2017 O level P2

1 (2017/O/GCSE/P2/01) The formulae of some elements are given in the following list.

Al Cu Fe H_2 Na O_2 Zn

(a) Choose elements from the list to answer the questions.

(i) Which element is used as a catalyst in the Haber process?

[1]

(ii) Choose **one** element which shows both metallic and non-metallic character

[1]

(iii) Which element can be extracted from its ore by heating with carbon and is purified by electrolysis?

[1]

(iv) Which element is produced at the graphite anode during electrolysis of aqueous sodium sulfate?

[1]

(v) Which element is used for galvanizing?

[1]

(b)

(i) Which elements in the list are transition elements?

[1]

(ii) Give **three** characteristic properties of transition elements

[1]

2 (2017/O/GCSE/P2/02) Aqueous silver nitrate reacts with aqueous potassium halides to form precipitates.
The precipitate are unstable and break down to form solid silver and a halogen.
These reactions are summarized in these equations (X represents the symbol for the halogen).

Reaction 1: $AgNO_3$ (   ) + KX (   ) → AgX (   ) + KNO_3 (   )

Reaction 2: 2AgX → 2Ag + X_2

(a)

(i) Complete the equation for **reaction 1** by filling missing state symbols.

[2]

(ii) One of these reactions is a redox reaction, the other is not. Use oxidation states to show that statement is true.

[2]

(b) The table shows the colours of some silver halide precipitates and the observations made when the precipitates are left to stand.

Silver halide	**Colour of silver halide**	**Observations on standing**
Silver chloride	White	Rapid formation of grey solid.
Silver bromide	Cream	Slow formation of grey solid
Silver iodide		No visible change after several minutes

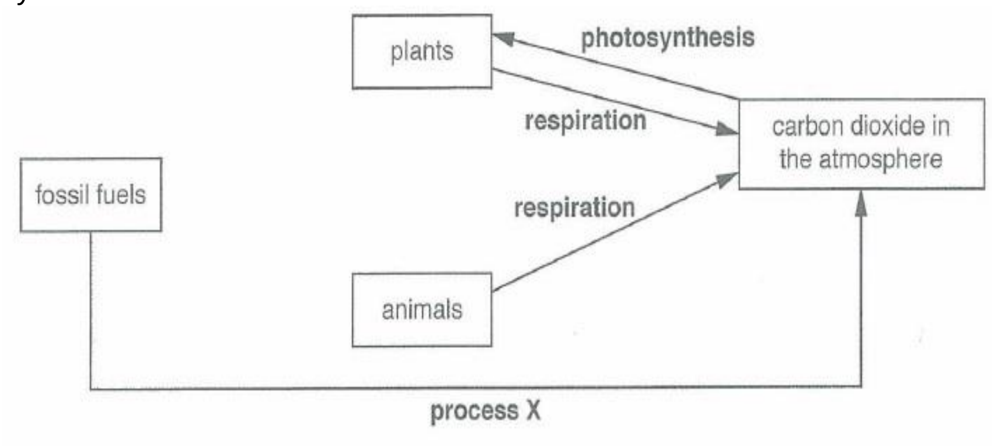
(i) Complete the table to show the colour of silver iodide.

[1]

(ii) What conclusion can you make from the table about the relationship between reactivity of the halogen and the rate of breakdown of the silver halide?

[1]

3 (2017/O/GCSE/P2/03) The diagram shows some of the process that happen in the carbon cycle.



(a) Name **process X**

[1]

(b)

(i) Write equations for the processes that happen during photosynthesis and respiration.

Photosynthesis:

Respiration:

[2]

(ii) Use your equations to explain how the processes of photosynthesis and respiration help to regulate the amount of carbon dioxide in the atmosphere

[1]

(c) The amount of carbon dioxide in the atmosphere is increasing due to our use of fossil fuels. One approach to this problem is to plant more trees. Suggest why planting more trees is **not** a long term solution to the increase in the amount of carbon dioxide.

[2]

4 (2017/O/GCSE/P2/04) Alkenes are manufactured from alkanes in cure in crude oil.

(a)

(i) Name the process which is used to manufacture alkenes.

