

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?

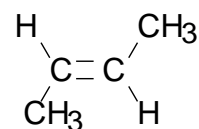
- A. 2-methyl butan-1-ol
- B. 2-methyl butan-2-ol
- C. 2,2-dimethyl butan-1-ol
- D. 3-methyl butan-2-ol

2. A carbon-carbon double bond consists of

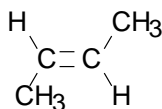
- A. two sigma bonds
- B. two pi bonds
- C. two pi bonds and one sigma bond
- D. one pi bond and one sigma bond

3. The name of the molecule shown opposite is

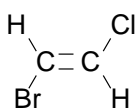
- A. E-but-2-ene
- B. Z-but-2-ene
- C. methylpropene
- D. Z-but-1-ene



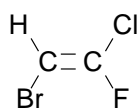
4. Which molecule is a Z (geometric) isomer?



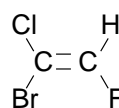
A



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

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

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

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