1. Question part 1/2 | 5070 Oct-Nov 2023 P2 V1 Q2

2 This question is about metals.

(a) Potassium is an element in Group I of the Periodic Table.
Copper is a transition element.

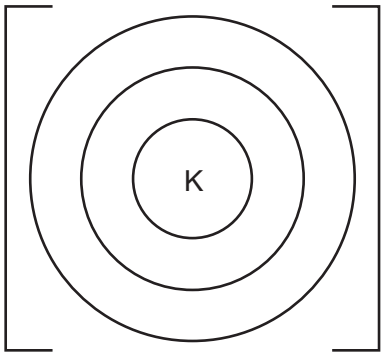
State **two** physical properties of potassium that are different from those of copper.

1 .....

2 .....
[2]

(b) Complete the diagram in Fig. 2.1 to show the electronic configuration of a potassium ion.

Include the charge on the ion.



.....

Fig. 2.1 [2]

(c) Table 2.1 shows the observations when four different metals react with cold water.

Table 2.1

metal	observations
cerium	bubbles form slowly
potassium	bubbles form rapidly
uranium	bubbles form very slowly
vanadium	no bubbles seen

Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[1]

1. Question part 2/2 | 5070 Oct-Nov 2023 P2 V1 Q2

(d) Deduce the number of protons and neutrons in the copper atom shown.

$^{65}_{29}Cu$

number of protons .....

number of neutrons .....
[2]

(e) In the presence of oxygen, copper reacts with sulfuric acid, H_2SO_4, to form copper(II) sulfate and water.

Construct the symbol equation for this reaction.

..... [2]

(f) Copper can be used as a catalyst.

(i) State how a catalyst increases the rate of a chemical reaction.

..... [1]

(ii) Name the catalyst used in the Contact process.

..... [1]

(g) Give **two** reasons why copper is used in electrical wiring.

1 .....

2 .....
[2]

[Total: 13]

2. Question part 1/2 | 5070 Oct-Nov 2023 P2 V2 Q2

2 This question is about metals.

(a) Chromium is a transition element.

Sodium is an element in Group I of the Periodic Table.

State **two** physical properties of chromium that are different to those of sodium.

1 .....

2 .....
[2]

(b) Deduce the number of protons and neutrons in the chromium atom shown.

$^{53}_{24}Cr$

number of protons .....

number of neutrons .....
[2]

(c) Chromium(III) oxide, Cr_2O_3, reacts with carbon and chlorine to produce chromium(III) chloride, $CrCl_3$, and carbon monoxide.

Construct the symbol equation for this reaction.

..... [2]

(d) Complete the diagram in Fig. 2.1 to show the electronic configuration of a sodium ion. Include the charge on the ion.

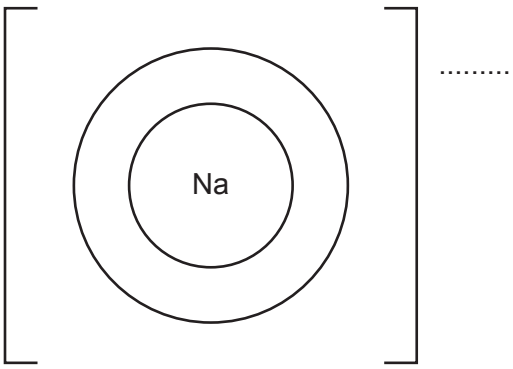


Fig. 2.1

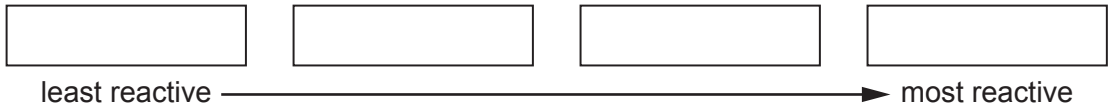
[2]

(e) Table 2.1 shows the observations made when four different metals are heated in oxygen.

Table 2.1

metal	observations
lanthanum	forms a layer of oxide rapidly on the surface but does not burn
mercury	does not form a layer of oxide on the surface
nickel	forms a layer of oxide slowly on the surface but does not burn
sodium	burns rapidly

Put the four metals in order of their reactivity.
Put the least reactive metal first.



