

6: Metals and the reactivity series – Topic questions**Paper 3**

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	March	32
5	2016	March	32
8	2016	June	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

3 Many metals react with either cold water or steam.

(a) Describe the reaction of sodium with cold water, and iron with steam.

In your answer describe

- the products formed,
- any observations that can be made.

.....

.....

.....

.....

..... [4]

(b) Iron reacts with hydrochloric acid.



Describe a practical method to investigate the rate of this reaction.

You may draw a labelled diagram.

.....

.....

..... [3]

(c) The experiment in (b) was repeated using different sized pieces of iron.

All other conditions remained the same.

The sizes of the pieces of iron were

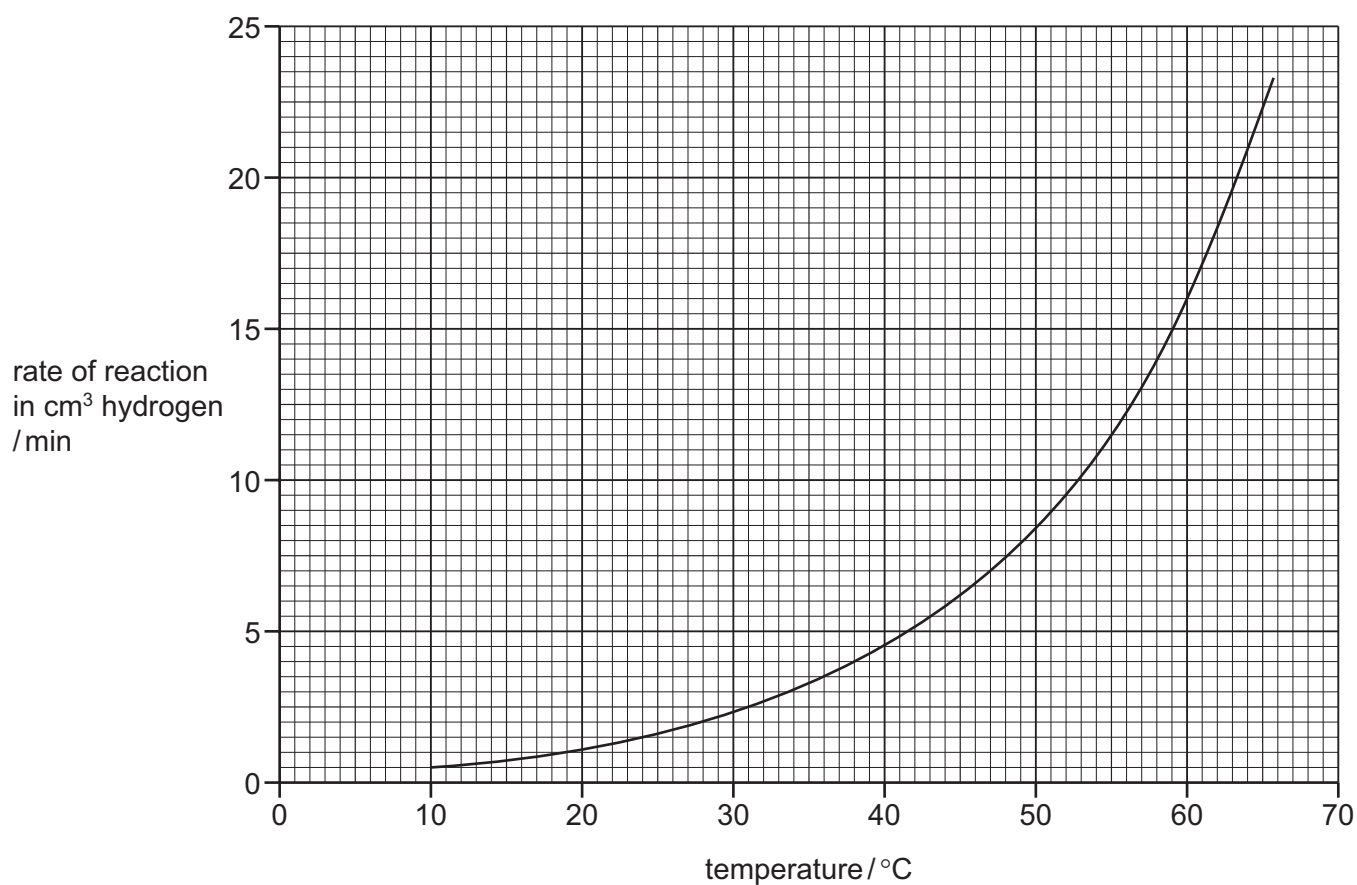
- large pieces,
- small pieces,
- iron powder.

