

U6A Chemistry · Lesson 1b

From alkenes to benzene

OCR A Level Chemistry A (H432) · 89 marks

Name: _____ Class: _____ Date: _____

	Part	Marks	My mark
1	Revision from last year	56	
2	Benzene: structure	11	
3	Benzene: the evidence	16	
	Exam question	6	
	Total	89	

What I need to go back over:

PART 1

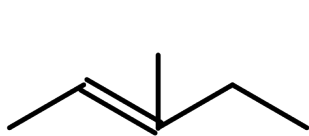
56 marks

Revision from last year

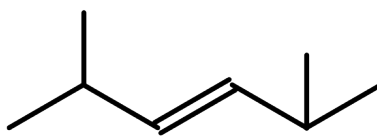
Specification 4.1.1 nomenclature · 4.1.3 alkenes

Naming**1.** Name these alkenes.**[5 marks]**

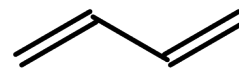
- (a) $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$
(b) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$
(c) $\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$
(d) $(\text{CH}_3)_2\text{C}=\text{CHCH}_3$
(e) $\text{CH}_2=\text{CHCH}=\text{CH}_2$

2. Name the three skeletal structures A, B and C.**[3 marks]**

A



B



C

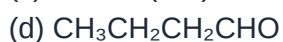
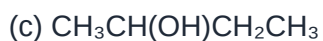
3. Only ONE of the alkenes in question 1 can show E/Z isomerism.**[3 marks]**

- (a) Which one? Explain how you can tell.
(b) Draw and label its E and its Z isomer.

(b) E isomer	(b) Z isomer
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4. Name one compound from each family.

[7 marks]



5. Draw the structure of each of these.

[3 marks]

(a) 3-methylbutan-2-ol (b) 2-chloro-2-methylpropane (c) 2-methylpropanoic acid

(a)	(b)	(c)
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6. Each of these names is wrong. Write the correct name and say what the mistake is. [3 marks]

(a) propan-1-al (b) 2-methylbutan-4-ol (c) 2-ethylpropane

Reactions of alkenes

7. Complete the table for propene, $\text{CH}_3\text{CH}=\text{CH}_2$. Two marks per row: one for the reagents and conditions, one for the name of the product. [10 marks]

Reaction	Reagent(s) and conditions	Name of the organic product
Hydrogenation		
With bromine		
With hydrogen bromide		
Hydration		
Addition polymerisation		

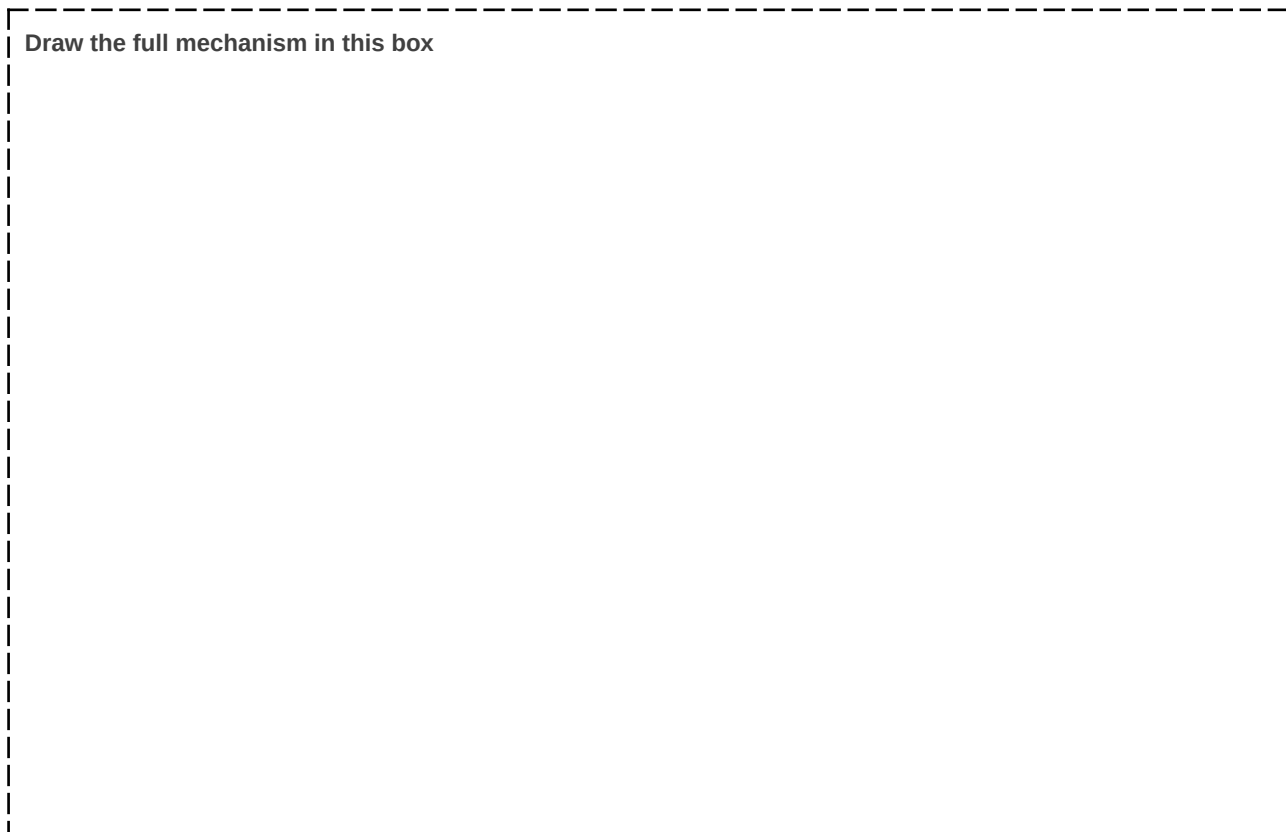
8. Bromine water is added to propene and the tube is shaken. State what you would see, and what the observation tells you about the molecule. [2 marks]

