

Appendix 2: National 5 and Higher Simulated Peer-Assessment Activities

National 5 Chemistry Mole Calculations Activity

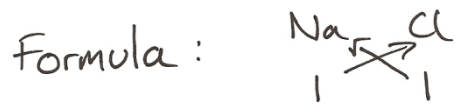
Students often find chemistry calculations one of the most difficult areas of the curriculum to master due to their complexity; similarly, teachers and exam markers often find them challenging to mark because student's solutions are rarely clear and easy to follow.

Instructions

In the following pages you will find a series of questions, along with a solution to each; however, the solution is incorrect. In your pairs, you are to read through the solution, locate the error(s), discuss how the error as occurred and then re-write the correct solution in your own way. Whilst you do this it is important that you discuss the good and bad features of each solution, such as how clear the layout is or how easy it is to follow the working, and try to improve your own solutions accordingly. Remember to ask your teacher for their opinions and to check your solutions.

Hopefully, by the end of the activity you will have increased your understanding of how to perform chemistry calculations and be able to write an easy to follow solution.

Q1 Calculate the mass of 2 moles of sodium chloride.



$$\begin{aligned} \text{mass} &= \frac{\text{RFM}}{\text{moles}} \\ &= \frac{58.5}{2} = \underline{\underline{29.25\text{g}}} \end{aligned}$$

NaCl Relative formula mass = 58.5
 Gram FM = 58.5g

Q2 Calculate the mass of 4 moles of CH₄.

| | | |
|-----------------------------|-----------|---|
| <u>RFM</u> | | |
| element | C | H |
| number | 1 | 4 |
| relative atomic mass | 12 | 1 |
| total relative mass of each | 12 | 4 |
| RFM of CH ₄ | <u>16</u> | |

so

$$\begin{array}{ccc} 1 & \longleftrightarrow & 16 \\ \div 4 \swarrow & & \searrow \div 4 \\ \underline{\underline{0.25}} & \longleftrightarrow & 4 \\ & & \underline{\underline{0.25\text{g}}} \end{array}$$

Q3 Calculate the mass of 0.5 moles of calcium chloride.

$$\begin{aligned} \text{CaCl} \quad \text{GFM of CaCl is } & 40 + 35.5 \\ & = 75.5 \text{ g} \end{aligned}$$

$$\begin{aligned} 1 \text{ mole CaCl} & \leftrightarrow 75.5 \text{ g} \\ 0.5 \text{ moles CaCl} & \leftrightarrow \underline{\underline{151 \text{ g}}} \end{aligned}$$

Q4 Calculate the number of moles in 108 g of water.

$$\begin{array}{ll} \text{Formula} & \text{H}_2\text{O} \\ \text{GFM} & 18 \text{ g} \\ 1 \text{ mole} & \leftrightarrow 18 \text{ g} \\ 18 \text{ moles} & \leftrightarrow 1 \text{ g} \\ \underline{\underline{1944 \text{ moles}}} & \leftrightarrow 108 \text{ g} \end{array}$$

Q5 Calculate the number of moles in 14 g of nitrogen.

RFM of nitrogen is 14

so GFM is 14g

therefore 1 mole is 14g

so answer is 1 mole.

Q6 Calculate the number of moles in 13.2 g of ammonium sulfate.

Formula NH_4SO_4

$$\text{RFM is } [(14+1) \times 4] + [(32+16) \times 4]$$
$$= 60 + 196$$
$$\frac{48}{\times 4}$$
$$196$$

$$= \underline{156}$$

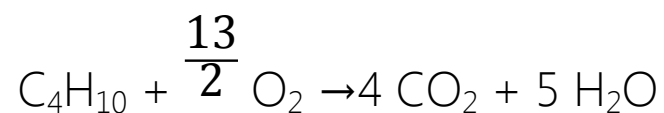
GFM is 156g

$$\text{so moles} = \frac{\text{GFM}}{\text{mass}}$$

$$= \frac{13.2}{156}$$

$$= \underline{\underline{0.084 \text{ moles}}}$$

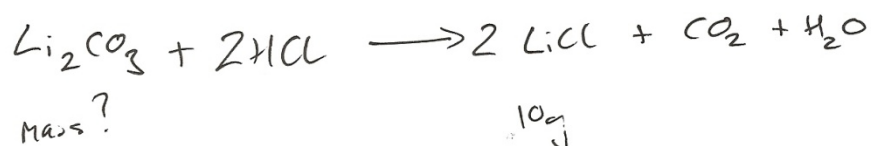
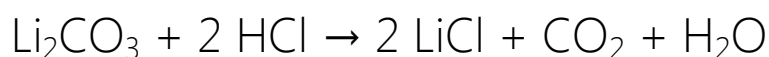
Q7 Calculate the mass of water produced upon burning 11.6 g of butane completely in oxygen. The balanced equation is provided below.



