

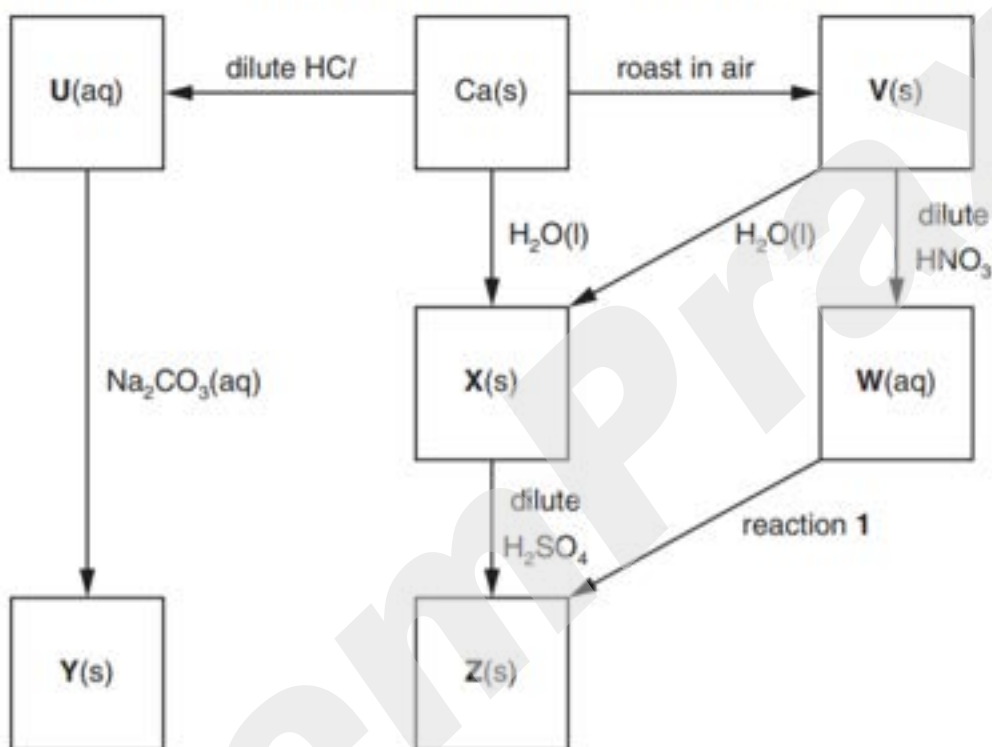
Inorganic Chemistry: Group 2

(Past Year Topical Questions 2010-2015)

May/June 2011 (21)

- 3 Calcium is the fifth most common element in the Earth's crust. Calcium compounds occur in bones and teeth and also in many minerals.

Some reactions of calcium and its compounds are shown in the reaction scheme below.



- (a) State the formula of each of the calcium compounds **U** to **Y**.

U

V

W

X

Y

[5]

- (b) Compound **Y** may be converted into compound **V**.
Outline how this reaction would be carried out in a school or college laboratory using a small sample of **Y**.

.....
..... [1]

- (c) (i) Construct balanced equations for the following reactions.

calcium to compound **U**

.....

compound **V** to compound **W**

.....

compound **U** to compound **Y**

.....

- (ii) Construct a balanced equation for the effect of heat on solid compound **W**.

.....

[4]

(d) Suggest the formula of an aqueous reagent, other than an acid, for reaction 1.

.....

[1]

(e) What would be observed when **each** of the following reactions is carried out in a test-tube?

the formation of **X** from Ca(s)

.....

the formation of **X** from **V**

.....

