

## GCE AS / A LEVEL – CHEMISTRY UNIT 2 QUESTION PACK

1092-01 (Legacy CH2) · New spec Unit 2 Topic 1 · AS unit, first sat 2016, 80 marks, 1h 30min paper

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# CHEMISTRY – UNIT 2 · ORGANIC NOMENCLATURE & ISOMERISM

Topic 2.4 – IUPAC nomenclature, structural isomerism and E-Z (cis-trans) stereoisomerism

*Naming and drawing organic molecules using systematic IUPAC rules, recognising structural and geometric (E-Z) isomers, and reading skeletal, displayed and condensed formulae.*

Legacy 2008 specification

**Estimated time for entire question pack: ~46 min***Derived from the legacy CH2 paper's pace of ~1.1 min/mark, padded for long-prose answers (29 marks over 13 questions).**You are advised to **not** attempt to complete all of this in one sitting.***ABOUT THIS QUESTION PACK**

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC CH2 papers (2008 modular spec, Jan 2010 – Jun 2016) that maps onto the new-spec AS Unit 2 Topic 2.4.

Questions are ordered by source paper date.

**INSTRUCTIONS**

Use black ink or black ball-point pen. Show all working – quality of written communication will affect marks. A calculator is allowed. You may need the WJEC Periodic Table / Data Booklet.

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Q	Source	Max	Mark
1	Jun 09 Q3	2	
2	Jan 10 Q6	1	
3	Jun 10 Q3	2	
4	Jan 11 Q8	14	
5	Jan 12 Q3	1	
6	Jun 12 Q2	1	
7	Jun 12 Q3	1	

Q	Source	Max	Mark
8	Jan 13 Q2	1	
9	Jan 13 Q4	1	
10	Jan 14 Q4	2	
11	Jun 14 Q2	1	
12	Jun 15 Q6	1	
13	Jun 16 Q2	1	
<b>Total</b>		<b>29</b>	

# Organic Nomenclature & Isomerism – what the new spec asks

WJEC GCE AS / A Level Chemistry (from 2015) · Unit 2: Energy, Rate & Chemistry of Carbon Compounds · Topic 2.4.

## IUPAC naming

- Find the longest carbon chain  $\Rightarrow$  root name (meth/eth/prop/but/pent ...).
- Identify the functional group  $\Rightarrow$  suffix (-ol, -oic acid, -al, -one, -ene).
- Number the chain so substituents get the lowest locants.
- List branches alphabetically with locants; di/tri prefixes don't affect order.

## Formulae representations

- Molecular: total atoms ( $C_2H_6O$ ).
- Empirical: simplest ratio ( $CH_3O$ ).
- Structural / condensed:  $CH_3CH_2OH$ .
- Displayed: every bond drawn.
- Skeletal: zig-zag, C and H implied.

## Structural isomerism

- Same molecular formula, different connectivity.
- Chain (branched vs straight); position (-OH on different C); functional (alcohol vs ether).
- Number rises rapidly with C count.

## E-Z (cis-trans) isomerism

- Requires C=C and each C bears two *different* groups.
- Priority by atomic number (CIP rules).
- Z (zusammen): higher-priority groups on same side.
- E (entgegen): higher-priority groups on opposite sides.

# Organic Nomenclature & Isomerism in one page

Quick-reference notes – revisit before each question.

## Root names

- C1 meth· C2 eth· C3 prop· C4 but
- C5 pent· C6 hex· C7 hept· C8 oct

## Suffixes

- alkane –ane
- alkene –ene
- alcohol –ol
- acid –oic acid
- aldehyde –al
- ketone –one
- ester –yl –oate

## Locant priority

Lowest set of locants for the principal functional group; ties broken by branch sum.

## E vs Z

CIP priority by atomic number. Same side = Z. Opposite = E.

## Skeletal trick

Each kink / end = a carbon. Hs to fill valency. Functional groups shown explicitly.

## Common pitfalls

- Numbering from the wrong end.
- Forgetting di-/tri- doesn't affect alphabet.
- E/Z only when C=C and both C have *different* substituents.

## SECTION A

Answer all questions in the spaces provided.

