AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.4.2 REACTIONS OF ACIDS (PACK 5)

SCORE	PERCENTAGE
/218	%

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Q1.

This question is about acids and bases.

(a) Which ion is found in all acids?

Tick **one** box.

Cl^- ☐ H^+ ☐ Na^+ ☐ OH^- ☐

(1)

(b) Zinc nitrate can be produced by reacting an acid and a metal oxide.

Name the acid and the metal oxide used to produce zinc nitrate.

Acid _____

Metal oxide _____

(2)

(c) In an equation, zinc nitrate is written as $Zn(NO_3)_2(aq)$.

What does (aq) mean?

Tick **one** box.

Dissolved in water ☐

Insoluble ☐

Not all reacted ☐

Reactant ☐

(1)

(d) The pH of a solution is 8

Some hydrochloric acid is added to the solution.

Suggest the pH of the solution after mixing.

pH = _____

(1)

(e) **Table 1** shows the solubility of three solids in water at room temperature.

Table 1

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Solid	The mass of the solid that dissolves in 100 cm^3 of water
Phosphorus oxide	50 g
Silicon dioxide	0 g
Sodium hydroxide	100 g

A teacher labelled these three solids **A**, **B** and **C**.

She gave a student the information shown in **Table 2**

Table 2

Solid	Observation when added to water	pH of the solid in water
A	colourless solution	14
B	colourless solution	2
C	solid does not dissolve	7

Describe a method that could be used to identify each of the three solids **A**, **B** and **C**.

You must use an indicator in the method.

Use information in **Table 1** and **Table 2**

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

Q2.

A student plans a method to prepare pure crystals of copper sulfate.

The student's method is:

1. Add one spatula of calcium carbonate to dilute hydrochloric acid in a beaker.

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2. When the fizzing stops, heat the solution with a Bunsen burner until all the liquid is gone.

The method contains several errors and does not produce copper sulfate crystals.

Explain the improvements the student should make to the method so that pure crystals of copper sulfate are produced.

(Total 6 marks)

Q3.

A scientist does two tests on four white solids. The solids are labelled **A**, **B**, **C** and **D**.

Test 1 Adds the sample of the solid to distilled water and stirs.

Test 2 Measures the pH of the solution after **Test 1**

Table 1 shows the results.

Table 1

Solid	Appearance after stirring	pH

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A	colourless solution, no solid	14
B	colourless solution, no solid	3
C	colourless solution, solid remains	9
D	colourless liquid, solid remains	7

These four solids are:

- magnesium oxide
- phosphorus oxide
- silicon dioxide
- sodium oxide.

Table 2 shows the solubility of these four solids in water.

Table 2

Solid	**Solubility in grams per 100 cm^3 of water**
Magnesium oxide	0.01
Phosphorus oxide	52
Silicon dioxide	0
Sodium oxide	109

(a) Identify the solids **A**, **B**, **C** and **D**.

Explain your answers.

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(6)

(b) 10 cm^3 of solution **B** is added to a beaker.

Distilled water is added to the beaker until the final volume in the beaker is 1000 cm^3

The pH of the solution is measured before and after distilled water is added.

Table 3 shows the results.

Table 3

Volume of solution in beaker	pH of solution B
10 cm^3	3
1000 cm^3	**X**

Calculate the value of **X**.

X = _____

(2)

(Total 8 marks)

Q4.

This question is about iron.

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

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(a) Name the other product.

_____

(1)

(b) Suggest how any unreacted iron can be separated from the mixture.

_____

_____

(1)

Magnesium reacts with iron chloride solution.

$$3\ Mg + 2\ FeCl_3 \longrightarrow 2\ Fe + 3\ MgCl_2$$

(c) 0.120 g of magnesium reacts with excess iron chloride solution.

Relative atomic masses (A_r): Mg = 24 Fe = 56

Calculate the mass of iron produced, in mg

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Mass of iron = _____ mg

(5)

(d) Explain which species is reduced in the reaction between magnesium and iron chloride.

$$3\ Mg + 2\ FeCl_3 \longrightarrow 2\ Fe + 3\ MgCl_2$$

Your answer should include the half equation for the reduction.

_____

_____

_____

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_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q5.

A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide.

This is the method used.

1. Add 25.0 cm^3 of sodium hydroxide solution to a polystyrene cup.
2. Measure the temperature of the sodium hydroxide solution.
3. Add 25.0 cm^3 of hydrochloric acid to the sodium hydroxide solution.
4. Stir the solution.
5. Measure the maximum temperature of the solution.

(a) Draw **one** line from each measurement to the most suitable piece of equipment to use to make the measurement.

Measurement	Equipment
	balance
Temperature of solution	beaker
	measuring cylinder
Volume of hydrochloric acid	metre rule
	thermometer

(2)

(b) The teacher did the experiment four times.

The table below shows the teacher's results.

Experiment	Maximum temperature rise in °C

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1	6.1
2	7.8
3	6.1
4	6.4

Calculate the mean maximum temperature rise.

Do **not** use the anomalous result in your calculation.

_____

_____

_____

_____

Mean maximum temperature rise = _____ °C

(2)

(c) How could the accuracy of the experiment be improved?

Tick **one** box.

Add 20.0 cm^3 of hydrochloric acid ☐

Use a lid on the polystyrene cup ☐

Use a metal beaker ☐

Use a thermometer with a resolution of 1 °C ☐

(1)

The reaction between hydrochloric acid and sodium hydroxide is a neutralisation reaction.

The reaction produces a salt and one other product.

(d) Complete the word equation for the reaction.

hydrochloric acid + sodium hydroxide ⟶ _____ + _____

(2)

(e) Universal indicator is used to measure the pH of solutions.

Hydrochloric acid is pH 1

Sodium hydroxide is pH 13

Draw **one** line from the pH to the colour of universal indicator in a solution with that

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pH.

pH	Colour of universal indicator
	green
1	orange
	purple
13	red
	yellow

(2)

(Total 9 marks)

Q6.

When a metal carbonate reacts with an acid, a salt, carbon dioxide and water are produced.

(a) Describe how you would test for carbon dioxide gas.

Test _____

_____

Result _____

_____

(2)

(b) Describe how to make pure dry crystals of magnesium chloride from magnesium carbonate and a dilute acid.

In your method you should name the apparatus and reagents you plan to use.

_____

_____

_____

_____

_____

_____

_____

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(6)

(Total 8 marks)

Q7.

A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide solution.

This is the method used.

1. Measure 25 cm^3 of sodium hydroxide solution using a measuring cylinder.
2. Add the sodium hydroxide solution to a polystyrene cup.
3. Record the temperature of the sodium hydroxide solution.
4. Add 5 cm^3 of hydrochloric acid from a burette to the sodium hydroxide solution.
5. Stir the solution.
6. Record the temperature of the solution.
7. Repeat steps 4−6 until 50 cm^3 of hydrochloric acid in total is added.

The table below shows some of the teacher's results.

Volume of hydrochloric acid added in cm^3	**Temperature in °C**
0	21.30
5	24.25
10	26.15
15	27.05
20	27.70

(a) The graph below shows the results when 30 cm^3 to 50 cm^3 of hydrochloric acid was added to sodium hydroxide solution.

