1. 0620/42/M/J/19/No.7

(a) Displacement reactions occur between metals and metal ions.

Displacement reactions can be used to determine the order of reactivity of metals such as lead (Pb), nickel (Ni), and silver (Ag).

The ionic equation for a displacement reaction is shown.

$$Ni(s) + Pb^{2+}(aq) \rightarrow Pb(s) + Ni^{2+}(aq)$$

The ionic half-equations for this reaction are shown.

$$Ni(s) \rightarrow Ni^{2+}(aq) + 2e^{-}$$

$$Pb^{2+}(aq) + 2e^{-} \rightarrow Pb(s)$$

The ionic half-equations show that electrons are donated by nickel atoms and accepted by lead ions.

(i) Identify the reducing agent in the displacement reaction. Give a reason for your answer.

reducing agent.....

reason.....

[2]

(ii) What is the general term given to the type of reaction in which electrons are transferred from one species to another?

..... [1]

(b) The ionic equation for another displacement reaction is shown.

$$Pb(s) + 2Ag^{+}(aq) \rightarrow 2Ag(s) + Pb^{2+}(aq)$$

Write the **two** ionic half-equations for this reaction.

1 .....

2 .....

[2]

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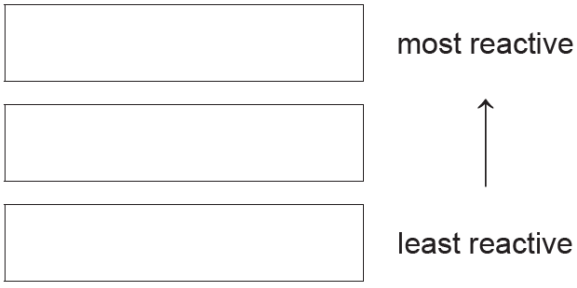
(c) Use the information in **(a)** and **(b)** to put the **three** metals lead, nickel and silver in order of reactivity.



[1]

(d) Nickel is a transition element. Nickel is stronger than sodium.

Describe **two** other differences in the physical properties of nickel and sodium.

1 .....

2 .....

[2]

(e) Predict **one** difference in the appearance of aqueous solutions of nickel compounds compared to aqueous solutions of sodium compounds.

.....

..... [1]

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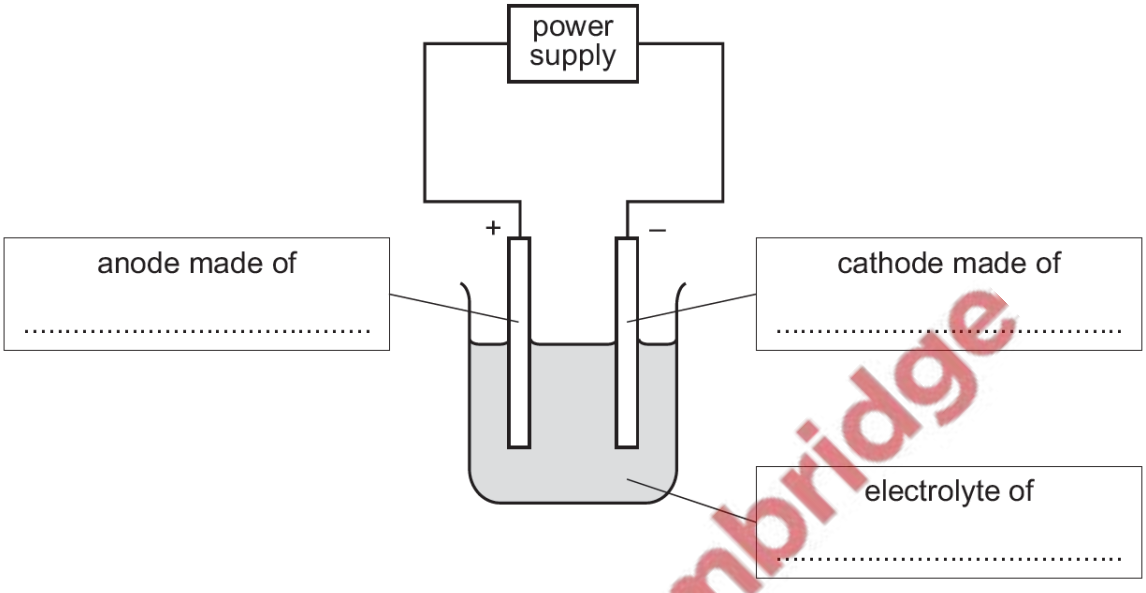
(f) Copper is refined (purified) by electrolysis. Nickel can be refined using a similar method.

(i) The diagram shows the refining of nickel by electrolysis.

Complete the labels in the boxes.



[3]

(ii) Indicate, by writing **N** on the diagram, where nickel is produced. [1]

[Total: 13]

