PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 0: FORMULAE, EQUATIONS AND HAZARDS (PAPER 2, PACK 2)

SCORE	PERCENTAGE
/83	%

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Q1.

Calcium nitrate solution can be made by adding solid calcium carbonate to dilute nitric acid in a beaker.

The solid calcium carbonate is added until some remains at the bottom of the beaker.

(i) After this reaction the liquid in the beaker is

(1)

☒ **A** acidic

☒ **B** alkaline

☒ **C** neutral

☒ **D** pure water

(ii) Explain why the calcium carbonate is added until some solid remains at the bottom of the beaker.

(2)

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(iii) Write the balanced equation for the reaction between calcium carbonate and nitric acid to form calcium nitrate, $Ca(NO_3)_2$.

(3)

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(Total for question = 6 marks)

Q2.

Acids are a hazard if a high concentration of hydrogen ions is present.

Hydrochloric acid is a strong acid, ethanoic acid is a weak acid.

Figure 5 shows the labels on bottles of dilute hydrochloric acid and concentrated ethanoic acid.

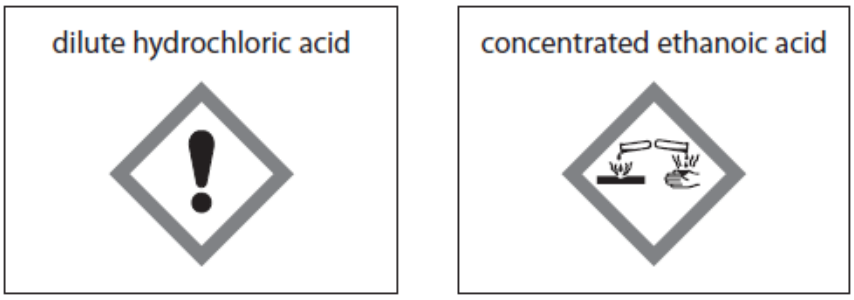


Figure 5

Explain why the hazard of the dilute hydrochloric acid is lower than the hazard of concentrated ethanoic acid, even though hydrochloric acid is a strong acid and ethanoic acid is a weak acid.

(4)

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(Total for question = 4 marks)

Q3.

Iron is extracted from iron oxide, Fe_2O_3.

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

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Q4.

Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

.....

Q5.

Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

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Q6.

When sodium sulfate solution is electrolysed, using inert electrodes, hydrogen is formed at the cathode.

Write the half equation for the formation of hydrogen gas, H_2, from hydrogen ions, H^+.

(2)

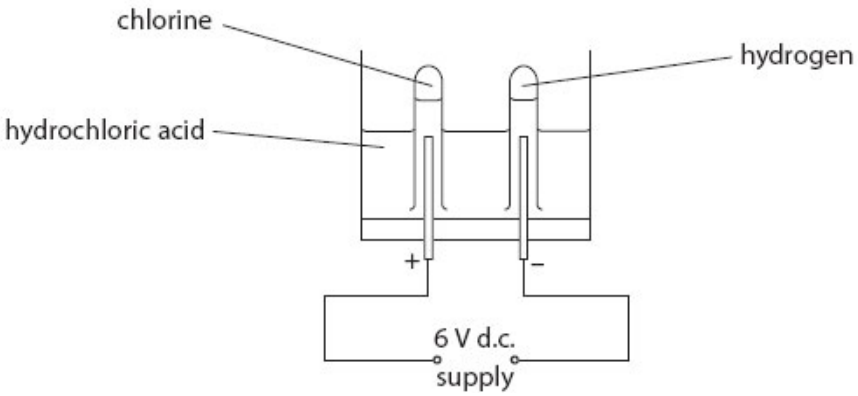
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(Total for question = 2 marks)

Q7.

(a) Electrolysis of hydrochloric acid produces chlorine and hydrogen.

The apparatus used is shown.



(i) Explain what is meant by **electrolysis.**

(2)

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(ii) Describe the test to show that a gas is chlorine.

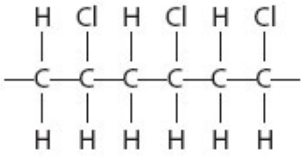
(2)

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(iii) Chlorine is used in the manufacture of a polymer.
Part of this polymer molecule is



State the name of the polymer.

