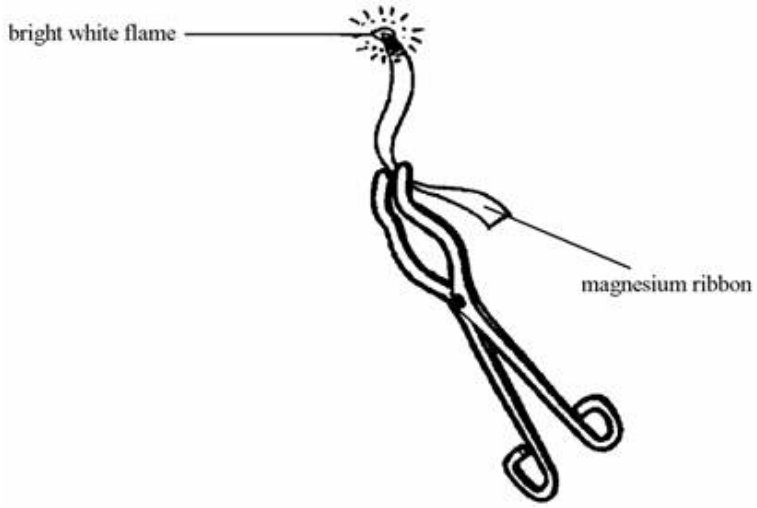
Q1. The diagram shows some magnesium ribbon burning.



(a) Choose words from the list to complete the sentences below.

electrical **heat** **light** **kinetic**

an endothermic **an exothermic** **a neutralisation** **a reduction**

When magnesium burns, it transfers .....

and ..... energy to the surroundings.

We say that it is ..... reaction.

(3)

(b) Complete the word equation for the reaction.

magnesium + _____ ⟶ magnesium oxide

(1)

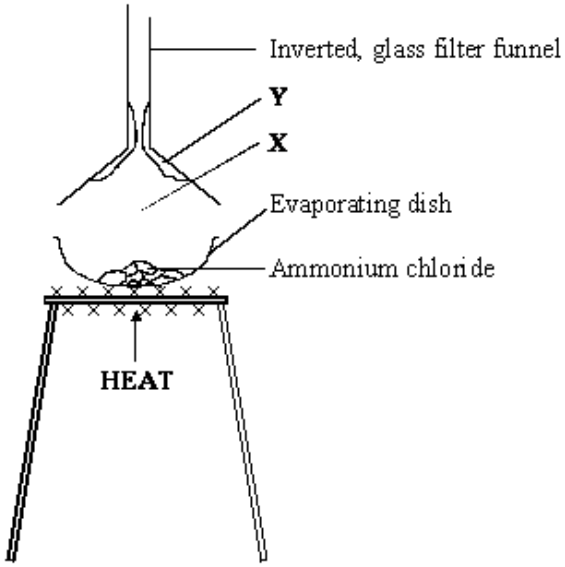
(Total 4 marks)

Q2. (a) The equation for the reaction that takes place when ammonium chloride is heated is:

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

ammonium chloride — ammonia — hydrogen chloride

The diagram shows how a teacher demonstrated this reaction. The demonstration was carried out in a fume cupboard.



(i) Apart from the gases normally in the atmosphere, which two gases would be at **X**?

..... and .....

(1)

(ii) Name the white solid that has formed at **Y**.

.....

(1)

(iii) Why was the demonstration carried out in a fume cupboard?

.....

.....

(1)

(iv) Complete the **four** spaces in the passage.

The chemical formula of ammonia is NH_3. This shows that there is one atom of

..... and three atoms of ..... in each

..... of ammonia. These atoms are joined by bonds that

are formed by sharing pairs of electrons. This type of bond is called

a ..... bond.

(4)

(b) Electrons, neutrons and protons are sub-atomic particles.

(i) Complete the **three** spaces in the table.

