

Organic Chemistry 2: Oxidation reactions and isomerism

All answers and explanations will be provided on video

Section A - Multiple Choice

(Total 10 marks, allow 15 minutes)

1. Which of the following is a secondary alcohol?

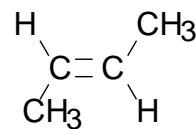
- A. 2-methyl butan-1-ol
- B. 2-methyl butan-2-ol
- C. 2,2-dimethyl butan-1-ol
- D. 3-methyl butan-2-ol

2. A carbon-carbon double bond consists of

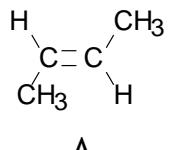
- A. two sigma bonds
- B. two pi bonds
- C. two pi bonds and one sigma bond
- D. one pi bond and one sigma bond

3. The name of the molecule shown opposite is

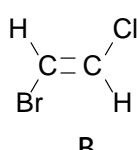
- A. E-but-2-ene
- B. Z-but-2-ene
- C. methylpropene
- D. Z-but-1-ene



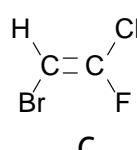
4. Which molecule is a Z (geometric) isomer?



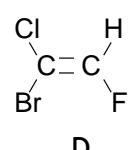
A



B



C



D

5. Which of the following alkenes exhibits E/Z isomerism?

- A. 2-methyl but-2-ene
- B. 2-methyl but-1-ene
- C. 3-methyl pent-2-ene
- D. 3-methyl pent-1-ene

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6. When a secondary alcohol is refluxed with acidified sodium dichromate (VI) solution, the product is...

- A an alkene
- B a carboxylic acid
- C a ketone
- D an aldehyde

7. Which of the following compounds could be oxidised to produce a carboxylic acid?

- A $\text{CH}_3\text{CH}_2\text{CH}_3$
- B $\text{CH}_3\text{CH}_2(\text{OH})\text{CH}_2\text{CH}_3$
- C CH_3CHO
- D $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CH}_3$

8. Which of these molecules would you expect to have the *lowest* boiling point?

- A Propene
- B Propanal
- C Propan-1-ol
- D Propanoic acid

9. How many grams of hydrogen chloride would be needed to fully react with one mole of hexa-1,4,-diene in an addition reaction?

- A 36.5 g
- B 18.25 g
- C 73 g
- D 2 g

10. In the reaction from Question 9 above, how many different isomers would be formed in the products?

- A 2
- B 3
- C 4
- D 8

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Section B – longer answer questions

(Total 30 marks, allow 35 minutes)

Question 1

Butan-1-ol can be oxidised by acidified potassium dichromate (VI) using two different methods.

(a) In the first method, butan-1-ol is added dropwise to acidified potassium dichromate(VI) and the product is immediately collected by distillation.

(i) Using the symbol [O] for the oxidising agent, write an equation for this oxidation of butan-1-ol, showing clearly the structure of the product.

State what colour change you would observe. (3 marks)

(ii) Explain, with reference to the intermolecular forces and relative boiling points of the reactants and products, why the product can easily be separated by distillation. (2 marks)

(iii) (extension) In the reaction, dichromate (VI) ions ($\text{Cr}_2\text{O}_7^{2-}$) are reduced to Cr^{3+} ions. Write balanced half equations for both the oxidation and reduction stages of the reaction, then combine them to write a full balanced equation for the reaction between dichromate (VII) and butan-1-ol. (4 marks)

(b) In a second method, the mixture of butan-1-ol and acidified potassium dichromate (VI) is heated under reflux.

(i) Draw a *labelled* diagram of the apparatus that can be used to heat the alcohol under reflux. (3 marks)

(ii) Name the product of the reaction. (1 mark)

(c) Give the displayed (full structural) formulae and names of **two branched chain alcohols** which are both isomers of butan-1-ol. Only one isomer is oxidised when warmed with acidified potassium dichromate(VI) - identify this isomer.

(3 marks)

Total 16 marks

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Question 2

Compound X has the empirical formula CH_2 . Analysis in a mass spectrometer showed a molecular ion peak with a mass of 70.

- a) i) Deduce the molecular formula of compound X. (1 mark)
ii) Bromine reacts with compound X in an addition reaction. Write an equation for this reaction. (1 mark)

- b) i) Compound X also reacts with steam under certain conditions to form an alcohol. Write an equation for this reaction. (1 mark)
ii) Compound X exists as two stereoisomers, E and Z. Draw the E and Z forms and name compound X. Explain the two conditions which give rise to this type of isomerism. (5 marks)
iii) When compound X reacts with steam, the products also contain two *structural* isomers, Y and Z. Draw the structures of Y and Z and name them. (4 marks)
iv) The mixture of Y and Z was reacted with acidified potassium dichromate under reflux. Name the two organic products formed from the mixture. (2 marks)

Total 14 marks