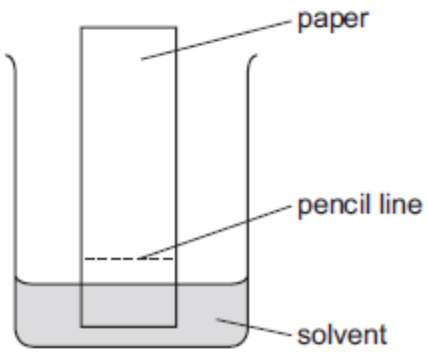
Section A

1 A student is investigating a coloured mixture using chromatography.



Where should the student place the coloured mixture?

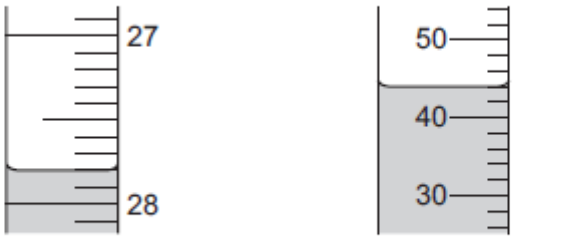
A in the solvent

B just above the pencil line

C just below the pencil line

D on the pencil line

2 The diagrams show liquids in a burette and a measuring cylinder.

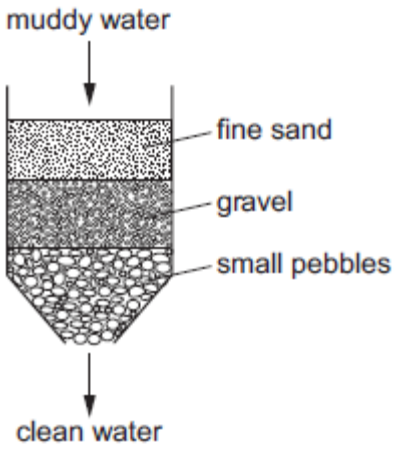


burette measuring cylinder

Which row shows the correct readings for the burette and the measuring cylinder?

	burette	measuring cylinder
A	27.8	42
B	27.8	44
C	28.2	42
D	28.2	44

3 The diagram shows how muddy water can be purified.



Which process for purifying the muddy water is shown?

A crystallisation

B distillation

C filtration

D solvent extraction

4 The aluminium ion, Al^{3+}, has the same electronic structure as an atom of which noble gas?

A argon

B helium

C krypton

D neon

5 A covalent molecule M contains a total of four shared electrons.

What is M?

A ammonia, NH_3

B hydrogen chloride, HCl

C methane, CH_4

D water, H_2O

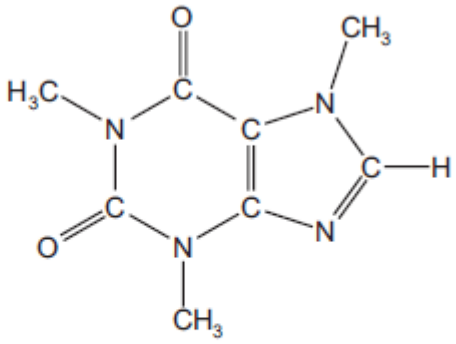
6 Three substances have the properties shown.

- X conducts electricity when solid and when molten.
- Y is soluble in water and the solution conducts electricity.
- Z only conducts electricity when molten.

What are X, Y and Z?

	X	Y	Z
A	Ca	MgO	NaOH
B	Ca	NaOH	MgO
C	MgO	Ca	NaOH
D	MgO	NaOH	Ca

7 Caffeine is a stimulant found in coffee.



caffeine

Which formula represents caffeine?

A $C_7H_{10}N_4O_2$ **B** $C_8H_{10}N_3O_2$ **C** $C_8H_{10}N_4O_2$ **D** $C_8H_{11}N_4O_2$

8 Four substances are electrolysed.

The substances are concentrated aqueous sodium chloride, concentrated hydrochloric acid, molten lead(II) bromide and molten sodium oxide.

Which statement about these electrolysis reactions is correct?

A A colourless gas is formed at the anode when molten sodium oxide is electrolysed.

B A green gas is formed at the cathode when concentrated hydrochloric acid is electrolysed.

C A metal is formed at the anode when molten lead(II) bromide is electrolysed.

D A metal is formed at the cathode when concentrated aqueous sodium chloride is electrolysed.

9 Ammonium chloride is added to 100 cm^3 of water. The temperature changes from 25 °C to 20 °C.

Which type of reaction occurs?

