)

_____

_____

Question 8 (6 marks)

Find the mass of the following:

a. 0.45 moles of I_2. (1 mark)

_____

_____

b. 6.16 moles of H_2SO_4. (1 mark)

_____

_____

c. 3.14×10^{14} molecules of C_6H_6. (2 marks)

_____

_____

_____

d. 6.01×10^9 molecules of HBr. (2 marks)

_____

_____

_____

Space for Personal Notes

Section C: Ramping Up (12 Marks)

INSTRUCTION: 12 Marks. 9 Minutes Writing.

Question 9 (1 mark)

Which of the following correctly depicts 4 significant figures?

A. 0.032

B. 3.24×10^4

C. 0.4032

D. 1000

Space for Personal Notes

Question 10 (4 marks)

A chemist is using certain chemicals within her lab to extract oxygen atoms O^{2-}. The chemicals present are H_2O, O_2 and O_3.

a. The chemist wishes to have 32 grams of pure oxygen atoms. How many moles would this be? (1 mark)

_____

_____

b. How many moles of H_2O would be required to achieve this? (1 mark)

_____

_____

c. How many grams of O_2 would be required to achieve this? (1 mark)

_____

_____

d. How many grams of O_3 would be required to achieve this? (1 mark)

_____

_____

Space for Personal Notes

Question 11 (7 marks)

Joel is working with the local council to test for dangerous metals in the water. Of these metals, Joel wishes to determine how much copper is present in water. After running a test on the local river water, Joel observes that there is 150 ug of copper sulphate in every litre of water.

a. How many grams of copper sulphate are present in every litre? (1 mark)

_____

_____

b. Thus, calculate the moles of copper present in every litre. (3 marks)

_____

_____

_____

_____

c. At another location, Joel finds that there are 6 grams of copper sulphate in every litre. How many ions would be present in every litre? (3 marks)

_____

_____

_____

_____

Space for Personal Notes

Section D: Getting Trickier I (15 Marks)

INSTRUCTION: 15 Marks. 12 Minutes Writing.

Question 12 (3 marks)

At her school chemistry lab, Piya weighs out 66 grams of silver sulphate (Ag_2SO_4).

a. How many moles of Ag_2SO_4 was weighed out? (1 mark)

_____

b. How many atoms of silver are present in Piya's sample? (2 marks)

_____

_____

_____

Space for Personal Notes

Question 13 (6 marks)

Nitrogen dioxide (NO_2) is a gaseous air pollutant composed of both nitrogen and oxygen. It can be used to manufacture nitric acid (HNO_3), which is used as a fertiliser or for explosives.

a. What mass of oxygen is required to make one mol of nitrogen dioxide? (2 marks)

_____

_____

_____

b. How many atoms of nitrogen are required to produce 15 g of nitric acid? (2 marks)

_____

_____

_____

c. Given that a manufacturing process begins with 1 kg of nitrogen dioxide, and leaves behind 135 g, find the amount of nitrogen dioxide consumed in this reaction. (2 marks)

_____

_____

_____

Space for Personal Notes

Question 14 (6 marks)

Aaron wishes to make an electrolyte drink which is better than its competitors, Crime and Patorade. To do this, he adds sodium nitrate into water, alongside magnesium nitrate. The volume of water for his initial trial run in 600 mL.

a. Given that Aaron uses 5 grams of sodium nitrate, how many moles of sodium would be present? (2 marks)

_____

_____

_____

b. How many atoms of sodium would this be? (1 mark)

_____

c. Aaron then adds the same mass of magnesium nitrate into the solution, and claims on his packaging that each of these ions contributes the same number of nitrate anions during dissociation. Explain whether Aaron is right or wrong with relevant working. (3 marks)

_____

_____

_____

_____

_____

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Section E: Getting Trickier II (10 Marks)

INSTRUCTION: 10 Marks. 9 Minutes Writing.

Question 15 (1 mark)

What is the molar mass of H_3PO_4?

A. 99.1 $g\ mol^{-1}$

B. 98 $g\ mol^{-1}$

C. 102.5 $g\ mol^{-1}$

D. 50 $g\ mol^{-1}$

Question 16 (5 marks)

Moles are fundamental units that are integral to modern chemistry.

a. What exactly does a mole represent? (1 mark)

_____

_____

b. Elva discusses with Subin that 1 mole of iron nitrate and 1 mole of H_2O, do not have the same number of particles because iron is much heavier than water. Explain if Elva is correct. (2 marks)

_____

_____

_____

c. Now, if a sample of iron (III) nitrate contains 6.02×10^3 moles, calculate the number of atoms of oxygen present. (2 marks)

_____

_____

_____

_____

Question 17 (4 marks)

Calculate the missing values of the following., Showingshowing your working.

a. The number of particles of H_2O, given that there is $3.76 \times 10^{-3}\ g$ of it present. (1 mark)

_____

_____

b. The mass of HNO_3, given that there is 2.3×10^{25} particles of HNO_3. (1 mark)

_____

_____

c. The moles of $Pb(NO_3)_2$, given that there is $2.34 \times 10^2\ mg$ of it present. (1 mark)

_____

_____

d. The number of atoms of oxygen that exists exist in $7.52\ g$ of $K_2Cr_2O_7$. (1 mark)

_____

_____

Let's take a BREAK!

Space for Personal Notes

Section F: VCAA-Level Questions I (11 Marks)

INSTRUCTION: 11 Marks. 30 Seconds Reading. 11 Minutes Writing.

