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A' Level Chemistry

Year 1

Unit 4: Introduction to Organic Chemistry & Alkanes

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator

Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

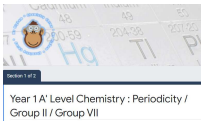
Quizlet

Quizlet Classes

Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes

Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms

Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

If you struggle with the questions in the pack, **STOP!** and complete some more revision.

If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

Answer **all** questions in the spaces provided.

0 1 This question is about the reactions of alkanes.

0 1 . 1 Alkanes can be used as fuels.

Give an equation for the combustion of heptane (C_7H_{16}) in an excess of oxygen.

[1 mark]

0 1 . 2 Heptane can be obtained from the catalytic cracking of hexadecane ($C_{16}H_{34}$) at a high temperature.

Identify a suitable catalyst for this process.
Give **one** condition other than high temperature.
Give an equation for the catalytic cracking of one molecule of hexadecane to produce one molecule of heptane, one molecule of cyclohexane and one other product.

[3 marks]

Catalyst

Condition

Equation

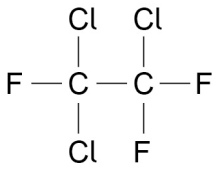
0 1 . 3 Alkanes can be used in free-radical substitution reactions to produce halogenoalkanes.

Give equations for the propagation steps in the reaction of butane to form 2-chlorobutane.

[2 marks]

0 1 . 4 Chlorofluorocarbons (CFCs) are a group of halogenoalkanes currently banned in many countries. They cannot be used as solvents or refrigerants because of their effect on the environment.

The structure of a CFC is shown.



Identify the radical produced from this CFC that is responsible for the depletion of ozone in the atmosphere.
Explain, with the aid of equations, why a single radical can cause the decomposition of many molecules of ozone.

[4 marks]

Radical _____

Explanation _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10

Turn over for the next question

Question	Answers	Mark	Additional Comments/Guidance
01.1	$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$	M1	Ignore state symbols Allow multiples
01.2	Zeolite OR aluminosilicate Slight/moderate pressure $C_{16}H_{34} \rightarrow C_7H_{16} + C_6H_{12} + C_3H_6$	M1 M2 M3	Allow porous pot / aluminium oxide / alumina / silica / silicon dioxide Slightly above atmospheric – allow 1-5 atmospheres / 100-500kPa
01.3	$Cl\bullet + CH_3CH_2CH_2CH_3 \longrightarrow CH_3CH_2\dot{C}HCH_3 + HCl$ $CH_3CH_2\dot{C}HCH_3 + Cl_2 \longrightarrow CH_3CH_2CHClCH_3 + Cl\bullet$	M1 M2	If incorrect radical or ambiguous radical lose M1 but can award M2 for ecf in each equation. Allow equations in either order Allow dot anywhere on the second carbon Ignore extra initiation and termination steps
01.4	$Cl\cdot$ $Cl\cdot + O_3 \rightarrow ClO\cdot + O_2$ $ClO\cdot + O_3 \rightarrow Cl\cdot + 2O_2$ $Cl\cdot$ is regenerated (and causes a chain reaction in the decomposition of ozone)	M1 M2 M3 M4	Allow Cl or Chlorine in M1 and M4 Penalise absence of dot once in the equations Allow dot anywhere on the radical Apply the list principle in the equations and penalise initiation from Cl_2 Allow equations in either order. Ignore $Cl\cdot$ acts as a catalyst
Total		10	

Do not write outside the box

0 2 This question is about fuels.

0 2 . 1 The petrol fraction obtained from crude oil can be used as fuel in cars.

State the meaning of fraction, as used in the term petrol fraction.

[1 mark]

0 2 . 2 Hexadecane ($C_{16}H_{34}$) can be cracked at high temperature to form petrol.

Complete the equation to show the cracking of one molecule of hexadecane to form hexane and cyclopentane only.

Give the name of a catalyst used in this cracking reaction.

[3 marks]

$C_{16}H_{34} \rightarrow$ _____ + _____

Catalyst _____

0 2 . 3 Carbon dioxide is formed when petrol is burned.
Carbon dioxide acts as a greenhouse gas when it absorbs infrared radiation.