A endothermic

B exothermic

C freezing

D neutralisation

10 In which reaction is the first substance in the equation oxidised?

A $CaO + H_2O \rightarrow Ca(OH)_2$

B $4FeO + O_2 \rightarrow 2Fe_2O_3$

C $SnO_2 + 2H_2 \rightarrow Sn + 2H_2O$

D $ZnCO_3 \rightarrow ZnO + CO_2$

11 Which reaction is a neutralisation reaction?

A $AgNO_3 + HCl \rightarrow AgCl + HNO_3$

B $CaCO_3 \rightarrow CaO + CO_2$

C $4Na + O_2 \rightarrow 2Na_2O$

D $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

12 Elements W and X are metals.

Elements Y and Z are non-metals.

The oxides of W, X, Y and Z all form solutions when added to water.

Which statement is correct?

A The solution of the oxide of element W turns blue litmus red.

B The solution of the oxide of element X fizzes when sodium carbonate is added.

C The solution of the oxide of element Y has a pH greater than pH 7.

D The solution of the oxide of element Z fizzes when powdered magnesium is added.

13 A student is given an unknown solution.

Which two tests provide evidence that the solution is copper(II) sulfate?

1 adding dilute hydrochloric acid

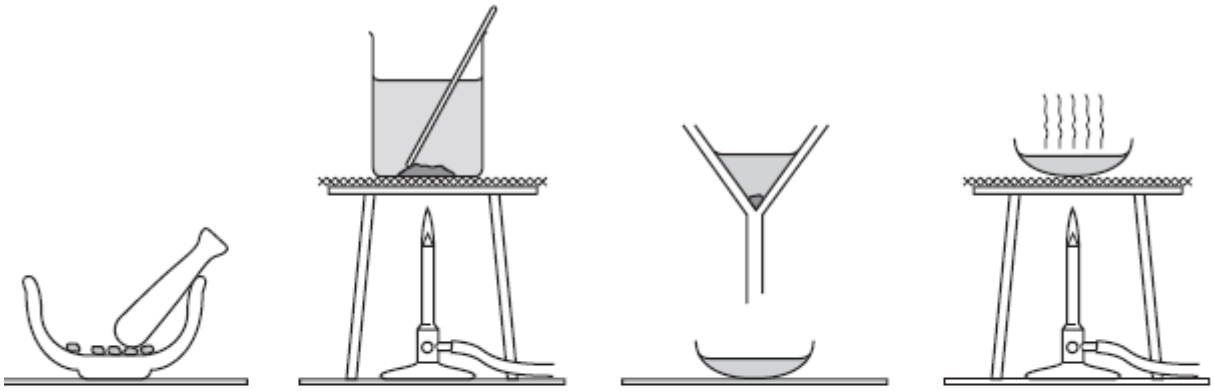
2 adding aqueous sodium hydroxide

3 adding dilute nitric acid, then silver nitrate solution

4 adding dilute nitric acid, then barium nitrate solution

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

14 The diagram shows the steps in the preparation of a salt.



step 1 step 2 step 3 step 4

Which salt is prepared by this method?

A barium sulfate

B copper(II) sulfate

C potassium sulfate

D sodium sulfate

15 Which property of elements increases across a period of the Periodic Table?

A metallic character

B number of electron shells

C number of outer shell electrons

D tendency to form positive ions

16 The noble gases are in Group VIII of the Periodic Table.

Which statement explains why noble gases are unreactive?

A They all have eight electrons in their outer shells.

B They all have full outer shells.

C They are all gases.

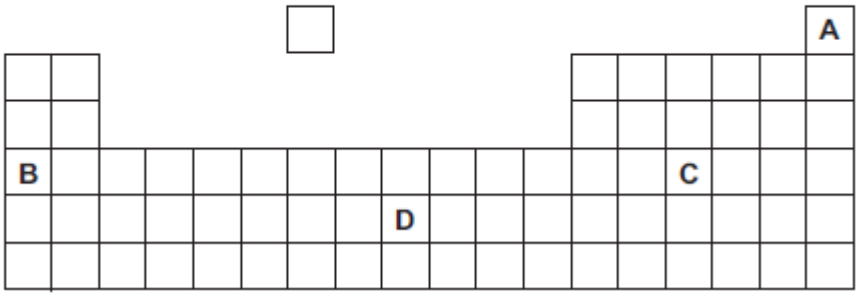
D They are all monoatomic.

17 Which compound is made from elements which are **all** in the same period?

A $Al_2(SO_4)_3$ **B** C_2H_5OH **C** $LiNO_3$ **D** Na_3AlF_6

18 Part of the Periodic Table is shown.

Which element is used as a catalyst?