Name of sub-atomic particle	Relative mass	Relative charge
.....	1	+1
.....	1	0
.....	$\frac{1}{1840}$	–1

(2)

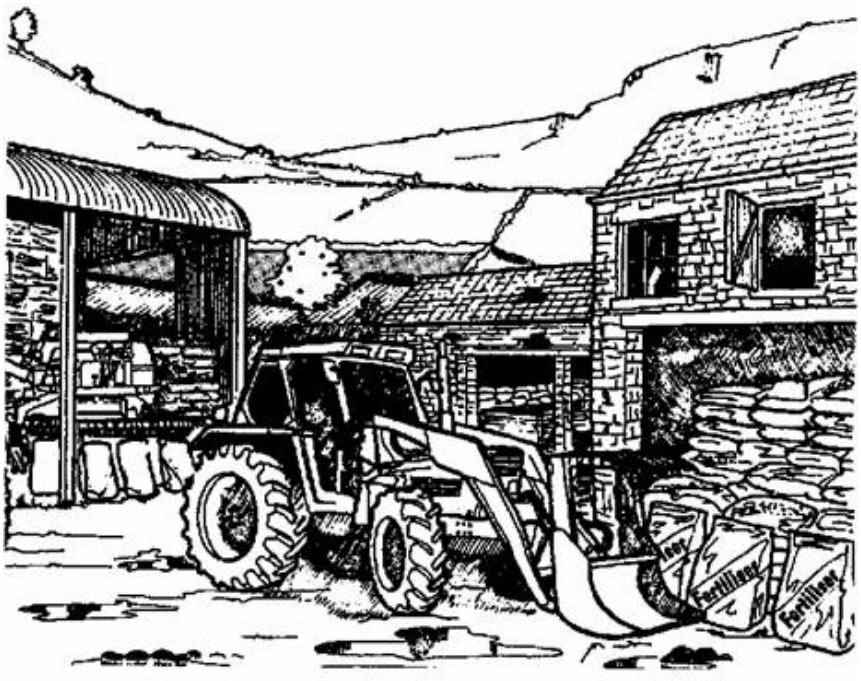
(ii) Which **two** sub-atomic particles are in the nucleus of an atom?

..... and .....

(1)

(Total 10 marks)

Q3. Ammonium nitrate and ammonium sulphate are used as fertilisers.



(i) Which acid reacts with ammonia to form ammonium nitrate?

.....

(1)

(ii) Which acid reacts with ammonia to form ammonium sulphate?

.....

(1)

(iii) The reactions in (i) and (ii) are both exothermic. How can you tell that a reaction is exothermic?

.....

.....

(1)

(iv) The reactions in (i) and (ii) are both examples of acid + base reactions. What is the name of the chemical change which takes place in every acid + base reaction?

.....

(1)

(Total 4 marks)

Q4. This item appeared in the Wolverhampton *Express and Star* on October 31st, 1997. Read the passage and answer the questions that follow.

Fumes scare at factory

Workers were forced to flee a factory after a chemical alert. The building was evacuated when a toxic gas filled the factory.
It happened when nitric acid spilled on to the floor and mixed with magnesium metal powder.

(a) The equation which represents the reaction between magnesium and nitric acid is:

$$Mg_{(s)} + 4HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + 2H_2O_{(1)} + 2NO_{2(g)}$$

Give the formula of the toxic gas that was produced.

.....

(1)

(b) Explain, in terms of particles, how the toxic gas was able to fill the factory quickly.

.....

.....

.....

(2)

(c) The reaction of nitric acid with magnesium metal powder is more dangerous than if the acid had fallen on to the same mass of magnesium bars. Explain why.

.....

.....

.....

(1)

(d) (i) Water was sprayed on to the magnesium and nitric acid to slow down the reaction. Explain, in terms of particles, why the reaction would slow down.

.....

.....

.....

(2)

(ii) Explain why it is better to add alkali, rather than just add water to the spillage.

.....

.....

(1)

(Total 7 marks)

Q5. (i) Which acid from the list should the student add to sodium hydroxide solution to make sodium sulphate?

ethanoic acid **hydrochloric acid** **nitric acid** **sulphuric acid**

.....

(1)

(ii) When the acid was added to the alkali the beaker became warm.
Name the type of reaction that releases heat.

.....

(1)

(iii) Use the Data Sheet to help you to write the formula of sodium sulphate.

Formula: .....