[1]

(ii) The same process also helps the oil industry to meet demand for crude oil fractions. Explain why

[2]

(b) Butene is an alkene. Draw the structure of **two** isomers of butane

[2]

(c) A student has a sample of ethane and a sample of propene. State a reagent and describe the observations which could be used to distinguish between the samples.

Reagent	Observation for ethane	Observation for propane

[2]

(d) Some vegetable oils are polyunsaturated.

(i) Give a similarity and a difference between the bonds in these vegetable oils and alkenes.

[2]

(ii) Describe the manufacture of margarine from vegetable

____

____

____ [2]

5 (2017/O/GCSE/P2/05) A student carried out some experiments to investigate the displacement reactions of four metals:
She added metals to salt solutions. The table shows her observations.

	Salt solution			
Metal	Copper (II) sulfate	Magnesium sulfate	Cobalt (II) sulfate	Chromium (III) sulfate
Copper		No change. Solution remains colourless	No change, solution remains pink	No change, solution remains green
Magnesium	Brown solid forms in colourless solution		Grey solid forms in colourless solution	Grey solid forms in colourless solution
Cobalt	Brown solid forms in pink solution	No change, solution remains colourless		No change, solution remains green
Chromium	Brown solid forms in green solution	No change, solution remains colourless	Grey solid forms in green solution	

(a) What is the order of reactivity for the four metals?

Most reactive

Least reactive

[1]

(b) Magnesium sulfate solution is colourless

Complete the table to show the colourless of the other metal sulfate solutions.

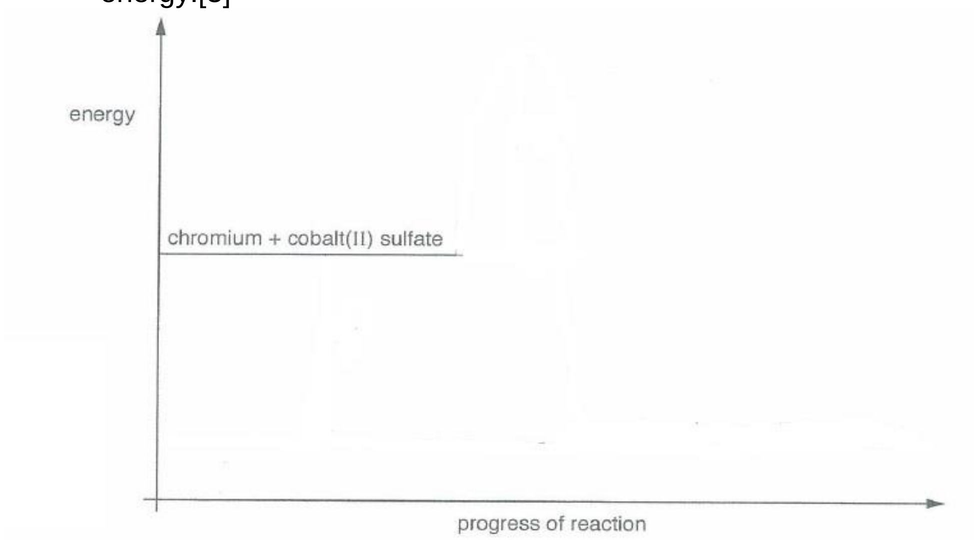
Metal sulfate	
Copper (II) sulfate	
Cobalt (II) sulfate	
Chromium sulfate	

[2]

(c)

(i) Complete the energy profile diagram for the reaction between chromium and cobalt (II) sulfate solution. Your diagram should include:

- The names of the products of the reaction.
- Labels to show the enthalpy change of reaction and the activation energy.[3]



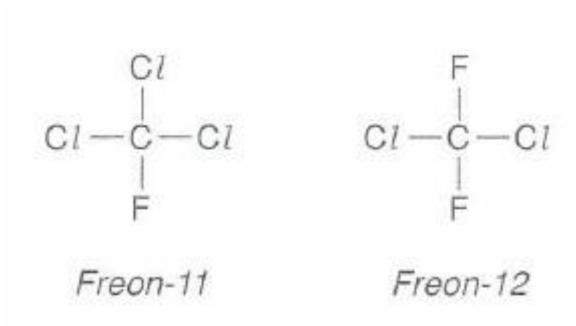
(ii) Write an ionic equation for the reaction when chromium metal is added to a solution of cobalt (II) sulfate

[2]

(d) The student added calcium to separate samples of each of the salt solution. The student observed fizzing. Explain this observation.