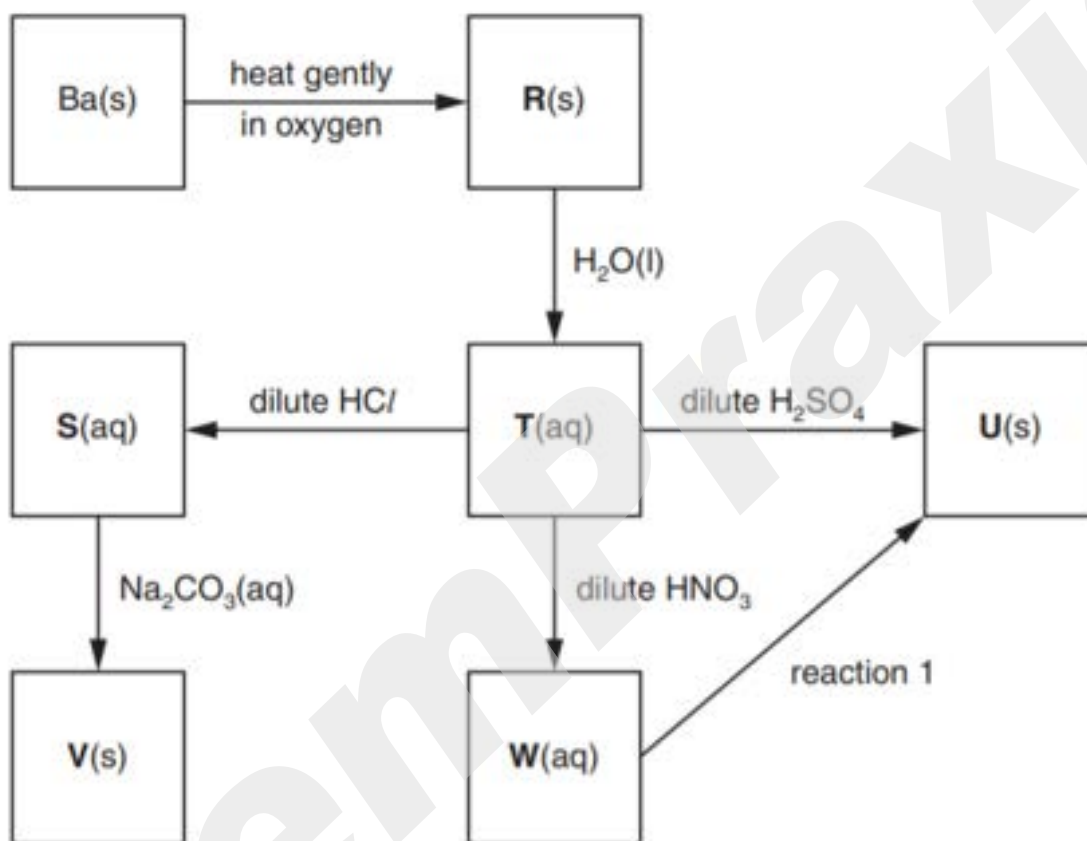
[2]

May/June 2011 (22)

3 Barium, proton number 56, is a Group II element which occurs in nature as the carbonate or sulfate.

The element was first isolated by Sir Humphry Davy in 1808.

Some reactions of barium and its compounds are shown in the reaction scheme below.



(a) State the formula of each of the barium compounds **R** to **W**.

R

S

T

U

V

W

[6]

(b) (i) Write balanced equations for the following reactions.

compound **T** to compound **W**

.....

the roasting of **V** in air

.....

(ii) Suggest a gaseous reagent for the conversion of **T** into **V** and write a balanced equation for the reaction.

reagent

equation

[4]

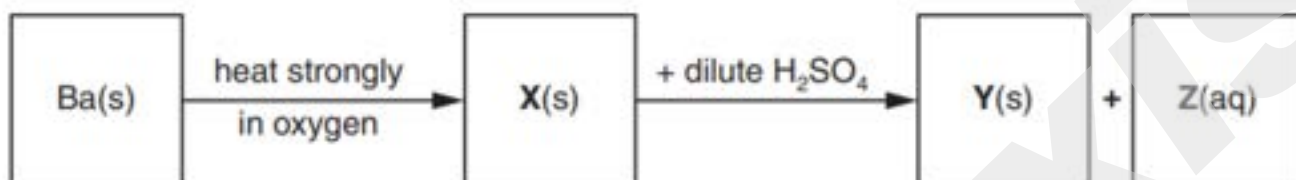
(c) Suggest the formula of an aqueous reagent, other than an acid, for reaction 1.

.....

[1]

When barium is heated strongly in oxygen, an oxide **X** is formed.
The oxide **X** contains 18.9% of oxygen by mass.

The oxide **X** reacts with dilute sulfuric acid in a 1:1 ratio.
Two products, one insoluble and one soluble, are formed.



(d) (i) Calculate the empirical formula of **X**.

(ii) Suggest the identity of the solid **Y**.

