



Paddington Academy

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OCR AS LEVEL CHEMISTRY A

1.1.2 MOLES AND EQUATIONS

1.1.3 ACIDS

ASSESSED HOMEWORK

Answer all questions

Max 71 marks

Name		
Mark/71%	Grade

1. Barium metal can be extracted from barium oxide, BaO, by reduction with aluminium.

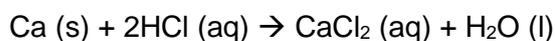


Calculate the mass of barium metal that could be produced from reduction of 500 g of barium oxide using this method.

answer = g

[Total 4 marks]

2. Calcium chloride can be prepared by reacting calcium with hydrochloric acid:



To prepare the aqueous calcium chloride, the student added the exact amount of calcium so that all the hydrochloric acid had reacted. She used 50 cm³ of 2.0 mol dm⁻³ HCl.

- (i) How many moles of HCl had she used?

[1]

- (ii) Calculate the mass of calcium that she used.

[2]

[Total 3 marks]

3. The Group 2 element barium, Ba, is silvery white when pure but blackens when exposed to air.

The blackening is due to the formation of both barium oxide and barium nitride. The nitride ion is N^{3-} .

- (a) Predict the formula of:

barium oxide barium nitride

[2]

- (b) A 0.11 g sample of pure barium was added to 100 cm^3 of water.



- (i) Show that 8.0×10^{-4} mol of Ba were added to the water.

[1]

- (ii) Calculate the volume of hydrogen, in cm^3 , produced at room temperature and pressure.

volume = cm^3

[1]

- (iii) Calculate the concentration, in mol dm^{-3} , of the $\text{Ba(OH)}_2\text{(aq)}$ solution formed.

concentration = mol dm^{-3}

[1]

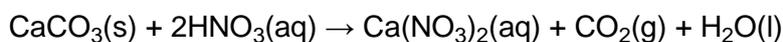
[Total 5 marks]

4. Calcium and its compounds, have properties typical of Group 2 in the Periodic Table.

Calcium carbonate, CaCO_3 , reacts with acids such as nitric acid.

A student neutralised 2.68 g of CaCO_3 with 2.50 mol dm^{-3} nitric acid, HNO_3 .

The equation for this reaction is shown below.



(i) Determine the amount, in mol, of CaCO_3 reacted.

amount = mol

[2]

(ii) Calculate the volume, in cm^3 , of CO_2 produced at room temperature and pressure.

volume = cm^3

[1]

(iii) Calculate the volume of 2.50 mol dm^{-3} HNO_3 needed to neutralise 2.68 g of CaCO_3 .

volume = cm^3

[2]

[Total 5 marks]

5. Calcium carbonate, CaCO_3 , reacts with hydrochloric acid as shown in the equation below.



7.50×10^{-3} mol CaCO_3 reacts with $0.200 \text{ mol dm}^{-3}$ HCl .

- (i) Calculate the volume, in cm^3 , of $0.200 \text{ mol dm}^{-3}$ HCl required to react with 7.50×10^{-3} mol CaCO_3 .

answer = cm^3

[2]

- (ii) Calculate the volume, in cm^3 , of CO_2 formed at room temperature and pressure.

answer = cm^3

[1]

[Total 3 marks]

6. A student bubbled chlorine through 120 cm³ of an aqueous solution of 0.275 mol dm⁻³ sodium hydroxide, NaOH(aq).

The equation for this reaction is shown below.



- (i) What is meant by the term *the mole*?

.....
.....
.....

[1]

- (ii) How many moles of NaOH were in the 120 cm³ volume of NaOH(aq)?

answer mol

[1]

- (iii) Calculate the volume of Cl₂(g) that was needed to react with the NaOH(aq) used.

answer

[2]

[Total 4 marks]

7. In 2000, the mass of CO₂ emitted in the UK was equivalent to 1 kg per person in every hour.

- (i) Calculate the volume of 1 kg of carbon dioxide. Assume that 1 mole of CO₂ occupies 24 dm³.

volume = dm³

[2]

- (ii) The UK has set a target to cut CO₂ emissions by 60% of the 2000 value by 2050. Calculate the reduction needed in the volume of CO₂ emissions each hour per person if the target is to be met.

answer: dm³

[1]

[Total 3 marks]

8. What is the molar mass of MgCl₂·6H₂O?

molar mass = g mol⁻¹

[Total 1 mark]

9. Water, ammonia and sulphur dioxide react together to form a compound **A** which has the following percentage composition by mass:

N, 24.12%;

H, 6.94%;

S, 27.61%;

O, 41.33%.

(i) Calculate the empirical formula of compound **A**.

[2]

(ii) Suggest a balanced equation for the formation of compound **A** from the reaction of water, ammonia and sulphur dioxide.

.....

[1]

[Total 3 marks]

10. Bromine forms three compounds with phosphorus. The compounds have the molecular formulae PBr_3 , PBr_5 and P_2Br_4 .

(i) Explain what is meant by the term *molecular formula*.

.....
.....

[1]

(ii) PBr_3 can be prepared by heating bromine with phosphorus, P_4 .

Write a balanced equation for this reaction.

.....

[1]

(iii) Compound **A** is one of the three bromides of phosphorus above. It has the following percentage composition by mass: P, 16.2%; Br, 83.8%.