9. When propene reacts with HBr, 2-bromopropane is the major product and 1-bromopropane the minor one. Explain why. [3 marks]

Electrophilic addition

10. Draw the full mechanism for the reaction of but-2-ene with bromine, Br₂. Show the dipole on the bromine molecule, every curly arrow, the intermediate with its charge, and the product. [5 marks]

Draw the full mechanism in this box



11. Bromine, Br₂, is a non-polar molecule. Explain how it is able to react with an alkene at all. [3 marks]

12. Name the type of mechanism you have drawn. [1 mark]

π bonding in ethene

13. Each carbon atom in ethene has four electrons in its outer shell. Describe how those four electrons are used, and explain how the π bond is formed. [4 marks]

14. State the shape around each carbon in ethene and the H–C–H bond angle. Then state what has happened to the π bond, and the new bond angle, when ethene reacts with bromine to give 1,2-dibromoethane. [4 marks]

PART 2**11 marks****Benzene: structure**Specification 6.1.1 (a)

15. Each carbon atom in benzene also has four outer electrons. Describe how they are used, and explain how the delocalised π system is formed. [4 marks]

16. State the shape of a benzene molecule, its bond angles, and the length of every C–C bond. [2 marks]

17. Draw the Kekulé structure and the delocalised structure of benzene. [2 marks]

Kekulé structure	Delocalised structure

18. Give the systematic name of the Kekulé structure. [1 mark]

19. State what each model predicts about the six C–C bonds in benzene. [2 marks]

PART 3**16 marks****Benzene: the evidence**

Specification 6.1.1 (b) (f)

Evidence 1 — benzene resists reaction

20. Cyclohexene decolourises bromine water at room temperature. Benzene does not. Explain why, in terms of electron density. [4 marks]

- 21.** Explain why this observation was a problem for Kekulé's model. [2 marks]

Evidence 2 — bond lengths

- 22.** X-ray diffraction was used to measure the carbon–carbon bonds in benzene. [4 marks]
(a) Give the length of a C–C single bond, a C=C double bond, and every bond in benzene.
(b) Explain what the benzene value tells you.

Evidence 3 — enthalpy change of hydrogenation

- 23.** Write the equation for the hydrogenation of ethene using DISPLAYED formulae, and state the conditions. [3 marks]

Draw the displayed equation here, and write the conditions above the arrow

24. The enthalpy change of hydrogenation of cyclohexene, which has ONE C=C, is -120 kJ mol^{-1} . Predict the enthalpy change of hydrogenation of the Kekulé structure of benzene. Show your working. [1 mark]

25. The measured enthalpy change of hydrogenation of benzene is -208 kJ mol^{-1} . Calculate the difference between the predicted and the measured value, and state what it tells you about benzene. [2 marks]

Exam question

6 marks

Specification 6.1.1 (a) (b)

E1. In 1865 Kekulé proposed a model for benzene with alternating single and double bonds. Describe and explain TWO pieces of experimental evidence that led scientists to replace this model with a delocalised model. In your answer, refer to bond lengths and to enthalpy changes. [6 marks]
