2013 O level P2

1 (2013/O/GCSE/P2/01) (metals, all) Iron is extracted from iron ore in the Blast Furnace. The questions A, B, C, D and E show some reactions that happen in the Blast Furnace.

A $C + O_2 \rightarrow CO_2$
B $CO_2 + C \rightarrow 2CO$
C $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
D $CaCO_3 \rightarrow CaO + Co_2$
E $SiO_2 + CaO \rightarrow CaSiO_3$

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

(a) Which equation shows combustion?

[1]

(b) Which equation shows thermal decomposition?

[1]

(c) Which equation shows a reaction between an acidic compound and a base?

[1]

(d) Which equation shows the formation of a toxic gas?

[1]

(e) Two equation show different elements in compounds being reduced. Give the letters for these two equations.

_____ and _____ [1]

(f) Iron from the Blast Furnace is further processed to make steel. Some types of steel contain more carbon than others. How are the properties of high carbon steel different from those of low carbon steel?

[2]

2 (2013/O/GCSE/P2/02) (chem bonding - sms) Carbon disulfide, CS_{2+} is a simple covalent compound used in manufacturing polymers and fibres.

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

[2]

(b) Using your understanding of bonding and structure, which of these statements would you predict to be true and which would you predict to be false?
Put a tick (√) in one box in each row.

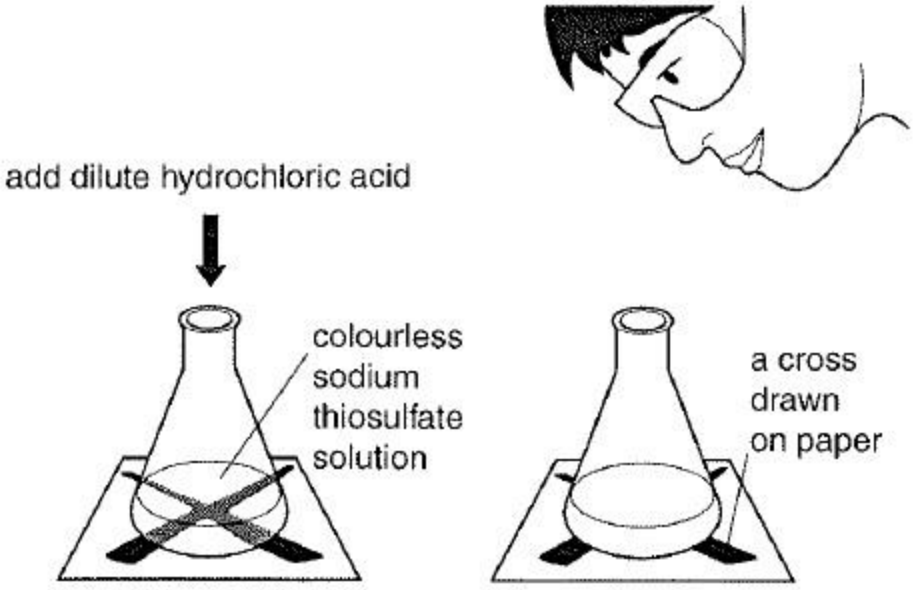
	True	False
Carbon disulfide has a low boiling point.		
Carbon disulfide has good electrical conductivity when molten.		
Carbon disulfide is very soluble in water.		
Carbon disulfide is a crystalline solid at room temperature.		

(i) Sulfur reacts with magnesium to form an ionic compound called magnesium sulfide. Draw 'dot-and-cross' diagram to show the arrangement of outer shell electrons and charges in a magnesium ion and sulfide ion.

Magnesium ion Sulfide ion

[2]

3 (2013/O/GCSE/P2/03) (rate) The rate of the reacting between dilute hydrochloride acid and sodium thiosulfate solution can be investigated using a cross dawn on a piece of paper.



As the reaction progresses, it becomes more difficult to see the cross through the solution.

(a) Look at the equation for the reaction.

$Na_2S_2O_3$ (aq) + 2HC/ (aq) + S(s) + SO_2 (g) + H_2O (l)

Explain why it becomes more difficult to see the cross as the reaction progresses.

[2]

(b) The table shows the results of some experiments to investigate the rate of reaction, using different concentrations of sodium thiosulfate. A student measured the time from when the acid was added until the cross can no longer be seen. The same concentration and volume of dilute hydrochloric acid and the same volume of sodium thiosulfate were used each time.

