2016 O level P2

1 (2016/O/GCSE/P2/01) The periodic Table shows trends down each group and across each period.

(a) Which trends are only true down a group, which trends are only true across a period and which trend(s) are true for both? Put a tick (√) in one box in each row.

Trend	Only true down a group	Only true across a period	True for both
The number of electron shells increases.			
The number of valency electrons increases.			
Proton number increases.			
There is a change in character from metallic to non-metallic.			

[2]

(b) Group I and Group VII show different trends in their properties.

Group I	Group VII
Li	F
Na	Cl
K	Br
Rb	I

(i) Describe the trend in melting point down each group.

[1]

(ii) Describe the trend in reactivity down each group

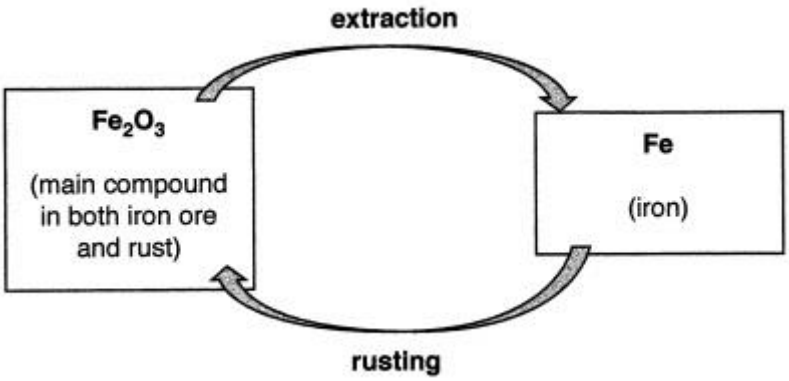
[1]

(c) The transition elements are in a block in the centre of the Periodic Table. Transition elements act as catalyst to increase the rate of industrial processes. Catalysts are expensive to buy but reduce costs in the long run. Give **two** reasons to explain why catalysts reduce costs in the long run.

[2]

2 (2016/O/GCSE/P2/02) Many parts of a bicycle contain iron. One problem with using iron is that it rusts.

(a) The diagram shows the cycle of changes that happen when iron is extracted and then rusts.



Use oxidation states to show which change involves oxidation and which change involves reduction.

[2]

(b) The diagram shows the rust prevention methods used on different parts of a bicycle.

(i) Stainless steel alloy is used to make some bicycle parts. What is meant by the term *alloy?*

[1]

(ii) Explain how the oil, the paint and the plastic coating slow down rusting

[2]

(iii) A shop sells a spray-on rust treatment. The spray stops iron from rusting even if the paint on the bicycle is scratched. The spray contains particles of zinc. Explain how zinc prevents rust from forming.

[2]

3 (2016/O/GCSE/P2/03) The table shows some information about Earth and some other planets. The predicted surface temperature of each planet takes into account a number of factors including its distance from the Sun. The prediction does not take into account the absorption of heat energy by the atmosphere.

	Earth	**Venus**	**Mercury**
Distance from Sun /millions of km	150	108	58
Predicted surface temperature /°C	—18	—41	163
Actual surface temperature/°C	15	462	167
Composition of atmosphere	78% N_2 21% O_2 0.04% CO_2 (plus other gases)	97% CO_2 (plus other gases)	None

(a) Use the information in the table to suggest reasons for the differences between the actual surface temperature and predicted surface temperature of each

[2]

(b) In the table the term "other gases" includes sulfur dioxide (SO_2)

(i) Suggest a possible source for the sulfur dioxide in the atmosphere of Venus.

[1]

(ii) There is much more sulfur dioxide in the atmosphere of Venus than in the atmosphere of Earth. Sulfur dioxide dissolves in drops of water in the atmosphere of Venus. What effect would you expect this to have on the pH of the water?

[1[

(iii) Rainwater never reaches the surface of Venus. Use the information in the table to suggest why

[3]

4 (2016/O/GCSE/P2/04) A chemical company makes salts for use in fertilizers.