(1)

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(b) Dilute hydrochloric acid reacts with silver nitrate solution to form silver chloride and nitric acid.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction produces silver chloride as a precipitate.
In an equation this would be shown as

(1)

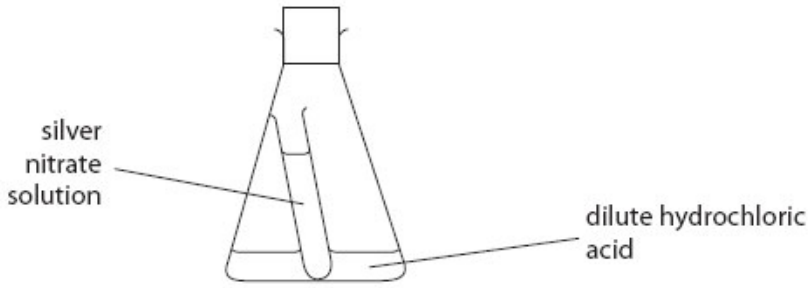
☒ **A** AgCl(aq)

☒ **B** AgCl(g)

☒ **C** AgCl(l)

☒ **D** AgCl(s)

(ii) This apparatus is used to investigate the mass of the reactants and the mass of products in this reaction.



The total mass of this apparatus was measured.
The flask was shaken to allow the silver nitrate solution and dilute hydrochloric acid to react.
After the reaction the total mass of the apparatus was measured again.

State how the total mass of the apparatus after the reaction will compare with the total mass of the apparatus before the reaction.

(1)

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(iii) Write the balanced equation for the reaction of silver nitrate solution, $AgNO_3$, with dilute hydrochloric acid to form silver chloride, AgCl, and nitric acid.

(2)

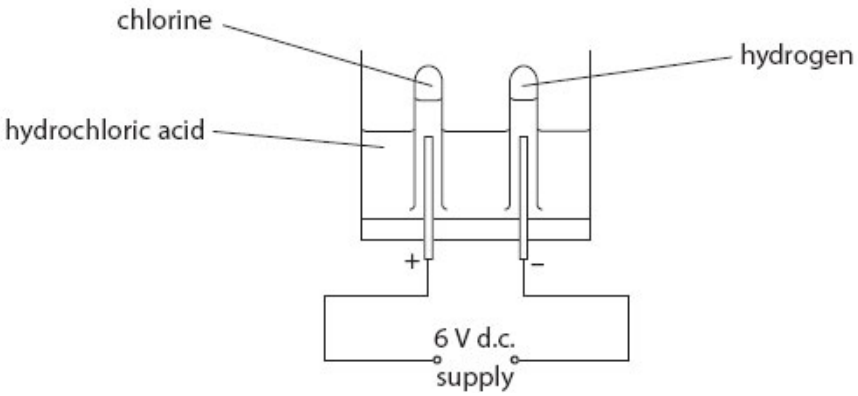
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(Total for Question = 9 marks)

Q8.

(a) Electrolysis of hydrochloric acid produces chlorine and hydrogen.

The apparatus used is shown.



(i) Explain what is meant by **electrolysis.**

(2)

.....

.....

(ii) Describe the test to show that a gas is chlorine.

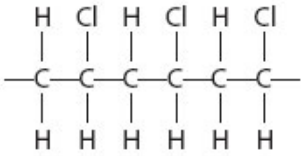
(2)

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(iii) Chlorine is used in the manufacture of a polymer.
Part of this polymer molecule is



State the name of the polymer.

(1)

.....