Concentration of $Na_2S_2O_3$ / mol/dm^3	**Time until cross cannot be seen / s**
1.0	8
0.8	10
0.4	20
0.2	39

(i) Use ideas about collisions between particles to explain the trend in the results.

[3]

(ii) The experiment was repeated with another concentration of sodium thiosulfate. The cross could not be seen after 14s. Estimate the concentration of sodium thiosulfate that was used.

[1]

Some metal oxides can act as catalysts for the reaction.

(iii) A student thinks that chromium (III) oxide acts as a catalyst for the reaction. Describe what he should do and what results he would obtain if he is right.

[3]

(iv) Catalysts lower the activation energy for the reaction. Explain how they do this.

[1]

4 (2013/O/GCSE/P2/04) (redox) The reaction of Iron (III) sulfate with potassium iodide is a redox reaction.

$Fe_2(SO_4)_3 + 2KI \rightarrow 2FeSO_4 + I_2 +$ **product X**

(a) At the end of the reaction, the solution appears brown. Explain why.

[1]

(b) Give the formula and name of product X.

[2]

(c) **(i)** Complete the table to show the oxidation states of iron and iodine.

Element	Oxidation state in reactants	Oxidation state in products
Iron		
Iodine		

(ii) Which element is reduced in the reaction? Use ideas about electrons transfer to explain your answer.

[1]

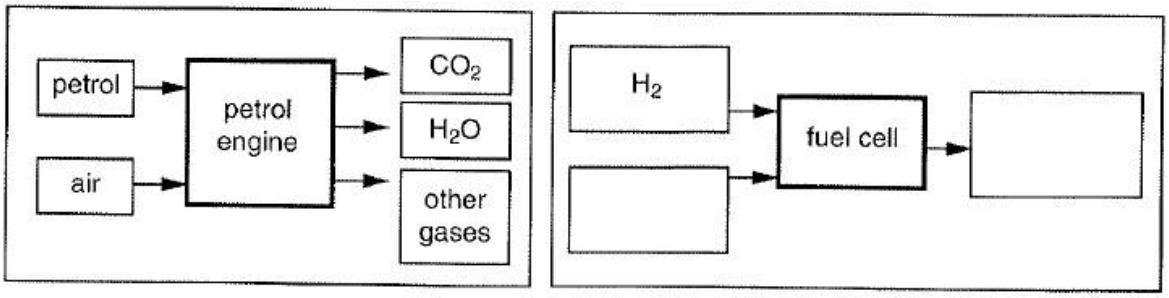
(iii) Aqueous sodium hydroxide can be used to distinguish between solutions of Iron (II) sulfate and Iron (III) sulfate. Describe what you see when aqueous sodium hydroxide is added to a solution of each salt.

[2]

(iv) Iron (II) sulfate tablets are given to people who lack iron in their diet. Iron (II) sulfate causes unpleasant side effects in some people because it is acidic. Describe a simple test to show that iron (II) sulfate solution is acidic.

[1]

5 (2013/O/GCSE/P2/05) (air and energy) Most vehicles petrol the substances entering and leaving a petrol engine and a fuel cell.



(a) Complete the flow chart for the fuel cell by filling in the empty boxes.

[1]

(b) The waste products from vehicles with petrol engines cause more harm to human health than those from vehicles with fuel cells. Explain why this statement is true.

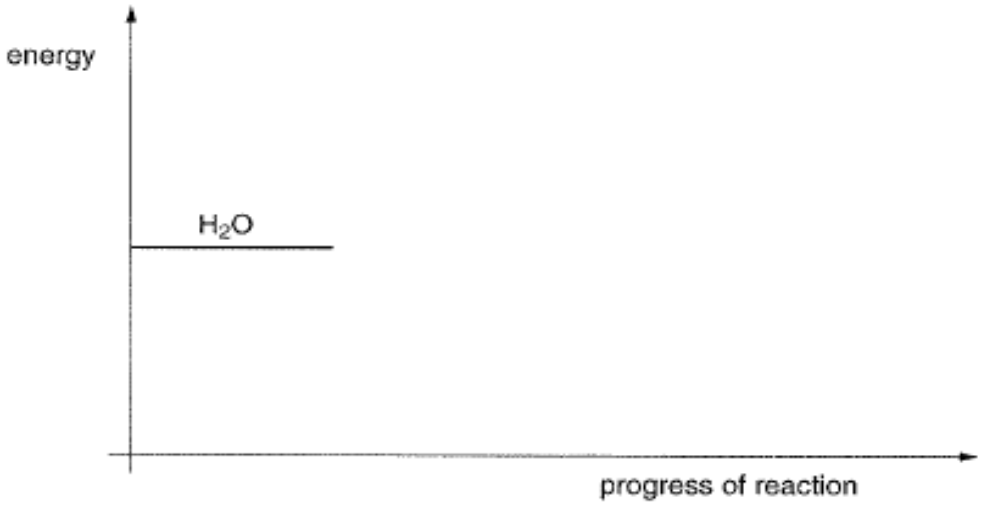
[3]

(c) Hydrogen for fuel cells can be obtained from water by electrolysis.
Electricity is used to provide energy for the electrolysis.