Give a reason why carbon dioxide absorbs infrared radiation.

[1 mark]

Question 2 continues on the next page

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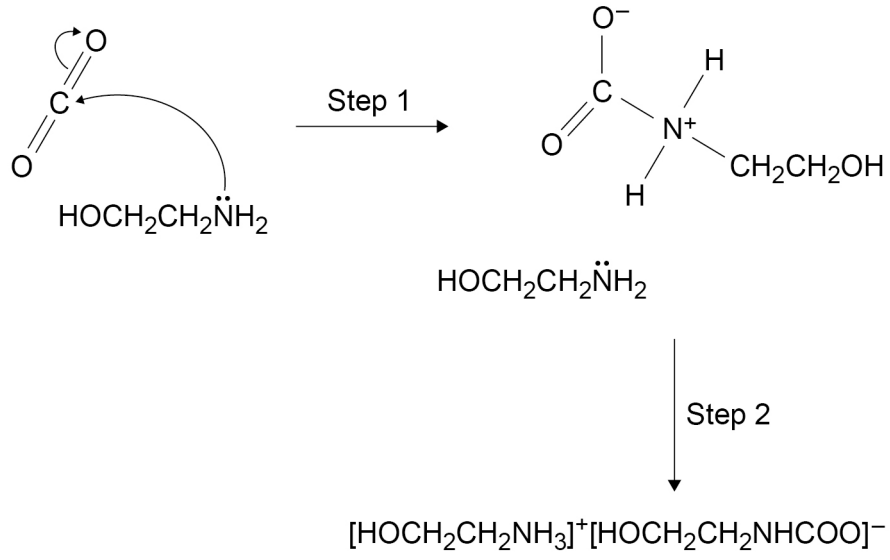
0 2 . 4 Compound **Z** ($HOCH_2CH_2NH_2$) can be used to remove carbon dioxide from the mixture of waste gases produced in some power stations.

Figure 1 shows part of a suggested mechanism for the reaction of **Z** with carbon dioxide.

Figure 1



Draw **two** curly arrows to complete the mechanism in **Figure 1**.

Name compound **Z** ($HOCH_2CH_2NH_2$)

Deduce the role of **Z** in step **2** of the mechanism.

[4 marks]

Name _____

Role _____

_____

Do not write outside the box

0 2 . 5 $HOCH_2CH_2NH_2$ can be represented as XNH_2
$[HOCH_2CH_2NH_3]^+$ can be represented as $[XNH_3]^+$

Draw the shape of XNH_2 and of $[XNH_3]^+$

State whether the H–N–H bond angle in XNH_2 is greater than, the same as, or smaller than that in $[XNH_3]^+$

Explain your answer.

[4 marks]

Shape of XNH_2 Shape of $[XNH_3]^+$

Bond angle _____

Explanation _____

_____

Question 2 continues on the next page

Do not write outside the box

0 2 . 6 Bioethanol is used as an alternative to fossil fuels.

This statement appeared on a website.

"The fact that bioethanol is a carbon-neutral fuel outweighs the environmental disadvantages of producing bioethanol."

Evaluate this statement.

In your answer you should include:
- an outline of how bioethanol is produced
- relevant equations
- analysis of the environmental impacts.

[6 marks]

Do not write outside the box

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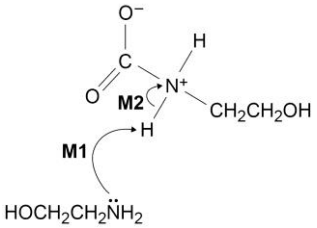
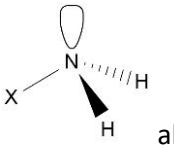
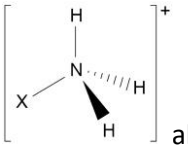
Turn over ►

Question	Answers	Additional Comments/Guidelines	Mark
02.1	A group of (hydrocarbons/compounds) with similar boiling points	Allow compounds that boil in a similar range of temperatures Compounds with similar (carbon) chain length with C5-C12 range or within range	1

Question	Answers	Additional Comments/Guidelines	Mark
02.2	zeolite All formulae correct Balanced equation $C_{16}H_{34} \rightarrow C_6H_{14} + 2\ C_5H_{10}$	Allow Aluminosilicate or aluminium oxide	M1 M2 M3