[1]

(f) Aluminium is used in food containers and overhead electrical cables because it is resistant to corrosion.

(i) Explain why aluminium is resistant to corrosion.

.....

..... [2]

(ii) State two **other** reasons why aluminium is used in overhead electrical cables.

1 .....

2 .....

[2]

[Total: 13]

3. Question part 1/2 | 5070 Oct-Nov 2024 P2 V2 Q2

2 Iron is extracted in the blast furnace by the reduction of iron(III) oxide, Fe_2O_3.

This process is made up of three steps.

(a) **(i)** In step 1, carbon burns in air to produce carbon dioxide.

Give one **other** reason why carbon is burned in air in the blast furnace.

..... [1]

(ii) In step 2, carbon monoxide is produced by the reaction of carbon dioxide with carbon.

State **one** adverse effect of carbon monoxide on health.

..... [1]

(iii) In step 3, iron(III) oxide is reduced by carbon monoxide.

Write the symbol equation for this reaction.

..... [1]

(b) Explain why calcium carbonate is added to the blast furnace.

Include any relevant reactions or equations in your answer.

.....

.....

..... [2]

(c) Iron is a transition element.

Transition elements have high melting and boiling points.

State two **other** properties that are typical of transition elements but **not** of Group I metals.

1 .....

2 .....
[2]

(d) Iron is prevented from rusting by galvanising with zinc.

Explain **two** different ways in which zinc prevents rusting.

.....

.....

.....

..... [3]

3. Question part 2/2 | 5070 Oct-Nov 2024 P2 V2 Q2

(e) The equation shows the reaction of iron with steam in a closed container.

$$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$$

Predict and explain what happens to the position of equilibrium when the pressure is increased. The temperature remains the same.

prediction .....

explanation .....

.....

[2]

(f) Fe_3O_4 reacts with concentrated hydrochloric acid.

The products are iron(II) chloride, iron(III) chloride and a liquid that turns blue cobalt(II) chloride paper pink.

Construct the symbol equation for this reaction.

..... [2]

[Total: 14]

4. Question | 5070 May-June 2025 P2 V1 Q7

7 Aluminium is used in the manufacture of aircraft and food containers.

Aluminium is resistant to corrosion by water and oxygen.

(a) Give one **other** reason why aluminium is used in the manufacture of aircraft.

..... [1]

(b) Explain why aluminium is resistant to corrosion by water and oxygen.

.....

.....

..... [2]

(c) Aluminium metal reacts with hot dilute sulfuric acid to form hydrogen and aqueous aluminium sulfate as the only products.

Construct the symbol equation for this reaction.

Include state symbols.

..... [2]

(d) Aluminium oxide reacts with sulfuric acid and with the alkali aqueous sodium hydroxide.

State the name of the type of oxide that reacts with both acids and alkalis.

..... [1]

[Total: 6]

5. Question | 5070 May-June 2025 P2 V2 Q7

7 Iron is used to make stainless steel.

Stainless steel is used to make cutlery because it is resistant to rusting.

(a) Give one **other** reason why stainless steel is used to make cutlery.

..... [1]

(b) Stainless steel is an alloy.

Give the meaning of the term alloy.

.....

.....

..... [1]

(c) Iron nails are galvanised with zinc to prevent rusting.

Explain **two** ways in which galvanising iron nails with zinc prevents rusting.

.....

.....

.....

.....

.....

..... [3]

(d) Iron reacts with hot dilute sulfuric acid to form hydrogen and aqueous iron(III) sulfate as the only products.

Construct a symbol equation for this reaction.

Include state symbols.

..... [2]

[Total: 7]

6. Question part 1/2 | 5070 Oct-Nov 2025 P2 V1 Q5

5 Nickel is a transition element.

(a) Nickel has good electrical conductivity and good thermal conductivity.

Nickel is also ductile and malleable.

State two **other** physical properties of nickel that are typical of a transition element.

1. .....

2. .....

[2]

(b) The physical properties of nickel can be explained using ideas about structure and bonding.

(i) Explain why nickel has good electrical conductivity.

.....

..... [1]

(ii) Explain why nickel is ductile.

.....

..... [1]

(c) Compound **X** contains nickel, carbon and oxygen only.

X contains 28.1% by mass carbon and 37.4% by mass oxygen.