(a) The company reacts acids with other compounds to make the salts. The table shows some names and formulae of salts used in fertilizers with the names of the acids and other compounds used to make them. Complete the table by filling in the missing information

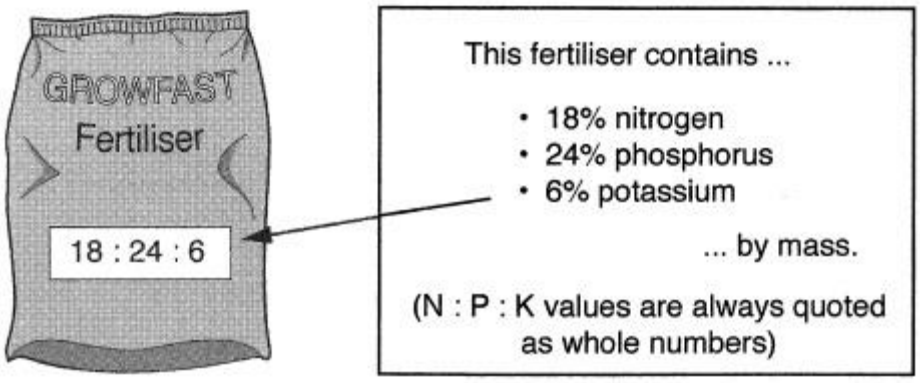
Name of salt	**Formula of salt**	**Name of acid used to make salt**	**Name of other compound used to make salt**
Potassium sulfate	K_2SO_4		
Potassium phosphate	K_3PO_4	Phosphoric acid	
Ammonium nitrate	NH_4NO_3		
Calcium phosphate		Phosphoric acid	Calcium hydroxide

(b) The salts are put into bags and sold as fertilizer. Fertilizers provide plants with essential elements (nitrogen, phosphorus and potassium). Which **two** salts in the table could be combined to make a fertilizer which contains all three of these essential elements

_____And_____

[1]

(c) Each bag has a label which gives the N: P: K ratio. The N: P: K ratio shows the ratio by mass of nitrogen, phosphorus and potassium in the fertilizer.



(i) Which salt in the table has the N: P: K ratio 0: 20: 0? Explain your reasoning

Salt

Reason

[2]

(ii) Calculate the N: P: K ratio of K_3PO_4

[3]

5 (2016/O/GCSE/P2/05) The table shows some salts and products that contain them.

Salt	**Product**
Silver chloride	Photographic film
Potassium nitrate	Fertilizer
Barium sulfate	Medical tracer
Sodium carbonate	Food additive
Lead sulfate	Car battery

(a) Which salts in the table can be made by **precipitation** reactions? Explain your reasoning

Salts

Reason

[3]

(b) Other compounds are used to make a range of useful products. Put a tick (√) in **one** box in each row to show a correct use of each compound

Compound	Use				
	To make detergents	**To make polymers for packaging**	**For flue gas desulfurization**	**As a solvent in inks**	**For road surfaces**
Bitumen					
Sulfuric acid					
Ethene					
Ethyl ethanoate					
Calcium carbonate					

[3]

6 (2016/O/GCSE/P2/06) Aldehydes are a homologous series of organic compounds. The table shows the names, formulae and boiling points of some aldehydes.

Name	Formula	Boiling point/°C
Methanal	HCHO	-19
Ethanal	CH_3CHO	20
Propanal	C_2H_5CHO	49
Pentanal	C_4H_9CHO	103

(a) Use the information in the table to give **two** pieces of evidence that suggest that the aldehydes are a homologous series.

[2]

(b) Butanal is an aldehyde. Deduce the formula and predict the boiling point of butanal.