Complete the energy profile diagram for the electrolysis of water.

Your diagram should include

1. The formulae of the products of the electrolysis,
2. A label for the enthalpy change of reaction.



[2]

(d) Some people think that hydrogen is a completely non-polluting fuel. Explain why this is incorrect.

[2]

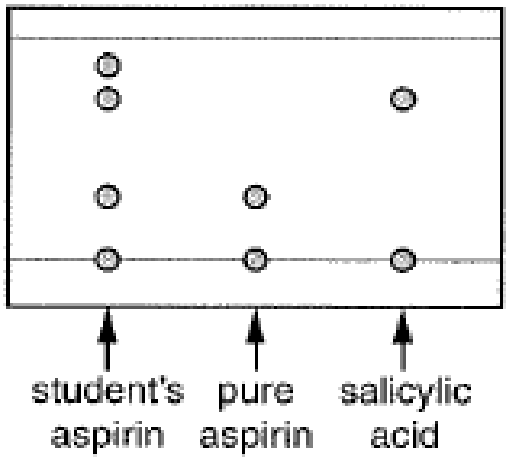
6 (2013/O/GCSE/P2/06) (experimental chem moles) Aspirin is a medicine that is used as a painkiller. It is made from salicylic acid.

(a) A student makes a sample of aspirin. He thinks is contains some impurities.

(i) The student tests the melting point of his sample of aspirin. Explain how he can use the result of the test to find out whether his sample contains impurities.

[2]

(ii) The student uses chromatography to produce a chromatogram. He uses his own aspirin and pure samples of aspirin and salicylic acid. The diagram shows his chromatogram.



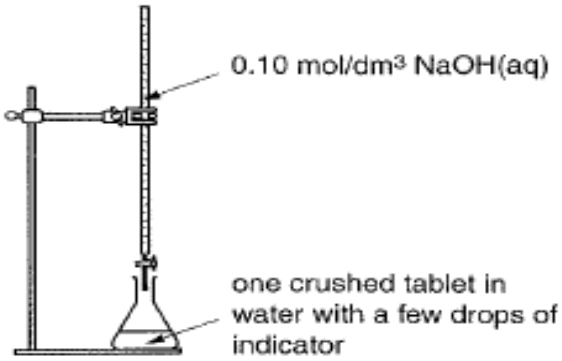
What information does the chromatogram give about the purity of the student's aspirin?

[2]

(iii) Aspirin is weak acid. Explain what is meant by the term weak acid.

[1]

(iv) The student buys and tests some tablets that contain aspirin. He performs a titration using a crushed tablet and aqueous sodium hydroxide.



The formula for aspirin can be represented as ☐—COOH. The equation for the reaction between aspirin and aqueous sodium hydroxide is shown below.

☐—COOH + NaOH → ☐— COONa + H_2O

The table shows the results of the student's titration.

Concentration of aqueous sodium hydroxide used	0.10mol/dm^3
Volume of aqueous sodium hydroxide needed for neutralization	16.70cm^3
Relative molecular mass of aspirin	180

The label on the bottle of tablets states that each tablet contains 300mg of aspirin.
(1000mg = 1g) Do the student's results agree with this value? Show your working.

[3]

(b) Some tablets that contain aspirin also contain citric acid. He student does another titration using one of these tablets. Explain why the mass of aspirin he calculates from his titration results is incorrect.

[2]

Section B

7 (2013/O/GCSE/P2/07) (periodic trends) Read the information about the chlorides of elements in Period 3 of the Periodic Table.

Elements and their chlorides

The formulae and chemical properties of the chlorides of elements change across Period 3.

