2015 O level P2

1 (2015/O/GCSE/P2/01) The table the most common oxidation states of some elements, A, B, C, D and E in their compounds

Element	Most common oxidation states	Metal or non-metal?
A	-2	
B	+2, +3, +4, +6, +7	
C	+1	Non-metal
D	+3	
E	-1	

(a) Complete the table by filing in the last column to show which elements are metals and which are non-metals.

[1]

(b) Use the letters A, B, C, D and E to answer the following questions.

(i) Which element is most likely to be hydrogen?

[1]

(ii) Which element is most likely to be in Group VI?

[1]

(iii) Which element is most likely to form coloured compounds?

[1]

(c) No elements from Group 0 appear in the table. Use the information in the table to explain why this statement is true.

[2]

2 (2015/O/GCSE/P2/02) Metals are extracted from their oxides by reduction. The table shows the minimum temperature that is needed for the reduction of some metal oxides by reaction with carbon

Metal Oxide	**Minimum temperature needed for reduction/°C**
Calcium oxide	2100
Zinc oxide	900
Copper oxide	100
Magnesium oxide	1600
Lead oxide	400

(a)

(i) How does the temperature needed for reduction relate to the reactivity of the metal?

_____

_____ [1]

(ii) Predict the minimum temperature needed for the reduction of iron oxide by reaction with carbon. Explain your reasoning

Temperature _____°C

_____

_____ [2]

(b) Metal oxides also react with some metals. Look at the list of metals and metal oxides below.

Copper	Silver oxide
Zinc	Sodium oxide
Magnesium	Calcium oxide
Iron	Potassium oxide

Which metal and which metal oxide are most likely to react together to give the most vigorous reaction?

Metal _____ and metal oxide_____

[1]

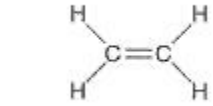
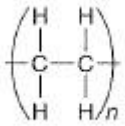
(c) Zinc metal reacts with steam. Give the names of the two products of this reaction.

_____ and _____

[2]

3 (2015/O/GCSE/P2/03)

(a) The table shows information about some organic compounds. Complete the table by filling in the missing names, formulae and by completing the description of the processes.

Name of Compound	**Structural Formula**	**Process(es) used to manufacture the compound**
	 _____	Fractional distillation Of _____ following By catalytic _____
		_____ Of ethene
Ethanol		Two separate processes can be used **Process 1:** Catalytic _____ Of _____ to ethane **Process 2:** _____ Of glucese
Ethanoic acid		Of ethanol.

[5]

(b) Dilute ethanoic acid reacts with metal oxides. Dilute hydrochloric acid also reacts with metal oxides.

(i) How are the reactions of the two acids with metal oxides similar?

_____

_____ [1]

(ii) The rate of the reaction of dilute ethanoic acid with metal oxides is slower than that of dilute hydrochloric acid (at the same concentration and temperature). Explain why

[2]

4 (2015/O/GCSE/P2/04) Aluminium is used to make drink cans. Aluminium for making cans is produced either from recycling used cans or by extraction from bauxite ore by electrolysis. The table shows information about these processes.

Process	Recycling used cans	Extraction from bauxite
Separation	Physical sorting. Steel and aluminium cans are separated using a magnet. Aluminium cans are shredded into small pieces	Physical extraction and breaking up of ore Concentrated sodium hydroxide is used to dissolve aluminium oxide to separate it from insoluble metal oxide impurities.
Main process	Heating to 700°C.	Dissolving in ionic solvent at 900°C. Electrolysis to form molten aluminium. Carbon dioxide is formed in the process.
Finishing	Cooling and shaping of molten aluminium.	Cooling and shaping of molten aluminium.

(a) Use the information in the table to estimate the melting point of aluminium.

°C [1]

(b) The extraction of aluminium from bauxite uses 95% more energy than the recycling of used aluminium cans. Use the information in the table to explain why.

