



Paddington Academy

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Part of United Learning

AS LEVEL CHEMISTRY

1.1.4 REDOX

1.3.2 GROUP 2

1.3.3 GROUP 7

ASSESSED HOMEWORK

Answer all questions

Max 90 marks

Name		
Mark/90%	Grade

1. The Group 2 element radium, Ra, is used in medicine for the treatment of cancer. Radium was discovered in 1898 by Pierre and Marie Curie by extracting radium chloride from its main ore pitchblende.

(a) Predict the formula of radium chloride.

.....

[1]

(b) Pierre and Marie Curie extracted radium from radium chloride by reduction. Explain what is meant by *reduction*, using this reaction as an example.

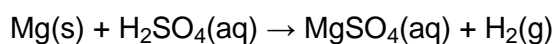
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[2]

[Total 3 marks]

2. The reaction between magnesium and sulfuric acid is a redox reaction.



(i) Use oxidation numbers to identify which element has been oxidised.

Explain your answer.

element oxidised

explanation

.....

[2]

(ii) Describe what you would **see** when magnesium reacts with an excess of sulfuric acid.

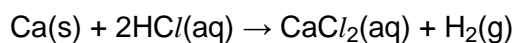
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[2]

[Total 4 marks]

3. A student prepared an aqueous solution of calcium chloride by reacting calcium with hydrochloric acid.



- (i) Using oxidation numbers, show that this is a redox reaction.

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[2]

- (ii) The student had added the exact amount of calcium required to react with the hydrochloric acid used. After carrying out the experiment, the student accidentally added some more calcium. The student was surprised that the extra calcium still reacted.

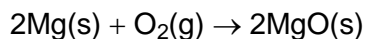
Explain this observation. Include an equation in your answer.

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[2]

[Total 4 marks]

4. Magnesium reacts with oxygen to form magnesium oxide.



Use oxidation numbers to show that oxygen has been reduced in its reaction with magnesium.

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[Total 2 marks]

5. Barium reacts with water in a redox reaction.



(i) Explain, in terms of electrons, what is meant by oxidation.

.....

[1]

(ii) Which element has been oxidised in this reaction? Deduce the change in its oxidation number.

element

oxidation number changes from to.....

[2]

[Total 3 marks]

6. Magnesium and strontium are in Group 2 of the Periodic Table.

- (i) When reacted with oxygen, magnesium forms a white powder called magnesium oxide.

Write the equation for the reaction of magnesium with oxygen.

.....

[1]

- (ii) Magnesium reacts with dilute acids.

Describe what you would expect to see when magnesium ribbon is added to an excess of dilute hydrochloric acid.

.....

.....

[2]

- (iii) Strontium reacts in a similar way to magnesium.

Describe **one** difference you might observe if strontium, instead of magnesium, was reacted with dilute hydrochloric acid.

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[1]

[Total 4 marks]

7. Radium reacts vigorously when added to water.



- (i) Use the equation to predict **two** observations that you would **see** during this reaction.

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.....

[2]

- (ii) Predict a pH value for this solution.

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[1]

[Total 3 marks]

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

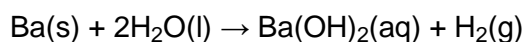
The blackening is due to the formation of both barium oxide and barium nitride. The nitride ion is N^{3-} .

- (a) Predict the formula of:

barium oxide barium nitride

[2]

- (b) A 0.11 g sample of pure barium was added to 100 cm³ of water.



State the approximate pH of the $\text{Ba(OH)}_2\text{(aq)}$ solution.

.....

[1]

- (c) A student repeated the experiment in (b) using a 0.11 g sample of barium that had blackened following exposure to the air.

Suggest why the volume of hydrogen produced would be slightly less than the volume collected using pure barium.

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[1]

- (d) Describe and explain the trend, down the group, in the reactivity of the Group 2 elements with water.

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[5]

[Total 9 marks]

9. Carbon dioxide can be prepared easily in the laboratory by the action of heat on most carbonates. Construct an equation to illustrate this reaction.

.....

[Total 1 mark]

10. 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.

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[3]

[Total 6 marks]

11. 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.

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.....
.....

[Total 2 marks]

12. In this question, one mark is available for the quality of written communication.

This question is about the Group 7 elements chlorine, bromine and iodine.

- Explain why chlorine, bromine and iodine have different physical states at room temperature and pressure.

[4]

- An aqueous solution of bromine was added to an aqueous solution of chloride ions and also to an aqueous solution of iodide ions.

State what you would see in each case.

Include an equation for any chemical reaction that takes place.

Explain the trend shown by these observations.

[4]

Quality of Written Communication [1]

[Total 9 marks]

13. The Group 7 element bromine was discovered by Balard in 1826. Bromine gets its name from the Greek *bromos* meaning stench.

Bromine consists of a mixture of two isotopes, ^{79}Br and ^{81}Br .

A student added an aqueous solution of sodium iodide to a solution of bromine.

The colour turned from orange to a deep brown.

The student then added an aqueous solution of sodium chloride to a solution of bromine.

The orange colour was unchanged.

(i) Explain these observations.



In your answer, you should use appropriate technical terms, spelled correctly.

.....
.....
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[3]

(ii) Write an ionic equation for the reaction that has taken place.

