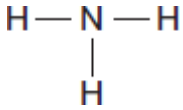
Name_____

2019 Bridging the Gap work for Chemistry A level

Q1.(a) A particle of ammonia is represented by the formula NH_3 or as:



(i) How many different elements are there in a particle of ammonia?

..... **(1)**

(ii) Draw a ring around the correct answer to complete the sentence.

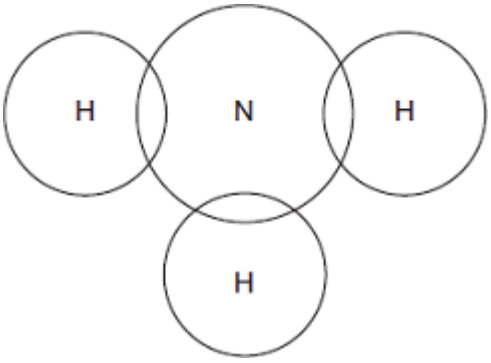
A particle of ammonia is called

an atom.
an ion.
a molecule.

(1)

(iii) Complete the dot and cross bonding diagram for ammonia.

Show **only** electrons in the outer energy level of each atom. **(2)**



(b) Ammonia gas reacts with hydrogen chloride gas to produce a white solid.

The formula of the white solid is NH_4Cl

(i) Complete the equation by adding the correct state symbols.

NH_3(g) + HCl(.....) ⟶ NH_4Cl(.....)

(1)

(ii) The white solid has the formula NH_4Cl

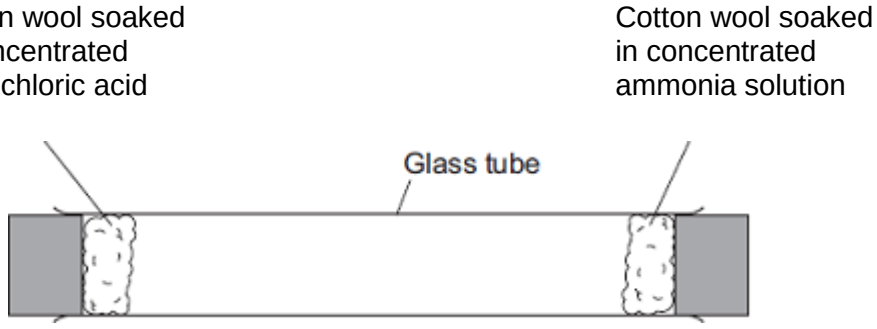
Complete the name of the white solid. Ammonium .....

(1)

(c) Concentrated ammonia solution gives off ammonia gas.
Concentrated hydrochloric acid gives off hydrogen chloride gas.

Apparatus was set up as shown in **Diagram 1**.

Diagram 1



(i) Concentrated hydrochloric acid is corrosive.
Give **one** safety precaution you should take when using concentrated hydrochloric acid.

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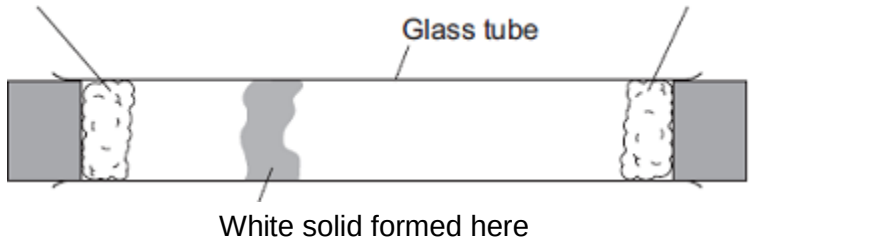
..... **(1)**

(ii) After 3 minutes a white solid was seen in the glass tube, as shown in **Diagram 2**.

Diagram 2



Suggest why the white solid is seen nearer the concentrated hydrochloric acid than the concentrated ammonia.

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..... **(1)**

(iii) The experiment was repeated at a higher temperature.
Explain why the white solid was produced in less than 3 minutes.

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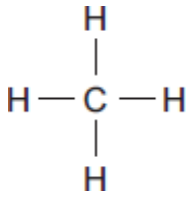
..... **(2)**

(Total 10 marks)

Q2. Saturated hydrocarbons, for example methane and octane, are often used as fuels.

(a) Methane can be represented as:



(i) The formula of methane is ..... .

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

In a saturated hydrocarbon molecule all of the bonds are

double.
ionic.
single.

(1)

(iii) Draw a ring around the correct answer to complete the sentence.