[2]

(c) The extraction of aluminium from bauxite creates waste products that could cause harm to the environment. Two of these waste products are concentrated sodium hydroxide and carbon dioxide. Why would each of these product cause harm if they were released directly into the environment?

[2]

(d) Recycling used cans uses less energy and products less waste than extraction from bauxite. Give one other reason why recycling metals such as aluminium is important.

[1]

(e) Some aluminium is used to make Duralumin. Duralumin has many uses, including to build aircraft. Duralumin is a mixture of aluminium with added copper, magnesium and manganese

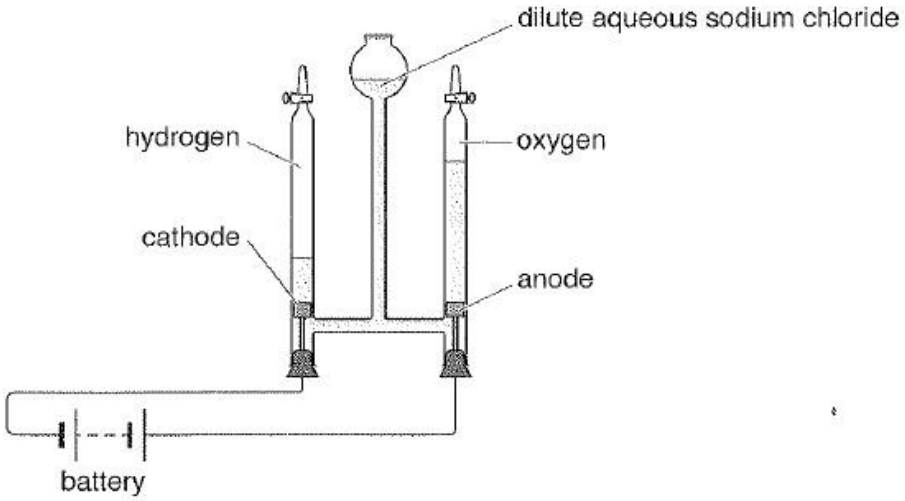
(i) What is the name given to mixture such as Duralumin?

[1]

(ii) Suggest why Duralumin is more useful for building aircraft than pure aluminium.

[1]

5 (2015/O/GCSE/P2/05) Dilute aqueous sodium chloride forms hydrogen and oxygen during electrolysis.



(a) Write ionic equations for the reactions at the cathode and anode.

At the cathode

_____

At the anode

_____

[2]

(b) The gases are collected and their volumes are measured. In theory, the ratio of hydrogen to oxygen should be 2:1. Oxygen is more soluble than hydrogen in water. This changes the ratio of gases that are collected.

(i) Why is the theoretical ratio of hydrogen to oxygen 2:1?

_____

_____

[2]

(ii) Explain how and why the solubility of oxygen affects the ratio of hydrogen to oxygen that is collected.

_____

[1]

(iii) The difference from the expected ratio is greater when the electrolysis starts but less noticeable after the electrolysis has been running for some time. Suggest why this happens.

[1]

(c) What happens to the concentration of sodium chloride during the electrolysis? Explain your reasoning.

[1]

(d) The same apparatus can be used to electrolyse concentrated aqueous sodium chloride. Give one similarity and one difference between the products of the electrolysis of dilute and concentrated aqueous sodium chloride.

[2]

(e) Platinum metal electrodes are used. Why is platinum a suitable material for use as an electrode?

[1]

6 (2015/O/GCSE/P2/06) Some compounds make products to sell to farmers as soil improvers. Some compounds in the products neutralise acidity. The table shows information about some substances that companies use to make these products.

Substance	**Chemical composition**	**Effectiveness at neutralising acidity**	**Other points**
Limestone	$CaCO_3$	Fair	Insoluble in water. Needs to be ground to a very fine powder.
Quicklime	CaO	Very high	Made by heating limestone to a high temperature. Reacts exothermically with water to make an alkaline solution.
Slaked lime	$Ca(OH)_2$	Very high	Made by adding water to quicklime. Slaked lime is an alkali
Blast furnace slag (solid waste from the blast furnace)	Mixture of $CaCO_3$ and $CaSiO_3$ with other impurities.	Fair	Insoluble in water. Impurities include silicon oxides and other non-metal compounds. Composition of mixture varies.