$$1 \text{ mole } \text{C}_4\text{H}_{10} \leftrightarrow 5 \text{ moles } \text{H}_2\text{O}$$

$$11.6 \text{ g} \leftrightarrow 5 \times 11.6 \text{ g}$$
$$= \underline{\underline{58 \text{ g}}}$$

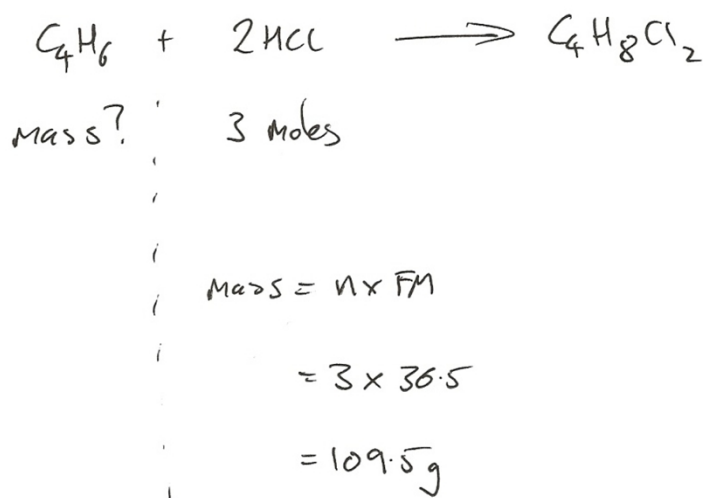
Q8 Lithium carbonate reacts with excess hydrochloric acid to form lithium chloride, carbon dioxide and water. If 10 g of lithium carbonate is produced, how much lithium carbonate was required? The balanced equation is provided below.



$$\begin{aligned} \text{moles} &= \frac{\text{mass}}{\text{F.M}} \\ &= \frac{10}{42.4} \\ &= \underline{0.24 \text{ moles}} \end{aligned}$$

$$\begin{aligned} 1 \text{ mole} &\longrightarrow 2 \text{ moles} \\ 0.24 \text{ moles} &\longrightarrow 0.48 \text{ moles} \\ \text{mass} &= \text{moles} \times \text{F.M} \\ &= 0.48 \times 73.8 \\ &= \underline{\underline{35.4 \text{ g}}} \end{aligned}$$

Q9 Butadiene is a molecule which contains two double bonds, this means it can participate in two addition reactions. The equation for the reaction of butadiene with hydrogen chloride is outlined below. What mass of butadiene is necessary to react with 3 moles of hydrogen chloride?



$$\begin{array}{l} 1 \longleftarrow 2 \\ \underline{\underline{54.75 \text{ g}}} \longleftarrow \frac{109.5}{2} \end{array}$$

Higher Chemistry Calculations Activity

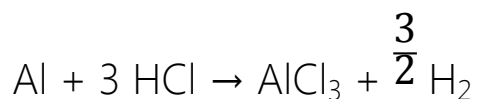
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Q1 2.7 g Aluminium reacts with 200 cm³ of 2 mol⁻¹ hydrochloric acid according to the equation below. What mass of AlCl₃ would be produced?



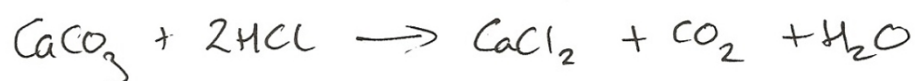
$$\begin{aligned} \text{Moles} &= \frac{2.7}{27} \\ &= \underline{0.1 \text{ moles}} \end{aligned}$$

$$\begin{aligned} n &= CV \\ &= 2 \times 0.1 \\ &= \underline{0.2 \text{ moles}} \end{aligned}$$

3 moles give 1 mole AlCl₃
so 0.2 moles gives 0.067 moles AlCl₃

$$\begin{aligned} \text{mass} &= 0.067 \times 133.5 \\ &= \underline{\underline{8.94 \text{ g}}} \end{aligned}$$

Q2 Calculate the mass of water produced upon reacting 0.6 g of calcium carbonate with 24 cm³ of 0.5 mol l⁻¹ hydrochloric acid.



| | | |
|-------------------------|--------------------------------|--|
| 0.6g | 24 cm ³ | |
| | 0.5 mol l ⁻¹ | |
| $n = \frac{0.6}{100}$ | $n = CV$ | |
| | $= 0.5 \times \frac{24}{1000}$ | |
| $= 0.006 \text{ moles}$ | $= 0.012 \text{ moles}$ | |

neither in XS



$$\begin{aligned} \text{Mass H}_2\text{O} &= n \times \text{FM} \\ &= 0.024 \times 18 \\ &= \underline{\underline{0.432 \text{g}}} \end{aligned}$$

Q3 What mass of ammonia is needed in the reaction with sulfuric acid to produce 132 g of ammonium sulfate? The equation is provided below.