The chlorides behave differently when they are added to water. Some of the chloride dissolve in water to form a solution. Some hydrolyse when they are added to water. This means that they react chemically with water to produce new products.

element	**Metal/ non-metal**	**Formula of main chloride**	**Bonding in chloride**	**Effect of adding chloride to water**	**Products of adding chloride to water**
Na	metal	NaCl	ionic	dissolves	NaCl(aq)
Mg	metal	$MgCl_2$	ionic	dissolves	$MgCl_2$(aq)
Al	metal	$AlCl_3$	covalent	hydrolyses	Complex mixture of products including HCl(aq)
Si	non-metal	$SiCl_4$	covalent	hydrolyses	SiO_2(s) HCl(aq)
P	non-metal	PCl_3	covalent	hydrolyses	H_3PO_3(aq) HCl(aq)
S	non-metal	$S2Cl_2$	covalent	hydrolyses	Complex mixture of products including HCl(aq)
Cl	non-metal	Cl_2	covalent	hydrolyses	HClO(aq) HCl(aq)

The reaction of chlorine with water is interesting because it is an example of a disproportionation reaction. Disproportionation happens when the oxidation state of the same element both increases and decreases in the reaction.

The chlorides have different formulae and the ratio of the element to chlorine changes across Period 3. Some examples are shown in the table below.

Formula of chloride	Ratio of element to chlorine
NaC*l*	1:1
$MgCl_2$	1:2
$AlCl_3$	1:3

(a) Describe the pattern for the ratio of each element to chloride across. Period 3. Include ratios in your answer.

[2]

(b) **(i)** Which chloride forms a precipitate when it is added to water?

[1]

(ii) Write a balanced forms equation for the reaction of phosphorus (III) chloride with water.

[1]

(iii) Use ideas about oxidation state to explain why the reaction of chloride with water is a disproportion reaction.

[2]

(iv) Two students talk about the data.

Student 1: 'I think that whether or not chloride hydrolyses is linked to the metal or non-metal character of the element'.

Student 2: 'I think that whether or not the chloride hydrolyses is linked to the bonding of the chloride'

Does the information in the table support the ideas of the students? Explain your reasoning.

[3]

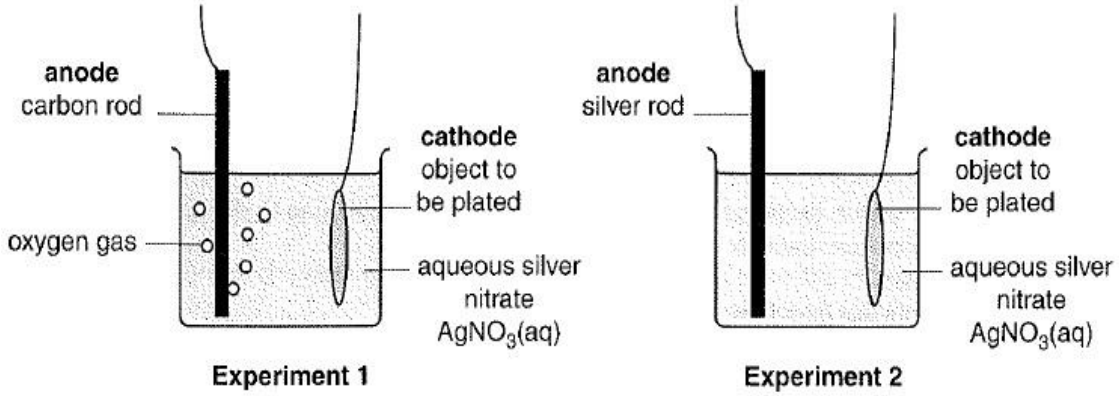
(c) Another student performs an experiment to test whether some other chloride dissolve or hydrolyse when they are added to water. He adds each chloride to water and test pH of the mixture. Explain how the result of a pH test shows whether or not a chloride has hydrolysed.

[2]

(d) Suggest a reason why argon is not included in the table of information about Period 3 chlorides.

[1]

8 (2013/O/GCSE/P2/08) (electrolysis) A student sets up two different experiments for electroplating an object with silver.



(a) Write equations, with state symbols, to show the reactions that happen at the anode and cathode during each experiment.

[3]

(b) At the beginning of each experiment the student removes a sample of the electrolyte, aqueous silver nitrate, and puts it in a test-tube. The student then adds a few drops of aqueous sodium chloride to the sample.

(i) Describe and explain what the student sees. Include an equation in your answer

[2]

(ii) After some time, the student observes that no more silver is being deposited on the object in experiment 1 but more silver is still being deposited on the object in experiment 2. Suggest a reason for this observation and describe how he could use aqueous sodium chloride to find out if his reasoning is correct.