(a) Use the information in the table to suggest why limestone is less effective at neutralising acidity than quicklime and slaked lime.

[2]

(b)

(i) Suggest an advantage of marking products from blast furnace slag rather than the other substance.

[1]

(ii) Blast furnace slag may contain impurities of Group IV and Group V oxides. These impurities cause the slag to be less effective at neutralising acidity. Explain why Group IV and Group V oxides are less effective at neutralising acidity.

[2]

(c) The calcium content of the substance is important because it adds to the mineral content of the soil. Show by calculation that quicklime has a higher percentage by mass of calcium than both limestone and slaked lime

[3]

(d) One mole of gas occupies 24 dm^3 at room temperature and pressure (r.t.p.) Quicklime is made by strongly heating limestone in a kiln. The reaction produces carbon dioxide. A kiln holds 25 tonnes of limestone (1 tonne = 1 000 000 g.) Assuming that limestone is pure calcium carbonate. Calculate the volume of carbon dioxide (at r.t.p.) that is produced when 25 tonnes of limestone are heated.

[3]

Section B

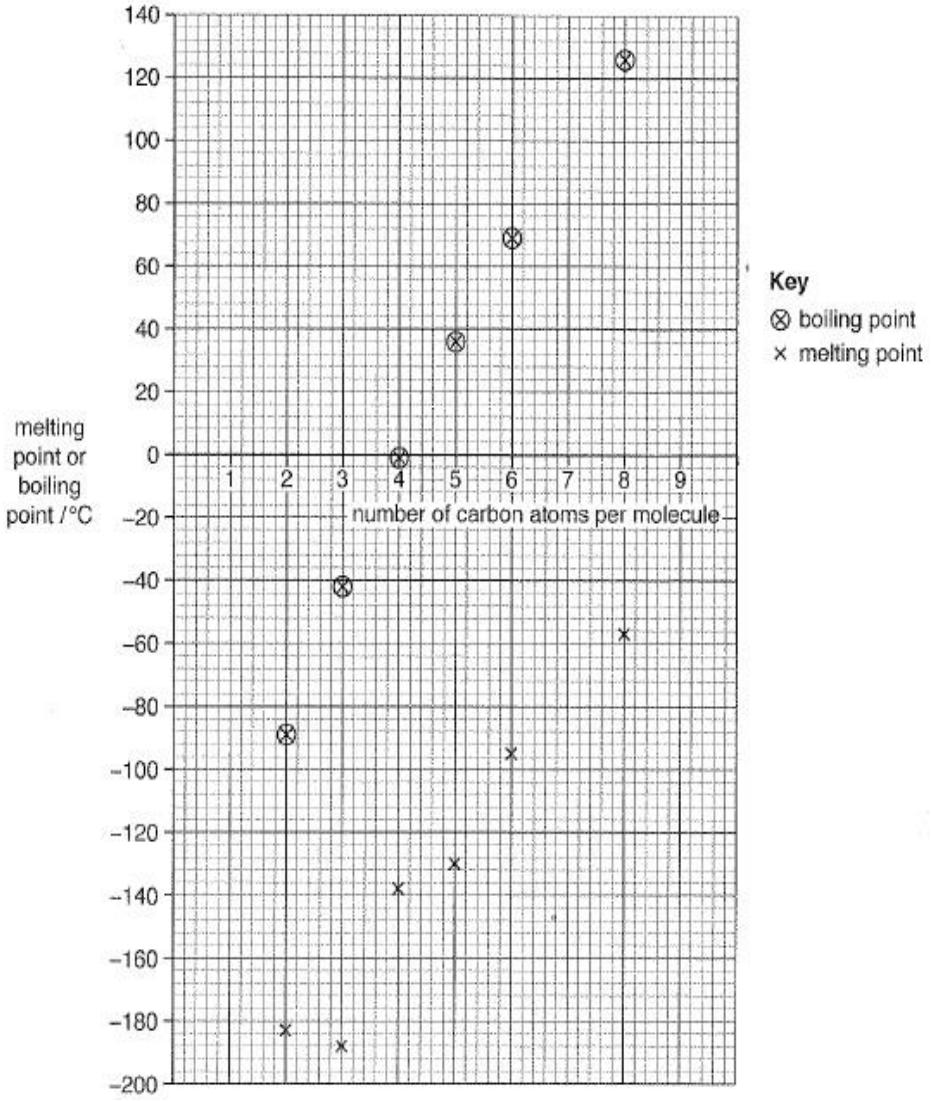
7 (2015/O/GCSE/P2/07) Properties of hydrocarbons. Table 1 shows the melting points and boiling points of some alkanes.