1. Complete the table below by putting a tick (✓) in the boxes that correctly describe graphite. [1]

Conducts electricity		Melting temperature		Bonding	
Yes	No	High	Low	Covalent	Ionic

2. (i) Give the equation for the reaction of barium metal with water. [1]

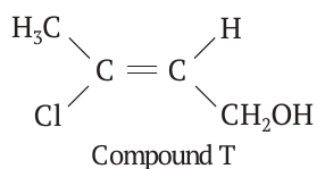
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- (ii) The solution obtained in (i) contains barium ions.  
State a reagent that would be added to this solution to show the presence of barium ions, giving the result of the test.

Reagent ..... [1]

Observation ..... [1]

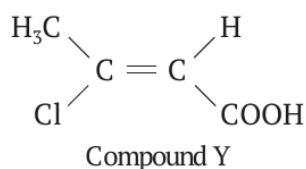
3. (i) Explain why Compound T has E-Z (trans-cis) isomers. [1]



.....

.....

- (ii) State a reagent, used in acid solution, that reacts with Compound T to give Compound Y. [1]

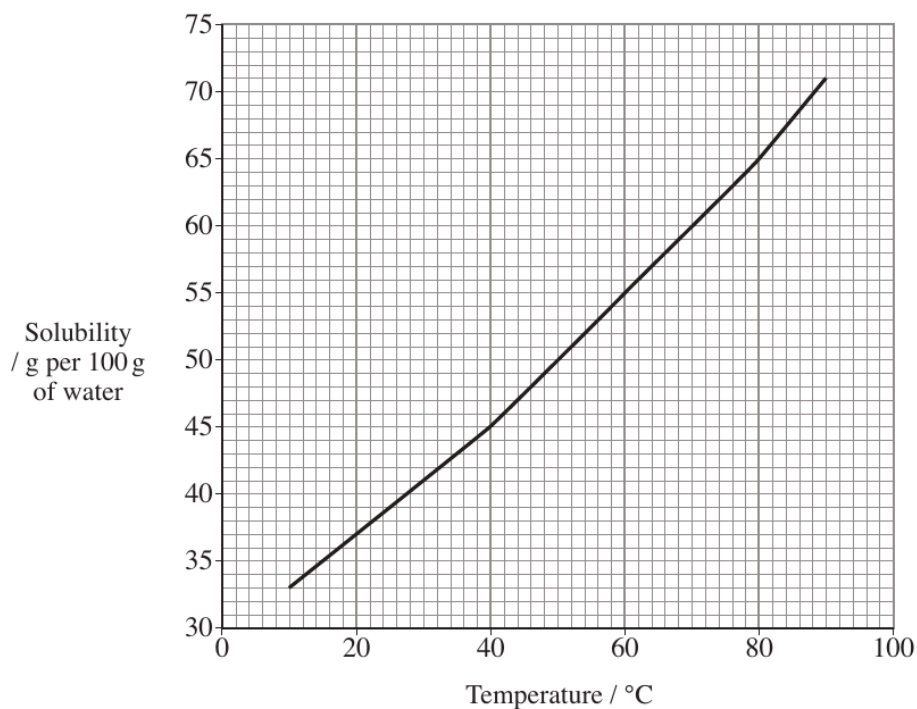


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4. Using **outer** electrons only, draw a dot and cross diagram to show the bonding in sodium oxide. Show the charges on the ions formed. [2]

5. The solubility curve for ammonium chloride is shown below.



Calculate the mass of ammonium chloride that dissolves in 50 g of water to form a saturated solution at 30°C. [2]

.....

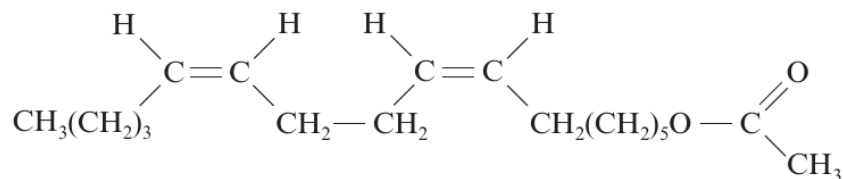
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6. Draw the skeletal formula of 2-chloro-3-methylhexane. [1]