(1)

(Total 3 marks)

Q6. The word equation below shows a reaction used in an industrial process.

chromium oxide + aluminium → chromium + aluminium oxide

The reaction is highly exothermic.

(a) What is an exothermic reaction?

.....

.....

(2)

(b) Name the products of this reaction.

.....

(1)

(c) In the reaction one substance is reduced.

(i) Name the substance which is reduced.

.....

(1)

(ii) What happens to the substance when it is reduced?

.....

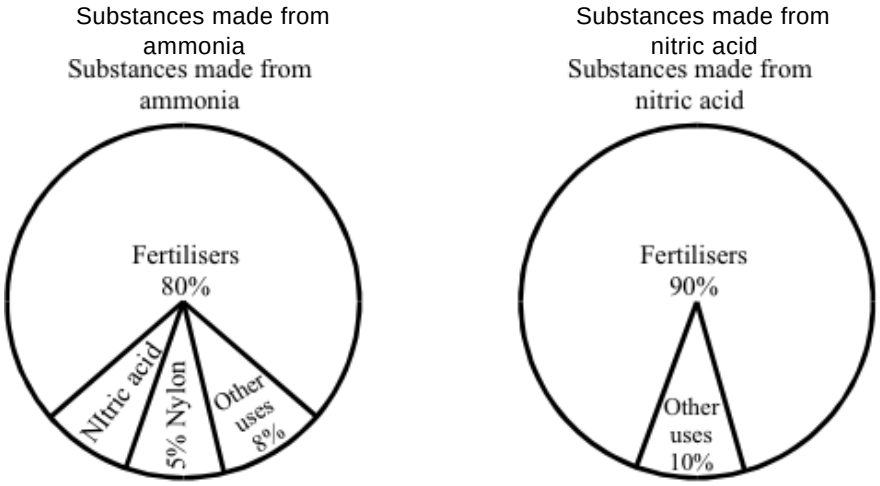
.....

(1)

(Total 5 marks)

Q7. Ammonia and nitric acid are both important chemicals. Nitric acid is made from ammonia.

The charts below show substances made from ammonia and nitric acid.



(a) Use the charts to help you answer these questions.

(i) What is the main use of both ammonia and nitric acid?

.....

(1)

(ii) Work out the percentage of ammonia used to make nitric acid.

Percentage = ... %

(1)

(iii) 100 million tonnes of ammonia are made in the world each year.

How much of this ammonia is used to make nylon?

..... million tonnes

(1)

(b) The word equations below show how nitric acid is made.

1. nitrogen + hydrogen → ammonia
2. ammonia + oxygen → nitrogen monoxide + water
3. nitrogen monoxide + oxygen → nitrogen dioxide
4. nitrogen dioxide + water → nitric acid

Use the word equations to help you answer these questions.

(i) From which **two** elements is ammonia made?

..... and .....

(1)

(ii) Name **two** of the raw materials needed to make nitric acid.

..... and .....

(2)

(c) A large amount of nitric acid is reacted with ammonia to make a fertiliser.

nitric acid + ammonia → fertiliser

(i) The reaction is a neutralisation reaction.

What type of chemical must ammonia be?

.....

(1)

(ii) Complete the chemical name for the fertiliser made from ammonia and nitric acid.

ammonium .....

(1)

(iii) The reaction of nitric acid with ammonia is exothermic.

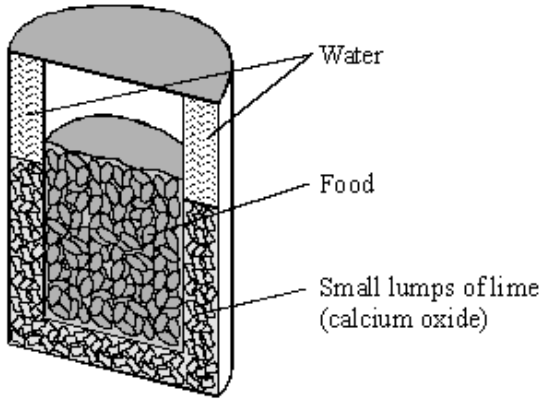
Name the piece of equipment you could put into the solution to prove that the reaction is exothermic.

