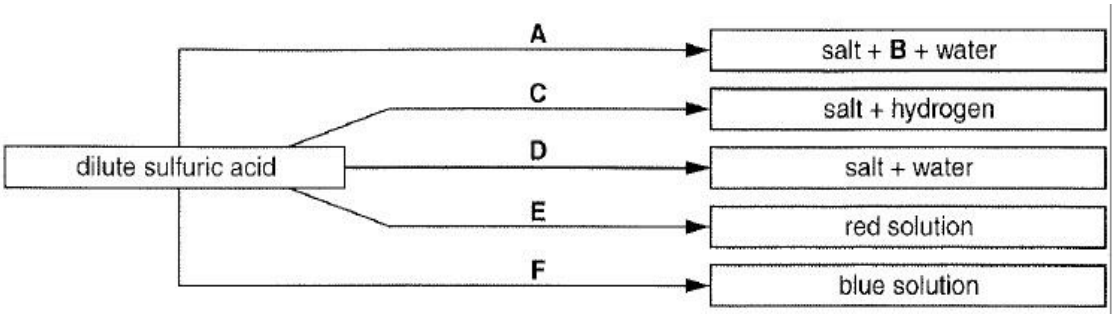
2012 O level P2

1 (2012/O/GCSE/P2/01) all The flow chart shows some reactions of dilute sulfuric acid. Six unknown substances, A, B, C, D, E and F are shown in the chart



(a) Use the substances A, B, C, D, E and F to answer the following questions

(i) Which substance is Universal Indicator?

[1]

(ii) Which substance is carbon dioxide?

[1]

(iii) Which substance is a mental?

[1]

(iv) Which substance could be sodium hydrogen-carbonate?

[1]

(b) Substance F is a metal oxide. Suggest the name of this oxide

[1]

(c) Substance D can be titrated with dilute sulfuric acid to give the products shown in the flow chart. Suggest name of substance D.

[1]

2 (2012/O/GCSE/P2/02) atoms The table shows the names and symbols of some isotopes of common elements.

Isotope name	Fluorine-19	Carbon-12	Iodine-131	Strontium-90	Neon-20	Carbon-14	Magnesium-24
Isotope Symbol	$_{9}^{19}F$	$_{6}^{12}C$	$_{53}^{131}I$	$_{38}^{90}Sr$	$_{10}^{20}Ne$	$_{6}^{14}C$	$_{12}^{24}Mg$

Use the isotopes in the table to answer the following questions.

(a) Give the name of two isotopes that contain the same number of protons in each of their atoms

_____ and _____ [1]

(b) Give the names of two isotopes that contain the same number of neutrons in each of their atoms

_____ and _____ [1]

(c) Give the names of two isotopes that contain seven electrons in the outer shell of each of their atoms

_____ and _____ [1]

(d) Which two isotopes form stable compounds that contain ions with a charge of +2?

_____ and _____ [1]

3 (2012/O/GCSE/P2/03) air Nitrogen oxides in the upper atmosphere cause damage to the ozone layer.
Aircraft engines are one source of nitrogen oxides.

(a) **(i)** Explain how nitrogen oxides are formed in the engine of an aircraft

_____

_____

_____ [2]

(ii) Give one natural source of nitrogen oxides in the atmosphere.

_____ [1]

(b) Nitrogen monoxide, NO, damages the ozone layer by reacting with ozone in two step reaction.

$NO + O_3 \rightarrow NO_2 + O_2$ step 1

$NO_2 + O_3 \rightarrow NO + 2^oO_2$ step 2

(i) Use oxidation states to identify which element is oxidised in step

Element _____

Change in oxidation state_____

[2]

(ii) One nitrogen monoxide molecule can destroy thousands of ozone molecules. Use the equations for steps 1 and 2 to explain why.

_____

_____

_____ [2]

(c) Nitrogen oxides are removed from car exhaust emissions by catalytic converters. In a converter, nitrogen monoxide reacts with carbon monoxide.

(i) Write an equation for this reaction.

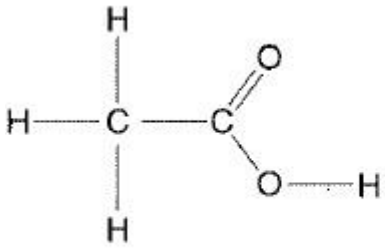
_____ [1]

(ii) Cars fitted with catalytic converters still give out environmentally harmful gases. Name one environmentally harmful gas that is emitted in large amounts, and describe the problem it causes.