**Section A Total [10]**

**Turn over.**

3. The formula for an attraction pheromone for the pink bollworm is shown below.



- (i) State a suitable catalyst for the hydrogenation of the  $\begin{array}{c} \diagdown \\ \text{C} = \text{C} \\ \diagup \end{array}$  bonds present. [1]
- .....
- (ii) This pheromone molecule contains two  $\begin{array}{c} \diagdown \\ \text{C} = \text{C} \\ \diagup \end{array}$  bonds which both have the Z (cis) configuration. Explain why an alkene can exist as either an E (trans) or a Z (cis) isomer. [1]
- .....
- .....
4. The relative molecular mass of a **branched-chain** alkane is 72. Alkanes have the general formula  $\text{C}_n\text{H}_{2n+2}$ .
- (i) State the **molecular** formula of the alkane. .... [1]
- (ii) Draw one **displayed** formula of this alkane. [1]

5. Use the words 'increases' or 'decreases' to complete the sentence below. [1]  
**Each word can be used once, more than once or not at all.**

As the hydrocarbon chain length in carboxylic acids increases, the boiling temperature  
..... and the solubility in water .....

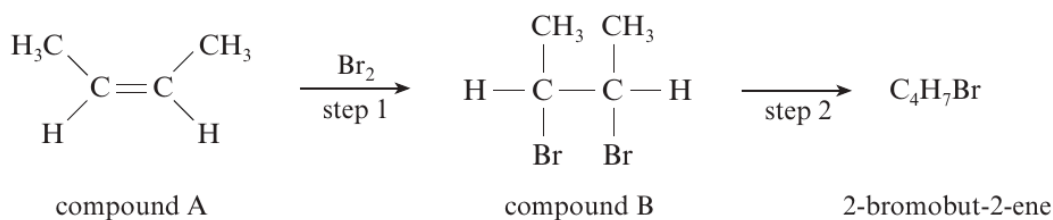
6. State the type of reaction occurring during this chemical change. [1]



.....  
**Total Section A [10]**

**Turn over.**

8. Compound A can be converted to 2-bromobut-2-ene in two steps:



- (a) (i) Compound A exhibits *E-Z* isomerism. Explain why this type of isomerism is possible in this molecule but not in compound B. [2]

.....

.....

.....

- (ii) The 2-bromobut-2-ene produced in this reaction is a mixture of two isomers. Draw the **displayed formula** (showing all the bonds) for *E*-2-bromobut-2-ene. [2]

- (b) During step 1, compound A is bubbled through bromine water to produce a layer of compound B which does not mix with water.

- (i) Give the colour change that would be noted during step 1. [1]

.....

- (ii) **Name** compound B. [1]

.....

- (iii) Explain why compound B will not dissolve in water. [1]

.....

.....

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- (iv) Step 2 is performed using similar reagents and conditions to those used in the production of ethene from bromoethane. Give the reagents and conditions required for this reaction. [2]

*Reagents* .....

*Conditions* .....

.....

- (c) (i) Compound A also reacts with hydrogen bromide, HBr. Give the mechanism for this reaction.

*You may assume compound A reacts in a similar way to propene.* [4]

- (ii) Classify the mechanism of the reaction in (c)(i) above. [1]

.....

Total [14]

## SECTION A

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

1. 'Smart' alloys have an increasing importance in many applications. State how 'smart' alloys differ from other alloys in the way in which they act when used for a particular purpose. [2]

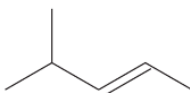
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2. A small piece of sodium metal is added to water. Give the equation for this reaction and suggest a pH value for the resulting solution. [2]

Equation .....

pH of solution .....

3. The skeletal formula of a hydrocarbon is shown below.



Give the **systematic name** of this hydrocarbon. [1]

.....

4. Police use a breathalyser to test motorists for the presence of alcohol.

(a) An early type of breathalyser required the motorist to breathe into a tube that contained acidified potassium dichromate. The alcohol in their breath was oxidised to ethanal and ethanoic acid. State the colour change that occurred if the test was positive. [1]

..... to .....

(b) Modern breathalysers use infrared spectroscopy to detect and measure the concentration of alcohol in breath. An absorption frequency at  $2940\text{cm}^{-1}$  is used rather than the frequency caused by the O—H bond, as this is also present in water.

(i) Use the Data Sheet to identify the bond that causes the absorption at  $2940\text{cm}^{-1}$ . [1]

.....







## SECTION A

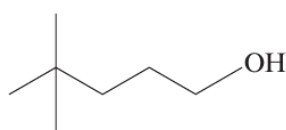
Answer **all** questions in the spaces provided.

1. Calcium and magnesium are essential elements in living things. Give **one** use of each element in biological systems. [1]

*Magnesium* .....

*Calcium* .....

