1 A student carries out an investigation to compare the reactivities of four metals, aluminium, copper, zinc and M.

He adds strips of zinc to the aqueous solutions of the nitrates of each metal.

After a few minutes he removes the strips of zinc and examines them.

The table shows his results.

Solution	Result
aluminium nitrate	no change
copper(II) nitrate	brown coating on zinc
zinc nitrate	no change
nitrate of metal M	grey coating on zinc

(a) Name the substance that causes the brown coating on the zinc.

(1)

.....

(b) State why there is no change in the experiment with zinc nitrate solution.

(1)

.....

.....

(c) The student repeats the experiment with strips of metal M instead of strips of zinc. The table shows his results.

Solution	Result
aluminium nitrate	no change
copper(II) nitrate	brown coating on M
zinc nitrate	no change
nitrate of metal M	no change

Using information from both tables of results, place the metals aluminium, copper, zinc and M in order of decreasing reactivity.

(2)

most reactive .....

.....

.....

least reactive .....

(d) Magnesium reacts with an aqueous solution of silver nitrate.

The reaction can be represented by the ionic equation

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

(i) State why this reaction is described as a redox reaction.

(1)

.....

.....

(ii) Explain, in terms of electrons, which species is behaving as an oxidising agent in this reaction.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

2 The table gives information about barium salts.

Barium salt	Formula	Solubility in water	Toxic (poisonous)
barium chloride		soluble	yes
barium nitrate	$Ba(NO_3)_2$	soluble	yes
barium carbonate		insoluble	no
barium sulfate	$BaSO_4$	insoluble	no

(a) Complete the table by giving the formula of barium chloride and of barium carbonate.

(2)

(b) The human stomach contains hydrochloric acid.

Suggest why barium carbonate may cause poisoning when it enters the stomach.

(2)

.....

.....

.....

(c) Before patients have stomach X-rays they are given a barium salt to swallow.

Which salt in the table is safe to use?

(1)

.....

(d) A student accidentally swallowed a small amount of barium hydroxide solution, which is poisonous.

Suggest a reason why a solution of magnesium sulfate could be given to the student to swallow as a first aid treatment. Write a word equation for the reaction that takes place.

(3)

Reason.....

.....

.....

Word equation

.....

(e) The table gives information about the first five elements in Group 2 of the Periodic Table.

Element	Atomic number	Reaction with cold water	Reaction with air
beryllium	4	no reaction	burns when strongly heated
magnesium	12	reacts very slowly	burns when heated
calcium	20	reacts slowly	reacts slowly without heating
strontium	38	reacts quickly	reacts quickly without heating
barium	56		

Use the information in the table to help you answer the questions.

(i) Suggest how barium reacts with cold water and with air.

(2)

Reaction with cold water .....

.....

Reaction with air .....

.....

(ii) Use your answer to (e)(i) to suggest how barium should be stored.

(1)

.....

.....

(iii) Suggest a connection between the atomic number and the reactivity of the elements in Group 2.

(1)

.....

.....

(Total for Question 2 = 12 marks)