Table

Name of alkane	**Formula**	**Melting point/°C**	**Boiling point/°C**
Ethane	C_2H_6	-183	-89
Propane	C_3H_8	-188	-42
Butane	C_4H_{10}	-138	-1
Pentane	C_5H_{12}	-130	36
Hexane	C_6H_{14}	-95	69
Octane	C_8H_{18}	-57	126

Graph 1 shows the melting points and boiling points of some alkanes plotted against the number of carbon atoms in each alkane molecule

Graph 1



The flashpoint of a compound is the minimum temperature at which that compound gives off enough vapour to burn in air. The flashpoint is important to consider when hydrocarbons are blended to make fuels such as petrol. Compounds with lower flashpoints evaporate and burn more easily at lower temperatures and usually burn more smoothly in the car engine.

In a petrol refinery, isomerisation is used to convert straight chain alkanes into branched alkanes for use as fuels. The flashpoints of some straight chain and branched are shown in Table 2 and Table 3.

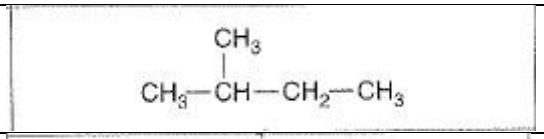
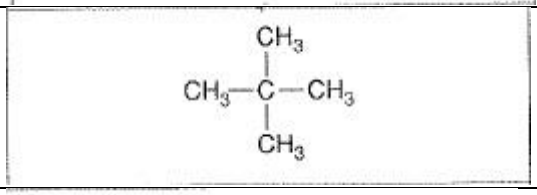
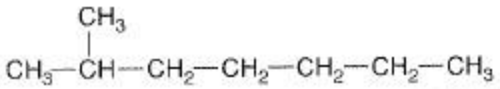
Table 2 shows the flashpoint of some straight chain alkanes.

Table 2

Name of alkane	**Formula**	**Flashpoint/°C**
Propane	C_3H_8	-104
Butane	C_4H_{10}	-71
Pentane	C_5H_{12}	-49
Hexane	C_6H_{14}	-23

Heptane	C_7H_{16}	-4
Octane	C_8H_{18}	13

Table 3 shows the flashpoints of some branched alkanes.

	Number of carbon atoms in molecule	Formula	Flashpoint/°C
Branched alkane 1	5		-57
Branched alkane 2	5		-65
Branched alkane 3	8		4

(a) What trends are shown by the data in Table 1 and Graph 1?

[1]

(b) One of the alkanes appears to have a melting point that is different from the expected value. Name the alkane and explain your choice.

[1]

(c) Heptane has the formula C_7H_{16}. Predict the melting point and boiling point of heptane.

Melting point: _____ °C Boiling point: _____ °C

[1]

(d) The boiling points and flashpoints of straight chain alkanes both follow similar trends. Describe these trends.

[1]

(e) How is the flashpoint of a straight chain alkane affected by isomerisation? Use evidence from the information to explain your reasoning.