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[1]

[Total 4 marks]

14. A student used the internet to research chlorine and some of its compounds.

(a) He discovered that sea water contains chloride ions. The student added aqueous silver nitrate to a sample of sea water.

(i) What would the student see?

.....

[1]

(ii) Write an ionic equation, including state symbols, for the reaction that would occur.

.....

[2]

(iii) After carrying out the test in (i), the student added dilute aqueous ammonia to the mixture.

What would the student see?

.....

[1]

(b) The student also discovered that chlorine, Cl_2 , is used in the large-scale treatment of water.

(i) State **one** benefit of adding chlorine to water.

.....

.....

[1]

(ii) Not everyone agrees that chlorine should be added to drinking water.

Suggest **one** possible hazard of adding chlorine to drinking water.

.....

.....

[1]

(c) The equation for the reaction of chlorine with water is shown below.



(i) State the oxidation number of chlorine in:

Cl_2 HCl HClO

[1]

(ii) The reaction of chlorine with water is a *disproportionation* reaction.

Use the oxidation numbers in (i) to explain why.

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

[2]

(iii) Chlorine reacts with sodium hydroxide to form bleach in another disproportionation reaction.

Write an equation for this reaction.

.....

[1]

(d) Two other chlorine compounds of chlorine are chlorine dioxide and chloric(V) acid.

(i) Chlorine dioxide, ClO_2 , is used as a bleaching agent in both the paper and the flour industry. When dry, ClO_2 decomposes explosively to form oxygen and chlorine.

Construct an equation for the decomposition of ClO_2 .

.....

[1]

(ii) Chloric(V) acid has the following percentage composition by mass:

H, 1.20%; Cl, 42.0%; O, 56.8%.

Using this information, calculate the empirical formula of chloric(V) acid.

Show **all** of your working.

empirical formula =

[2]

(iii) What does (V) represent in chloric(V) acid?

.....

.....

[1]

[Total 14 marks]

15. Chlorine is used in the preparation of many commercially important materials such as bleach and iodine.

Bleach is a solution of sodium chlorate(I), NaOCl, made by dissolving chlorine in aqueous sodium hydroxide.



Determine the changes in oxidation number of chlorine during the preparation of bleach and comment on your results.

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.....
.....

[Total 3 marks]

16. Chlorine and bromine are elements in Group 7 of the Periodic Table.

Chlorine is used in water treatment.

State **one** advantage and **one** disadvantage of using chlorine in water treatment.

advantage:

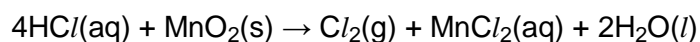
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disadvantage:

.....

[Total 2 marks]

17. Chlorine can be prepared by reacting concentrated hydrochloric acid with manganese(IV) oxide.



In this reaction, chlorine is oxidised.

Use oxidation numbers to determine what is reduced.

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[Total 2 marks]

18. Chlorine reacts differently with dilute and concentrated aqueous solutions of sodium hydroxide.
- When chlorine reacts with dilute sodium hydroxide, one of the products is sodium chlorate(I). This is the reaction that is used to manufacture bleach.
 - When chlorine is reacted with hot concentrated sodium hydroxide, a different reaction takes place. One of the products is NaClO_3 , used as a weedkiller.

In each reaction, chlorine has been both oxidised and reduced.

- (i) What term is used to describe a redox reaction in which an element is both oxidised and reduced?

.....

[1]

- (ii) Write equations for these two reactions of chlorine with sodium hydroxide:

equation for reaction with **dilute** sodium hydroxide,

.....

equation for reaction with **hot concentrated** sodium hydroxide.

.....

[3]

- (iii) Chlorine forms another chlorate called sodium chlorate(VII), used in the manufacture of matches.

Suggest the formula of sodium chlorate(VII).

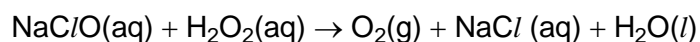
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[1]

[Total 5 mark]

19. A household bleach contains sodium chlorate(I), NaClO , as its active ingredient.

The concentration of NaClO in the bleach can be found by using its reaction with hydrogen peroxide, H_2O_2 .



- (a) Chlorine has been reduced in this reaction.

Use oxidation numbers to prove this.

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.....

.....

[2]

(b) A student added an excess of aqueous hydrogen peroxide to 5.0 cm^3 of the bleach. 84 cm^3 of oxygen gas were released.

(i) How many moles of O_2 were released?

Assume that, under the laboratory conditions, 1.00 mol of gas molecules occupies 24 dm^3 .

answer mol

[1]

(ii) How many moles of NaClO were in 5.0 cm^3 of the bleach?

answer mol

[1]

(iii) What was the concentration, in mol dm^{-3} , of NaClO in the bleach?

answer mol dm^{-3}

[1]

(c) The label on the bottle of household bleach states that the bleach contains a minimum of 4.5 g per 100 cm^3 of NaClO .

Use your answer to (b)(iii) to decide whether or not the information on the label is correct.

[3]

(d) It is extremely important that household bleach is not used with acids. This is because a reaction takes place that releases toxic chlorine gas.

Suggest an equation for the reaction of an excess of hydrochloric acid with household bleach.

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[2]

[Total 10 marks]