Question	Answers	Additional Comments/Guidelines	Mark
02.3	C=O bonds vibrate at the same frequency as IR	The difference in energy between the ground and first excited vibrational state of CO_2 is equal to the energy of the infrared radiation. Allow Bond vibrations match frequency of IR radiation C=O bonds vibrate in range 1680-1750cm^{-1} C=O bonds are polar	1

Question	Answers	Additional Comments/Guidelines	Mark
02.4		Curly arrow from N lp to H	M1
		Curly arrow from N-H bond to N^+	M2
	2-aminoethanol	Allow 2-hydroxyethylamine 2-hydroxyethanamine ethanolamine	M3
	Base	Allow proton acceptor / removes H^+ / electron pair donor	M4

Question	Answers	Additional Comments/Guidelines	Mark
02.5	 allow with/without lone pair	Allow these shapes with lines instead of wedges and dashed lines	M1
	 allow with/without charge		M2
	Smaller	Allow comparison of correct numbers	M3
	lone (or non-bonding) pair repulsion greater than bond pair repulsion		M4

Question	Answers		Additional Comments/Guidelines	Mark
02.6	This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.		**Indicative Chemistry content** Stage 1 names of processes 1a Photosynthesis (is the natural process in plants that takes CO_2 from the air) 1b Fermentation (is the process used to make bioethanol releasing some CO_2) 1c Combustion (is the process where bioethanol is burned and releases CO_2) Stage 2 Equations 2a $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ 2b $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ 2c $2C_2H_5OH + 6O_2 \rightarrow 6H_2O + 4CO_2$ Stage 3 Carbon neutrality and environmental issues 3a Deforestation / Sacrifice land that could be used for food 3b Loss of biodiversity / habitat 3c $6CO_2$ in and $6CO_2$ out but It isn't actually C neutral as fuel is used in production, distribution, etc	6
	Level 3 5-6 marks	All stages are covered and each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3 Covers at least 2 points for stage 1, 2 for stage 2 and 3 for stage 3.		
	Level 2 3-4 marks	All stages are covered but stage(s) may be incomplete or may contain inaccuracies **OR** two stages are covered and are generally correct and virtually complete. Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3. Covers at least 1 point for stage 1 to stages 2 and 3.		
	Level 1 1-2 marks	Two stages are covered but stage(s) may be incomplete or may contain inaccuracies **OR** only one stage is covered but is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order.		
	0 mark	Insufficient correct chemistry to gain a mark		

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0 9 This question is about the ozone layer in the upper atmosphere.

0 9 . 1 State why the ozone layer is beneficial for living organisms.

[1 mark]

0 9 . 2 State how chlorofluorocarbons (CFCs) form chlorine atoms in the upper atmosphere.

[1 mark]

0 9 . 3 Give equations to show how chlorine atoms catalyse the decomposition of ozone.

[2 marks]

0 9 . 4 Hydrochlorofluorocarbons (HCFCs) have been used in place of CFCs.
In the mechanism to make an HCFC from a fluoroalkane, two incomplete steps are shown.

Complete each step in the mechanism.

Give the name of the type of step shown by both these equations.

[3 marks]

_____ → $\bullet CHF_2$ + HCl

$\bullet CHF_2$ + Cl_2 → _____

Type of step _____

7

Question	Answers	Additional Comments/Guidelines	Mark
09.1	Absorbs/prevents harmful uv	Allow reduced risk of skin cancer from uv	1

Question	Answers	Additional Comments/Guidelines	Mark
09.2	C-Cl bonds broken (homolytically)	Could show in an equation showing the bond	1

Question	Answers	Additional Comments/Guidelines	Mark
09.3	$Cl^{\bullet} + O_3 \rightarrow ClO^{\bullet} + O_2$ $ClO^{\bullet} + O_3 \rightarrow Cl^{\bullet} + 2O_2$		M1 M2

Question	Answers	Additional Comments/Guidelines	Mark
09.4	$Cl^{\bullet} + CH_2F_2 \rightarrow$ $\rightarrow CHClF_2 + Cl^{\bullet}$ Propagation	Penalise missing dot once only	M1 M2 M3