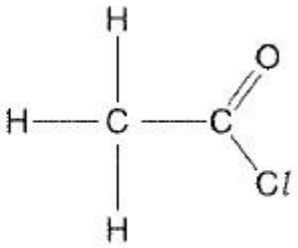
_____

_____ [1]

4 (2012/O/GCSE/P2/04) organic chem - ester The structures of ethanoic acid and ethanoyl chloride are shown below.



ethanoic acid



ethanoyl chloride

(a) Both compounds react with methanol to make the same ester.

(i) Draw the structure of the ester.

[1]

(ii) Complete the table to show the formula of the other product of each reaction.

	Formula

(iii) Give two uses of esters.

_____

[1]

(b) Ethanoyl chloride is a member of a homologous series.

(i) Give the name and structural formula of the next member of this homologous series.

Name _____

Structural formula

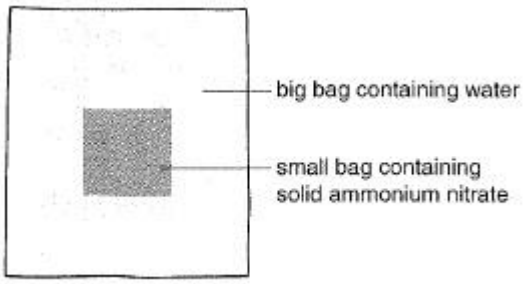
(ii) What is the general formula of the members of this homologous series?

[1]

(iii) The physical properties of a homologous series change as the size of the molecules increases. Describe the trends in two properties as the molecules increase in size.

[2]

5 (2012/O/GCSE/P2/05) (energy changes) Instant cooling packs are used to treat sports injuries. The packs contain a small bag of solid ammonium nitrate in a bag of water.



When the pack is squeezed, the small bag breaks open and the ammonium nitrate mixes with the water. An endothermic change occurs and the water in the bag becomes very cold.

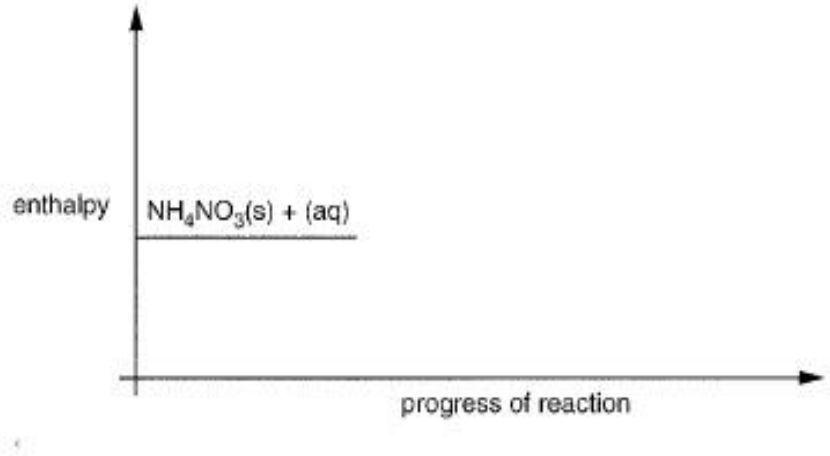
(a) The endothermic change has a positive value of ΔH. Why does this endothermic change cause the water to become could?

[1]

(b) When the pack is squeezed, ammonium nitrate solution forms.

$NH_4NO_3(s) + (aq) \rightarrow NH_4NO_3(aq)$ $\Delta H = +26 Kj/mol$

Complete the energy profile diagram below.
Label clearly the reaction enthalpy change and the activation energy



(c) Ammonium nitrate is also used as a fertilizer. It is made from ammonia.

(i) Complete the table about the source of the gases used on the manufacture of ammonia.

gas	source	Obtained by
nitrogen		Fractional distillation
hydrogen	Crude oil	

[3]

(ii) Crops use nitrogen from ammonium nitrate for growth. A typical bag of fertiliser contains 50 kg of ammonium nitrate, NH_4NO_3. Calculate the mass of nitrogen in this bag of fertiliser (1 kg= 1000g).

[3]

(iii) Fertilisers that contain ammonium nitrate are slightly acidic. Calcium carbonate can be added to the fertiliser so that soil does not become acidic, but calcium hydroxide should not be used. Explain why calcium hydroxide should not be added to ammonium nitrate fertilizer.

[2]

6 (2012/O/GCSE/P2/06) (periodic trends) Group I and Group VII elements show trends in their melting points and boiling points.

	element	melting Point/^{o}C	boiling Point/^{o}C
Group i	lithium	180	1330
	sodium	97.8	890
	potassium	64	774
Group VII	chlorine	-101	-35
	bromine	-7	59
	iodine	144	184

(a) **(i)** The trends in melting points and boiling points for elements in Group I differ from those of Group VII. Describe the trends down each group.