2. Give the **systematic** name of the molecule shown below. [1]



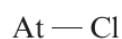
3. The electronegativity values of the halogens are listed below.

Atom	F	Cl	Br	I	At
Electronegativity value	4.0	3.0	2.9	2.6	2.2

- (a) Define the term *electronegativity*. [1]

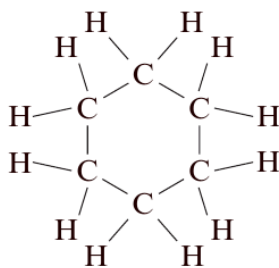
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- (b) Use the data in the table to identify any dipoles present in the following bonds, marking their polarity clearly. [1]



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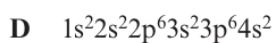
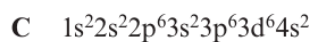
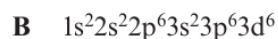
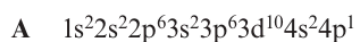
4. Cyclohexane is an example of a hydrocarbon containing a ring of carbon atoms. Its structure is shown below.



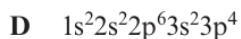
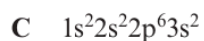
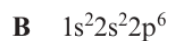
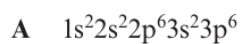
Give the **empirical** formula of this compound. [1]

.....

5. (a) Write the letter corresponding to the correct electronic structure of an atom that is a member of the *d*-block in the box below. [1]




- (b) Write the letter corresponding to the electronic structure of the atom with the highest first ionisation energy in the box below. [1]

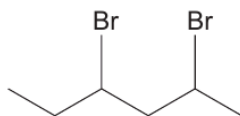


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4. (a) State the **molecular** formula of compound **L** that has the skeletal formula shown.



..... [1]

- (b) Compound **L** reacts with alcoholic sodium hydroxide solution to give hex-1,3-diene as one of the products.

State the type of reaction that has occurred. [1]

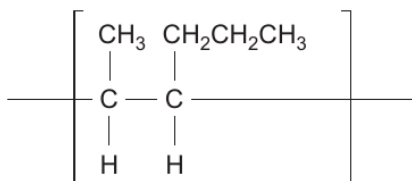
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5. In industry, ethanol is produced by reacting ethene with water / steam.

State the conditions of temperature and pressure used for this reaction. [1]

Temperature .....°C      Pressure ..... atm.

6. A section of an addition polymer is shown below.



State the **systematic name** of the monomer that gives this polymer. [1]

.....

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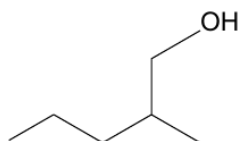
Examiner  
only**SECTION A***Answer all questions in the spaces provided.*

1. Put the following in order of increasing strength. [1]

*covalent bonds      hydrogen bonds      van der Waals' forces*

*weakest ..... strongest*

2. Give the **systematic** name of the compound whose structure is shown below. [1]



3. Draw dot-and-cross diagrams to show the formation of calcium chloride from atoms of chlorine and calcium. [2]



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5. State the reagent(s) used and the colour change seen when a primary alcohol is oxidised to give a carboxylic acid. [2]

Reagent(s) .....

Colour change from ..... to .....

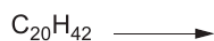
6. State the systematic name of the compound shown below. [1]



.....

7. On cracking, one molecule of  $\text{C}_{20}\text{H}_{42}$  can produce one molecule of pentene, one molecule of hexene and one molecule of another product.

Complete the equation for this reaction. [1]



8. Draw the repeat unit of the polymer formed from the monomer  $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3$ . [1]

**Total Section A [10]**

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**SECTION A**

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

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1. Barium chloride is used to test for sulfate ions in solution. Give the observation expected for a positive result. [1]

.....

2. Draw the **displayed** structure of 2,3-dichloropropene. [1]

3. (a) State what is meant by the term *covalent bond*. [1]

.....

.....

- (b) Give a reason why atoms of aluminium and chlorine form covalent bonds in aluminium chloride, whilst aluminium and oxygen form ionic bonds in aluminium oxide. [1]

.....

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**END OF QUESTION PACK**

13 questions · 29 marks · ~46 min  
Source: WJEC CH2 (2008 modular spec, Jan 2010 – Jun 2016)  
Curated for WJEC Chemistry 2015 spec AS Unit 2 – Topic 1 (2.4)

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