[1]

6 (2017/O/GCSE/P2/06) Chlorofluorocarbons (CFCs) were widely used as aerosol propellants until the mid – 1980s. They are now banned in most countries because they lead to the depletion of the ozone layer. Two CFCs have the trade names Freon-11 and Freon-12



(a)

(i) Draw a 'dot-and-cross' diagram to show the bonding in Freon-11. Show outer shell electrons only.

[2]

(ii) Suggest the full structural formula for Freon-13

[1]

(iii) Another Freon has the formula CF_4. Suggest the trade name of this Freon.

[1]

(iv) Can all of these Freons be classified as CFCs? Give a reason for your answer.

[1]

(b) CFCs cause the breakdown of ozone in several steps. The first step happens when energy from sunlight breaks a bond in a CFC to produce a chlorine atom.

For example: $CF_2Cl_2 \rightarrow CF_2Cl + Cl$

The table shows the bond energies for some of the bonds in CFCs.

Bond	**Bond energy in kJ / mol**
C – F	485
C – C*l*	327

Use the date in the table to explain why the ozone layer contains many more chlorine atoms than fluorine atoms.

[2]

(c) Chloride atoms cause the breakdown of ozone in a two-step reaction.

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O_3 \rightarrow 2O_2 + Cl$

(i) Use the equations to write an overall equation for the reaction

[2]

(ii) Explain how the equations show that chlorine atoms act as a catalyst for the breakdown of ozone.

[1]

7 (2017/O/GCSE/P2/07) The history of chemical formulae
The idea that chemical compounds could be represented by formulae was developed in the first part of the nineteenth century

A French chemist called Joseph Proust developed the Law of Constant Composition in the early 1800s. He noticed that if different masses of metals were heated in air to constant mass, the increase in the mass was proportional to the each metal used. His law states that, 'All samples of a particular chemical compound have the same elemental composition by mass.'

Proust collected data about the change in mass when the metals iron, lead and mercury were heated in air to constant mass.

He used the data to calculate the percentage composition by mass of the metal oxides.

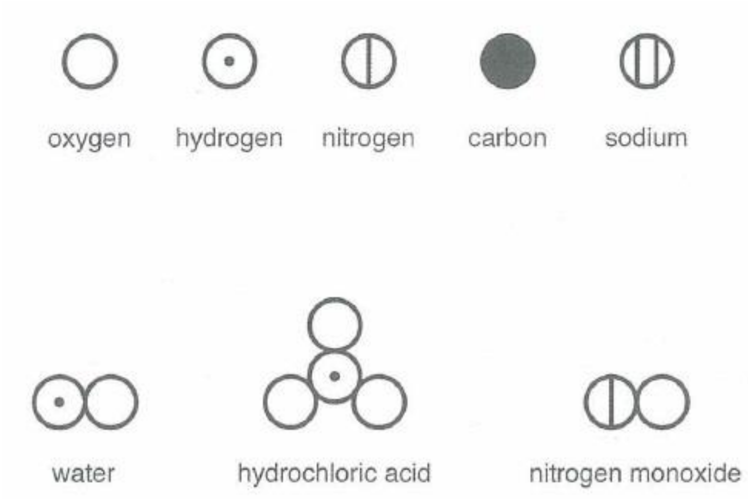
Table 1 shows some data from an experiment to find the increase in mass when iron, lead and mercury are heated.

Table 1

Metal	Mass of metal before heating / g	Mass after heating to constant mass / g
Iron	20.0	28.6
	30.0	42.7
Lead	25.0	26.9
	30.0	32.3
Mercury	25.0	27.0
	40.0	41.6

The law of constant composition does not work for all metals because different oxides may be formed under different conditions.

John Dalton was a British chemist who worked a few years later than Proust. He realised that the Law of Constant Composition could be explained if all compounds contained small particles of each element. This was the beginning of atomic theory. Dalton developed symbols and used them to represent elements and compounds.



Some of our modern formulae for compounds show that Dalton's formulae were not always correct.