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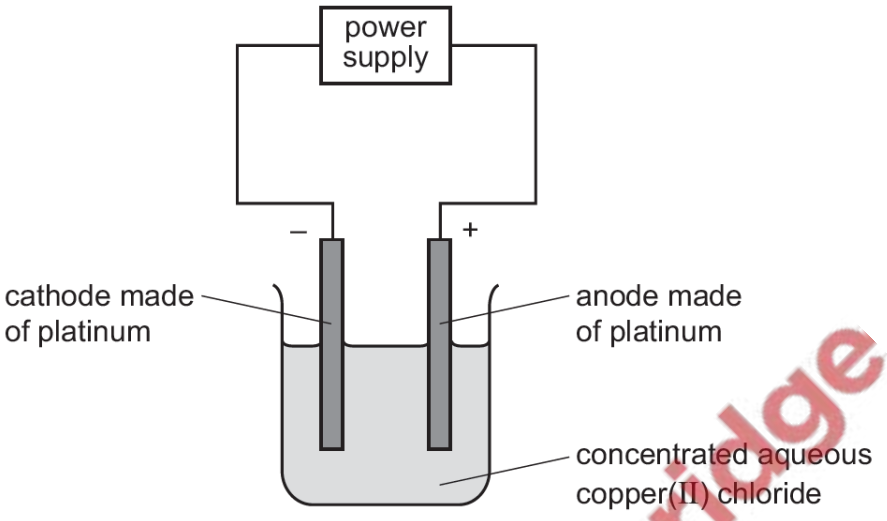
2. 0620/43/M/J/19/No.4

Solutions of ionic compounds can be broken down by electrolysis.

(a) Concentrated aqueous copper(II) chloride was electrolysed using the apparatus shown.



The ionic half-equations for the reactions at the electrodes are shown.

negative electrode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

positive electrode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

(i) Platinum is a solid which is a good conductor of electricity.

State **one** other property of platinum which makes it suitable for use as electrodes.

.....

..... [1]

(ii) State what would be **seen** at the positive electrode during this electrolysis.

.....

..... [1]

(iii) State and explain what would happen to the mass of the negative electrode during this electrolysis.

.....

.....

..... [2]

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(iv) The concentrated aqueous copper(II) chloride electrolyte is green.

Suggest what would happen to the colour of the electrolyte during this electrolysis.
Explain your answer.

.....

.....

..... [2]

(v) Identify the species that is oxidised during this electrolysis.
Explain your answer.

species that is oxidised .....

explanation .....

.....

[2]

(b) Metal objects can be electroplated with silver.

(i) Describe how a metal spoon can be electroplated with silver.
Include:

- what to use as the positive electrode and as the negative electrode
- what to use as the electrolyte
- an ionic half-equation to show the formation of silver.

You may include a diagram in your answer.

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.....

.....

.....

ionic half-equation .....

[4]

(ii) Give **one** reason why metal spoons are electroplated with silver.

.....

..... [1]

[Total: 13]

3. 0620/32/F/M/19/No.6

This question is about chromium and chromium compounds.

(a) (i) Suggest why chromium is manufactured by electrolysis and **not** by the reduction of chromium(VI) oxide, CrO_3, with carbon.

..... [1]

(ii) Suggest the products of electrolysis of molten chromium(VI) oxide at:

- the positive electrode .....
- the negative electrode. .....

[2]

(b) Chromium can also be manufactured by the reduction of chromium(III) oxide, Cr_2O_3, with aluminium.

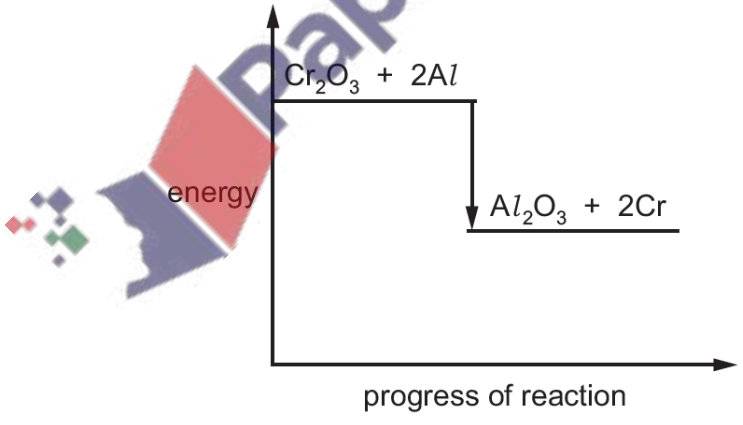
$$Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$$

(i) How does this equation show that chromium(III) oxide is reduced?

.....

..... [1]

(ii) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

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(c) Chromium is a transition element. Sodium is an element in Group I of the Periodic Table.

Describe **two** ways in which the properties of chromium are different from those of sodium.

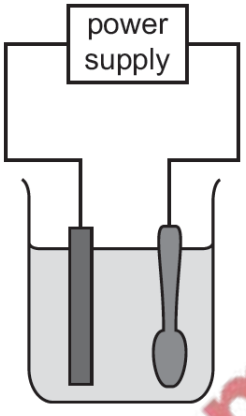
1 .....

2 .....

[2]

(d) Chromium is a silver-coloured metal.

The diagram shows how a copper spoon can be electroplated with chromium.



(i) On the diagram, label:

- the cathode
- the electrolyte.

[2]

(ii) Give **one** observation that is made during the electroplating process.

..... [1]

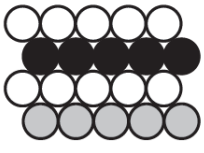
(iii) Suggest **one** reason why metal objects are electroplated.

..... [1]

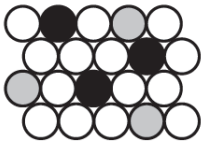
(e) Nichrome is an alloy of nickel, iron and chromium.

Which **one** of these diagrams, **J**, **K**, **L** or **M**, best represents nichrome?

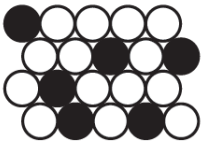
J



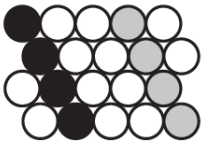
K



L



M



..... [1]

[Total: 12]

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