[2]

(c) If an iron object is placed in a beaker of aqueous silver nitrate, a silver coating forms on the iron. If a gold object is placed in aqueous silver nitrate, no reaction happens. Explain why

[1]

EITHER

9 (2013/O/GCSE/P2/09) (organic alkenes) A student collects some data about the fat content of some margarines.

The margarines tested are all mixtures of saturated fat, A, unsaturated fat, B, and water.

He also does an experiment to count how many drops of bromine water react with 10 g of each type of margarine.

The table show his results.

Margarines	Percentage by mass of saturated fat	Percentage by mass of unsaturated fat	Number of drops of bromine water per 10 g
1	10	80	12
2	20	70	11
3	40	20	3

(a) **(i)** What colour change happens when bromine reacts with a margarine?

[1]

(ii) What is seen when the bromine is in excess?

[1]

(iii) The margarines are sold in 500g packs. Which margarine contains most water per 500 g? Explain your reasoning.

[2]

(b) Another margarine contains 50 g of saturated fat, A, and 20 g of unsaturated fat, B, per 100 g. Estimate the number of drops of bromine water that react with 10 g of this margarine.

[1]

(c) Some cooking oils contain a mixture of water with molecules of saturated and unsaturated fats.

Iodine and bromine both react in a similar way with fat molecules.

The mass of iodine that reacts with three different types of oil are shown in the table.

Oil	**Mass of iodine that reacts with 100 g of the oil / g**
C	175
D	124
E	163

(i) A student says 'oil C contains mass of fat than oil D'. Do you agree with the student? Explain your reasoning.

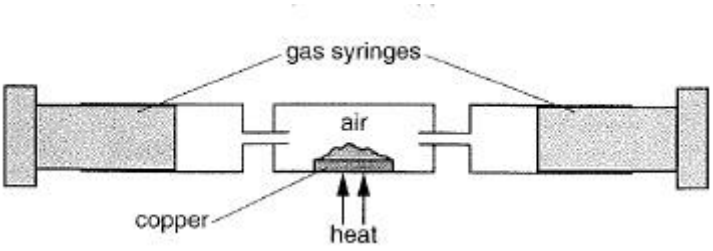
[2]

(ii) A pure fat has a molecular mass of 400. 100 g of the fat reacts with 127 g iodine. How many double bonds are there in each molecule of the fat? Show your working

[3]

OR

10 (2013/O/GCSE/P2/10) (air,, moles) An experiment (Experiment 1) was set up to heat copper in air.



At the start of experiment 1, the apparatus contained a total of 200 cm^3 of air.

During heating, the copper reacted with oxygen in the air to form black copper (II) oxide.

The copper was heated until the volume of gas, measured at room temperature and pressure, remained constant.

(a) **(i)** Explain why it was important to continue heating until the volume remained constant.

[1]

(ii) The table shows some fata about the mass change during the experiment.

Mass of copper at start of the experiment	**Mass of solid left at the end of the experiment**
1.00 g	1.07 g

(iii) Use the data in the table to show that solid left at the end of the experiment contains unreacted copper.

[3]

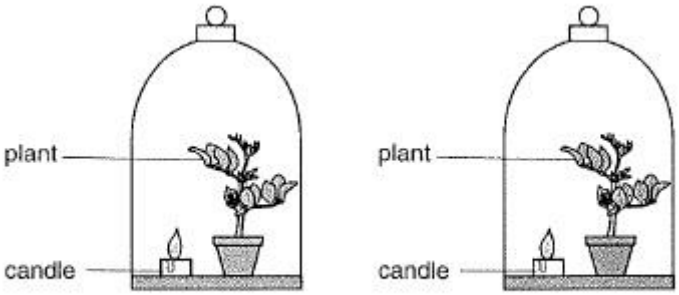
(b) **(i)** Name the gas that is left in the gas syringes, in the largest amount, at the end of the experiment.

[1]

(ii) Estimate the total volume of gas left in the gas syringes at the end of the experiment. Explain your reasoning.

[2]

(c) A burning candle and a plant were placed in two jars of air. Both jars ware left in sunlight.



Jar A Jar B

A 200 cm^3 sample of the air from. Jar A was tested immediately after the candle burned out using the same procedure as in Experiment 1.

A 200 cm^3 sample of the air from Jar B was tested a few days after the candle burned out using the same procedure as in Experiment 1

Describe and explain how the results of the tests would differ for each jar.

[3]