The homologous series that contains methane and octane is called the

alcohols.
alkanes.
alkenes.

(1)

(b) (i) The complete combustion of petrol produces carbon dioxide, water vapour and sulfur dioxide.

Name **three** elements petrol must contain.

1 .....

2 .....

3 .....

(3)

(ii) The exhaust gases from cars can contain oxides of nitrogen.

Complete the sentence.

Nitrogen in the oxides of nitrogen comes from ..... .

(1)

(iii) The sulfur dioxide and oxides of nitrogen from cars cause an environmental problem.

Name the problem and describe **one** effect of the problem.

Name of problem .....

Effect of problem .....

.....

(2)

(c) When a fuel burns without enough oxygen, there is incomplete combustion.

One gaseous product of incomplete combustion is carbon monoxide.

Name **one** solid product of incomplete combustion.

.....

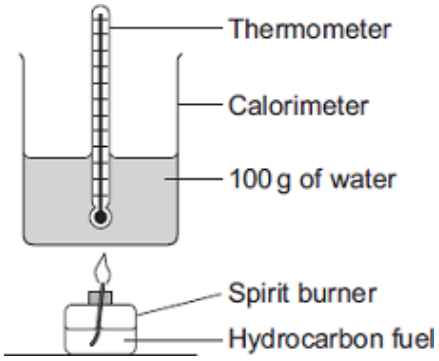
(1)

(d) A student investigated how well different hydrocarbon fuels would heat up 100 g of water.

Her hypothesis was:

The more carbon atoms there are in a molecule of any fuel, the better the fuel is.

The apparatus the student used is shown in the diagram.



She burned each hydrocarbon fuel for 2 minutes.

Her results are shown in the table.

Name of hydrocarbon fuel	Number of carbon atoms in a molecule of hydrocarbon fuel	Temperature change of water in °C after 2 minutes	Temperature change per g of fuel burned	Observations
Pentane	5	30	60	no smoke
Hexane	6	40	57	very small amount of smoke
Octane	8	55	55	small amount of smoke
Decane	10	57	52	large amount of smoke
Dodecane	12	60	43	very large amount of smoke

The student investigated only hydrocarbons.

Look carefully at her results.

How well do the student's results support her hypothesis?

The more carbon atoms there are in a molecule of any fuel, the better the fuel is.

Give reasons for your answer.

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(4)

(e) A 0.050 mol sample of a hydrocarbon was burned in excess oxygen.

The products were 3.60 g of water and 6.60 g of carbon dioxide.

(i) Calculate the number of moles of carbon dioxide produced.

Relative atomic masses: C = 12; O = 16.

.....

.....

Moles of carbon dioxide = ...

(2)

(ii) When the hydrocarbon was burned 0.20 mol of water were produced.

How many moles of hydrogen atoms are there in 0.20 mol of water?

.....

Moles of hydrogen atoms = ...

(1)

(iii) The amount of hydrocarbon burned was 0.050 mol.

Use this information and your answers to parts **(e) (i)** and **(e) (ii)** to calculate the molecular formula of the hydrocarbon.

If you could not answer parts **(e) (i)** or **(e) (ii)** use the values of 0.20 moles carbon dioxide and 0.50 moles hydrogen. These are **not** the answers to parts **(e) (i)** and **(e) (ii)**.

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Formula = ...

(2)

(Total 19 marks)

Q3. Copper is a widely used material.

One method of obtaining copper involves roasting copper(I) sulfide in air.

$$Cu_2S + O_2 \longrightarrow 2Cu + SO_2$$

(a) (i) Sulfur dioxide released into the air can cause acid rain.

State **one** problem caused by acid rain.

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(1)

(ii) The sulfur dioxide produced is soluble in water.

Write a chemical equation for the reaction of sulfur dioxide with water.

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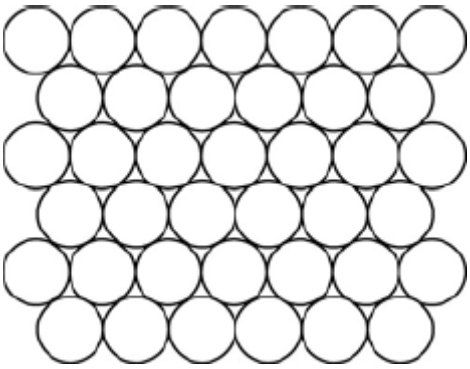
(1)

(b) The diagram shows the structure of a metal such as copper.