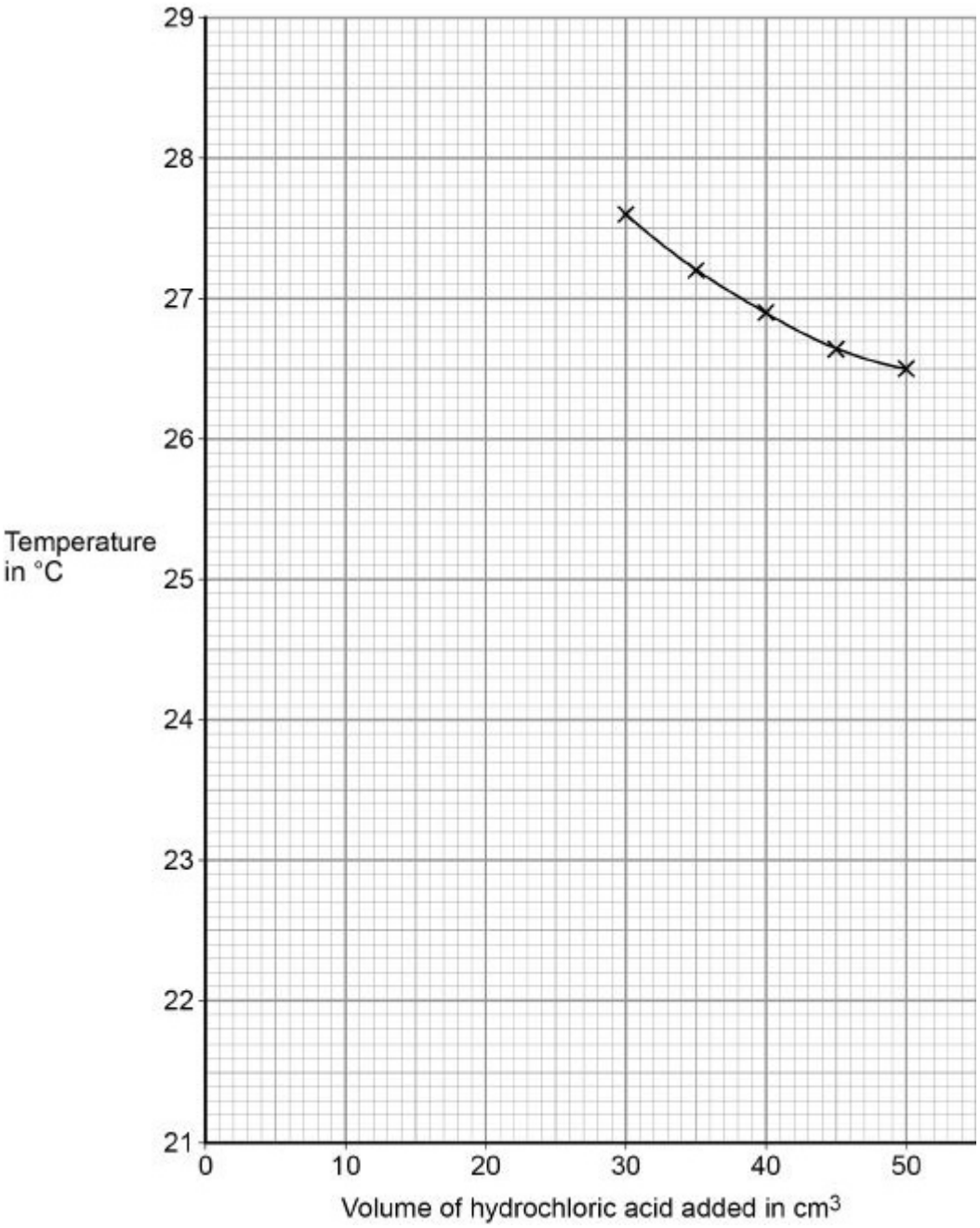
A line of best fit has been drawn through these results.

Complete the graph below.

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You should:

- plot the data from the table above on the graph below
- draw a line of best fit through these results
- continue both lines of best fit until the lines meet.



(4)

(b) Estimate the maximum temperature reached in the reaction.

Use the graph above

Maximum temperature = _____ °C

(1)

(c) The teacher used a temperature sensor to measure the temperature of the reaction mixture.

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What is the resolution of the temperature sensor?

Tick **one** box.

1×10^{-1} °C ☐

1×10^{-2} °C ☐

1×10^{-3} °C ☐

1×10^{-4} °C ☐

(1)

(d) Suggest **two** ways of improving the accuracy of the results.

1. _____

_____

2. _____

_____

(2)

(e) The pH of the solution changes as hydrochloric acid is gradually added to sodium hydroxide solution, until hydrochloric acid is in excess.

Describe how the pH of the solution changes.

Give reasons for these changes.

You should refer to the pH value of the solution at different stages in the procedure.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

(6)

(f) In a different demonstration the teacher used a 25 cm^3 solution containing 1.4 g of sodium hydroxide.

Calculate the concentration of the sodium hydroxide solution in g/dm^3

_____

_____

_____

_____

Concentration of sodium hydroxide solution = _____ g/dm^3

(2)

(Total 16 marks)

Q8.

This question is about electrolysis.

(a) How many different elements are in the formula $AgNO_3$?

Tick **one** box.

2 ☐ 3 ☐ 5 ☐ 6 ☐

(1)

(b) How many atoms are in the formula $AgNO_3$?

Tick **one** box.

2 ☐ 3 ☐ 5 ☐ 6 ☐

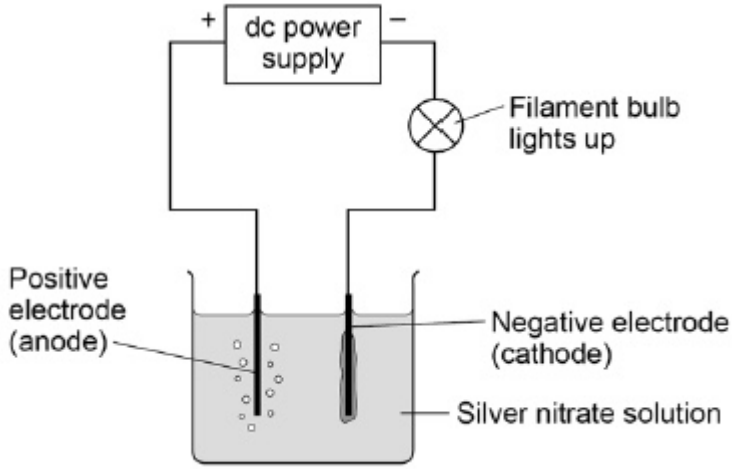
(1)

An electric current is passed through silver nitrate solution.

Figure 1 shows the apparatus.

Figure 1

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The solution contains four ions:

- Ag^+
- H^+
- NO_3^-
- OH^-

(c) Where do the H^+ and OH^- ions come from?

Tick **one** box.

Air	☐
Electrodes	☐
Silver nitrate	☐
Water	☐

(1)

(d) Ag^+ ions and H^+ ions are attracted to the negative electrode (cathode).

Give a reason why.

_____

_____

(1)

(e) Silver is produced at the negative electrode (cathode) and not hydrogen.

What does this tell you about the reactivity of silver?

Tick **one** box.

Silver is less reactive than hydrogen	☐
Silver is less reactive than	☐

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oxygen

Silver is more reactive than nitrate ☐

Silver is more reactive than water ☐

(1)

(f) The hydroxide ion (OH^-) is attracted to the positive electrode (anode).