Use this percentage composition to calculate the empirical formula and to determine the identity of compound **A**.

empirical formula

identity of compound **A**

[3]

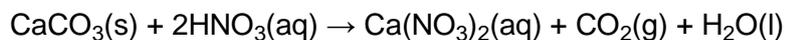
[Total 5 marks]

11. Calcium and its compounds, have properties typical of Group 2 in the Periodic Table.

Calcium carbonate, CaCO_3 , reacts with acids such as nitric acid.

A student neutralised 2.68 g of CaCO_3 with 2.50 mol dm^{-3} nitric acid, HNO_3 .

The equation for this reaction is shown below.



The student left the solution of calcium nitrate formed to crystallise. Crystals of hydrated calcium nitrate formed containing 30.50% of H_2O , by mass.

Calculate the formula of the hydrated calcium nitrate.

[Total 3 marks]

12. Hydrochloric acid is a strong acid.

What is meant by the term *acid*?

.....
.....

[Total 1 mark]

13. Hydrochloric acid reacts with a solution of sodium carbonate.

(i) Write appropriate state symbols in the equation for this reaction shown below.



[1]

(ii) State what you would see to indicate that the reaction was taking place.

.....

[1]

[Total 2 marks]

14. Chewing chalk has been used for many years to combat excess stomach acid and indigestion tablets often contain calcium carbonate, CaCO_3 . Suggest, with the aid of an equation, how these tablets work.

.....
.....
.....

[Total 2 marks]

15. Old samples of magnesium oxide become contaminated with magnesium carbonate.

(i) Suggest how this contamination takes place.

.....
.....

[1]

(ii) A student added an excess of hydrochloric acid to an old sample of magnesium oxide that is contaminated with magnesium carbonate.

State **two** observations that the student would make.

.....
.....

[2]

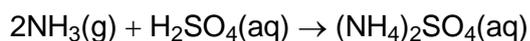
(iii) Explain, with the aid of equations, why the resulting solution contained only one dissolved compound of magnesium.

.....
.....
.....
.....
.....

[3]

[Total 6 marks]

16. Ammonia reacts with sulphuric acid, as shown in the equation below.



(i) Complete the statement below to describe how ammonia is behaving in this reaction.

Ammonia is behaving as a because

.....

[2]

(ii) State **one** important use for the compound $(\text{NH}_4)_2\text{SO}_4$.

.....

[1]

[Total 3 marks]

17. The ions present in $\text{Ca}(\text{OH})_2$ are Ca^{2+} and OH^- .

(i) Complete the electronic configuration of a Ca^{2+} ion.

$1s^2$

[1]

(ii) How many moles of ions are in one mole of $\text{Ca}(\text{OH})_2$?

moles of ions =

[1]

(iii) How many moles of electrons are in one mole of OH^- ions?

moles of electrons =

[1]

[Total 5 marks]

18. Calcium nitrate decomposes on heating to form calcium oxide, oxygen and nitrogen(IV) oxide, NO_2 .

Construct a balanced equation for this reaction.

.....

[Total 1 mark]

19. Sodium reacts with oxygen to form sodium oxide, Na_2O , which is an ionic compound.

Write the equation for the reaction of sodium with oxygen to form sodium oxide.

.....

[Total 1 mark]

20. Sodium reacts with excess oxygen to form sodium peroxide, Na_2O_2 .

Na_2O_2 is used in laundry bleaches. When added to water a reaction takes place forming an alkaline solution and hydrogen peroxide, H_2O_2 .

(i) Construct a balanced equation for the formation of sodium peroxide from sodium.

.....

[1]

(ii) Construct a balanced equation for the reaction of sodium peroxide with water.

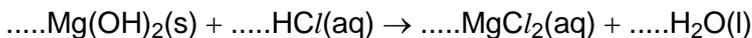
.....

[1]

[Total 2 marks]

21. A student had a stomach-ache and needed to take something to neutralise excess stomach acid. He decided to take some Milk of Magnesia, which is an aqueous suspension of magnesium hydroxide, $\text{Mg}(\text{OH})_2$.

- (a) The main acid in the stomach is hydrochloric acid, $\text{HCl}(\text{aq})$, and the unbalanced equation for the reaction that takes place with Milk of Magnesia is shown below.



Balance the equation by adding numbers where necessary in the unbalanced equation above.

[1]

- (b) The student's stomach contained 500 cm^3 of stomach fluid with an acid concentration of $0.108 \text{ mol dm}^{-3}$. The student swallowed some Milk of Magnesia containing $2.42 \text{ g Mg}(\text{OH})_2$. He wondered whether this dose was sufficient to neutralise the stomach acid.

Assume that all the acid in the stomach fluid was $0.108 \text{ mol dm}^{-3}$ hydrochloric acid.

- (i) How many moles of HCl were in the 500 cm^3 of stomach fluid?

[1]

- (ii) Calculate the mass of $\text{Mg}(\text{OH})_2$ necessary to neutralise this stomach fluid.

[3]

- (iii) Determine whether the student swallowed too much, too little, or just the right amount of Milk of Magnesia to neutralise the stomach acid.

.....
.....

[1]

[Total 6 marks]