PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 0: FORMULAE, EQUATIONS AND HAZARDS (PAPER 2, PACK 1)

SCORE	PERCENTAGE
/113	%

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Q1.

Acid solutions contain hydrogen ions.

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}.

Complete the balanced ionic equation for this reaction.

(2)

..... + ... H^+ → ..... Al^{3+} + ...

(Total for question = 2 marks)

Q2.

Sodium reacts with fluorine to form sodium fluoride, NaF.

Complete the balanced equation for this reaction.

(2)

2Na + ... → .....NaF

(Total for question = 2 marks)

Q3.

The energies of some bonds are shown in Figure 13.

bond	energy of bond / kJ mol^{-1}
H—H	436
Cl—Cl	243
H—Cl	432

Figure 13

Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

Calculate the energy change, in kJ mol^{-1}, for the reaction of 1 mol of hydrogen gas, H_2, with 1 mol of chlorine gas, Cl_2, to form 2 mol of hydrogen chloride gas, HCl.

(4)

energy change = ... kJ mol^{-1}

(Total for question = 4 marks)

Q4.

(a) Which of these is the formula of a molecule of a hydrocarbon?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** CH_3COOCH_3

☒ **B** CH_3CH_2Cl

☒ **C** CH_3CH_3

☒ **D** CH_3COOH

(b) The formula of a molecule of propene is C_3H_6.

Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(c) Methane burns in oxygen to form carbon dioxide and water.
Write the balanced equation for this reaction.

(3)

.....

*(d) Natural gas is mainly methane.

A gas with similar composition, known as bio-methane, can be produced from plants grown specifically for this purpose.

Describe the advantages and disadvantages of using bio-methane rather than natural gas as a source of energy.

(6)

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(Total for Question is = marks)

Q5.

(a) Which of these is the formula of a molecule of a hydrocarbon?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** CH_3COOCH_3

☒ **B** CH_3CH_2Cl

☒ **C** CH_3CH_3

☒ **D** CH_3COOH

(b) The formula of a molecule of propene is C_3H_6.

Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(c) Methane burns in oxygen to form carbon dioxide and water.
Write the balanced equation for this reaction.

(3)

.....

*(d) Natural gas is mainly methane.
A gas with similar composition, known as bio-methane, can be produced from plants grown specifically for this purpose.

Describe the advantages and disadvantages of using bio-methane rather than natural gas as a source of energy.

(6)

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(Total for Question is = marks)

Q6.

Chlorine is a halogen.

Chlorine reacts with potassium iodide solution to form potassium chloride solution and iodine.

$$Cl_2 + 2KI \rightarrow 2KCl + I_2$$

(i) State what would be **seen** when this reaction occurs.

(1)

.....

.....

(ii) Write the ionic equation for this reaction.

(3)

.....

(iii) Explain, in terms of their electronic configurations, why chlorine is more reactive than iodine.

(2)

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.....

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(iv) Explain why this reaction is an example of a redox reaction.

(4)

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(Total for question = 10 marks)

Q7.

A student investigated the rate of reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Calcium chloride, carbon dioxide and water are formed.

Complete and balance the equation for the reaction.

(2)

$CaCO_3$ + HCl → ..... + ... + ...

(Total for question = 2 marks)

Q8.

When decane undergoes complete combustion, a mixture of carbon dioxide and water is formed.

Complete the balanced equation for this reaction.

(2)

$2C_{10}H_{22}$ + ... O_2 → ..... CO_2 + ... H_2O

(Total for question = 2 marks)

Q9.

The scientist John Dalton lived over 200 years ago.

Another gas that Dalton investigated was chlorine.

Chlorine gas reacts with water.
The two products are a solution of hydrogen chloride and the substance HClO.

(i) Complete the balanced equation for this reaction, including the three missing state symbols.

(3)

..... (.....) + ... (.....) ↔ .....
(.....) + HClO (aq)

(ii) Hydrogen chloride solution is acidic.

The formulae of four ions are shown in Figure 2.

H^+	H^-	Cl^+	Cl^-

Figure 2

Give the formula of the ion in Figure 2 that causes the hydrogen chloride solution to be acidic.

(1)

formula .....

(iii) An acid reacts with an alkali.

Give the name of this type of reaction.

(1)

.....

(Total for question = 5 marks)

Q10.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The word equation for the reaction between copper carbonate and dilute sulfuric acid is

$$\text{copper carbonate} + \text{sulfuric acid} \rightarrow \text{copper sulfate} + \text{carbon dioxide} + \text{water}$$

(i) Complete the balanced equation for this reaction.