(a) Use the data from the experiment in **table 1** for this question.

(i) Use calculations to decide whether iron and mercury obey the law of constant composition when they are heated in air. Show your working.

[3]

(ii) Lead is a metal in Group IV of the Periodic Table. Lead forms two common oxides, lead (II) oxide and lead (IV) oxide. Which oxide was formed when lead was heated in this experiment? Calculate the empirical formula of the oxide formed to support your answer

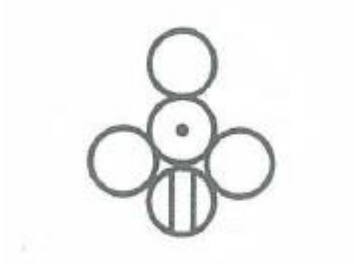
[3]

(b)

(i) Describe how Dalton's formulae for water, hydrochloric acid and nitrogen monoxide compare to their modern formulae

[4]

(ii) This is Dalton's formula for a common metal salt.

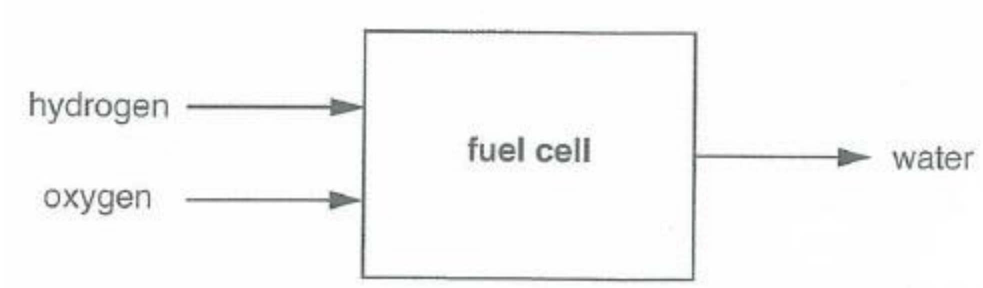


This formula of the salt does not agree with its modern formula.
Suggest the name of the salt based on the modern formula. Explain your reasoning.

Name
Reason

[2]

8 (2017/O/GCSE/P2/08) Petrol is used as a fuel in cars. Petrol contains mainly octane C_8H_{18}.
An alternative fuel for cars is hydrogen. Hydrogen can be used in a fuel cell.



The table shows some information about octane and hydrogen

Fuel	Boilin g	Density at room temperatur	Volume of 1 mol of fuel at	Enthalpy change when 1	Enthalpy change when 1 kg of fuel is

	point /°C	e and pressure in g / dm^3	room temperatur e and pressure / dm^3	mol of fuel is completel y burned in kJ / mol	completely burned in kJ / kg
Octane (C_8H_{18})	125	703		-5075	
Hydrogen	-253	0.083	24	-286	

(a) Complete the table by calculating the volume of 1 mol of octane and the enthalpy change when 1 kg of each fuel is completely burned. Use the space below to show your working.

[5]

(b) Use the information in the table to evaluate the use of hydrogen and octane as fuels. Your answer should consider:

- The ease of storage
- The energy content of the fuels

[3]

9 (2017/O/GCSE/P2/09) A student investigated the rate of reaction when dilute acid reacts with excess solid copper(II) carbonate. He used the same volume of acid each time. He measured the time taken to collect 10 cm3 of gas at room temperature and pressure. He also measured the total volume of gas at the end of the experiment at room temperature and pressure.

The table shows his results.

Experime nt	Acid	Concentration in mol / dm^3	Time taken to collect 10 cm^3 of gas / s	Total volume of gas / cm^3
1	Hydrochloric	0.5	15	150
2	Hydrochloric	1.0	6	300
3	Hydrochloric	0.5	7	150
4	Nitric	0.5	15	150

(a) Give the formula for the salt which forms in experiment 4

[1]

(b)

(i) The student carried out three experiments using acid at room temperature and one experiment using acid a higher temperature. Which experiment was carried out at a higher temperature? Explain your reasoning.