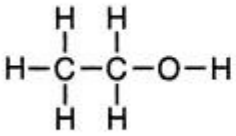
Formula

Predicted boiling point

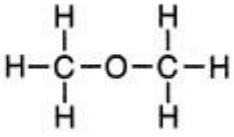
[2]

(c) Petrol for cars contains small amounts of added ethanol (an alcohol) and methoxymethane (an ether)

ethanol

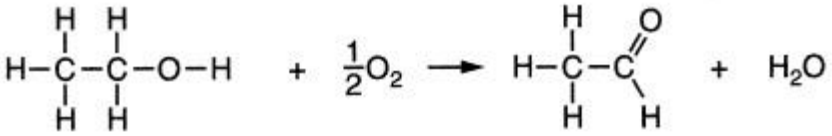


methoxymethane



At the high temperatures in a car engine, some ethanol is oxidized to produce ethanol (an aldehyde). The equation for this reaction is shown below.

ethanol **ethanal**



(i) **Ethanol, methoxymethane** and **ethanal** are all compounds of carbon, hydrogen and oxygen. Define the term *isomer*. Use your definition to show which of the three compounds isomers of each other are and which are not.

[3]

(ii) Ethanal in car exhaust emissions is a pollutant that is harmful to heath. The ethanal is removed by oxidation in the catalytic converter of the car. The reaction in the catalytic converter produces the same products as complete combustion. Write an equation to show this reaction

[2]

(iii) If any ethanal leaves the car exhaust. It can react with oxygen from the air to make ethanoic acid. Write an equation to show this reaction. Show the organic compounds as displayed formulae.

[1]

Section B

Answer all **three** equation in this section.

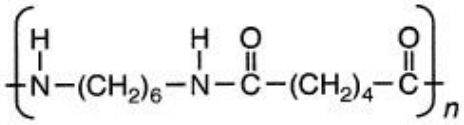
The last question is in the form of an either/or and only one of the alternatives should be attempted

7 (2016/O/GCSE/P2/07) **The story of nylon. Discovery, naming and properties**

Wallace Carothers was an American research chemist in the 1930s. He researched new synthetic polymers to replace silk. At the time, silk was needed in very large quantities for parachutes. He is most famous for developing the first “nylon”.

Carothers reacted together a diamine and a dicarboxylic acid to make a type of polyamide that we now call “nylon 6, 6”

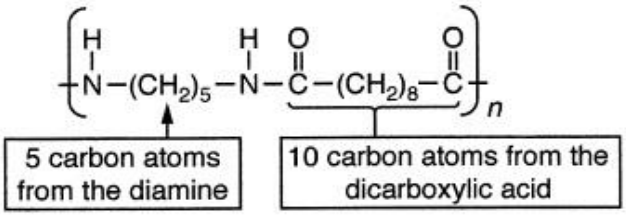
Nylon 6, 6



The numbers in the systematic names of each nylon refer to the number of carbon atoms from the diamine (the first number) and the dicarboxylic acid (the second number) which were used to make the nylon. For example, another type of nylon (nylon 5, 10) was also made by Carothers.

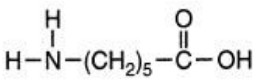
The structure of nylon 5, 10 is shown below.

Nylon 5, 10

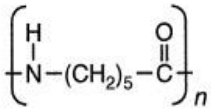


Later, nylon 6 was invented. This can be made from a single monomer that has an amine group at one and a carboxylic acid group at the other end.

monomer of nylon 6

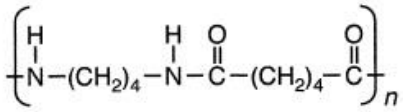


repeating unit of nylon 6

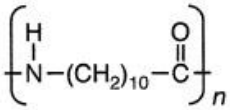


Other types of nylon were developed later.

repeating unit of nylon X



repeating unit of nylon Y



Different types of nylon are used for different purposes. One of the limits to their use is that they cannot be used in contact with solutions of strong acids because they react slowly with strong acids to form their original monomer molecules. Some uses of nylon are related to their melting points. For nylons made from two different monomers, the melting point is affected by the chain lengths of the diamine and the dicarboxylic acid used to make the nylon.