The equation shows what happens at the positive electrode (anode).

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

Name the gas produced at the positive electrode (anode).

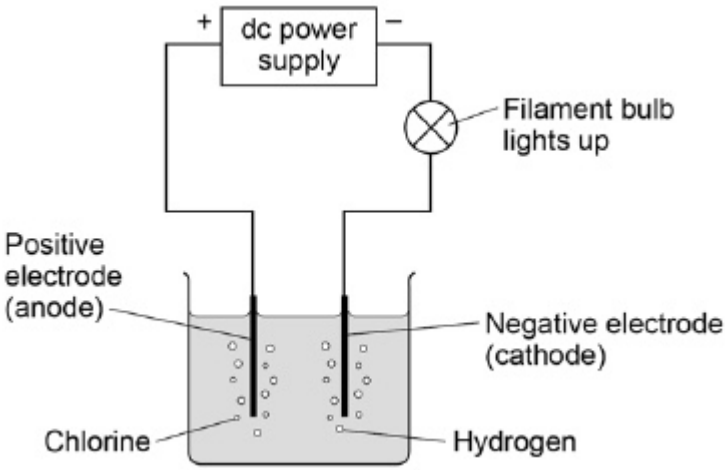
_____

(1)

(g) An electric current is passed through sodium chloride solution.

Figure 2 shows the apparatus.

Figure 2



After passing an electric current through sodium chloride solution one product is sodium hydroxide (NaOH) solution.

The presence of sodium hydroxide can be shown by adding an indicator.

Name an indicator.

Give the colour of the indicator in sodium hydroxide solution.

Indicator _____

Colour _____

(2)

(Total 8 marks)

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Q9.

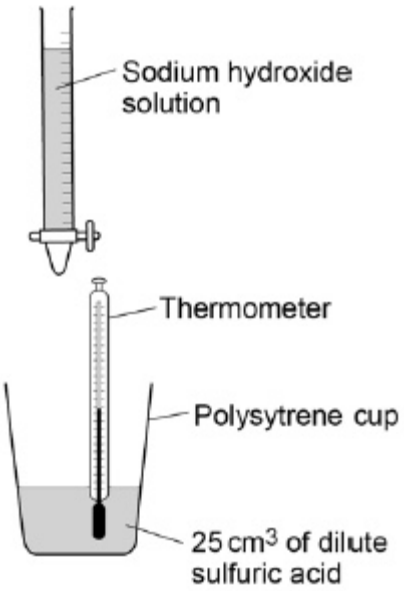
Some students investigated the change in temperature as sodium hydroxide solution is added to dilute sulfuric acid.

This is the method used.

1. Put 25 cm^3 of dilute sulfuric acid into a polystyrene cup.
2. Measure the initial temperature of the dilute sulfuric acid.
3. Add 4 cm^3 of sodium hydroxide solution to the dilute sulfuric acid.
4. Stir the mixture.
5. Measure the highest temperature of the mixture.
6. Repeat steps 3–5 until 40 cm^3 of sodium hydroxide solution have been added.

Figure 1 shows the apparatus the student used.

Figure 1



(a) The volume of sodium hydroxide solution is a variable.

Which **two** words can be used to describe this type of variable?

Tick **two** boxes.

- Categoric ☐
- Continuous ☐
- Control ☐
- Dependent ☐

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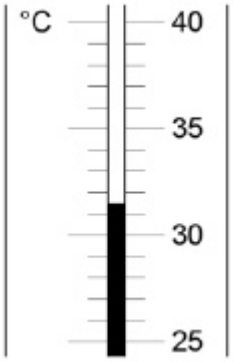
Independent ☐

(2)

(b) The dilute sulfuric acid has an initial temperature of 24.0 °C

Figure 2 shows the highest temperature.

Figure 2



Calculate the change in temperature.

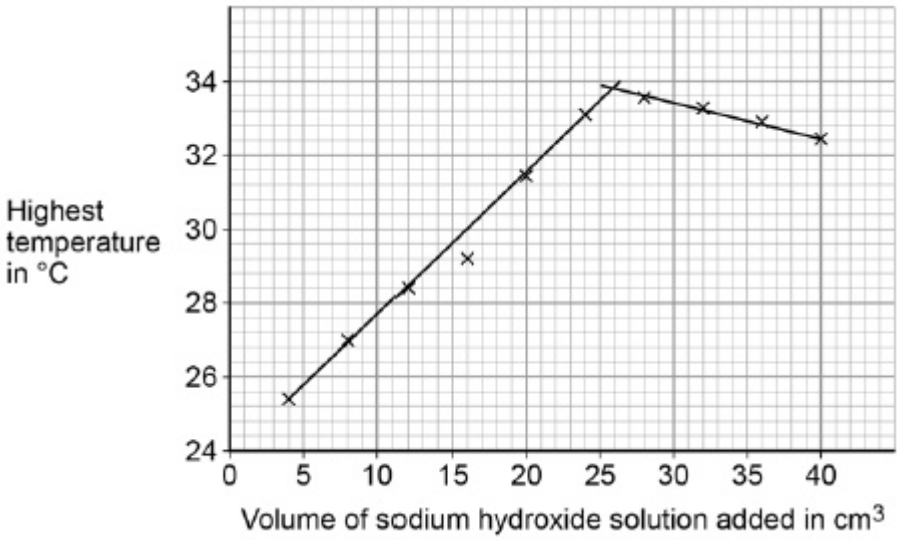
_____

Temperature = _____ °C

(2)

Figure 3 shows the students' results.

Figure 3



(c) Determine the volume of sodium hydroxide solution that gives the highest temperature change.

Use **Figure 3** to help you answer this question.

Volume = _____ cm^3

(1)

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(d) In **Figure 3** the temperature when 16 cm^3 of sodium hydroxide solution is added is anomalous.

Suggest **one** error that could have been made in the method which would cause this anomalous result.

_____

_____

(1)

(e) The sodium hydroxide solution in this investigation contains 80 grams per dm^3

The students use 40 cm^3 of sodium hydroxide solution.

Calculate the mass of sodium hydroxide in 40 cm^3

_____

_____

_____

_____

_____

Mass = _____ g

(3)

(Total 9 marks)

Q10.

This question is about metals and metal compounds.

(a) Copper oxide reacts with hydrochloric acid to produce copper chloride and water.