[2]

(ii) The melting point and boiling point of sodium is higher than of chlorine. Use ideas about bonding to explain why.

[3]

(b) The table shows the densities of chlorine and bromine at room temperature and pressure.

Element	Density g/cm^3
Chlorine	0.03
bromine	3.12

A student makes a comment about the densities.The difference in molecular mass of chlorine and bromine is not enough to account for the difference in densities.

(i) Explain why the student is correct.

[2]

(ii) What is the main reason that the densities of chlorine and bromine are so different?

[1]

(c) All of the elements in group VII are diatomic.

(i) Explain the meaning of the word diatomic.

[1]

(ii) Draw a 'dot-and-cross' diagram to show the bonding in a chlorine molecule. Show the outer shell electrons only.

[1]

(d) Sodium and chlorine react together to form sodium chloride. Describe what happens when a sodium atom and chlorine atom react together to from ions. You may use a diagram in your answer.

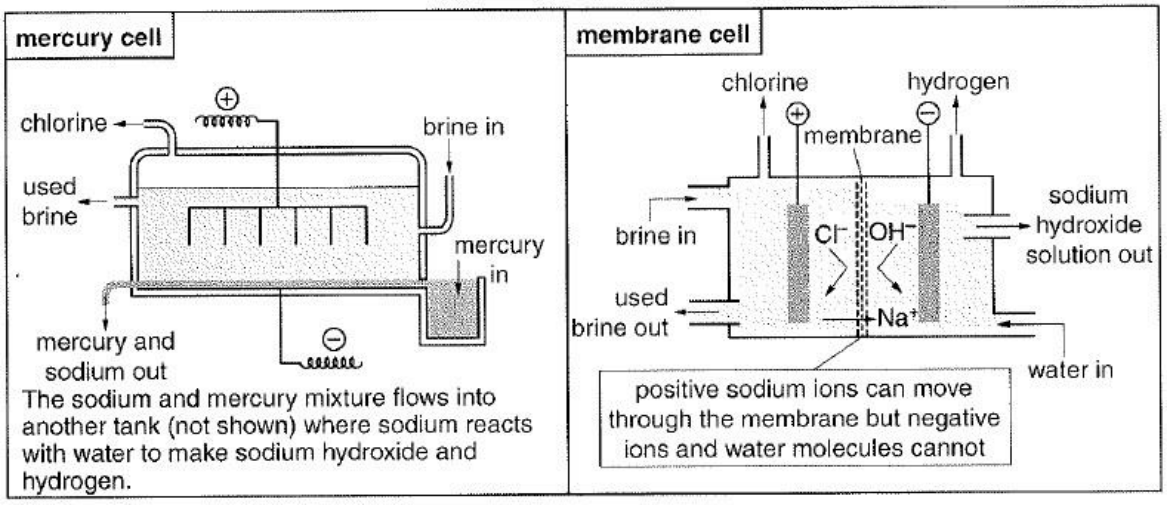
[2]

Section B

7 (2012/O/GCSE/P2/07) (electrolysis) Read information about the industrial electrolysis of brine.

Industrial Electrolysis of Brine

Brine is a saturated solution of sodium chloride, containing about 25% by mass of sodium chloride. Electrolysis of brine produces chlorine, hydrogen and sodium hydroxide. Industrial electrolysis of brine used to be carried out in mercury cells but is now carried out in membrane cells. The diagrams show these cells work



The membrane cell was a major breakthrough when it was developed because it allows sodium hydroxide and chlorine to be produced in the same call. Without the membrane, the sodium hydroxide would not be pure because it would contain chloride ions. One other problem that the membrane cell solves is that it keeps the chlorine gas and hydroxide ions separate. Chlorine and hydroxide ions react together. This would reduce the amount of chlorine made and create more impurities in the sodium hydroxide.

The table shows some information about the two types of cells.

	mercury	Membrane
Overall energy consumption (kWh per tonne of chlorine) 1tonne= 1000000g	3360	2750
Purity of sodium hydroxide produced	High purity	High purity
Concentration of sodium hydroxide produced	50% concentration	35% concentration
Other points	Mercury is toxic and must be removed from used brine	Low maintenance costs

(a) **(i)** In the membrane cell, it is important that negative ions do not pass through the membrane. Explain why.

[3]

(ii) It is an advantage that negative ions do not pass through the membrane. Describe the other advantages of using the membrane cell instead of the mercury cell.

[2]

(iii) Give one disadvantage of using the membrane cell instead of the mercury cell

[1]

(b) Calculate the energy consumption of the membrane cell per mole of chlorine gas produced.