(b) Dilute hydrochloric acid reacts with silver nitrate solution to form silver chloride and nitric acid.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction produces silver chloride as a precipitate.
In an equation this would be shown as

(1)

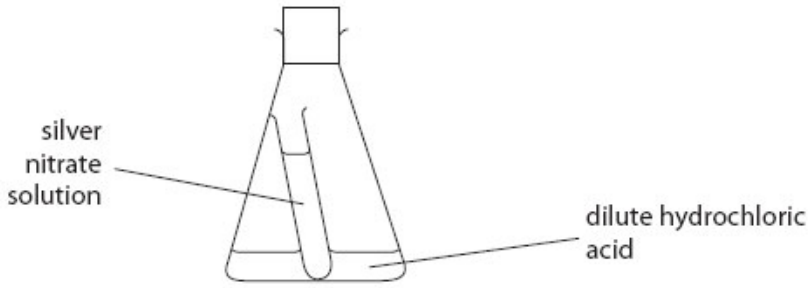
☒ **A** AgCl(aq)

☒ **B** AgCl(g)

☒ **C** AgCl(l)

☒ **D** AgCl(s)

(ii) This apparatus is used to investigate the mass of the reactants and the mass of products in this reaction.



The total mass of this apparatus was measured.
The flask was shaken to allow the silver nitrate solution and dilute hydrochloric acid to react.
After the reaction the total mass of the apparatus was measured again.

State how the total mass of the apparatus after the reaction will compare with the total mass of the apparatus before the reaction.

(1)

.....

(iii) Write the balanced equation for the reaction of silver nitrate solution, $AgNO_3$, with dilute hydrochloric acid to form silver chloride, AgCl, and nitric acid.

(2)

.....

(Total for Question = 9 marks)

Q9.

(a) Substance **X** is an ammonium salt.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A test was carried out to find which anion is present in substance **X**.
Dilute hydrochloric acid was added to a sample of substance **X**.
There was effervescence and the gas given off turned limewater milky.

The anion present in substance **X**is

(1)

☒ **A** carbonate ion, CO_3^{2-}

☒ **B** chloride ion, Cl^-

☒ **C** nitrate ion, NO_3^-

☒ **D** sulfate ion, SO_4^{2-}

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

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(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

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*(c) A technician found some colourless crystals of a substance left, unlabelled, in a beaker in a laboratory.

She knew the substance was one of potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

Explain how, using chemical tests, the technician could find out if the substance left in the beaker was potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

You may include equations in your answer.

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(Total for Question = 12 marks)

Q10.

(a) Substance **X** is an ammonium salt.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A test was carried out to find which anion is present in substance **X**.
Dilute hydrochloric acid was added to a sample of substance **X**.
There was effervescence and the gas given off turned limewater milky.

The anion present in substance **X**is

(1)

☒ **A** carbonate ion, CO_3^{2-}

☒ **B** chloride ion, Cl^-

☒ **C** nitrate ion, NO_3^-

☒ **D** sulfate ion, SO_4^{2-}

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

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(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

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*(c) A technician found some colourless crystals of a substance left, unlabelled, in a beaker in a laboratory.

She knew the substance was one of potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

Explain how, using chemical tests, the technician could find out if the substance left in the beaker was potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

You may include equations in your answer.

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(Total for Question = 12 marks)

Q11.

When sodium hydroxide solution is mixed with a solution containing copper ions, Cu^{2+}, copper hydroxide, $Cu(OH)_2$, is formed.

(i) Describe what you would **see** when these solutions are mixed.

(2)

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(ii) Write the ionic equation for this reaction.

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(3)

Q12.

When sodium hydroxide solution is mixed with a solution containing copper ions, Cu^{2+}, copper hydroxide, $Cu(OH)_2$, is formed.

(i) Describe what you would **see** when these solutions are mixed.

(2)

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(ii) Write the ionic equation for this reaction.

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(3)

Q13.

Complete the balanced equation for the reaction of magnesium with dilute hydrochloric acid forming magnesium chloride and hydrogen.

(2)

Mg + ... HCl → ..... + ...

(Total for question = 2 marks)

Q14.

Making sodium chloride

To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.

(a) Ethanol is produced by fermentation of carbohydrates.

The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(.....) + H_2O(.....)$$

(a) Which state symbols follow NaCl and H_2O to complete the equation?

Put a cross (☒) in the box next to your answer.

(1)

		NaCl	H_2O
☒	**A**	s	l
☒	**B**	aq	aq
☒	**C**	s	aq
☒	**D**	aq	l

(b) The reaction above is a neutralisation reaction.

Write the ionic equation for the reaction.

(2)

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(c) When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used.
The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask. At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

.....