.....

(1)

(Total 9 marks)

Q8. Mountaineers can warm their food in self-heating, sealed containers.



(a) The water is allowed to react with the lime. The heat from the reaction warms the food. What type of reaction causes a rise in temperature?

.....

(1)

(b) Some students investigated the effect of adding different sized lumps of lime to water. The results of their investigation are shown.

Time in minutes	Temperature in °C		
	Large lumps of lime	Small lumps of lime	Powdered lime
0	18	18	18
1	19	20	28
2	21	23	43
3	24	27	63
4	28	32	88
5	33	38	100

What do these results show? Give an explanation for your answer.

.....

.....

.....

.....

(2)

(c) Suggest and explain **one** disadvantage of using powdered lime to heat food.

.....

.....

.....

(2)

(Total 5 marks)

Q9. Read the information in the box.

Flash powder is used to produce special effects at pop concerts.

Flash powder contains aluminium. The powder burns with a bright white flame and gives out lots of heat and light. It also produces white smoke.

The flash powder is placed on stage in a special container. At the bottom of the container there is a thin piece of wire. When the flash is needed, electricity is passed through the wire. The wire gets hot and starts the aluminium burning.

By russelljsmith [CC BY 2.0], via Flickr

(a) When aluminium burns the reaction is *exothermic*.

What is the meaning of *exothermic*?

.....

.....

(1)

(b) The hot wire provides energy to start the aluminium burning.

What is the name given to the heat energy needed to start a chemical reaction?

..... energy

(1)

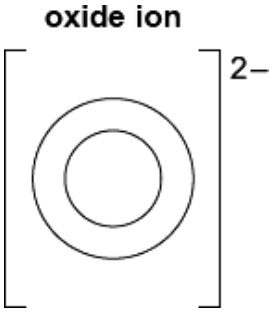
(c) The white smoke produced is aluminium oxide.

Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

(i) Complete the diagram to show the electronic structure of an oxide ion.

The atomic number of oxygen = 8

Use crosses (x) to represent the electrons.



(1)

(ii) The bonding in aluminium oxide is ionic.

What causes the aluminium ions and oxide ions to be held together strongly?

.....

.....

(1)
(Total 4 marks)

Q10. Read the information.

> Alumina is a white solid. In 1800, scientists thought that alumina contained an undiscovered metal. We now call this metal aluminium. At that time, scientists could not extract the aluminium from alumina.
>
> In 1825, Christian Oersted, a Danish scientist, did experiments with alumina.
>
> **Step 1** He reacted a mixture of hot alumina and carbon with chlorine to form aluminium chloride. The reaction is very endothermic.
>
> **Step 2** The aluminium chloride was reacted with potassium. He was left with potassium chloride and tiny particles of aluminium metal.
>
> Other scientists were **not** able to obtain the same results using his experiment and his work was not accepted at that time.
>
> In 1827, Friedrich Wöhler, a German chemist, made some changes to Oersted's experiment. He obtained a lump of aluminium. He tested the aluminium and recorded its properties.

(a) Suggest why scientists in 1800 could not extract aluminium from alumina.

.....

.....

(1)

(b) Oersted's experiment in 1825 was **not** thought to be reliable.

Explain why

.....

.....

(1)

(c) Why must the reaction in **Step 1** be heated to make it work?

.....

.....

(1)

(d) Complete the word equation for the reaction in **Step 2**.

aluminium chloride + potassium → ..... + ...

(1)

(e) Suggest how Wöhler was able to prove that he had made a new metal.

.....

.....

.....

.....

(2)
(Total 6 marks)

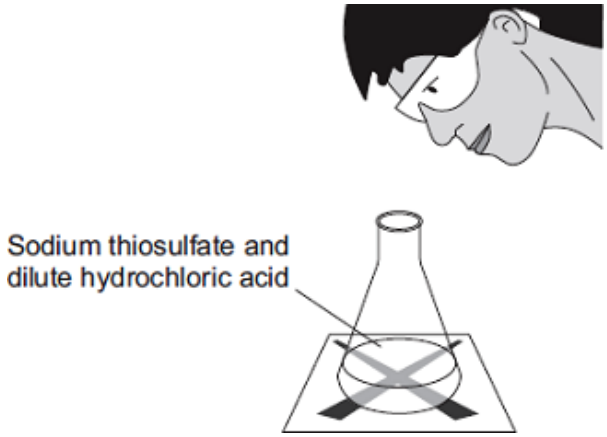
Q11. A student investigated the rate of reaction between sodium thiosulfate and dilute hydrochloric acid.