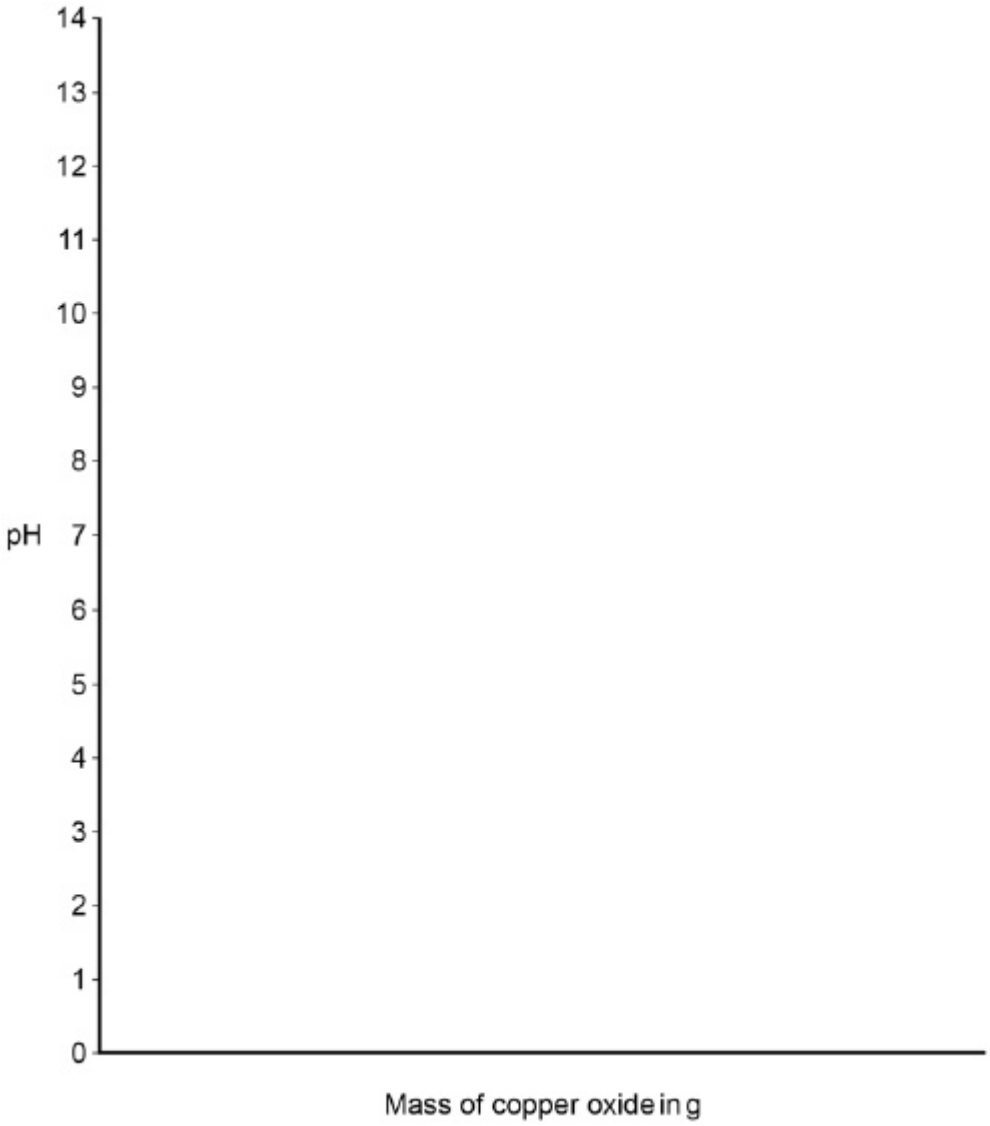
Copper oxide is insoluble in water.

Copper oxide is gradually added to hydrochloric acid until in excess.

Sketch a graph on **Figure 1** to show how the pH of the hydrochloric acid would change.

Figure 1

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(3)

(b) Magnesium reacts with hydrochloric acid to produce magnesium chloride and hydrogen.

Plan an investigation to find the accurate volume of hydrogen produced from magnesium.

You do **not** need to write about safety precautions.

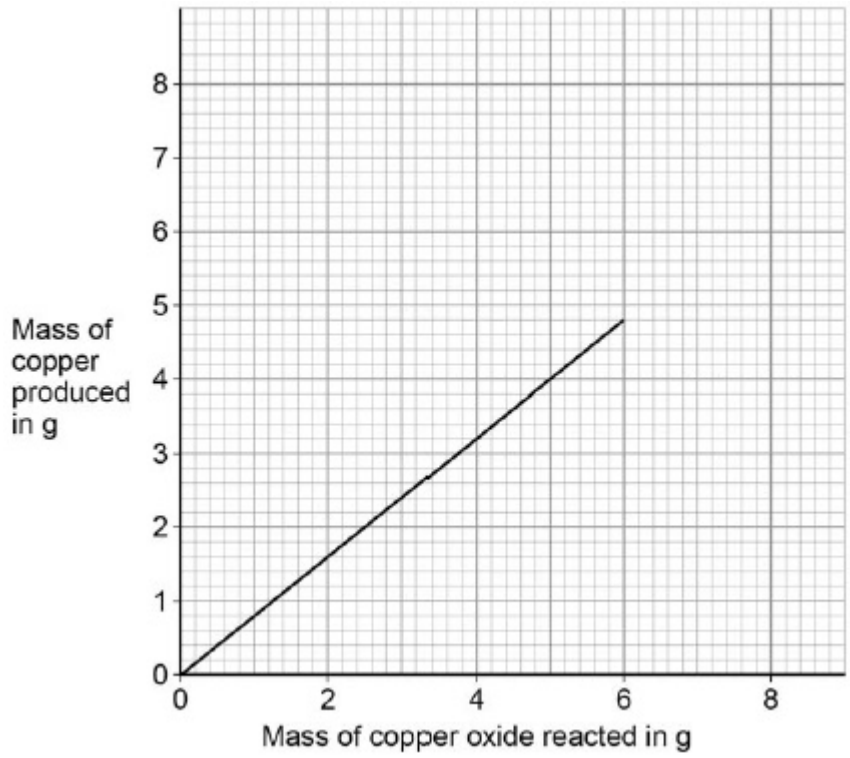
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(6)

A student reacts different masses of copper oxide with excess zinc to produce copper.

Figure 2 shows the student's results.

Figure 2



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(c) Calculate the gradient (slope) of the line on **Figure 2**.

Gradient = _____ g of copper per g of copper oxide

(2)

(d) Determine the mass of copper that can be produced from 75 g of copper oxide.

Use **Figure 2**

Mass = _____ g

(3)

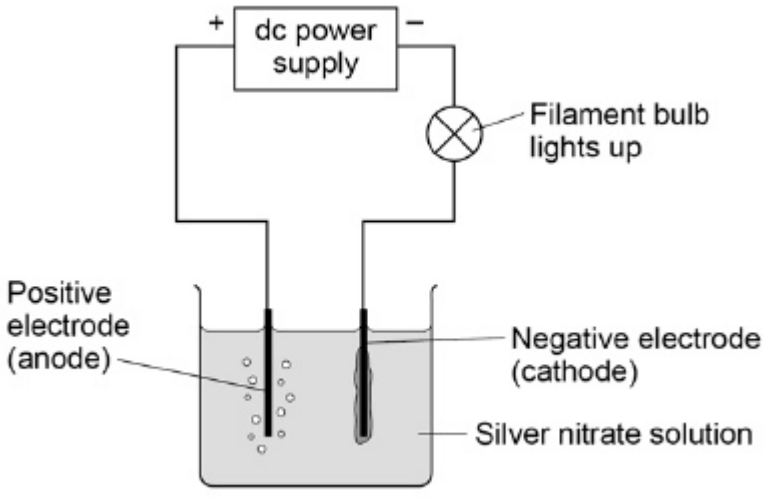
(Total 14 marks)

Q11.

This question is about electrolysis.

(a) **Figure 1** shows the apparatus used to electrolyse silver nitrate ($AgNO_3$) solution.

Figure 1



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Name the product discharged at each electrode.

Write a half equation for the reaction at each electrode.