19 Which statement about **all** metals is correct?

A They are attracted to a magnet.

B They are weak and brittle.

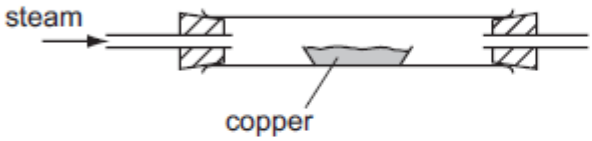
C They may be used to form alloys.

D They react with water.

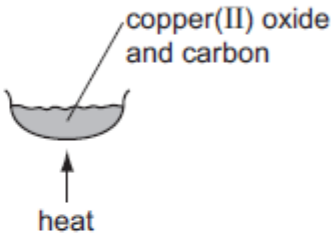
20 Two experiments are carried out.

In experiment 1, copper is heated with steam.

In experiment 2, copper(II) oxide is heated with carbon.



experiment 1



experiment 2

Which row describes what happens in experiments 1 and 2?

	experiment 1	experiment 2
A	no reaction	no reaction
B	no reaction	reaction
C	reaction	no reaction
D	reaction	reaction

Section B

1 **(a)** Choose from the list of elements to answer the following questions.

aluminium
argon
carbon
lithium
magnesium
nickel
nitrogen
oxygen
sulfur

Each element can be used once, more than once or not at all.

Which element

(i) forms 21% of dry air,

..... [1]

(ii) reacts rapidly with cold water to produce hydrogen,

..... [1]

(iii) is in Group III of the Periodic Table,

..... [1]

(iv) has atoms which have a complete outer shell of electrons,

..... [1]

(v) is a transition element,

..... [1]

(vi) forms stable ions with a single positive charge?

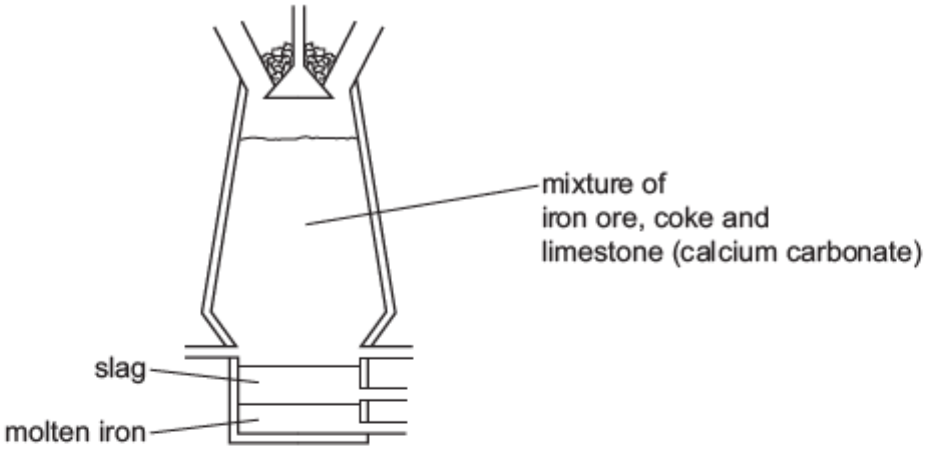
..... [1]

(b) Complete the table to show the number of electrons, neutrons and protons in the nickel atom and oxide ion shown.

	number of electrons	number of neutrons	number of protons
$^{62}_{28}Ni$			28
$^{18}_{8}O^{2-}$			

[4]

2 The diagram shows a blast furnace for extracting iron.



(a) (i) On the diagram write

- the letter **A** to show where air is blown into the furnace,
- the letter **W** to show where waste gases exit the furnace.

[2]

(ii) How do you know from the information in the diagram that slag is less dense than molten iron?

..... [1]

(b) Limestone (calcium carbonate) is one of the raw materials added to the blast furnace. Calcium carbonate undergoes thermal decomposition in the blast furnace.

(i) What is meant by the term *thermal decomposition*?

.....

..... [2]

(ii) Complete the chemical equation for this reaction.

$$CaCO_3 \rightarrow CaO + ...$$ [1]

(iii) A further reaction in the blast furnace involves calcium oxide, CaO.

Describe this reaction and explain its importance.

.....

..... [2]

(c) Pure iron can be prepared by electrolysis of an aqueous solution of a suitable iron(II) salt.

Draw a labelled diagram of an electrolysis cell that could be used to carry out this reaction.
In your diagram include

- the electrodes,
- the electrolyte,
- the power supply.