Question 18 (11 marks)

Molar mass is typically in applied chemistry and is also another fundamental concept required in chemistry.

a. Explain what molar mass represents. (2 marks)

_____

_____

_____

b. If we have a sample of K_2SO_4 and $Pb(NO_3)_2$, and they both weigh to aboutweigh about 2.04 g, explain if this means that they contain the same number of particles. (2 marks)

_____

_____

_____

c. Calculate the moles of each sample.

i. K_2SO_4. (1 mark)

_____

_____

ii. $Pb(NO_3)_2$. (1 mark)

_____

_____

d. These two compounds can actually react with each other.

i. Write the fully balanced chemical reaction between these two compounds, including states. (1 mark)

_____

_____

ii. State and name the precipitate that forms, if any. (1 mark)

_____

e. Between the two compound samples, calculate the total number of oxygen atoms that exist. (3 marks)

_____

_____

_____

_____

_____

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Section G: Multiple Choice Questions (8 Marks)

INSTRUCTION: 8 Marks. 8 Minutes Writing.

Question 19 (1 mark)

Which definition of Avogadro's Number is most correct?

A. The number of atoms that exist within 1 mole of a molecule.

B. The number of particles that exists exist within 1 mole of a given substance, either molecule or atom.

C. The number of moles that exists exist within 1 gram of a given substance, either molecule or atom.

D. The number of molecules that exists exist within 1 mole of a given substance.

Question 20 (1 mark)

What is the number of particles of nitrogen present in 8.65 g of nitrogen gas?

A. 3.72×10^{23} particles.

B. 1.86×10^{23} particles.

C. 5.21×10^{24} particles.

D. 1.04×10^{25} particles.

Question 21 (1 mark)

What is the number of particles that exist within 3.45 moles of neon atoms?

A. 5.73×10^{24}

B. 5.73×10^{-24}

C. 2.08×10^{23}

D. 2.08×10^{24}

Question 22 (1 mark)

How many moles exist within 8.23×10^{19} particles of lithium atoms?

A. 1.38×10^{-4} moles.

B. 1.38 moles.

C. 0.00138 moles.

D. 1.38×10^{4} moles.

Question 23 (1 mark)

Which of the following contains the greatest number of particles of hydrogen?

A. 1 mole of H_2O.

B. $1\ g$ of H_2 gas.

C. $1.0 \times 10^{2}\ g$ of H_3PO_4.

D. 1.0×10^{-1} mole of HCl.

Question 24 (1 mark)

Which of the following samples have the greatest mass?

A. 6.02×10^{23} particles of CO_2.

B. 2.03×10^{3} mg of H_2O.

C. 8.93×10^{2} moles of NH_3.

D. 2.53×10^{3} millimoles of Br_2.

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Question 25 (1 mark)

How many grams of oxygen gas are present in 0.258 moles?

A. $4.128\ g$.

B. 0.016 moles.

C. $8.256\ g$.

D. 0.008 moles.

Question 26 (1 mark)

What is the number of particles of oxygen present given that there is $4.61 \times 10^{-2}\ g$ of $CaCO_3$?

A. 2.77×10^{20} particles.

B. 2.77×10^{22} particles.

C. 8.32×10^{22} particles.

D. 8.32×10^{20} particles.

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Section H: VCAA-Level Questions II (9 Marks)

INSTRUCTION: 9 Marks. 30 Seconds Reading. 9 Minutes Writing.

Question 27 (9 marks)

Consider an experiment where Jason would like to determine Avogadro's number himself.

a. State what Avogadro's number represents. (1 mark)

_____

_____

b. State what the unit of Avogadro's number is and explain why it is written like it is. (2 marks)

_____

_____

_____

c. Now Jason will determine this experimentally, using a sample of sulphuric acid, H_2SO_4.

i. What is the molar mass of sulphuric acid? (1 mark)

_____

ii. Calculate the amount number of moles of sulphuric acid present, given that Jason weighed the sample to be around $4.58 \times 10^{-1}\ g$. (2 marks)

_____

_____

_____

_____

iii. Now, given that we know that the sample contains approximately 1.00×10^{22} atoms of oxygen, calculate the experimental value of Avogadro's Number. (3 marks)

_____

_____

_____

_____

_____

_____

Space for Personal Notes

Section I: Extension Questions (15 Marks)

Question 28 (8 marks)

At times, in industry, we want our container material to be safe and fit for purpose.

a. Consider a solution containing silver and ethanoate.

i. Write the molecular formula of silver ethanoate. (1 mark)

_____

ii. State the molar mass of silver ethanoate. (1 mark)

_____

b. This solution of silver ethanoate needs to be transported to another location and must be put into a container with another solution to act as a stabiliser.

i. If we mixed silver ethanoate with a solution of potassium sulphate, would it be suitable? Justify your answer using chemical reactions. (3 marks)

_____

_____

_____

_____

_____

_____

ii. Suggest a solution containing zinc that would be compatible with silver ethanoate in transportation. (1 mark)

_____

c. If the sample of silver ethanoate was weighed out to be $7.52 \times 10^3\ g$, then how many particles of silver were there in the solution? (2 marks)

_____

_____

_____

_____

Question 29 (7 marks)

Consider a molecule of tin (IV) nitrate.

a. What is the molecular formula of tin (IV) nitrate? (1 mark)

_____

b. It is possible to react tin (IV) nitrate with another ionic compound, such as sodium phosphate. Write the fully balanced chemical reaction between these two compounds, including states. (2 marks)

_____

c. One of the products of the reaction from **part b.**, has turned out to be a precipitate.

i. If there was $4.57 \times 10^4\ mg$ of the precipitate that was formed, calculate the moles of the precipitate. (2 marks)

_____

_____

_____

_____

ii. In the mass of the precipitate formed, how many atoms of the element with the smallest molar mass are present? (2 marks)

_____

_____

_____

_____

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