Product at negative electrode (cathode) _____

Half equation for negative electrode

_____

Product at positive electrode (anode) _____

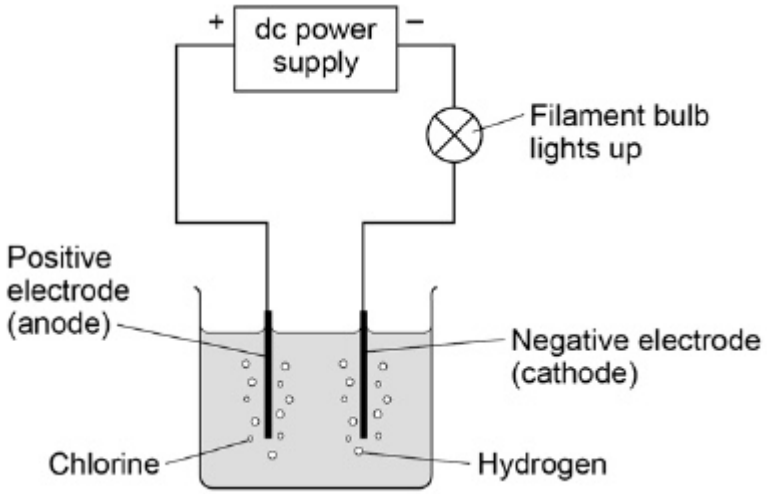
Half equation for positive electrode

_____

(4)

(b) **Figure 2** shows the apparatus used to electrolyse sodium chloride (NaCl) solution.

Figure 2



Hydrogen and chlorine are produced.

Explain how another different product is formed in solution during this electrolysis.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

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Q12.

Tablets to cure indigestion contain a mixture that has been designed as a useful product.

(a) Complete the sentence.

Choose the answer from the box.

catalyst	**formulation**	**hydrocarbon**	**solvent**

Tablets to cure indigestion are an example of a _____ .

(1)

The table shows the substances in one tablet.

Substance	**Mass in mg**
Sodium hydrogencarbonate	64
Calcium carbonate	522
Magnesium carbonate	68

(b) The total mass of these substances in the tablet is 654 mg

What is the approximate fraction of magnesium carbonate in the total mass of these substances?

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{100}$ ☐ $\frac{1}{1000}$ ☐ $\frac{1}{10\,000}$ ☐

(1)

(c) The tablets also contain sugar.

Suggest why.

_____

_____

(1)

(d) Sodium hydrogencarbonate cures indigestion by reacting with acid in the stomach.

What type of reaction is this?

Tick **one** box.

Combustion ☐

Displacement ☐

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Neutralisation ☐

(1)

A student adds an indigestion tablet to dilute hydrochloric acid.

(e) The gas produced is bubbled through limewater.

The gas turns the limewater milky.

Name the gas produced.

_____

(1)

(f) Water is also produced.

Which **two** statements are reasons why water is a liquid at room temperature?

Tick **two** boxes.

Water has a boiling point of 100 °C ☐

Water has a giant covalent structure ☐

Water has a melting point lower than room temperature ☐

Water has delocalised electrons ☐

Water is made of ions ☐

(2)

(g) Calcium chloride is also produced.

- The formula for a calcium ion is Ca^{2+}
- The formula for a chloride ion is Cl^-

What is the formula of calcium chloride?

Tick **one** box.

CaCl ☐ Ca_2Cl ☐ $CaCl_2$ ☐ Ca_2Cl_2 ☐

(1)

(h) The tablets are stored in glass bottles.

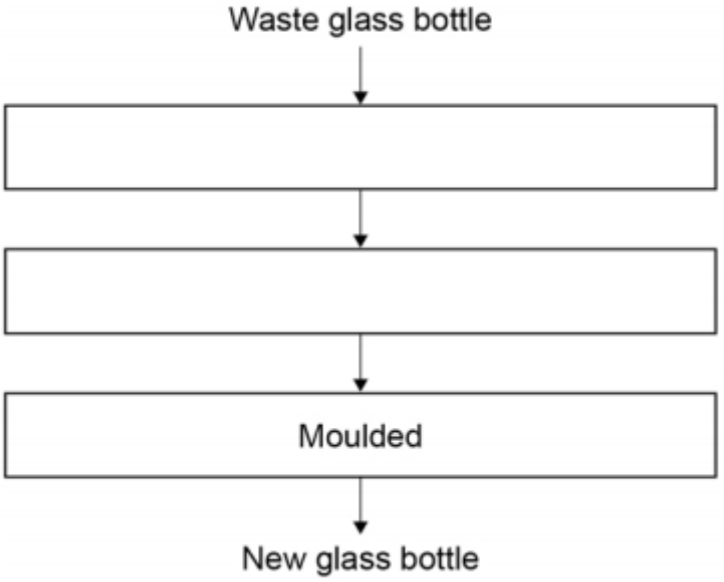
The flow chart shows part of a flowchart for recycling glass.

Complete the flow chart.

Choose the answers from the box.

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crushed	electrolysed	frozen	melted	oxidised



(2)

(Total 10 marks)

Q13.

This question is about copper and its compounds.

(a) The table shows information about bioleaching and phytomining.

Bioleaching and phytomining are used to extract copper from low grade ores.

	Bioleaching	Phytomining
Metal extracted from	Waste from quarrying	Contaminated ground
Speed of process	Very slow	Slow, made more efficient using quick-growing plants
Pollution	Produces a solution of toxic chemicals which may run off into rivers Takes a long time to stop the process if river pollution occurs	Involves combustion of plants but decontaminates polluted ground

Compare phytomining and bioleaching.

Use the information in the table.

_____

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(4)

(b) Describe how copper sulfate solution is obtained from the plants used in phytomining.

(2)

(c) Copper is displaced from a solution of copper sulfate using iron.

Write a balanced symbol equation for this reaction.

(2)

(d) How does this displacement reaction take place?

Tick **one** box.

Electron sharing ☐

Electron transfer ☐

Proton transfer ☐

(1)

(e) Describe how copper conducts electricity.

(2)

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(f) Suggest how anhydrous copper sulfate is used to test for water.

_____

_____

_____

_____

(2)

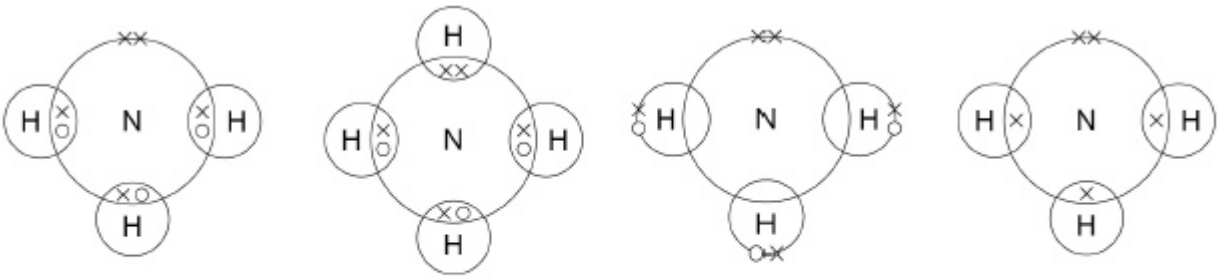
(Total 13 marks)

Q14.