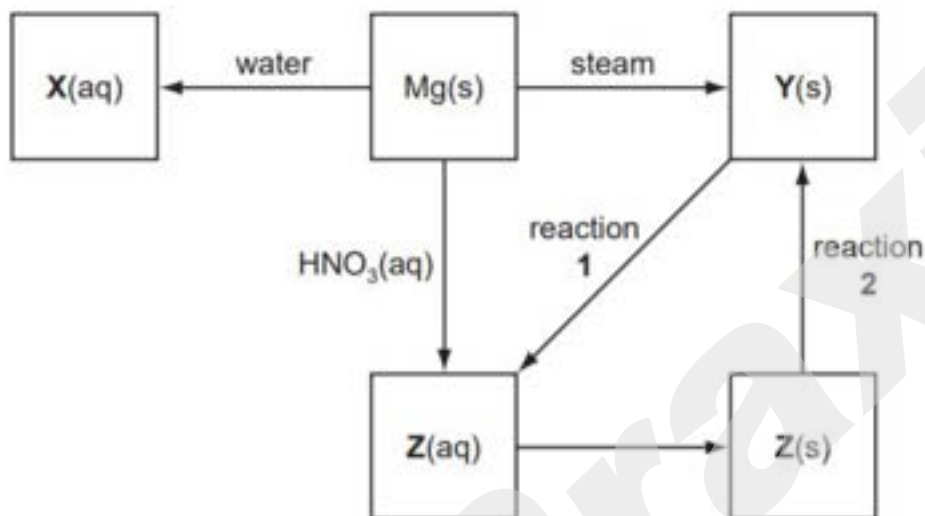
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(iii) Use your answers to (i) and (ii) to construct an equation for the reaction of **X** with H_2SO_4 .

..... [4]

Oct/Nov 2014 (21)/Q1

(d) Some reactions involving magnesium and its compounds are shown in the reaction scheme below.



(i) Give the formulae of the compounds **X**, **Y** and **Z**.

X

Y

Z

[3]

(ii) Name the reagent needed to convert **Y(s)** into **Z(aq)** in reaction 1 and write an equation for the reaction.

reagent

equation

[2]

(iii) How would you convert a sample of Z(s) into Y(s) in reaction 2?

..... [1]

(iv) Give equations for the conversions of Mg into X, and Z(s) into Y.

Mg to X

Z to Y [2]

May/June 2015 (23)

2 The elements in Group II, and their compounds, show a variety of trends in their properties.

(a) Magnesium, calcium and barium all react with cold water to form hydroxides.

(i) Describe and explain the trend in reactivity of these three elements with cold water.

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

(ii) Give the equation for the reaction of magnesium with cold water.

..... [1]

(iii) Suggest why the water eventually turns cloudy during the reaction of magnesium with cold water.

.....
..... [1]

(iv) Suggest the equation for the reaction of hot magnesium with steam.

..... [1]

(b) The oxides of magnesium, calcium and barium all react with dilute nitric acid to form nitrates.

(i) Give the equation for the reaction of magnesium oxide with nitric acid.

..... [1]

(ii) State the trend in thermal stability of the nitrates of Group II.

.....
..... [1]

(iii) Give the equation for the thermal decomposition of magnesium nitrate.

..... [1]

- (iv) Apart from lithium nitrate, the nitrates of the Group I elements decompose in a different way to those of the Group II elements.

The equation for the thermal decomposition of potassium nitrate is



By identifying any changes in oxidation number, explain which element is reduced and which is oxidised in this decomposition.

.....

.....

.....

..... [3]

- (c) A refractory material is one that does not decompose or melt at very high temperatures. Over 50% of magnesium oxide production is for use as a refractory material.

Explain why magnesium oxide has a very high melting point.

.....

.....

..... [2]

- (d) The word 'lime' is usually used to refer to a range of calcium-containing compounds that have a range of uses.

(i) Write equations to show how calcium carbonate can be converted into calcium hydroxide by a two-step process.

.....

..... [2]

A garden pond, with a total volume of 8000dm^3 , has been contaminated in such a way that its pH has fallen to 4. This means that the concentration of hydrogen ions, H^+ , in the water is $1 \times 10^{-4}\text{mol dm}^{-3}$.

- (ii) Write an ionic equation for the neutralisation reaction that occurs between hydrogen ions and carbonate ions, CO_3^{2-} .

..... [1]

- (iii) Use your equation to calculate the mass of powdered calcium carbonate that would need to be added to the pond to neutralise the acidity.

mass = g [2]