(ii) State the colour change for this indicator at the end point.

(1)

from ..... to .....

(d) A sodium hydroxide solution was made up by dissolving 20.0 g of sodium hydroxide in water and making the volume of the solution up to 1.00 dm^3. Calculate the concentration of sodium hydroxide, NaOH, in this solution in mol dm^{-3}.

(relative atomic masses: H = 1.00, O = 16.0, Na = 23.0)

(2)

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.....

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concentration = ... mol dm^{-3}

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid. The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

(3)

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concentration = ... mol dm^{-3}

(Total for question = 10 marks)

Q15.

Making sodium chloride

To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.

(a) Ethanol is produced by fermentation of carbohydrates.

The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(.....) + H_2O(.....)$$

(a) Which state symbols follow NaCl and H_2O to complete the equation?

Put a cross (☒) in the box next to your answer.

(1)

		NaCl	H_2O
☒	A	s	l
☒	B	aq	aq
☒	C	s	aq
☒	D	aq	l

(b) The reaction above is a neutralisation reaction.

Write the ionic equation for the reaction.

(2)

.....

(c) When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used.
The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask. At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

.....

(ii) State the colour change for this indicator at the end point.

(1)

from ..... to .....

(d) A sodium hydroxide solution was made up by dissolving 20.0 g of sodium hydroxide in water and making the volume of the solution up to 1.00 dm^3. Calculate the concentration of sodium hydroxide, NaOH, in this solution in mol dm^{-3}.

(relative atomic masses: H = 1.00, O = 16.0, Na = 23.0)

(2)

.....

.....

.....

concentration = ... mol dm^{-3}

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid. The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

$HCl + NaOH \rightarrow NaCl + H_2O$

(3)

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concentration = ... mol dm^{-3}

(Total for question = 10 marks)

Q16.

Metals

There are many metallic elements in the periodic table.

(a) Which row of the table correctly shows two metals that are in group 1 and two metals that are transition metals?

Put a cross (☒) in the box next to your answer.

(1)

	group 1	transition metals
☒ A	lithium and zinc	calcium and copper
☒ B	potassium and caesium	copper and iron
☒ C	sodium and potassium	copper and magnesium
☒ D	sodium and magnesium	manganese and nickel

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

(2)

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(ii) Explain how metals conduct electricity.

(2)

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(c) (i) Describe what you would **see** when a small piece of sodium is added to water.

(2)

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.....

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

.....

(Total for question = 10 marks)

Q17.

Metals

There are many metallic elements in the periodic table.

(a) Which row of the table correctly shows two metals that are in group 1 and two metals that are transition metals?

Put a cross (☒) in the box next to your answer.

(1)

	group 1	transition metals
☐ **A**	lithium and zinc	calcium and copper
☐ **B**	potassium and caesium	copper and iron
☐ **C**	sodium and potassium	copper and magnesium
☐ **D**	sodium and magnesium	manganese and nickel

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

(2)

.....

.....

.....

(ii) Explain how metals conduct electricity.

(2)

.....

.....

.....

(c) (i) Describe what you would **see** when a small piece of sodium is added to water.

(2)

.....

.....

.....

.....

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

.....

(Total for question = 10 marks)

Q18.

Methane burns in oxygen to form carbon dioxide and water.
Write the balanced equation for this reaction.

(3)

.....

Q19.

Methane burns in oxygen to form carbon dioxide and water.
Write the balanced equation for this reaction.

(3)

.....

Q20.

(a) (i) Which of the following is the formula for a molecule of butane?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** C_3H_6

☒ **B** C_3H_8

☒ **C** C_4H_8

☒ **D** C_4H_{10}

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Ethanol, C_2H_5OH, can be converted into ethanoic acid, CH_3COOH.

In this reaction, ethanol is

(1)

☒ **A** dehydrated

☒ **B** neutralised

☒ **C** neutralised

☒ **D** reduced

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

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.....

.....

.....

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ ..... + ...

(Total for Question = 8 marks)

Q21.

(a) (i) Which of the following is the formula for a molecule of butane?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** C_3H_6

☒ **B** C_3H_8

☒ **C** C_4H_8

☒ **D** C_4H_{10}

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Ethanol, C_2H_5OH, can be converted into ethanoic acid, CH_3COOH.