This question is about ammonia (NH_3) and compounds of ammonia.

(a) Which diagram shows the arrangement of outer shell electrons in a molecule of ammonia?

Tick **one** box.



☐ ☐ ☐ ☐

(1)

(b) What type of bonding is present in ammonia?

Tick **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

Ammonia is produced by reacting nitrogen and hydrogen.

(c) Balance the equation for the reaction.

$$N_2 + 3H_2 \rightleftharpoons ___NH_3$$

(1)

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(d) What does the sign ⇌ represent?

_____

(1)

(e) Ammonia dissolves in water to form an alkaline solution.

Ammonia solution reacts with an acid to produce a salt, ammonium nitrate.

Which acid is used to produce ammonium nitrate?

Tick **one** box.

Citric acid ☐

Hydrochloric acid ☐

Nitric acid ☐

Sulfuric acid ☐

(1)

A student investigated the temperature change when ammonium nitrate is dissolved in water.

This is the method used.

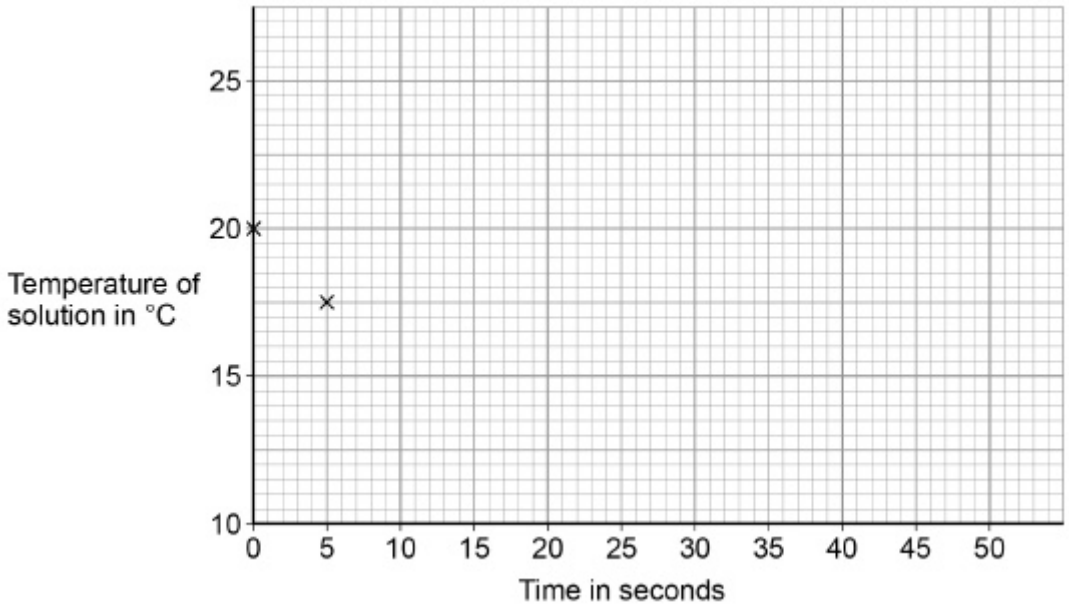
1. Add ammonium nitrate to water.
2. Stir the mixture.
3. Record the temperature of the solution every 5 seconds.

The table shows the results.

Time in seconds	**Temperature of solution in °C**
0	20.0
5	17.5
10	15.5
15	14.0
20	13.0
25	12.5
30	12.0
35	12.0

The graph shows some of the student's results.

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(f) Complete the graph.

- Plot the data from the table on the graph.
- Draw a line of best fit. Your line should be a smooth curve.

(3)

(g) Use the table to suggest a value for room temperature.

_____

(1)

(h) What is **one** use for the dissolving of ammonium nitrate in water?

Tick **one** box.

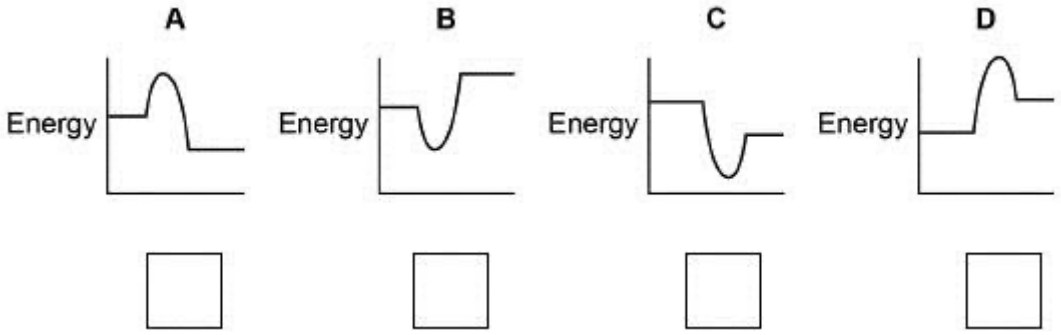
Cold pack to treat injuries	☐
Glow sticks	☐
Hand warmers	☐
Self-heating can to warm food	☐

(1)

(i) Which reaction profile diagram represents the dissolving of ammonium nitrate in water?

Tick **one** box.

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(1)

(Total 11 marks)

Q15.

The pH scale is a measure of the acidity or alkalinity of a solution.

(a) Draw one line from each solution to the pH value of the solution.

Solution	pH value of the solution
	5
Acid	7
	9
Neutral	11
	13

(2)

(b) Which ion in aqueous solution causes acidity?

Tick **one** box.

H^+ ☐

Na^+ ☐

O^{2-} ☐

OH^- ☐

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(1)

(c) When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.

The equation is:

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

How many elements are in the formula H_2SO_4?

Tick **one** box.

3 ☐

4 ☐

6 ☐

7 ☐

(1)

(d) What is this type of reaction?

Tick **one** box.

Decomposition ☐

Displacement ☐

Neutralisation ☐

Reduction ☐

(1)

(e) Name the salt produced.

_____

(1)