[4]

(f) Petrol contains straight chain octane. Other compounds are added to improve the performance of the fuel. In cold countries, "winter blend" petrol is sold. Winter blend petrol contains increased amounts of compounds that include pentane and branched alkane 2.

(i) Explain how and why this mixture works better than pure octane alone.

[2]

(ii) Petrol tanks are not air tight. Winter blend petrol is not sold in very hot weather conditions because it leads to an increased loss of petrol from the petrol tank. Explain how and why the petrol is lost.

[2]

8 (2015/O/GCSE/P2/08) Car engines are adjusted to work at a particular air: fuel ratio.

The amount of air that is mixed with the fuel affects the temperature of the engine, the amount of pollutant gases that form and how efficiently the catalytic converter works.

Two major pollutant gases are carbon monoxide (CO) and nitrogen monoxide (NO).

(a) A "lean burn" engine runs with a higher ratio of air to fuel than a normal car engine. This means that the mixture contains a higher amount of air compared to fuel.

One effect of this is a lower running temperature of the engine.

How will a lean burn engine affect the amount of carbon monoxide and nitrogen monoxide formed compared to a normal car engine?

Explain your reasoning.

[3]

(b) The catalytic converter removes pollutant gases. The converter removes carbon monoxide and nitrogen monoxide by oxidation and reduction.

from oxidising agent

$$CO + [O] \longrightarrow CO_2$$

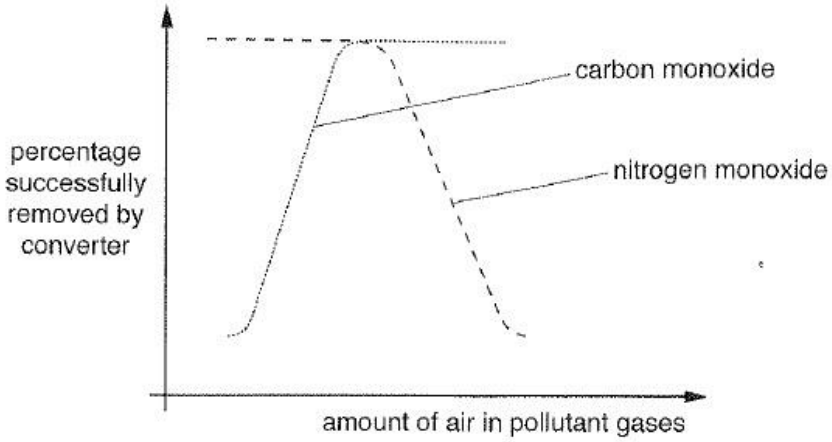
to reducing agent

$$2NO \longrightarrow N_2 + 2[O]$$

Write an overall equation to show how carbon monoxide and nitrogen monoxide react together in the converter.

[1]

(c) The amount of air in the pollutant gases that enter the catalytic converter affects the reactions in the converter. The graph shows the percentage of carbon monoxide and nitrogen monoxide that the catalytic converter successfully removes.



(i) Describe and explain how increased amounts of air affect the removal of carbon monoxide and nitrogen monoxide.

