

6: Metals and the reactivity series – Topic questions**Paper 4**

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
2	2016	March	42
3	2016	June	42
6	2016	March	42

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

- 2 Rubidium, Rb, is a Group I element. It has similar physical and chemical properties to the other elements in Group I.

(a) Predict how many electrons there are in the outer shell of a rubidium atom.

..... [1]

(b) Predict **one** physical property of rubidium which is the same as that of a transition element such as iron.

..... [1]

(c) Predict **two** physical properties of rubidium which are different to those of a transition element such as iron.

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

(d) When rubidium is added to cold water a reaction occurs.

(i) Suggest **two** observations that would be made when rubidium is added to cold water.

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

(ii) What would be the colour of the solution if methyl orange was added to it after the reaction?

..... [1]

(iii) Write a chemical equation for the reaction between rubidium and water.

..... [2]

(iv) Put the Group I elements, caesium, lithium, potassium, rubidium and sodium in their order of reactivity with water. Put the most reactive element first.

most reactive $\xrightarrow{\hspace{15em}}$ least reactive

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[1]

(v) Suggest **one** safety measure that should be used when rubidium is added to cold water.

..... [1]

(e) The phosphate ion has the formula PO_4^{3-} .

Deduce the formula of rubidium phosphate.

..... [1]

[Total: 12]

3 Gallium is a metallic element in Group III. It has similar properties to aluminium.

- (a) (i)** Describe the structure and bonding in a metallic element.
You should include a labelled diagram in your answer.

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

- (ii)** Explain why metallic elements such as gallium are good conductors of electricity.

..... [1]

- (b)** Give the formula of

gallium(III) chloride,

gallium(III) sulfate. [2]

- (c)** Gallium(III) oxide, Ga_2O_3 , is amphoteric.

- (i)** Write the chemical equation for the reaction between gallium(III) oxide and dilute nitric acid to form a salt and water only.

..... [2]

- (ii)** The reaction between gallium(III) oxide and sodium hydroxide solution forms only water and a salt containing the negative ion $\text{Ga}_2\text{O}_4^{2-}$.

Write the chemical equation for this reaction.

..... [2]

- (d)** Alloys of gallium and other elements are often more useful than the metallic element itself.

Suggest **two** reasons why alloys of gallium are more useful than the metallic element.

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

[Total: 12]

- 6 Iron pyrite, FeS_2 , is known as Fool's Gold because it is a shiny yellow solid which is similar in appearance to gold. Iron pyrite is an ionic compound. Gold is a metallic element.

(a) Iron pyrite, FeS_2 , contains positive and negative ions. The positive ion is Fe^{2+} .

Deduce the formula of the negative ion.

..... [1]

(b) A student is provided with a sample of iron pyrite and a sample of gold.

Suggest how the student could distinguish between the two substances.

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

(c) Sulfur dioxide is produced on a large scale by heating iron pyrite strongly in air. The iron pyrite reacts with oxygen in the air producing iron(III) oxide, Fe_2O_3 , and sulfur dioxide.

(i) Construct a chemical equation for the reaction between iron pyrite and oxygen.

..... [2]

(ii) Give **one** use of sulfur dioxide.

..... [1]

[Total: 6]

Question	Answer	Marks
2 (a)	1;	1
2 (b)	conducts electricity or heat / malleable / ductile / sonorous / shiny;	1
2 (c)	any two from: (low) melting point / (low) boiling point; hardness / softness / rubidium can be cut easily; strength; (low) density;	2
2 (d) (i)	any two from: bubbles / effervescence / fizzing; flame / sparks / ignites; movement; dissolves / forms a solution / disappears / gets smaller; floats; rubidium melts / rubidium forms a ball; explosion;	2
2 (d) (ii)	yellow;	1
2 (d) (iii)	$2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ formula of RbOH; whole correct equation completely correct;	2
2 (d) (iv)	caesium \rightarrow rubidium \rightarrow potassium \rightarrow sodium \rightarrow lithium / Cs \rightarrow Rb \rightarrow K \rightarrow Na \rightarrow Li;	1
2 (d) (v)	goggles / glasses / gloves / safety screen / stand at safe distance / tongs / open space;	1
2 (e)	Rb_3PO_4 ;	1
		Total: 12

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Question	Answer	Marks
3 (a) (i)	M1 positive ions / cations (labelled or named in text); M2 electrons (labelled or named in text); M3 attraction between positive and negative;	1 1 1
3 (a) (ii)	(conduction due to) movement of electrons / mobile electrons;	1
3 (b)	GaCl_3 ; $\text{Ga}_2(\text{SO}_4)_3$;	1 1
3 (c) (i)	$\text{Ga}_2\text{O}_3 + 6\text{HNO}_3 \rightarrow 2\text{Ga}(\text{NO}_3)_3 + 3\text{H}_2\text{O}$; formula of $\text{Ga}(\text{NO}_3)_3$; all formulae and balancing correct;	2
3 (c) (ii)	$\text{Ga}_2\text{O}_3 + 2\text{NaOH} \rightarrow \text{Na}_2\text{Ga}_2\text{O}_4 + \text{H}_2\text{O}$; formula of $\text{Na}_2\text{Ga}_2\text{O}_4$; all formulae and balancing correct;	2
3 (d)	any 2 from: (do not) corrode; strong; hard; (improved) appearance;	2
		Total: 12

Continues on next page ...

Question	Answer	Marks
6 (a)	S_2^{2-} ; OR S^- ;	1
6 (b)	test conductivity; gold conducts / ora; OR malleability / hit with a hammer; gold malleable / only gold produces ringing sound / ora; OR density; gold denser / ora; OR add acid / any named / formula of acid; gold does not react (ignore products with pyrites) / ora; OR heat (both strongly) in air / oxygen; iron pyrite reacts (ignore products); OR melting point; gold lower / ora; OR heat with a more reactive metal than iron; gold does not react / ora;	2
6 (c) (i)	$4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$ all formulae; balancing;	2
6 (c) (ii)	bleaching (in the manufacture of) wood pulp (for paper or straw or wool or cotton) / (food) preservative or killing bacteria in food or wine / fumigant / refrigerant / tanning (leather);	1
		Total: 7