

Teacher Mole's Nightmare

Simulation: edtechsims.com/teacher-moles-nightmare

Name: _____ Class: _____ Date: _____



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Data

Useful data	
Ar: H = 1, C = 12, N = 14, O = 16, Na = 23, Mg = 24, Al = 27, S = 32, Cl = 35.5, Ca = 40, Fe = 56, Cu = 64	
Avogadro constant $L = 6.02 \times 10^{23} / \text{mol}$	Molar gas volume = 24 dm^3 ($24\,000 \text{ cm}^3$) at r.t.p.

Part A: Escape the Nightmare

On the sim: Choose Solo or Team mode. Solve at least 5 of the 9 stations (3 questions each) to unlock the Final Vault, then sort the true statements from the traps to wake up.

A1 Record your progress in Table 1. For each station you solve, note one mistake (misconception) it warned you about.

Station	Solved (✓)	Misconception I learned about/ Step I must be careful carrying out
Asteroid Shower		
Seesaw of Moles		
Atom Accountant		
Formula Forensics		
Balloon Mania		
Toxic Brew		
Canteen Rush		
Gas Guesses		
Titration Terror		

Part B: Station Practice

Each station's questions change every time you play. Use these questions to practise the same skills.

B1 Asteroid Shower: relative molecular mass

Calculate the Mr of each substance.

[4]

Substance	Mr	Substance	Mr
Mg(NO ₃) ₂		CuSO ₄ ·5H ₂ O	
Al ₂ (SO ₄) ₃		Cl ₂	

B2 Seesaw of Moles: moles from mass

(a) Calculate the number of moles in 8.0 g of O₂ and in 11 g of CO₂.

[2]

.....
.....

(b) Do the two samples contain the same number of molecules? Explain.

[1]

.....

B3 Atom Accountant: atoms vs molecules

Sample	Number of molecules	Number of atoms
0.5 mol of H ₂ O		
2 mol of O ₂		
0.25 mol of CH ₄		

B4 Formula Forensics: empirical and molecular formulae

(a) A hydrocarbon contains 85.7% carbon and 14.3% hydrogen by mass. Find its empirical formula. [3]

(b) The Mr of the hydrocarbon is 56. Find its molecular formula. [2]

B5 Balloon Mania: molar gas volume

(a) Calculate the volume of 0.25 mol of CO₂ at r.t.p. [1]

volume = ... dm³

(b) Calculate the number of moles in 600 cm³ of H₂ at r.t.p. [1]

moles = ... mol

B6 Toxic Brew: concentration and standard solutions

(a) Calculate the mass of NaOH needed to make 250 cm³ of 0.200 mol/dm³ solution. [2]

mass = ... g

(b) Number the steps (1–4) for making this standard solution. [2]

Step	Order
Make up to the mark with distilled water, then invert to mix	
Weigh the NaOH accurately	
Transfer the solution and rinsings to a 250 cm ³ volumetric flask	
Dissolve the solid in a little distilled water in a beaker	

B7 Canteen Rush: limiting reactant

4.8 g of Mg is burned in 4.0 g of O₂: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

(a) Identify the limiting reactant. Show your working. [2]

.....

.....

.....

(b) Calculate the mass of MgO formed. [2]

mass = ... g

B8 Gas Guesses: volume of gas produced

$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

(a) Calculate the volume of H₂ produced when 0.12 g of Mg reacts with excess acid at r.t.p. [2]

volume = ... cm³

(b) In $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$, what volume of O₂ reacts with 50 cm³ of H₂? [1]

volume = ... cm³

B9 Titration Terror: titres and concentration

A student records these titres: rough 24.10 cm³; 23.40 cm³; 23.45 cm³; 23.80 cm³.

(a) Which titres are concordant? Calculate the mean titre. [2]

.....

.....

(b) 25.0 cm³ of 0.100 mol/dm³ NaOH is neutralised by 12.50 cm³ of H₂SO₄. Calculate the concentration of the H₂SO₄. $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ [3]

concentration = ... mol/dm³

Part C: The Final Vault

Like the Final Vault in the game, there are 8 statements. Circle True or False. If a statement is a trap, correct it.

1. The Mr of Cl_2 is 35.5.

True / False Correction:.....

2. 2 g of H_2 and 32 g of O_2 contain the same number of molecules.

True / False Correction:.....

3. 1 mol of O_2 contains 6.02×10^{23} atoms.

True / False Correction:.....

4. Glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, has the empirical formula CH_2O .

True / False Correction:.....

5. Diluting a solution decreases the number of moles of solute.

True / False Correction:.....

6. The reactant with the smaller mass is always the limiting reactant.

True / False Correction:.....

7. In $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$, 40 cm^3 of H_2 reacts with 20 cm^3 of O_2 .

True / False Correction:.....

8. The rough titre should be included when calculating the mean titre.

True / False Correction:.....

Part D: Practice Questions

D1 5.0 g of calcium carbonate reacts with excess hydrochloric acid. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

(a) Calculate the number of moles of CaCO_3 used. [1]

moles = ... mol

(b) Calculate the volume of CO_2 produced at r.t.p. [2]

volume = ... dm^3

(c) Only 1.0 dm^3 of CO_2 was collected. Calculate the percentage yield. [2]

percentage yield = ... %

D2 3.2 g of sulfur burns completely in oxygen. $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$

(a) Calculate the mass of SO_2 formed. [2]

mass = ... g

(b) Calculate the volume of O_2 used at r.t.p. [1]

volume = ... dm^3