Questions are for both separate science and combined science students unless indicated in the question

1 This question is about the reactions of calcium and some calcium compounds.

(a) Calcium reacts with cold water. The equation for the reaction is

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$$

(i) State two observations that are made when calcium reacts with water.

(2)

1 .....

2 .....

(ii) Explain a possible value for the pH of the solution formed.

(2)

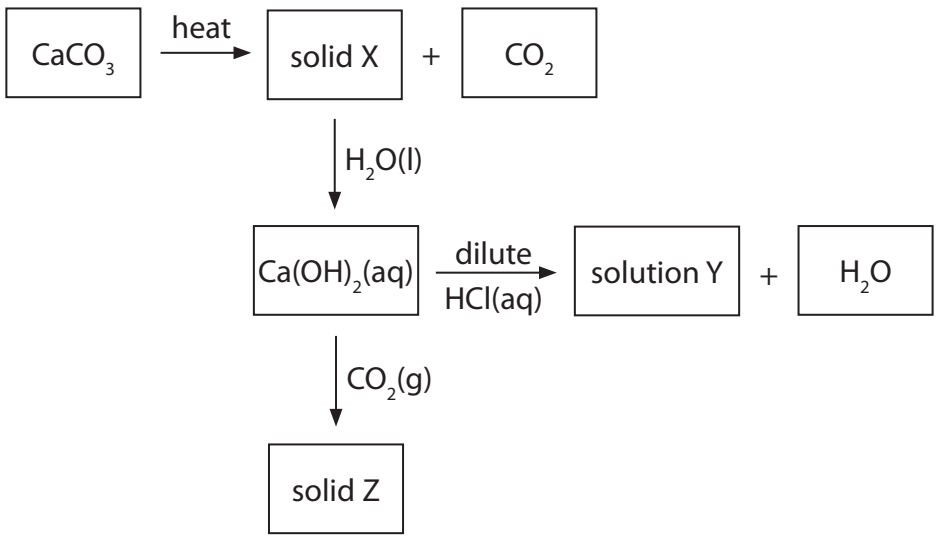
.....

.....

.....

(b) The diagram shows some reactions involving calcium compounds.

Identify solid X, solution Y and solid Z.



(3)

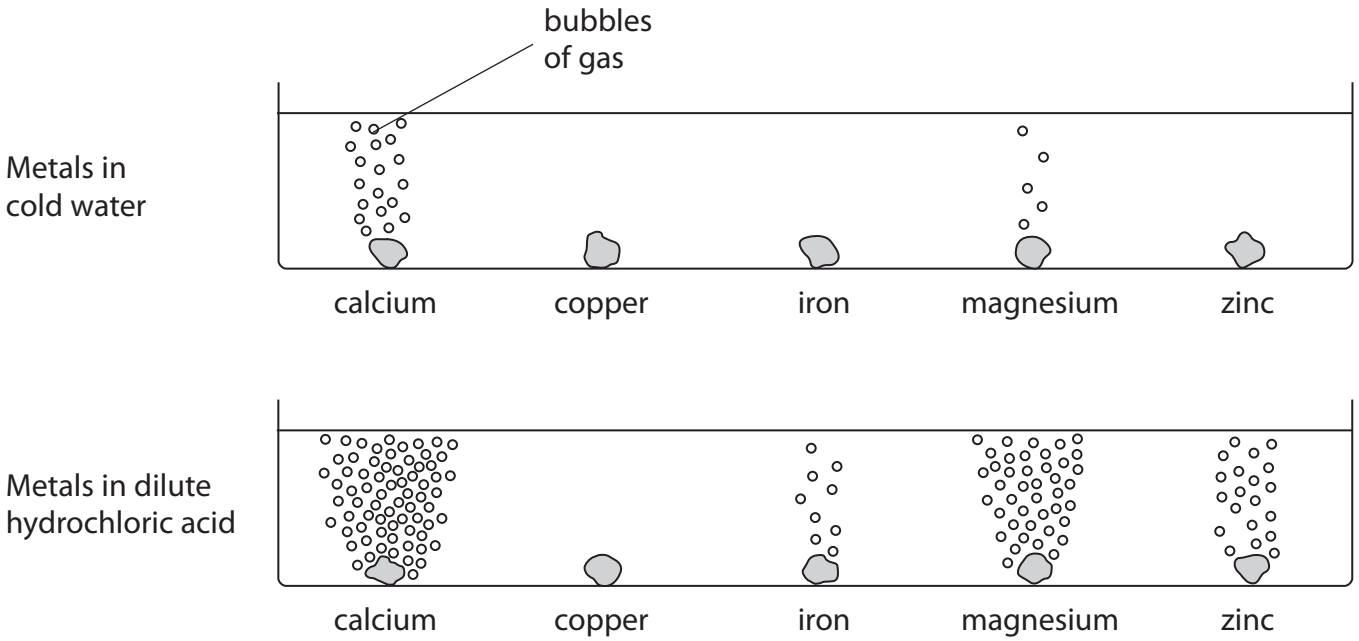
solid X .....

solution Y .....

solid Z .....