The student placed a conical flask over a cross on a piece of paper.

The student mixed the solutions in the flask.

The solution slowly went cloudy.

The student timed how long it took until the cross could not be seen.



The equation for the reaction is:

$Na_2S_2O_3$ (aq)	+	2 HCl(aq)	→	2 NaCl(aq)	+	H_2O(l)	+	SO_2(g)	+	S(s)
sodium thiosulfate	+	hydrochloric acid	→	sodium chloride	+	water	+	sulfur dioxide	+	sulfur

(a) Explain why the solution goes cloudy.

.....

.....

.....

.....

(2)

(b) The student repeated the experiment with different concentrations of sodium thiosulfate.

Concentration of sodium thiosulfate in moles per dm^3	Time taken until the cross could not be seen in seconds			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
0.040	71	67	69	69
0.060	42	45	45	44
0.080	31	41	33	

(i) Calculate the mean time for 0.080 moles per dm^3 of sodium thiosulfate.

.....

.....

.....

Mean = ... seconds

(2)

(ii) Describe and explain, in terms of particles and collisions, the effect that increasing the concentration of sodium thiosulfate has on the rate of the reaction.

.....

.....

.....

.....

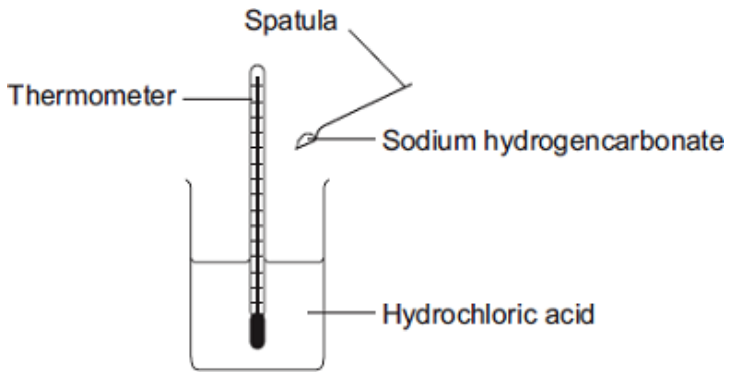
.....

.....

(3)

(Total 7 marks)

Q12. (a) Some students did an experiment to find the temperature change when hydrochloric acid reacts with sodium hydrogencarbonate.



The results are in the table.

Number of spatula measures of sodium hydrogencarbonate	Start temperature in °C	Final temperature in °C	Change in temperature in °C
2	20	16	4
4	20	14	6
6	19	11	8
8	20	10	10
10	19	9	10
12	20	10	10

(i) Describe, as fully as you can, the trends shown in the students' results.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) State the type of energy transfer for this reaction.

.....

.....

(1)

(b) Sodium hydrogencarbonate is used as baking powder for making cakes.

When the cake mixture is baked the sodium hydrogencarbonate decomposes.

The equation for the reaction is:

$$2\,NaHCO_3(s) \xrightarrow{\text{Heat}} Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

(i) The cake mixture rises when baked.

© Michael Valdez/iStock

Use the equation to suggest why.

.....

.....

(1)

(ii) The same reaction can be reversed to produce sodium hydrogencarbonate from sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2NaHCO_3$$

Do the reactants need to be heated?

Give a reason for your answer.

.....

.....

(1)

(c) (i) Calculate the relative formula mass of sodium hydrogencarbonate ($NaHCO_3$).

Relative atomic masses (A_r): H=1; C=12; O=16; Na=23

.....

.....

.....

Relative formula mass (M_r) = ...

(2)

(ii) Calculate the percentage by mass of carbon in sodium hydrogencarbonate.

.....

.....

Percentage of carbon = ... %

(1)

(Total 9 marks)