In this reaction, ethanol is

(1)

☒ **A** dehydrated

☒ **B** neutralised

☒ **C** neutralised

☒ **D** reduced

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

.....

.....

.....

.....

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ ..... + ...

(Total for Question = 8 marks)

Q22.

Particles and formulae

(a) Atoms contain protons, neutrons and electrons.

Complete the table to show the relative mass and relative charge of each particle and its

position in an atom.

(3)

	relative mass	relative charge	position in atom
proton		+1	
neutron	1		in nucleus
electron			

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

An atom of an element **always** contains

(1)

☒ **A** more protons than neutrons

☒ **B** equal numbers of protons and neutrons

☒ **C** more electrons than protons

☒ **D** equal numbers of protons and electrons

(c) The symbols for some atoms are given in the box

Ca	Cl	K	N	Ne	O

From the box, choose the symbol of

(i) an atom in group 2 of the periodic table

(1)

.....

(ii) an atom that readily forms an ion with a charge of 2−

(1)

.....

(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

(1)

.....

(ii) What is the most likely formula of aluminium nitride?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** $Al(NO_3)_2$

☒ **B** $AlNO_3$

☒ **C** $AlNO_2$

☒ **D** AlN

(Total for question = 8 marks)

Q23.

Particles and formulae

(a) Atoms contain protons, neutrons and electrons.

Complete the table to show the relative mass and relative charge of each particle and its position in an atom.

(3)

	relative mass	relative charge	position in atom
proton		+1	
neutron	1		in nucleus
electron			

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

An atom of an element **always** contains

(1)

☒ **A** more protons than neutrons

☒ **B** equal numbers of protons and neutrons

☒ **C** more electrons than protons

☒ **D** equal numbers of protons and electrons

(c) The symbols for some atoms are given in the box

Ca	Cl	K	N	Ne	O

From the box, choose the symbol of

(i) an atom in group 2 of the periodic table

(1)

.....

(ii) an atom that readily forms an ion with a charge of 2−

(1)

.....

(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

(1)

.....

(ii) What is the most likely formula of aluminium nitride?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** $Al(NO_3)_2$

☒ **B** $AlNO_3$

☒ **C** $AlNO_2$

☒ **D** AlN

(Total for question = 8 marks)

Q24.

A student carried out an experiment to see how reactive different metals are when they are placed in dilute hydrochloric acid.

A sample of each metal was placed in a separate test tube of acid.

When zinc reacts with dilute hydrochloric acid, a gas is given off and zinc chloride is formed.

(i) Which gas is given off?

☒ **A** carbon dioxide

☒ **B** chlorine

☒ **C** hydrogen

☒ **D** oxygen

(1)

(ii) What is the formula of zinc chloride?

☒ **A** ZnCl

☒ **B** Zn_2Cl

☒ **C** $ZnCl_2$

☒ **D** Zn_2Cl_2

(1)

(Total for question = 2 marks)

Q25.

A student investigated the rate of a reaction.
The student investigated the reaction between zinc and dilute sulfuric acid.
The products are zinc sulfate, $ZnSO_4$, and hydrogen.

(i) Write the balanced equation for this reaction.

(2)

.....

*(ii) The student carried out two experiments.
The same mass of zinc and the same sized pieces of zinc were used in each experiment.

The results are shown in the table.

	experiment 1	experiment 2
concentration of sulfuric acid / mol dm^{-3}	0.5	1.5
temperature / °C	20	40
rate of reaction	slow	fast

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

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Q26.

A student investigated the rate of a reaction.
The student investigated the reaction between zinc and dilute sulfuric acid.
The products are zinc sulfate, $ZnSO_4$, and hydrogen.

(i) Write the balanced equation for this reaction.

(2)

.....

*(ii) The student carried out two experiments.
The same mass of zinc and the same sized pieces of zinc were used in each experiment.

The results are shown in the table.

	experiment 1	experiment 2
concentration of sulfuric acid / mol dm^{-3}	0.5	1.5
temperature / °C	20	40
rate of reaction	slow	fast

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

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Q27.