(Total for Question 1 = 7 marks)

2 The diagrams show the reactions of some metals with cold water and with dilute hydrochloric acid.



(a) Answer the following questions, using only the metals that appear in the diagrams.

(i) Name **two** metals that react with cold water.

(2)

..... and .....

(ii) Name **one** metal that reacts with dilute hydrochloric acid but **not** with cold water.

(1)

.....

(iii) Arrange the five metals in order of reactivity.

(3)

Most reactive metal .....

.....

.....

.....

Least reactive metal .....

(b) Some magnesium powder is added to dilute sulfuric acid in a test tube.
A colourless solution is formed and a gas is given off.

When more magnesium is added, the reaction continues for a while and then stops, leaving some magnesium powder in the test tube.

When a flame is placed at the mouth of the test tube, the gas burns with a squeaky pop.

(i) Identify the gas produced.

(1)

.....

(ii) Suggest why the reaction stops.

(1)

.....

.....

(iii) State the name of the colourless solution.

(1)

.....

(iv) How could you separate the magnesium powder from the colourless solution?

(1)

.....

.....

(c) In some fireworks, magnesium powder reacts quickly with oxygen in the air.
During this reaction heat energy is produced.

(i) What name is given to reactions in which heat energy is produced?

(1)

.....

(ii) Name the compound formed when magnesium reacts with oxygen.

(1)

.....

(Total for Question 2 = 12 marks)

3 Several methods are used to prepare salts. The method chosen depends on whether the salt is soluble or insoluble in water.

(a) An insoluble salt is prepared by mixing solutions of silver nitrate and sodium chloride.

(i) State the **name** of the insoluble salt formed. **(separate only)**

(1)

(ii) Write a chemical equation for the reaction occurring. **(separate only)**

(2)

(b) The chemical equation for the preparation of the insoluble salt lead(II) sulfate is shown below.

Complete the equation by adding state symbols. **(separate only)**

(1)

$$Pb(NO_3)_2(\quad) + Na_2SO_4(\quad) \rightarrow PbSO_4(\quad) + 2NaNO_3(\quad)$$

(c) A soluble salt is prepared from solutions of an acid and an alkali.

(i) Identify the acid and the alkali used to prepare sodium nitrate. **(separate only)**

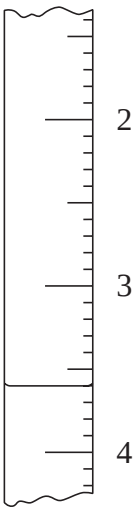
(2)

Acid

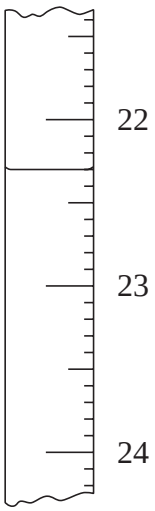
Alkali

(ii) The diagrams show the readings on a burette before and after a student added an alkali to an acid during a titration.

Before



After



Use these diagrams to complete the table below, entering all values to the nearest 0.05 cm^3. **(separate only)**

Burette reading after adding alkali in cm^3	
Burette reading before adding alkali in cm^3	
Volume of alkali added in cm^3	

(3)

(d) A second student also did the titration and recorded these results:

Burette reading after adding alkali in cm^3	24.05	23.30	23.55	23.80
Burette reading before adding alkali in cm^3	0.50	0.80	0.60	1.20
Volume of alkali added in cm^3	23.55	22.50	22.95	22.60
Titration results to be used (✓)				

The volumes of alkali added during these titrations are not all the same. The average (mean) volume of alkali should be calculated using only concordant results.

Concordant results are those volumes that differ from each other by 0.20 cm^3 or less.

(i) Identify the concordant results by placing ticks (✓) in the table as shown.
(separate only) **(1)**

(ii) Use your ticked results to calculate the average (mean) volume of alkali added.
(separate only) **(2)**

Average (mean) volume = cm^3

(e) A student mixed together the acid and alkali to form sodium nitrate solution. She used the volumes needed for complete reaction found in the titration. She heated this solution in an evaporating basin to remove some of the water.

After cooling the concentrated solution, crystals of sodium nitrate formed.

What steps should she now take to obtain dry crystals of sodium nitrate?

(2)

(f) Sodium nitrate decomposes when heated, as shown by the equation

$$2NaNO_3 \rightarrow 2NaNO_2 + O_2$$

A 1.70 g sample of sodium nitrate (M_r = 85) was completely decomposed to sodium nitrite ($NaNO_2$) and oxygen.

Calculate the mass of sodium nitrite formed.

(3)

Mass of sodium nitrite = g

(Total for Question 3 = 17 marks)