

## Organic Chemistry 1: Mechanisms and General Organic Chemistry

All answers and explanations will be provided on video

### Section A - Multiple Choice

(Total 10 marks, allow 15 minutes)

#### Questions 1-4

Which of the terms, **A-D**, *best describes* the following reactions?

**A** - Addition

**B** - Substitution

**C** - Reduction

**D** - Dehydration

1. The conversion of propan-1-ol into propene using concentrated phosphoric (V) acid
2. The conversion of 1-chlorobutane into butan-1-ol with aqueous potassium hydroxide
3. The reaction between but-2-ene and hydrogen bromide
4. The conversion of propanoic acid to propan-1-ol
5. The type of reaction involved in making 2-chloro 2-methyl propane from 2-methyl-propan-2-ol is:

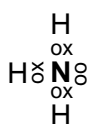
A - electrophilic substitution

B - nucleophilic substitution

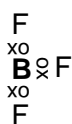
C - free radical substitution

D - electrophilic addition

6. Which particle could act as an electrophile?



A



B



C

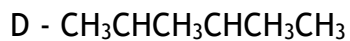
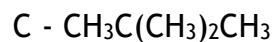
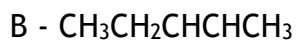
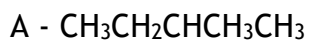


D

# CK Science Tuition

## Questions 7-10

The structural formulae of a some hydrocarbon compounds are given below:



Which one is

7. 2,2 dimethyl propane

8. 2 methyl butane

9. 2,3 dimethylbutane

10. pent-2-ene

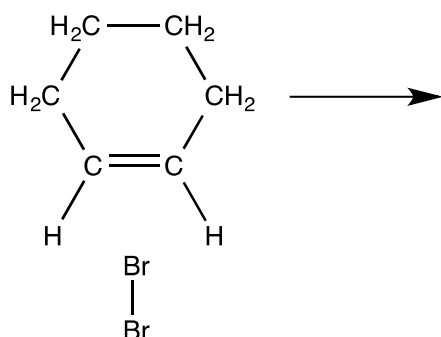
## Section B – longer answer questions

(Total 36 marks, allow 40 minutes)

### Question 1

Cyclohexene can react with bromine, Br<sub>2</sub>, to form a halogenoalkane.

a) Complete the mechanism for this reaction, showing relevant dipoles, curly arrows and charges. Give the name for the type and mechanism of this reaction



Name of mechanism: ..... (5 marks)

b) (*extension question!*) In an experiment, some sodium chloride was added to the cyclohexene before the bromine was added. Analysis of the reaction mixture found an additional product which had the following percentage composition by mass:

Carbon: 37.6      Hydrogen: 2.1      Bromine: 41.8      Chlorine: 18.5

- Calculate the empirical formula of the additional product. (2 marks)
- With reference to the mechanism of the reaction, explain how the additional product forms. (2 marks)

Chlorine exists as two isotopes, <sup>35</sup>Cl and <sup>37</sup>Cl; Bromine also exists as two isotopes, <sup>79</sup>Br and <sup>81</sup>Br.

- Predict the number of molecular ion peaks which would be found in a mass spectrum of a mixture of **both** organic products. Show clearly how you arrived at your answer, and give the mass of each peak. (3 marks)

Total 12 marks

## Question 2

Crude oil is a complex mixture of hydrocarbons. Initial separation is achieved by fractional distillation. The separate fractions are then further refined to produce hydrocarbons such as decane.

- (a) (i) State what is meant by the term *hydrocarbon*. (1 mark)
- (ii) A molecule of decane contains ten carbon atoms. State the molecular formula of decane. (1 mark)
- (iii) Deduce the empirical formula of decane. (1 mark)

(b) Dodecane,  $C_{12}H_{26}$ , is a straight chain alkane that reacts with chlorine to produce a compound with molecular formula  $C_{12}H_{25}Cl$ .

- i) Write a balanced equation for this reaction (1 mark)

The reaction is initiated by the formation of chlorine free radicals from chlorine.

- (ii) What is meant by the term *free radical*? (1 mark)
- (iii) State the conditions necessary to bring about the formation of the chlorine free radicals from  $Cl_2$ . (1 mark)
- (iv) The chlorine free radicals react with dodecane to produce  $C_{12}H_{25}Cl$ . Write equations for the **two** propagation steps involved. (2 mark)
- v) The reaction with chlorine produces a number of other products, including one with an empirical formula  $C_{12}H_{25}$ . Suggest the molecular formula of this product and give an equation for the termination reaction that would result in its formation. (2 marks)

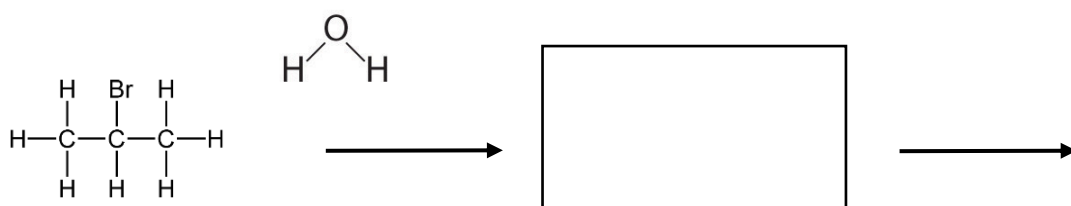
(c) Dodecane,  $C_{12}H_{26}$ , can be cracked into ethene and a straight chain alkane such that the molar ratio ethene: straight chain alkane is 2 : 1.

- (i) Write a balanced equation for this reaction. (2 marks)
- (ii) Name the straight chain alkane formed. (1 mark)

*Total 13 marks*

## Question 3

- a) Draw the displayed (full structural) formula of 2-bromopropane (1 mark)
- b) A sample of 2-bromopropane was mixed with ethanol and an aqueous solution of silver nitrate. The mixture was warmed in a water bath and, after a short period of time, a cream precipitate appeared.
- Write a balanced equation for the organic reaction, and give the name and mechanism for this reaction (3 marks)
  - Write an **ionic** equation, including state symbols, for the reaction that results in the formation of the precipitate. (2 marks)
- c) Complete the mechanism for the organic reaction, including relevant dipoles, curly arrows and charges. (4 marks)



- d) Suggest a reason for adding ethanol to the reaction mixture. (1 mark)

*Total 11 marks*