Use the diagram to help you explain why:

(i) copper is malleable

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(2)

(ii) copper is an element.

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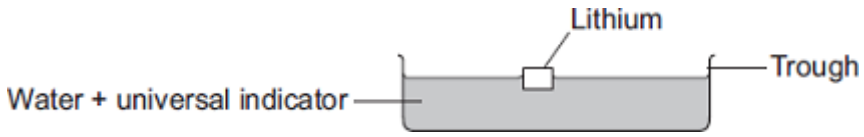
(1)

(Total 5 marks)

Q4. A student was investigating the reaction of lithium and water.

She added a few drops of universal indicator to water in a trough and added a piece of lithium.



The word equation for the reaction is:

lithium + water ⟶ lithium hydroxide + hydrogen

(a) (i) The lithium floated on the water.

State **two** other observations that the student would **see** during the reaction.

1 .....

2 .....

(2)

(ii) Balance the symbol equation for the reaction of lithium and water.

2 Li(s) + ... H_2O(l) ⟶ ..... LiOH(aq) + H_2(g)

(2)

(iii) Describe a simple test and the result that would show the gas was hydrogen.

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(1)

(iv) All Group 1 metals have similar reactions with water.

State why, in terms of electronic structure.

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(1)

(b) Lithium and other Group 1 metals have different properties from the transition metals.

Tick (✓) **two** properties that are properties of Group 1 metals.

They react with oxygen. ☐

They form coloured compounds. ☐

They are strong and hard. ☐

They have low melting points. ☐

(2)

(c) The electronic structure of a potassium atom is 2, 8, 8, 1

(i) Draw a diagram to show the electronic structure of a potassium ion.

Show the charge on the potassium ion.

(2)

(ii) Potassium is more reactive than sodium.

Explain why, in terms of electronic structure.

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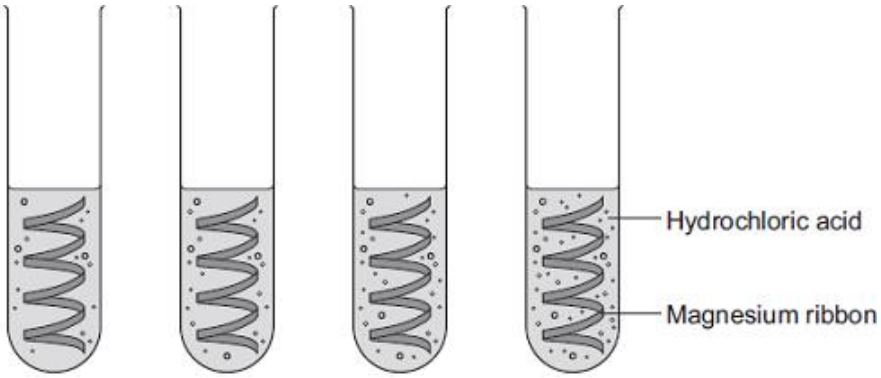
(3)
(Total 13 marks)

Q5. A student investigated the rate of reaction of magnesium and hydrochloric acid.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

The student studied the effect of changing the concentration of the hydrochloric acid.

She measured the time for the magnesium to stop reacting.



Concentration of hydrochloric acid in moles per dm^3	0.5	1.0	1.5	2.0

(a) The student changed the concentration of the hydrochloric acid.

Give **two** variables that the student should control.

1 .....

2 ..... **(2)**

(b) (i) The rate of reaction increased as the concentration of hydrochloric acid increased.

Explain why.

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..... **(2)**

(ii) Explain why increasing the temperature would increase the rate of reaction.

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..... **(3)**

(c) (i) The student had a solution of sodium hydroxide with a concentration of 0.100 moles per dm^3.

She wanted to check the concentration of a solution of hydrochloric acid.

She used a pipette to transfer 5.00 cm^3 of the hydrochloric acid into a conical flask.

She filled a burette with the 0.100 moles per dm^3 sodium hydroxide solution.

Describe how she should use titration to obtain accurate results.

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(4)

(ii) Sodium hydroxide neutralises hydrochloric acid as shown in the equation:

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

The student found that 27.20 cm^3 of 0.100 moles per dm^3 sodium hydroxide neutralised 5.00 cm^3 of hydrochloric acid.

Calculate the concentration of the hydrochloric acid in moles per dm^3.

Give your answer to three significant figures.

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Concentration of hydrochloric acid = ... moles per dm^3

(3)

(Total 14 marks)