Name of nylon	Melting point/°C
Nylon 6, 6	269
Nylon 6, 10	220
Nylon 6	220
Nylon 4, 6	275
Nylon 6, 12	218
Nylon 11	190

Using nylon

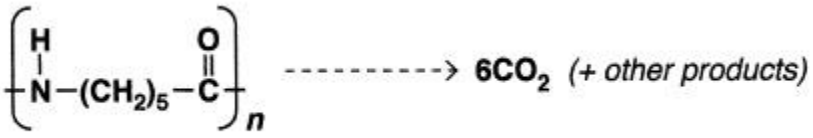
Nylons are useful because they are generally unreactive and can be made into very strong fibres. They are used to make clothing, fishing lines, ropes and machine parts. To be suitable for making fibres, the nylon chains must have a relative molecular mass of between 10 000 and 20 000. This length of molecule gives enough strength but is still flexible enough to be spun into fibres easily

Disposal of used nylon

All types of nylon are difficult to dispose of at the end of their useful life because they do not biodegrade easily. However, into the 1970s a strain of bacteria was discovered that breaks down nylon. Nylon can also be disposed of by burning at a high temperature.
Both these methods of disposal give off carbon dioxide. This means that the disposal of nylon has a “carbon footprint”. The carbon footprint of nylon is the mass of carbon dioxide that is given off per kilogram of nylon.

Carbon footprint = mass of carbon dioxide given off per kilogram of nylon

The carbon footprint can be calculated by considering the amount of carbon dioxide given off by each repeating unit of the nylon, for example, for nylon 6:



(a) Name **nylon X** and **nylon Y**.

Nylon X

Nylon Y

[3]

(b) Give the structural formulae of the **two** produces that form when nylon 5, 10 is left in contact with s strong acid.

[2]

(c) A company wants to use nylon 6, 6 to make fibres. Calculate the minimum number of repeating units which must be present in one chain of the nylon 6, 6

[2]

(d) The article says "for nylons made two different monomers, the melting point is affected by the chain lengths of the diamine and the dicarboxylic acid used to make the nylon". How is the melting point of the nylon affected by the chain lengths of the diamine and the dicarboxylic acid used? Explain your reasoning.

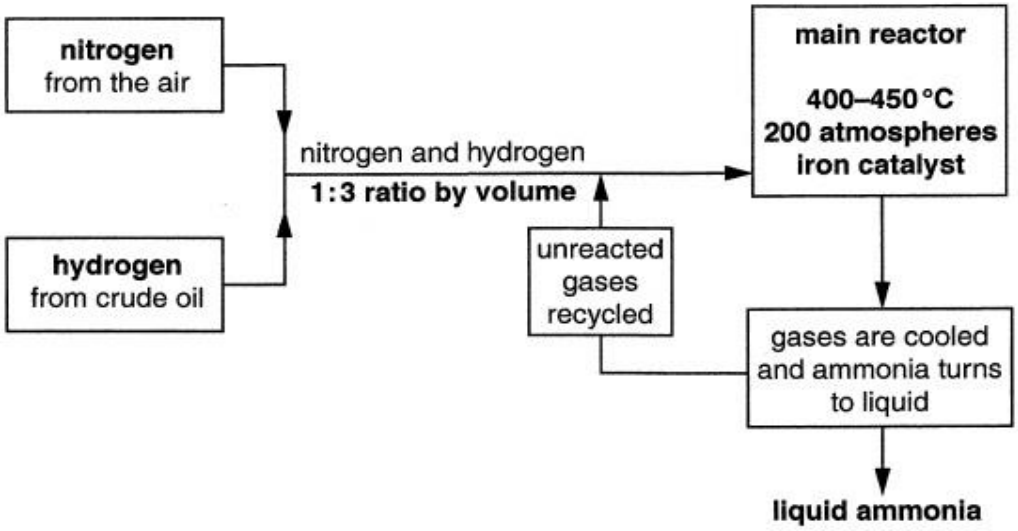
Diamine
Dicarboxylic acid

[3]

(e) Calculate the carbon footprint of nylon 6

[2]