FM of ammonia is 17 g/mol

FM of $(\text{NH}_4)_2\text{SO}_4$ is $14 + (4 \times 2) + 32 + (4 \times 16)$
 $= 118 \text{ g/mol}$

$$17 \text{ g} \longleftrightarrow 118 \text{ g}$$

$$\frac{17}{118} \text{ g} \longleftrightarrow 1 \text{ g}$$

$$\frac{17}{118} \times 132 \text{ g} \longleftrightarrow 132 \text{ g}$$

$$\underline{\sim 19 \text{ g}} \longleftrightarrow 132 \text{ g}$$

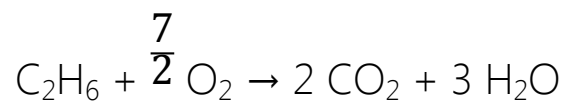
Q4 At a certain temperature and pressure, the molar volume of hydrogen is 22.4 l mol^{-1} . Calculate the volume of 0.04 moles of hydrogen.

1 mole is 22.4 L

4 moles is 5.6 L

0.04 moles is 0.056 L

Q5 100 cm³ of ethane was combusted with 300 cm³ of oxygen.
 Calculate the volume of carbon dioxide produced. The equation is
 provided below.



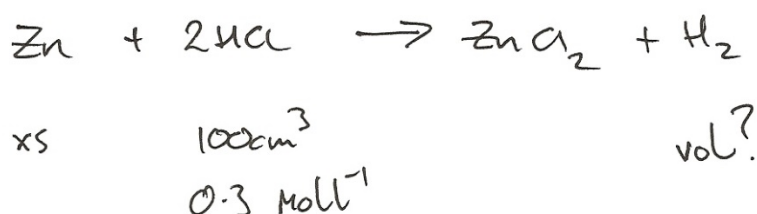
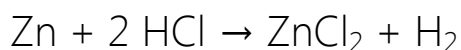
if 100 cm³ then - 350 cm³

so use 300 cm³

$$\begin{array}{l|l} \frac{7}{2} \longleftrightarrow 2 & \div 2 \\ 7 \longleftrightarrow 1 & \div 7 \\ 1 \longleftrightarrow \frac{1}{7} & \times 300 \\ 300 \longleftrightarrow \frac{300}{7} & \end{array}$$

so 42.9 cm³

Q6 An excess mass of zinc was added to 100 cm³ of 0.3 mol l⁻¹ hydrochloric acid. What volume of hydrogen was produced, given that the molar volume of hydrogen is 24 l mol⁻¹. The equation is provided below.



$$\begin{aligned} n &= CV \\ &= 0.3 \times 0.1 \\ &= \underline{0.03 \text{ moles}} \end{aligned}$$

$$\begin{aligned} 2 \text{ moles} &\leftrightarrow 1 \text{ mole} \\ 1 \text{ mole} &\leftrightarrow 0.5 \text{ moles} \\ 0.03 \text{ moles} &\leftrightarrow \underline{0.015 \text{ moles}} \end{aligned}$$

$$\begin{array}{l} 24 \text{ moles} \leftrightarrow 1 \text{ L} \\ 1 \text{ mole} \leftrightarrow \frac{1}{24} \text{ L} \\ 0.015 \text{ moles} \leftrightarrow \underline{\underline{2.78 \text{ L}}} \end{array} \quad \left| \begin{array}{l} \\ \\ \div 0.015 \end{array} \right.$$

Q7 How many positive ions are present in 2 g of $(\text{Mg}^{2+})_3(\text{PO}_4^{3-})_2$?

MW is 200

1 mole contains $\{ (\text{Mg}^{2+})_3 (\text{PO}_4^{3-})_2 \}$ units

1 mole is 200g

200g contains 200L +ve ions

2g contains L +ve ions

so 6.02×10^{23} +ve ions

Q8 How many sodium atoms are found in 46 g of sodium?

$$\text{moles} = \frac{46}{23} = 2 \text{ moles} \quad 1 \text{ mole} \leftrightarrow 23 \text{ L}$$
$$2 \text{ moles} \leftrightarrow 46 \text{ L}$$

$$\text{So } 46 \times 6.02 \times 10^{23}$$
$$= 2.77 \times 10^{25} \text{ atoms}$$

Q9 Calculate the mass of glucose, $C_6H_{12}O_6$, which contains 1.204×10^{24} atoms.

1 mole of glucose contains 6 atoms
2 moles of glucose contains 12 atoms

$$\begin{aligned} \text{Mass} &= 2 \times ((12 \times 6) + (12 \times 1) + (6 \times 16)) \\ &= \underline{\underline{360g}} \end{aligned}$$