[3]

(d) (i) State the name of an element that could be used for the electrodes.

..... [1]

(ii) State **one** property that an electrode should have.

..... [1]

3 Metals have characteristic properties.

(a) Write about the properties of metals.
In your answer

- refer to the physical properties which are characteristic of metals,
- refer to the chemical properties which are characteristic of metals,
- include a word equation to show a chemical reaction of a metal.

.....

.....

.....

.....

.....

.....

..... [5]

(b) The table shows how easy it is to reduce four metal oxides.

metal oxide	ease of reduction
calcium oxide	not reduced by carbon at 1600 °C
magnesium oxide	reduced by carbon at 1600 °C
nickel(II) oxide	reduced by carbon at 350 °C
zinc oxide	reduced by carbon at 850 °C

Use this information to put the metals in order of their reactivity. Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

(c) Uranium is a radioactive metal which has several isotopes.

(i) What is the meaning of the term *isotopes*?

.....

..... [1]

(ii) Give the main use of the isotope ^{235}U.

..... [1]

4 Silver dichromate, $Ag_2Cr_2O_7$, is a red insoluble salt.

Silver dichromate can be made by reacting silver nitrate solution with ammonium dichromate solution. The chemical equation for the reaction is shown.

$$2AgNO_3(aq) + (NH_4)_2Cr_2O_7(aq) \rightarrow 2NH_4NO_3(aq) + Ag_2Cr_2O_7(s)$$

(a) Describe how you could obtain pure dry solid silver dichromate after mixing silver nitrate solution and ammonium dichromate solution.

.....

.....

.....

..... [3]

(c) Dilute aqueous sodium hydroxide was added to the ammonium nitrate solution made in the reaction. The mixture was then warmed and damp Universal Indicator paper was held above the mixture.

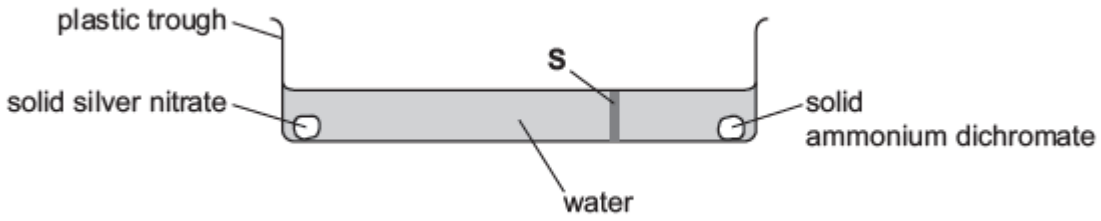
State and explain what would happen to the Universal Indicator paper.

.....

.....

..... [2]

(d) The apparatus shown was set up.



After five minutes, a red solid appeared along the line marked **S** on the diagram.

(i) Explain why a red solid appeared along the line marked **S**.

.....

.....

.....

..... [3]

(ii) The experiment was repeated at a higher temperature.

What effect, if any, would this have on the time taken for the red solid to appear? Explain your answer.

.....

..... [2]

(e) Ammonium dichromate, $(NH_4)_2Cr_2O_7$, undergoes thermal decomposition.
The products are chromium(III) oxide, nitrogen and water.

(i) What is meant by *thermal decomposition*?

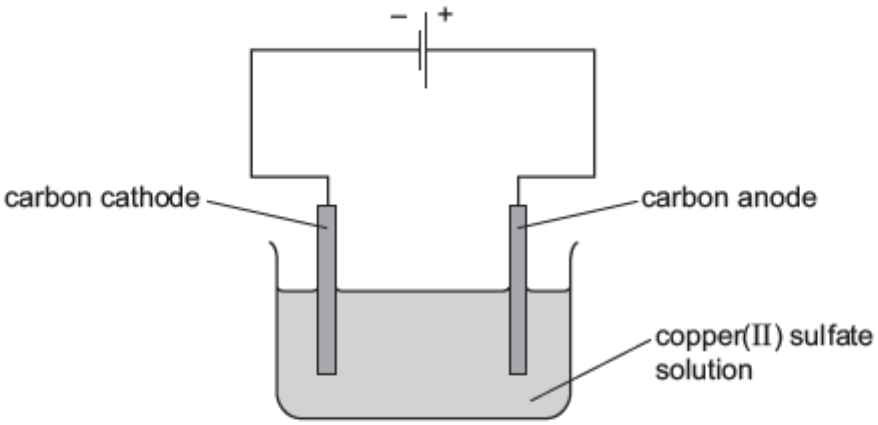
.....