(f) Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

_____

_____

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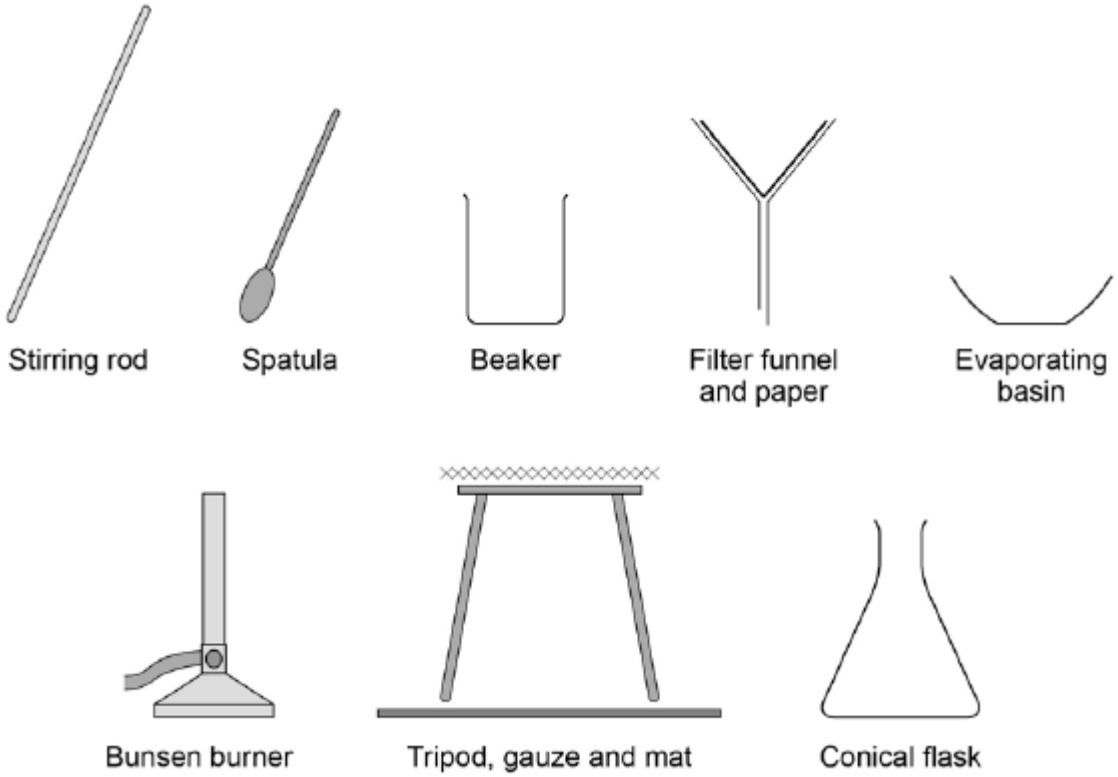
(3)

(Total 9 marks)

Q16.

This question is about making copper salts.

The figure below shows the apparatus given to a student.



Outline a safe plan the student could use to make pure, dry, crystals of the soluble salt copper sulfate from the insoluble metal oxide and dilute acid.

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_____

_____

_____

(Total 6 marks)

Q17.

This question is about calcium.

(a) What type of compound is calcium oxide?

Tick **one** box.

An acid ☐

A base ☐

A carbonate ☐

A salt ☐

(1)

(b) Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

bonds	**forces**	**ions**
	layers	

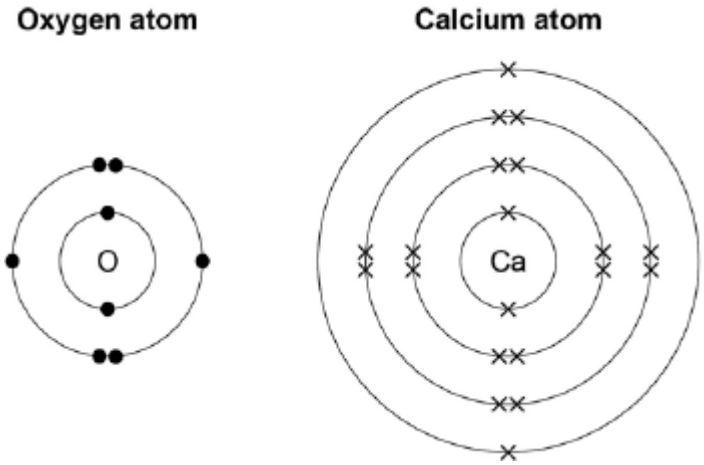
Calcium oxide has a giant ionic lattice in which there are strong electrostatic

_____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.

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Describe how the calcium atom and the oxygen atom forms calcium oxide.

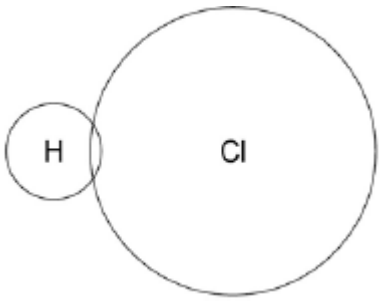
You should give the charge on each ion formed.

(4)
(Total 6 marks)

Q18.

Hydrogen chloride (HCl) is a gas.

(a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



(1)

(b) Hydrochloric acid is a strong acid.
Ethanoic acid is a weak acid.

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Describe a reaction that could be used to show the difference between a weak acid and a strong acid.

You should explain why the weak acid and the strong acid give different results.

(6)

(Total 7 marks)

Q19.

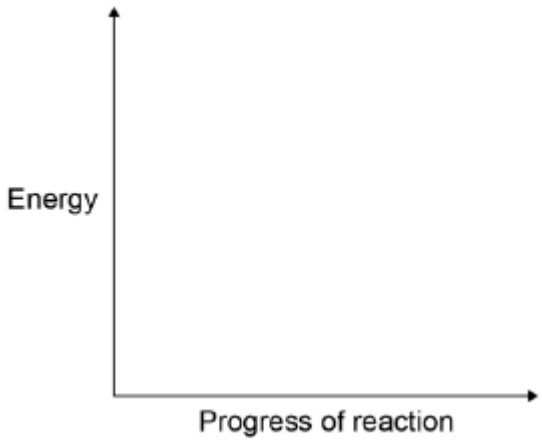
Exothermic reactions transfer energy to the surroundings.

(a) Draw a reaction profile for an exothermic reaction using the axes in **Figure 1**.

Show the:

- relative energies of the reactants and products
- activation energy and overall energy change.

Figure 1



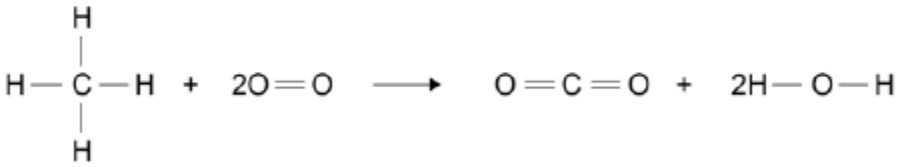
(2)

(b) Combustion is an exothermic reaction.

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Calculate the overall energy change for the complete combustion of one mole of methane in oxygen.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$



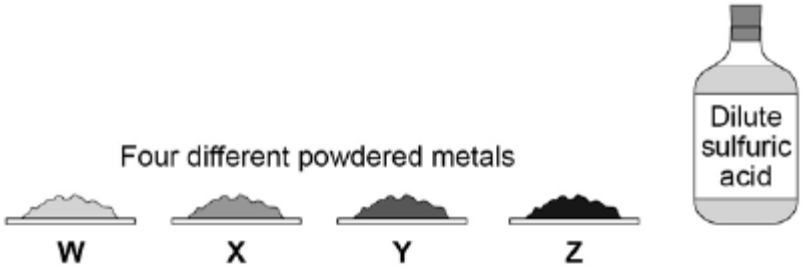
Bond	Bond energy in kJ / mol
C — H	413
O = O	498
C = O	805
O — H	464

Overall energy change = _____ kJ / mol

(3)

(c) **Figure 2** shows the chemicals given to a student.

Figure 2



The student wants to investigate the reactivity of the four metals.

Outline a plan the student could use to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The plan should use the fact that all four metals react exothermically with dilute sulfuric acid.

You should name the apparatus used and comment on the safe use of the

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chemicals.

(6)

(d) Another student used displacement reactions to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The table below shows the student's results.

	Observations			
Solution	**Metal W**	**Metal X**	**Metal Y**	**Metal Z**
Copper nitrate	Brown layer formed on metal	Brown layer formed on metal	Brown layer formed on metal	No change
Magnesium sulfate	No change	No change	No change	No change
Sulfuric acid	Gas bubbles produced	Few gas bubbles produced	Gas bubbles produced	No change
Zinc chloride	Grey layer formed on metal	No change	No change	No change

Give the order of reactivity of metals, **W**, **X**, **Y** and **Z**.