(2)

$$CuCO_3 + \text{.....} \rightarrow \text{.....} + CO_2 + H_2O$$

(ii) Calculate the relative formula mass of copper carbonate, CuCO3 .
(relative atomic masses: C = 12.0, O = 16.0, Cu = 63.5)

(2)

.....

.....

.....

relative formula mass of $CuCO_3$ = ...

(iii) What is the chemical test to show that a gas is carbon dioxide?

(1)

☒ **A** bubble the gas through limewater, limewater turns cloudy

☒ **B** put damp blue litmus paper in the gas, litmus paper turns red

☒ **C** put a lighted splint into the gas, the splint is extinguished

☒ **D** measure the pH of the gas, pH = 4

(Total for question = 5 marks)

Q11.

1 mole of pentadecane can be cracked to form 1 mole of octane, C_8H_{18}, and 1 mole of propene, C_3H_6, and 2 moles of another product.

Complete the balanced equation for this reaction by adding the formula of the missing product.

(1)

$$C_{15}H_{32} \rightarrow C_8H_{18} + C_3H_6 + 2 \text{ .....}$$

(Total for question = 1 mark)

Q12.

When fuels such as diesel oil are burned, the high temperatures produced can cause nitrogen and oxygen in the air to form the pollutant nitrogen dioxide.

Complete the balanced equation for the reaction.

(2)

$N_2 + 2O_2 \rightarrow$ .....

(Total for question = 2 marks)

Q13.

Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols.

(3)

.....K (.....) + F_2(g) → .....KF (.....)

(Total for question = 3 marks)

Q14.

Some pieces of calcium carbonate were added to dilute hydrochloric acid in a conical flask and the volume of carbon dioxide produced was measured.

Complete the diagram in Figure 5 to show the apparatus to collect the gas produced and measure its volume.

(2)

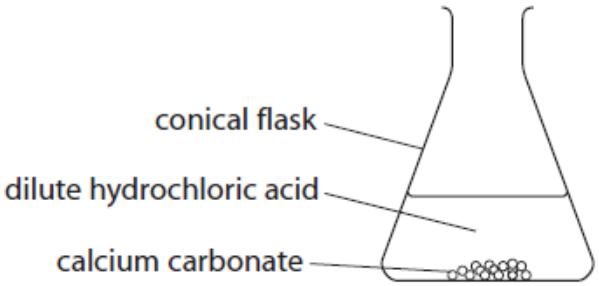


Figure 5

(Total for question = 2 marks)

Q15.

Waste water may contain phosphate ions, PO_4^{3-}.

Aluminium ions react with phosphate ions to form aluminium phosphate.

Complete the ionic equation for the formation of aluminium phosphate in this reaction.

(2)

..... + PO_4^{3-} → .....

(Total for question = 2 marks)

Q16.

Much of the carbon dioxide present in the Earth's early atmosphere dissolved into the oceans.

This led to the formation of compounds including calcium carbonate, $CaCO_3$.

Some of the calcium carbonate reacted with magnesium ions to form dolomite, $CaMg(CO_3)_2$.

Complete the **ionic** equation for the reaction of calcium carbonate with magnesium ions.

(2)

$$\text{.....}CaCO_3 + \text{.....} \rightarrow \underset{\text{dolomite}}{CaMg(CO_3)_2} + Ca^{2+}$$

(Total for question = 2 marks)

Q17.

Crude oil is a complex mixture of substances.

When crude oil is separated into fractions, the amount of each fraction obtained rarely matches the demand for that fraction.

Figure 9 shows the relative amounts of six of the fractions present in a crude oil and the relative demand for each of these fractions.