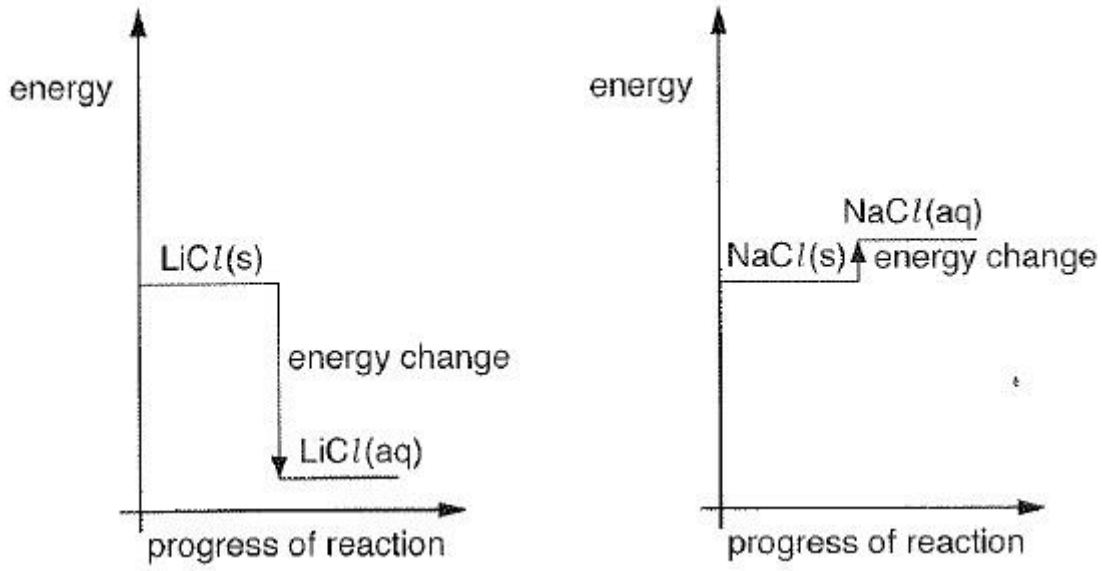
[3]

(ii) In the converter, apart from reacting with each other, carbon monoxide and nitrogen monoxide react with other substances as well. How does the graph show that this statement is true?

[1]

EITHER

9 (2015/O/GCSE/P2/09) The diagrams show the energy changes when lithium chloride and sodium chloride are dissolved in water.



(a) Describe the differences in the energy changes and temperature changes that happen as each compound dissolves.

[4]

(b) A student measured the temperature change when 4.0g of potassium chloride was dissolved in excess water. The table shows her results.

Temperature at start/°C	20
Lowest temperature recorded after dissolving/°C	12
Calculate energy change/J	+720

(i) Explain why the calculated energy change includes a plus sign, "+".

[1]

(ii) Use the student's results to calculate the enthalpy change when one mole of potassium chloride dissolves in excess water. Give your answer in kJ/mol, to 3 significant figures.

[3]

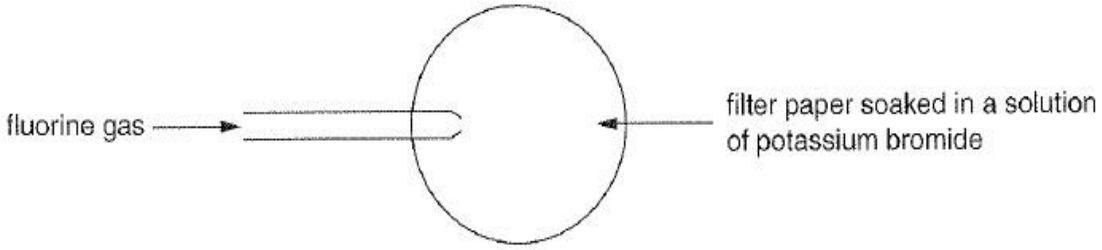
(iii) Describe what happens to the arrangement and movement of the particles in potassium chloride when it dissolves in water.

[2]

OR

10 (2015/O/GCSE/P2/10) Fluorine is an element in Group VII.

(a) A jet of fluorine gas is aimed at a filter paper soaked in a solution of potassium bromide.



The solution on the filter paper quickly turns brown.

(i) Explain why the solution turns brown. Include an ionic equation to support your answer.

[3]

(ii) The experiment is repeated. A jet chloride gas and a jet of iodine gas are each aimed at separate filter papers soaked in a solution of potassium bromide. State and explain what you would expect to see in each experiment.

[3]

(b) Fluorine also reacts with iron. A jet of fluorine is aimed at some iron wool. The iron glows and appears to burn. An ash of iron (III) fluorine is left behind.

(i) Write an equation, with state symbols, for this reaction.

[2]

(ii) The equation in i show that fluorine acts as an oxidising agent. Use ideas about oxidation state and electron transfer to explain why this statement is true.

[2]