..... [2]

(ii) Write a chemical equation for the thermal decomposition of ammonium dichromate.

..... [2]

5 Copper(II) sulfate solution was electrolysed using the apparatus shown.



(a) **(i)** Draw an arrow on the diagram to show the direction of movement of electrons in the wire.
Label the arrow **A**. [1]

(ii) Draw an arrow on the diagram to show the direction of movement of positive ions in the copper(II) sulfate solution.
Label the arrow **B**. [1]

(b) Oxygen was formed at the anode and copper was formed at the cathode.

(i) The ionic half-equation for the formation of oxygen is shown.

$$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$$

Explain why this reaction is oxidation.

..... [1]

(ii) Write the ionic half-equation for the formation of copper at the cathode.

..... [2]

(c) The electrolysis was repeated using copper electrodes in place of carbon electrodes.

State and explain what happens to the masses of the anode and the cathode during this electrolysis.

.....

.....

.....

.....

..... [4]

6 Barium carbonate decomposes when heated.

$$BaCO_3(s) \rightarrow BaO(s) + CO_2(g)$$

(a) A student heated a 10.0 g sample of barium carbonate until it was fully decomposed.

(i) Calculate the number of moles of barium carbonate the student used.

moles of barium carbonate = ... mol [2]

(ii) Calculate the volume of carbon dioxide gas produced at room temperature and pressure. Give your answer in dm^3.

volume of carbon dioxide = ... dm^3 [1]

(b) The student added 2.00 g of the barium oxide produced to water.

$$BaO + H_2O \rightarrow Ba(OH)_2$$

Calculate the mass of barium hydroxide that can be made from 2.00 g of barium oxide. The M_r of $Ba(OH)_2$ is 171.

mass of barium hydroxide = ... g [1]

(c) A 1.50 g sample of barium hydroxide was dissolved in water. The total volume of the solution was 100 cm^3.

A 25.0 cm^3 portion of the barium hydroxide solution was titrated against hydrochloric acid. The volume of hydrochloric acid required was 18.75 cm^3.

$$Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$$

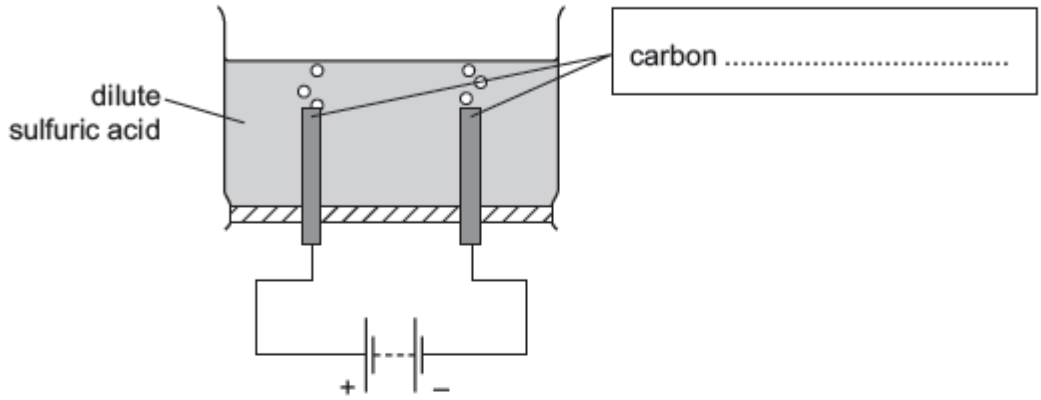
(i) Calculate how many moles of barium hydroxide were in the 25.0 cm^3 portion used in the titration.

moles of barium hydroxide = ... mol [1]

(ii) Calculate the concentration of the hydrochloric acid used.

concentration of hydrochloric acid = ... mol / dm^3 [2]

7 A student investigated the gases formed during the electrolysis of dilute sulfuric acid using the apparatus shown.
Hydrogen and oxygen were produced.



(a) Complete the box to name the apparatus used. [1]

(b) On the diagram, sketch how a sample of **one** of the gases could be collected. [2]

(c) Give a test for oxygen.

test .....

result .....

[1]

(d) The gas collected at the positive side turned limewater milky.

(i) Based on this observation, what gas was present?

..... [1]

(ii) Suggest how this gas was formed.

..... [1]

(e) A solution of dilute sulfuric acid was electrolysed for 1 hour.

Suggest why the pH of the solution **decreased** during the electrolysis.

.....

..... [2]