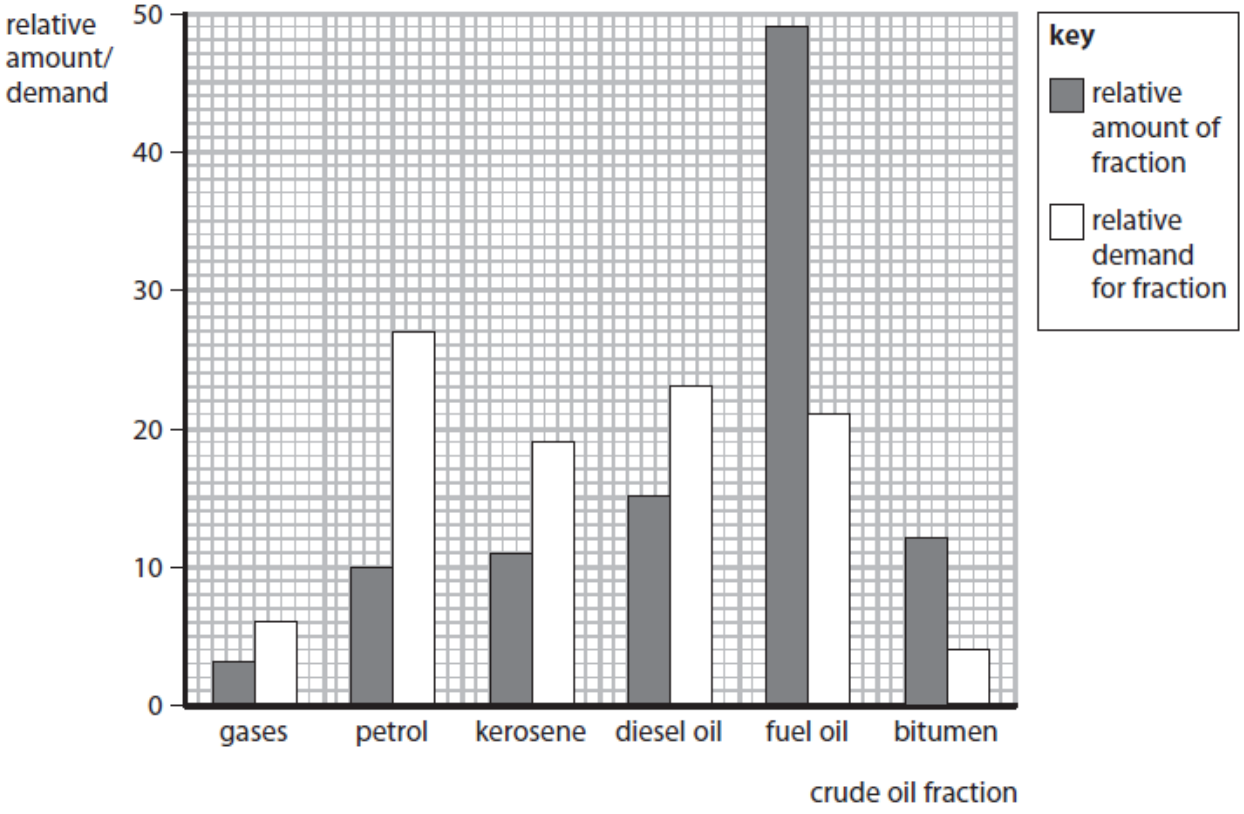


Figure 9

Cracking is used to match the relative amount of a fraction of crude oil to the demand for that fraction.

(i) Use the information in Figure 9 to give the name of the fraction that is most likely to need to be cracked.

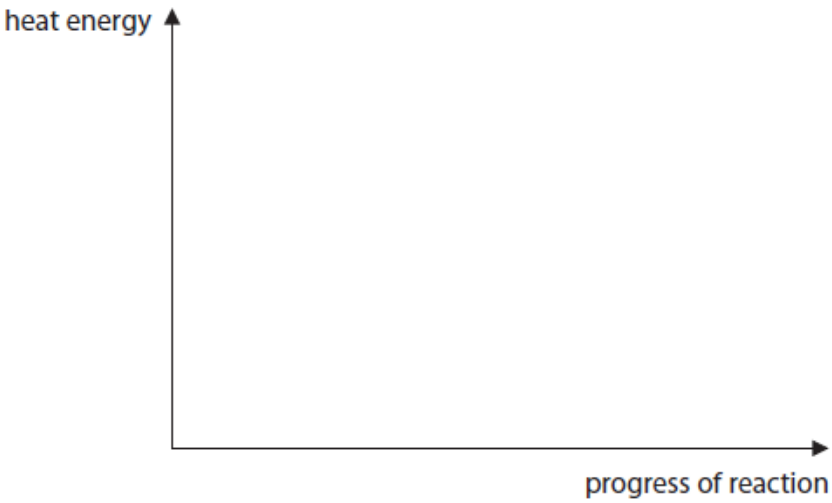
(1)

.....

(ii) In a cracking reaction, reactants are heated to form products.
This reaction is endothermic.

On the axes provided, draw the reaction profile of this reaction.
Label the energy of the reactants, the energy of the products and the activation energy of the reaction.

(3)



(iii) Dodecane, $C_{12}H_{26}$, can be cracked to form useful products.

Complete the equation for the cracking of dodecane by filling in the formula of the single molecule needed to balance the equation.