Use the results in the table above to justify your answer.

_____ > _____ > _____ > _____

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(3)

(e) The student concluded that these results could also be used to justify the order of reactivity of copper, magnesium, hydrogen and zinc.

The student is **not completely** correct. Use the results in the table above to explain why.

Suggest one further experiment that would provide evidence for the student's conclusion.

(4)

(Total 18 marks)

Q20.

This question is about the reactions of acids.

(a) When dilute hydrochloric acid is reacted with sodium hydroxide solution there is a temperature change.

Explain how the temperature changes.

(2)

(b) Acids produce hydrogen ions in aqueous solutions.

What is the ionic equation for neutralisation reactions?

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Tick **one** box.

$H^+(aq) + H_2O(l) \rightarrow H_3O^+(aq)$ ☐

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ ☐

$2\ H_2O(l) \rightarrow H_3O^+(aq) + OH^-(aq)$ ☐

$H_2O(l) \rightarrow 2\ H^+(aq) + O^{2-}(aq)$ ☐

(1)

(c) Sulfuric acid reacts with copper carbonate to produce a salt, water and carbon dioxide.

$$H_2SO_4 + CuCO_3 \longrightarrow CuSO_4 + H_2O + CO_2$$

What is the name of the salt produced?

_____

(1)

(d) A student reacted four metals with water and with a dilute acid to work out the order of reactivity of the metals.

The table below shows some of the observations.

Metal	Reaction with water	Reaction with dilute acid
Calcium	Bubbles of gas	**X**
Copper	**Y**	No bubbles of gas
Magnesium	Few bubbles of gas	Bubbles of gas
Zinc	No bubbles of gas	Bubbles of gas

Write the observations for **X** and **Y**.

Observation at **X** _____

Observation at **Y** _____

(2)

(e) Write the four metals, calcium, copper, magnesium and zinc, in order of reactivity.

Start with the **most** reactive metal.

_____ _____ _____ _____

(2)

(f) Some gases given off in reactions can be identified by chemical tests.

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Draw **one** line from each chemical test to the name of the gas.

Chemical test	Gas
Put in a lighted splint. The gas burns with a pop sound.	Carbon dioxide
	Chlorine
Put in a glowing splint. The gas relights the splint.	Hydrogen
	Nitrogen
Put into limewater. The gas turns limewater cloudy.	Oxygen

(3)

(g) Acids react with bases to produce salts and water (H_2O).

The electronic structure of a hydrogen atom is 2,1

The electronic structure of an oxygen atom is 2,6

Draw a diagram to show the arrangement of the outer shell electrons in a molecule of water.

(2)

(Total 13 marks)

Q21.

The salt copper sulfate can be made by reacting copper carbonate with dilute sulfuric acid.

$$CuCO_3(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l) + CO_2(g)$$

(a) Write a method that a student could use to prepare a pure, dry sample of copper

You do **not** need to write a risk assessment or include safety points.

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____

(6)

(b) Calculate the **number of molecules** in 14 g of carbon dioxide.

Give your answer in standard form.

Relative atomic masses (A_r): C = 14; O = 16

_____

_____

_____

_____

_____

Answer = _____ molecules

(4)

(Total 10 marks)

Q98.

Many sea creatures have shells containing calcium carbonate.

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Crab



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Whelk



© Edward Westmacott

Scallop



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(a) The seas are becoming more acidic.

Suggest and explain how acids affect the shells of sea creatures.

_____

_____

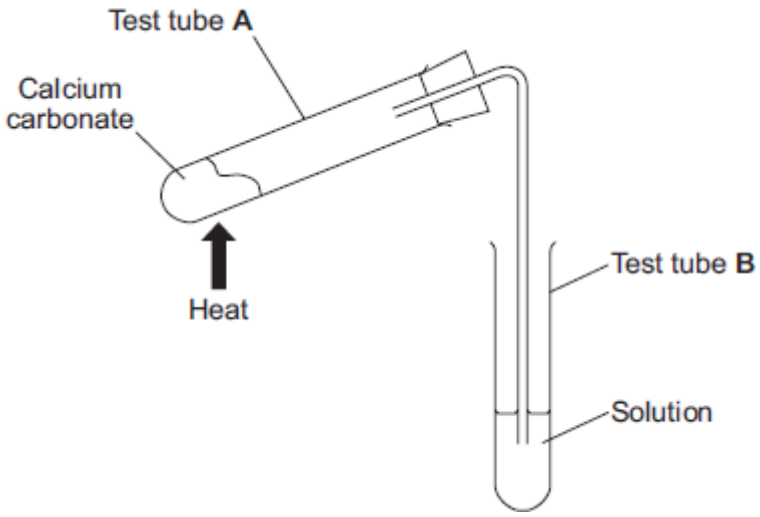
_____

_____

(2)

(b) A student investigated the effect of heating calcium carbonate.

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(i) The symbol equation for the chemical reaction that occurs when calcium carbonate is heated is:

$$CaCO_3 \rightarrow CaO + CO_2$$

Complete the word equation for the reaction.

_____ → _____ + carbon dioxide

(1)

(ii) 50 g of $CaCO_3$ produced 28 g of CaO.

What mass of CO_2 was produced?

_____

_____ g

(1)

(iii) When carbon dioxide passed through the solution in test tube **B**, the solution became cloudy.

Name the solution.

_____

(1)

(Total 5 marks)

Q99.

Many sea creatures have shells containing calcium carbonate.

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Crab



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Whelk



© Edward Westmacott

Scallop



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(a) The seas are becoming more acidic.

Suggest and explain how acids affect the shells of sea creatures.

_____

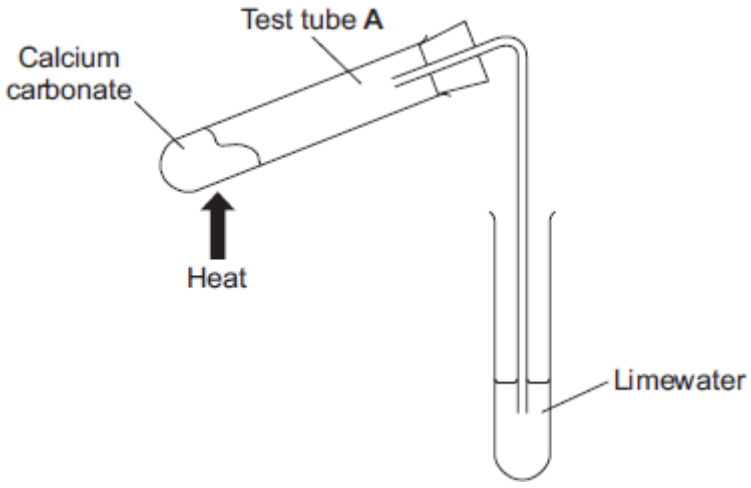
_____

_____

_____

(2)

(b) A student investigated the effect of heating calcium carbonate.



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A student heated 10.0 g of calcium carbonate. At the end of the investigation, there was 5.6 g of a white powder in test tube **A**.

Explain how this information about masses shows that a gas was produced.

_____

_____

_____

_____

(2)

(Total 4 marks)

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