Calculate the empirical formula of compound **X**.

empirical formula = ... [3]

6. Question part 2/2 | 5070 Oct-Nov 2025 P2 V1 Q5

(d) Nickel reacts slowly with dilute hydrochloric acid to form aqueous nickel(II) ions and hydrogen.

(i) Construct the ionic equation for this reaction.

Include state symbols in your answer.

..... [2]

(ii) Predict if nickel reacts with aqueous copper(II) ions.

Explain your answer.

prediction .....

explanation .....

.....

[1]

[Total: 10]

7. Question part 1/2 | 5070 Oct-Nov 2025 P2 V2 Q5

5 Nickel is a transition element.

(a) One of the properties of nickel is that it is a catalyst.

State a reaction that uses nickel as a catalyst.

..... [1]

(b) State one **other** chemical property of nickel that is typical of a transition element.

..... [1]

(c) The physical properties of nickel and its alloys can be explained using ideas about structure and bonding.

(i) Explain why nickel is malleable.

.....

..... [1]

(ii) Nickel and other elements are added to iron to make the alloy stainless steel.

Explain why stainless steel is harder than either pure nickel or pure iron.

Include a labelled diagram in your answer.

.....

.....

.....

..... [2]

(iii) Stainless steel is used to make cutlery because it is hard and strong.

State one **other** property that makes stainless steel suitable to make cutlery.

..... [1]

(d) Compound **X** contains nickel, hydrogen and oxygen only.

X contains 2.2% by mass of hydrogen and 34.5% by mass of oxygen.

Calculate the empirical formula of compound **X**.

empirical formula = ... [3]

(e) The equation for the reversible reaction between carbon monoxide and nickel is shown.

$$4CO(g) + Ni(s) \rightleftharpoons Ni(CO)_4(g)$$

The forward reaction is exothermic.

The reversible reaction is allowed to reach equilibrium in a closed system.

Predict and explain the effect of increasing the pressure on the position of equilibrium. The temperature remains constant.

prediction .....

explanation .....

.....

[2]

[Total: 11]

8. Question part 1/2 | 5070 May-June 2026 P2 V1 Q6

6 Iron is a transition element.

Iron has good electrical conductivity.

(a) State **two** chemical properties that are typical of a transition element.

1 .....

2 .....
[2]

(b) Explain why iron has good electrical conductivity.

Use ideas about structure and bonding.

.....

..... [1]

(c) Iron is used to make stainless steel.

(i) Name **two** elements that are mixed with iron to make stainless steel.

1 .....

2 .....
[2]

(ii) Stainless steel is used to make cutlery because it is hard.

Explain why stainless steel is harder than pure iron.

Use ideas about structure and bonding.

.....

.....

.....

..... [2]

8. Question part 2/2 | 5070 May-June 2026 P2 V1 Q6

(iii) Describe the extraction of iron from hematite in the blast furnace.

You may include word equations in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 12]

9. Question part 1/2 | 5070 May-June 2026 P2 V2 Q6

6 Copper and aluminium are metals.

Both metals have good electrical conductivity.

(a) Explain why both metals have good electrical conductivity.

Use ideas about structure and bonding.

.....

..... [1]

(b) Copper is a transition element but aluminium is **not**.

Aluminium has a lower melting point and boiling point than copper.

(i) Suggest one **other** difference between the physical properties of these two metals.

..... [1]

(ii) Suggest **one** difference between the chemical properties of these two metals.

..... [1]

(c) Copper is used to make the alloy brass.

(i) Name the main element mixed with copper to make brass.

..... [1]

(ii) Brass is harder than pure copper.

Explain why.

Use ideas about structure and bonding.

.....

.....

..... [2]

(d) Aluminium is used to manufacture food containers because of its resistance to corrosion.

(i) Explain why aluminium is resistant to corrosion.

.....

.....

..... [2]

(ii) State one **other** use for aluminium and explain why aluminium is suitable for this use.

use .....

explanation .....

.....

[2]

(e) Aluminium is manufactured by the electrolysis of purified bauxite mixed with cryolite. Carbon electrodes are used.

(i) Explain why cryolite is added to the purified bauxite.

.....

..... [1]

(ii) Explain why the carbon anodes need to be regularly replaced.

.....

..... [1]

[Total: 12]