(1)

$$C_{12}H_{26} \rightarrow \text{.....} + 3C_2H_4$$

(Total for question = 5 marks)

Q18.

Magnesium and calcium are in group 2 of the periodic table. They are less reactive than the metals in group 1.

Calcium reacts with water to form calcium hydroxide, $Ca(OH)_2$, and hydrogen, H_2.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

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(Total for question = 2 marks)

Q19.

2.24 g of iron combines with 0.96 g of oxygen to form an oxide of iron.

Determine the formula of this oxide of iron and use it to complete the balanced equation.

(relative atomic masses: Fe = 56.0, O = 16.0)

(4)

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balanced equation for the reaction is

..... Fe + ... O_2 → .....

(Total for question = 4 marks)

Q20.

Electrolysis

(a) Some metal objects are electroplated to improve their appearance.

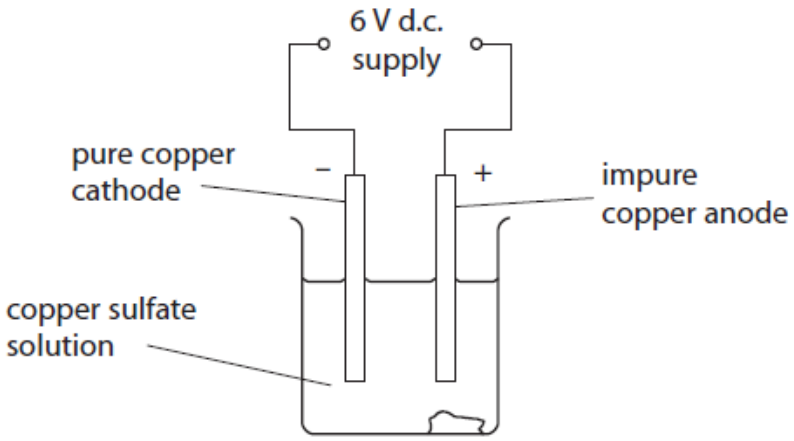
Give another reason why some metal objects are electroplated.

(1)

.....

.....

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

(3)

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(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

.....

*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

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(Total for question = 12 marks)

Q21.

Electrolysis

(a) Some metal objects are electroplated to improve their appearance.

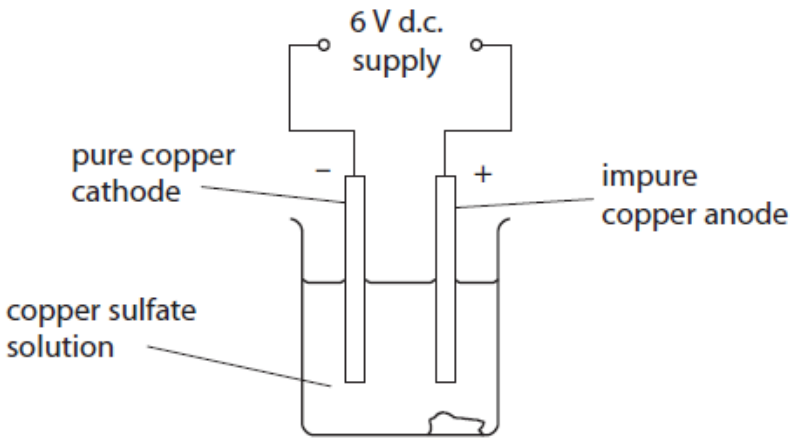
Give another reason why some metal objects are electroplated.

(1)

.....

.....

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

(3)

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(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

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*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

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(Total for question = 12 marks)

Q22.

Electrolysis

(a) When molten sodium chloride is electrolysed, the products are sodium and chlorine.

(i) Give the formula of sodium chloride.

(1)

.....

(ii) State why molten sodium is used in some nuclear reactors.

(1)

.....

.....

(b) Molten lead bromide is electrolysed.

(i) Complete the sentence describing the type of reaction.

(1)

During the electrolysis the lead ions gain electrons at the cathode.

The type of reactions in which metal ions gain electrons is called
.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Molten lead bromide, rather than solid lead bromide, has to be electrolysed because

(1)

☒ **A** ions can only move freely in molten lead bromide

☒ **B** electrolysis is too fast in solid lead bromide

☒ **C** molten lead bromide contains free electrons

☒ **D** lead bromide has a very low melting point

(iii) When molten lead bromide is electrolysed, a silver-coloured liquid is produced at the cathode and a red-brown gas is produced at the anode.

Complete the word equation by showing the products formed when molten lead bromide is electrolysed.

(2)

lead bromide → ..... + ...