Complete the table below by writing the sizes of the pieces in the first column.

sizes of the pieces of iron	rate of reaction in cm ³ hydrogen/min
	25
	3
	10

[1]

- (d) The graph shows the effect of temperature on the rate of the reaction of hydrochloric acid with iron.



- (i) Describe the effect of temperature on the rate of this reaction.

.....
..... [2]

- (ii) Determine the rate of reaction at 60 °C.

..... cm³ hydrogen / min [1]

- (e) Describe how the concentration of hydrochloric acid affects the rate of its reaction with iron.

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

[Total: 12]

- 5 (a) The table shows some properties of cobalt, copper, magnesium and tin.

metal	relative heat conduction	density in g/cm ³	melting point /°C	relative strength
cobalt	1.00	8.90	1495	55.0
copper	3.85	8.92	1083	32.0
magnesium	1.50	1.74	649	1.5
tin	0.64	7.28	232	1.0

Answer the questions using the information shown in the table.

- (i) Which metal is the best to use for the base of a pan for cooking food?
Use information in the table to give reasons for your answer.

.....
..... [2]

- (ii) Which **two** metals in the table are transition elements?
Use information in the table to give reasons for your answer.

.....
..... [2]

- (iii) Which metal in the table is most likely to be used in an alloy for aircraft bodies?
Use information in the table to give reasons for your answer.

.....
..... [2]

- (b) Some observations about the reactions of the four metals with hydrochloric acid are shown in the table.

metal	observations
cobalt	Bubbles formed very slowly.
copper	No bubbles formed.
magnesium	Many bubbles formed very rapidly.
tin	A steady stream of bubbles formed.

Use the information in the table to put these metals in order of their reactivity with hydrochloric acid.

least reactive  most reactive

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[2]

- (c) Crystals of hydrated cobalt(II) sulfate, $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$, can be made by reacting dilute sulfuric acid with insoluble cobalt carbonate.

Describe how you could prepare a pure dry sample of cobalt(II) sulfate crystals from dilute sulfuric acid and cobalt(II) carbonate.

.....

.....

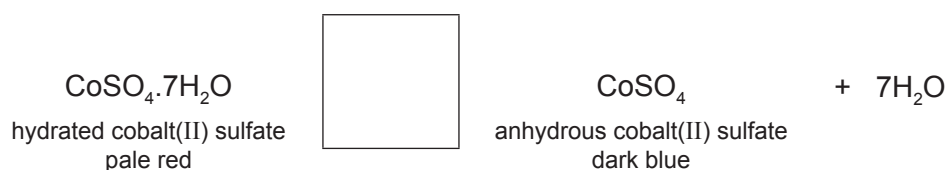
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.....

..... [4]

- (d) When heated, hydrated cobalt(II) sulfate forms an anhydrous salt in a reversible reaction.

- (i) Complete the equation for this reaction by inserting the sign for a reversible reaction in the box.



[1]

- (ii) Suggest how you could use this reaction to test for the presence of water.

.....