Rates of reactions and energy changes

(a) Marble chips react with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Which one of these changes would **decrease** the rate of this reaction?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** use hydrochloric acid which is more dilute

☒ **B** use smaller sized marble chips

☒ **C** use marble chips which have a larger surface area

☒ **D** use a larger volume of the hydrochloric acid

(b) Explain why increasing the temperature of a reaction increases the rate of the reaction.

(2)

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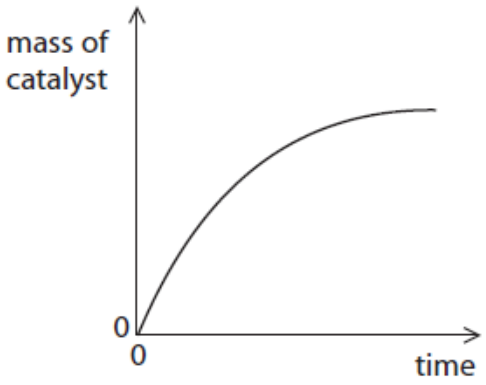
(c) (i) The rate of decomposition of hydrogen peroxide can be increased by adding a catalyst.

Which of these graphs shows the mass of the catalyst during the reaction?

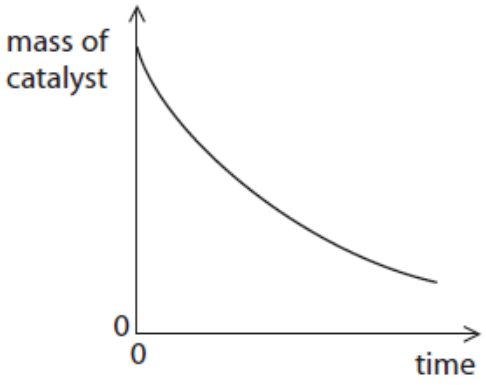
Put a cross (☒) in the box next to your answer.

(1)

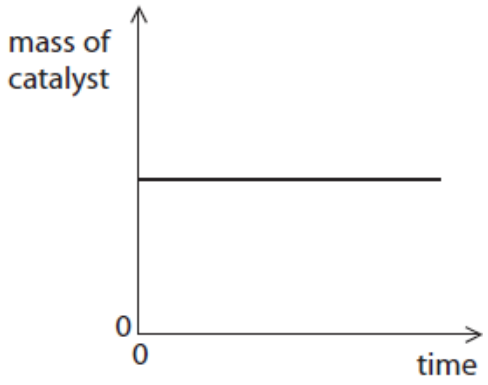
☒ **A**



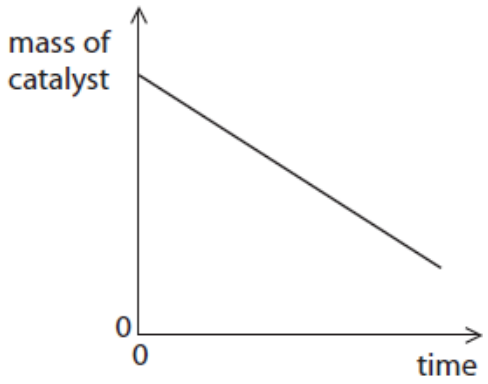
☒ **B**



☒ **C**



☒ **D**



(ii) The decomposition of hydrogen peroxide, H_2O_2, produces oxygen and water.

Give the balanced equation for this reaction.

(2)

.....

(d) Explain, in terms of the energy involved in the breaking of bonds and in the making of bonds, why some reactions are exothermic.

(2)

.....

.....

.....

.....

.....

(Total for question = 8 marks)

Q28.

Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

Q29.

Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

Q30.

Covalent substances can be simple molecular covalent or giant covalent.

(i) Ammonia is a simple molecular, covalent substance.

Which is the most likely set of properties for ammonia?

(1)

	melting point in °C	boiling point in °C	ability to conduct electricity in liquid state
☒ A	1713	2950	does not conduct
☒ B	−78	−33	does not conduct
☒ C	−39	357	conducts
☒ D	801	1413	conducts

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

(2)

.....

(Total for question = 3 marks)