(c) Three colourless liquids, **A**, **B** and **C**, are tested.

Tests 1, 2 and 3 are carried out on each of these liquids.

Test 1: the liquid is tested to see if it conducts electricity.

Test 2: 20 cm^3 of the liquid is shaken vigorously with a few drops of soap solution.

Test 3: 20 cm^3 of the liquid is boiled and then test 2 is carried out on the boiled liquid.

The results are shown in the table.

liquid	observations		
	test 1	test 2	test 3
A	conducts	scum formed, no lather	scum formed, no lather
B	conducts	scum formed, no lather	lather formed
C	does not conduct	lather formed	lather formed

(i) State which of the liquids are electrolytes.

(1)

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(ii) Use the results of the tests to explain whether each of the liquids **A**, **B** and **C** is soft, shows permanent hardness, or shows temporary hardness.

(3)

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(Total for question = 10 marks)

Q23.

Aluminium reacts with chlorine to form aluminium chloride.

Write the balanced equation for this reaction.

(3)

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(Total for question = 3 marks)

Q24.

Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

Sodium reacts with water to form sodium hydroxide solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

.....Na(.....) + $2H_2O$(.....) → ..... NaOH(.....) + H_2(.....)

(Total for question = 3 marks)

Q25.

Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

.....

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A dilute solution of ethanol can be converted to a concentrated solution of ethanol by

(1)

☒ **A** filtration

☒ **B** fractional distillation

☒ **C** dehydration

☒ **D** cracking

(iii) Write the balanced equation for the fermentation of glucose, $C_6H_{12}O_6$.

(2)

.....

Q26.

Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

.....

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A dilute solution of ethanol can be converted to a concentrated solution of ethanol by

(1)

☒ **A** filtration

☒ **B** fractional distillation

☒ **C** dehydration

☒ **D** cracking

(iii) Write the balanced equation for the fermentation of glucose, $C_6H_{12}O_6$.

(2)

.....

Q27.

(a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

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(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from

ethene.

(3)

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(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.

(2)

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(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

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(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol CH_3OH

ethanol C_2H_5OH

propanol C_3H_7OH

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

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(Total for Question = 9 marks)

Q28.

(a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

.....

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(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

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.....

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.

(2)

.....

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.....

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

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(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol CH_3OH

ethanol C_2H_5OH

propanol C_3H_7OH

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

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(Total for Question = 9 marks)

Q29.

Ethanol

Ethanol is present in alcoholic drinks.

(a) Ethanol is produced by fermentation of carbohydrates.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The conditions used for fermentation are

(1)

☒ **A** add manganese(IV) oxide, temperature below 20°C

☒ **B** add yeast, temperature of about 35°C

☒ **C** add manganese(IV) oxide, temperature of 45°C

☒ **D** add yeast, temperature above 60°C

(b) Ethanol, C_2H_5OH, is also produced by the reaction of ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(c) Ethanol is a member of the homologous series, the alcohols.

(i) Describe what is meant by an **homologous series**.

(2)

.....

.....

.....

.....

(ii) Draw the structure of a molecule of methanol, CH_3OH.

Show all the covalent bonds.

(1)

(d) When a bottle of wine is left open for a few days, ethanol in the wine changes into ethanoic acid.

(i) State the type of reaction that occurs when ethanol changes into ethanoic acid.

(1)

.....

(ii) Describe what you would **see** when a piece of magnesium ribbon is added to dilute ethanoic acid.

(2)

.....

.....

.....

.....

(Total for question = 9 marks)

Q30.

Ethanol

Ethanol is present in alcoholic drinks.

(a) Ethanol is produced by fermentation of carbohydrates.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The conditions used for fermentation are

(1)

☒ **A** add manganese(IV) oxide, temperature below 20°C

☒ **B** add yeast, temperature of about 35°C

☒ **C** add manganese(IV) oxide, temperature of 45°C

☒ **D** add yeast, temperature above 60°C

(b) Ethanol, C_2H_5OH, is also produced by the reaction of ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(c) Ethanol is a member of the homologous series, the alcohols.

(i) Describe what is meant by an **homologous series**.

(2)

.....

.....

.....

.....

(ii) Draw the structure of a molecule of methanol, CH_3OH.

Show all the covalent bonds.

(1)

(d) When a bottle of wine is left open for a few days, ethanol in the wine changes into ethanoic acid.

(i) State the type of reaction that occurs when ethanol changes into ethanoic acid.

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(ii) Describe what you would **see** when a piece of magnesium ribbon is added to dilute ethanoic acid.

(2)

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(Total for question = 9 marks)