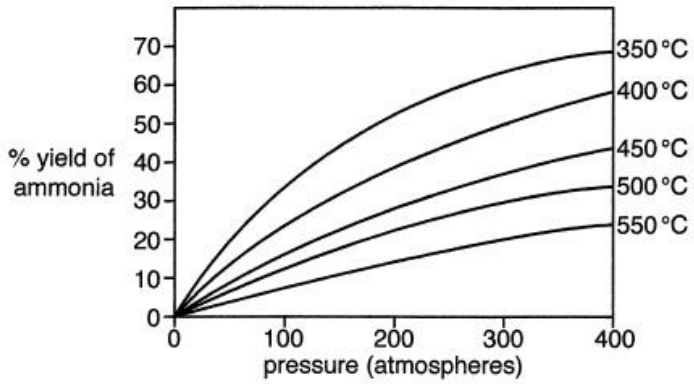
8 (2016/O/GCSE/P2/08) The Haber process for marking ammonia can be represented using a flow diagram.



(a) The nitrogen and hydrogen are mixed in a 1: 3 ratio by volume. Explain why the gases are mixed in a 1: 3 ratio. Include an equation in your answer.

[2]

(b) The graph shows the yield of ammonia that is made under different conditions.



(i) Explain, in terms of collision between (reacting) particles, how a lower pressure affects the **rates of reaction** in the reactor

[2]

(ii) Use the graph to predict how a lower pressure affects the relative amounts of ammonia, nitrogen and hydrogen that leave the main reactor. Explain your reasoning

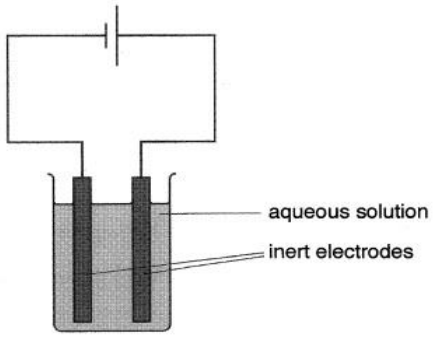
[2]

(iii) What effect does a lower pressure have on the **final** amount of ammonia made from a fixed amount of nitrogen and hydrogen? Explain your reasoning

[2]

9 (2016/O/GCSE/P2/09) Copper (II) chloride and copper (II) sulfate are both copper salts.

(a) The diagram shows the apparatus that a student used to electrolyze aqueous solutions of the salts.



Complete the table of information about the electrolysis

Solution	**Name of products of electrolysis**		**Ionic equation for reaction at each electrode**
Concentrated aqueous copper (II) chloride	At negative electrode		
	At positive electrode		
Dilute aqueous copper (II) sulfate	At negative electrode		
	At positive electrode		

[4]

(b) The student did some tests using four reagents, **A, B, C** and **D**. In each test he added a different reagent to separate fresh sample of aqueous copper (II) chloride and aqueous copper (II) sulfate. The table shows what reagents he used.

	Reagent
A	Zinc powder
B	Acidified aqueous silver nitrate
C	Acidified aqueous barium nitrate
D	Aqueous sodium hydroxide

(i) Which **two** reagents give the **same** observations for both aqueous copper (II) chloride and aqueous copper (II) sulfate?

[1]

(ii) Describe what the student would **observe** when he adds each of the four reagents to separate fresh samples of aqueous copper (II) chloride and aqueous copper (II) sulfate.

[5]

10 (2016/O/GCSE/P2/10) Displacement reactions are used to extract elements from their compounds.

(a) Bacteria can dissolve copper from mining waste to make a solution of aqueous copper (II) sulfate.

Copper can be extracted from the solution by adding scrap iron.
This is the ionic equation for the reaction.

$$Fe(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Fe^{2+}(aq)$$

(i) What would be **observed** when iron is added to aqueous copper (II) sulfate?

[2]

(ii) This process has economic and environmental advantages. Explain why

[2]

(b) Bromine is extracted from seawater. Bromide compounds in the seawater react with chlorine gas to make an orange solution of aqueous bromine. Write an ionic equation, with state symbols, for the reaction between bromide ions and chlorine gas

[2]

(c) The techniques for extracting both copper and bromide involve displacement reactions. Describe the **similarities** and **differences** between what happens during each displacement reaction.

[4]