[2]

(ii) Explain, in terms of collisions between reacting particles, why a higher temperature affects the rate of reaction

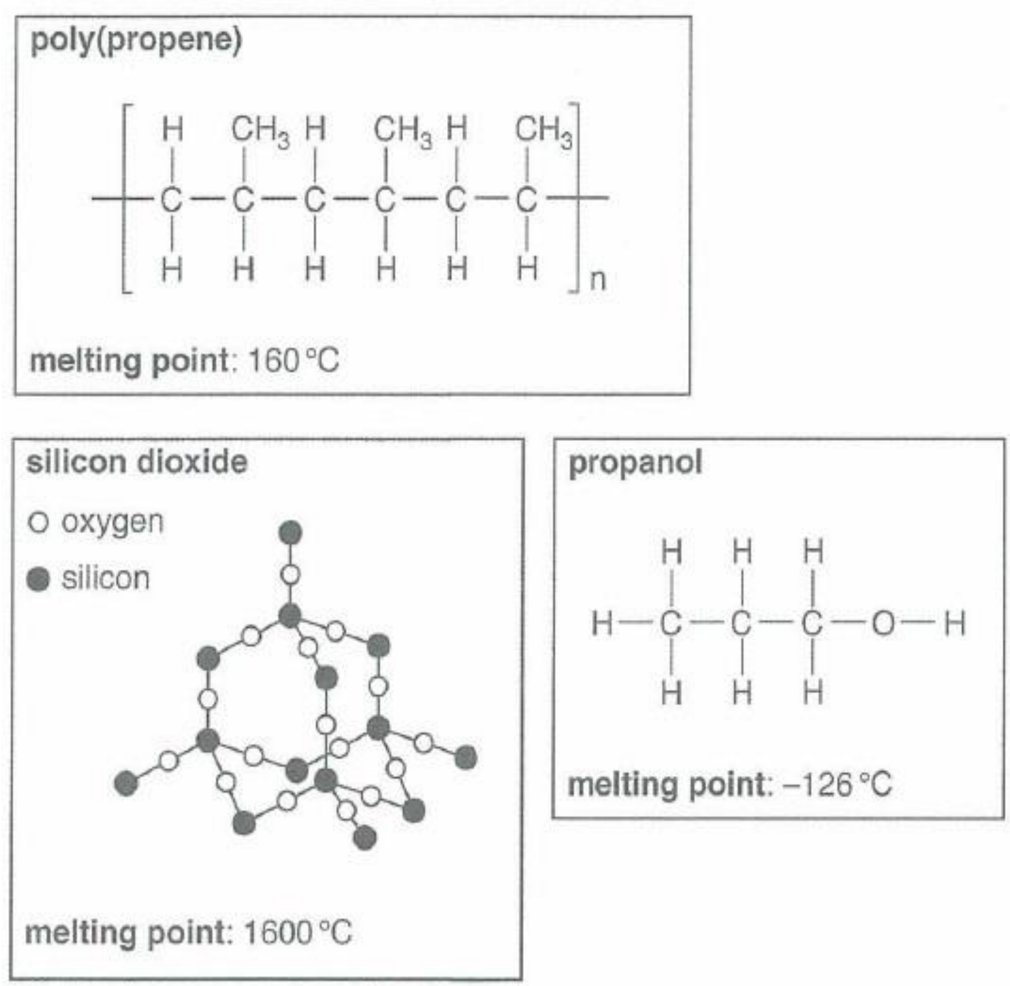
[2]

(c) The student carried out two further experiments at room temperature using 0.5mol/dm^3 ethanoic acid and 0.5 rnol/dm^3 sulfuric acid. He used the same volume of acids as in the previous experiments with excess solid copper (II) carbonate. Complete the table to predict what results he should expect and explain how you arrived at your answers.

Experiment	**Acid**	**Concentration in mol / dm^3**	**Time taken to collect 10 cm^3 of gas / s**	**Total volume of gas / cm^3**
5	Ethanoic	0.5		
6	Sulfuric	0.5		

[4]

10 (2017/O/GCSE/P2/10) The boxes show the structures and melting points of three compounds, poly (propene). silicon dioxide and propanol.



(a) Give the **empirical formula** of poly (propene) and the **molecular formula** of propanol.

Poly (propene)
Propanol

[2]

(b) Compare the bonding and structures of the three compounds

[4]

(c) Explain why the melting points of the three compounds differ from each other

[4]