..... [2]

[Total: 15]

8 Solder is an alloy of lead and tin.

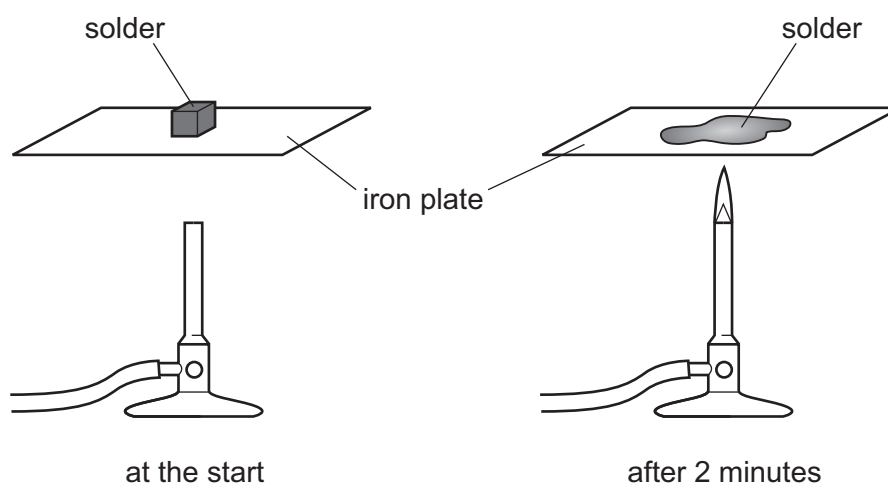
(a) What is the meaning of the term *alloy*?

..... [1]

(b) State the name of another alloy.

..... [1]

(c) A student heated a piece of solder carefully.
The diagram shows what happens to the solder.



Use the kinetic particle theory to describe and explain what happens to the solder as it changes state.

.....
.....
.....
.....
..... [4]

(d) When heated above 1744°C , lead forms a vapour.

Describe a general property of a vapour (gas) which is not shown by a solid.

..... [1]

[Total: 7]

Question	Answer	Marks
3 (a)	observations with sodium: fizzes or effervesces / sodium goes into a ball / sodium melts / moves over surface of water; products: sodium hydroxide / hydrogen; observations with iron: red or black or brown solid / iron glows; products: iron oxide / hydrogen;	4
3 (b)	gas syringe / upturned measuring cylinder filled with water / upturned burette filled with water; workable apparatus, e.g. airtight; use of stopclock / idea of timing;	3
3 (c)	powder → 25 large pieces → 3 small pieces → 10;	1
3 (d) (i)	rate increases with increasing temperature; idea that graph is not linear / rate does not increase proportionally / upward curve;	2
3 (d) (ii)	16 (cm ³ hydrogen/min);	1
3 (e)	increasing concentration increases rate;	1
		Total: 12

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Question	Answer	Marks
5 (a) (i)	copper; has high heat conductivity <u>and</u> high melting point;	2
5 (a) (ii)	cobalt <u>and</u> copper; high melting point / high strength / high density	2
5 (a) (iii)	magnesium; low density	2
5 (b)	copper → cobalt → tin → magnesium; one pair reversed = [1]	2
5 (c)	any four from: <ul style="list-style-type: none"> • add excess cobalt carbonate to sulfuric acid • filter (off excess cobalt carbonate) • evaporate filtrate to point of crystallisation / evaporate some of the water and allow to cool • filter (off crystals) • dry crystals with filter paper 	4
5 (d) (i)	\rightleftharpoons ;	1
5 (d) (ii)	Add water to anhydrous cobalt sulfate / add water to CoSO_4 ; Colour changes (from blue) to red / pink;	2
		Total: 15
8 (a)	<u>mixture</u> of 2 or more metals / <u>mixture</u> of a metal and a non-metal	1
8 (b)	any alloy, e.g. brass, bronze etc.;	1
8 (c)	any 4 from: <ul style="list-style-type: none"> • solder has melted; • atoms in solid (only) vibrate; • atoms in solid are regularly arranged / touching / close to each other; • atoms start to vibrate more; • atoms in liquid are irregularly arranged / close together / touching; • atoms in liquids slide over each other / atoms in liquids move slowly; • atoms move more during melting; • atoms become less regularly arranged during melting; 	4
8 (d)	vapour spreads everywhere / vapour does not stay in one place;	1
		Total: 7