[2]

(c) **(i)** Write an equation for the overall reaction that happens in the membrane cell

[1]

(ii) Calculate the maximum mass of sodium hydroxide that can be produced from 1 tonne of saturated brine.

[3]

8 (2012/O/GCSE/P2/08) (rates) A series of experiment was carried out to investigate the effect of different catalysts on the rate of a reaction. The table shows the time taken for the reaction to finish when different metal compounds were used as catalysts. The metal compounds contained Group I metals, Group II metals or transition metals.

experiment	catalyst	Temperature at start/^{o}C	Time taken for reaction to finish
1	NaCl	19	45
2	$FeCl_2$	20	22
3	$CoCl_2$	19	26
4	$MgCl_2$	20	46
5	$NaNO_3$	19	45
6	$Fe(NO_3)_2$	20	22
7	$Fe(NO_3)_2$	19	15
8	$Co(NO_3)_2$	19	26
9	$Mg(NO_3)_2$	19	46

(a) Explain why it is important to take note of the temperature at the start of the reaction

[1]

(b) Group I and Group II metal compounds are less effective than transition metal compounds as catalysts. Explain how the information in the table supports this statement.

[2]

(c) Two different iron ions were used in the experiments.

(i) Give how the information in the table supports this statement.

[1]

(ii) Which iron ion appears to be the more effective catalyst?
Explain your reasoning

[1]

(d) A student wrote this conclusion from results in the table.
The type of anion in the catalyst compound does not affect the rate of reaction.

The type of anion in the catalyst compound does not affect the rate of reaction.

(i) Do you agree this conclusion? Use the results to explain your reasoning.

[2]

(ii) Predict the time taken for the reaction to finish if iron (III) chloride was used as a catalyst.

[1]

EITHER

9 (2012/O/GCSE/P2/09) (metals displacement) A student carried out some experiments to place four metals, W, X, Y and Z in order of reactivity.
The table shows the results.

✓ shows a reaction happened

X Shows no reaction happened

— shows the experiment was not performed

	Metal **W**	Metal **X**	Metal **Y**	Metal **Z**
Solution of **W** nitrate	---	X	X	X
Solution of **X** nitrate	√	---	√	√
Solution of **Y** nitrate	√	X	---	√
Solution of **Z** nitrate	√	X	X	---

(a) Place the metals in order reactivity, starting with the most reactive.

[2]

(b) Metal Z reacts with hydrochloric acid. What would you see when metal Z reacts with hydrochloric acid? Explain your reasoning.

[2]

(c) The student carried out further experiments to place metal M in the list. She used dilute hydrochloric acid and samples of the metals. She found out that metal M is the fourth most reactive metal. Describe the experiments that student carried out. Your answer should include

- The experiments that the she carried out using dilute hydrochloric acid and samples of the metals.
- The measurements that she made.
- How the results showed that metal M is the fourth most reactive metal.

[3]

(d) The five metals, W, X, Y, Z and M are extracted from their ores in three different ways. Two of the metals are extracted from their ores by electrolysis. Metal M and one other metal are extracted by heating their ores with carbon. One of the metals occurs uncombined.

[3]

(i) Suggest which other metal, W, X, Y or Z is extracted by heating its ore with carbon. Explain your reasoning

(ii) Suggest the name of metal M

OR

10 (2012/O/GCSE/P2/10) (organic chemistry fuels) Some fractions of crude oil are cracked to from smaller molecules. There are two different cracking processes, steam cracking and catalytic cracking.

(a) Steam cracking uses a temperature of about 700 °C. This process breaks larger molecules into smaller molecules.

Dodecane is a straight chain alkane with the formula C10H22- When one molecule of dodecane is cracked, two possible products are hexane, C_6H_{14} and one other compound.

(i) Hexane is a straight chain alkane. Draw the structure of hexane and give the name and structure of the other compound.

[2]

(ii) Describe a simple test that can be used to distinguish between hexane and the other compound.

[2]

(b) Catalytic cracking operates at a lower temperature of around 500 °C.

A powdered catalyst of alumina and silica is used. This process produces branched chain alkanes. Petrol containing branched alkanes burns more smoothly and leads to more complete combustion of the fuel.

(i) Draw the structure of a branched chain isomer of hexane C_6H_{14}.

[1]

(ii) Write an equation for the complete combustion of hexane.

[1]

(iii) Explain why incomplete combustion in car engines in undesirable.

[1]

(iv) Explain why the catalyst in the process is powdered.

[1]

(c) There is large demand for the molecules in crude oil that be used to make petrol. Both cracking processes are important to make sure that supply meets demand. Explain how cracking helps the oil refinery to meet the demand for petrol.

[2]