II.5 Elimination Reactions

Civil Services 2016–2026: **17** parts, **175** marks · IFoS 2016–2025: **16** parts, **110** marks

Syllabus. E1, E2 and E1cb mechanisms; orientation in E2 reactions: Saytzeff and Hofmann; pyrolytic syn elimination: acetate pyrolysis, Chugaev and Cope eliminations.

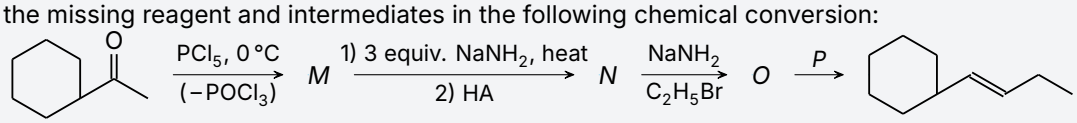
Marks	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CSE	20	30	10	15	15	35	15	10	5	20	0
IFoS	15	10	5	10	10	15	10	10	20	5	

How to use this chapter. Read every question once and mark the ones that repeat. Pick three, write them by hand against the clock (about 7 minutes for 10 marks), then compare with the model answers on vkcscience.com.

2025

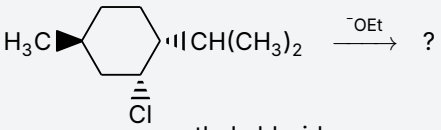
CSE 2025 · Q1(b) Missing reagent and intermediates [10 marks]

Identify the missing reagent and intermediates in the following chemical conversion:



CSE 2025 · Q1(c) Neomenthyl chloride with sodium ethoxide [10 marks]

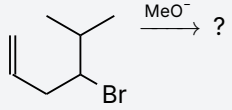
Write the structure of the major product when neomenthyl chloride is reacted with sodium ethoxide in ethanol. Justify your answer:



neomenthyl chloride

IFoS 2025 · Q1(d) Elimination next to an existing alkene [5 marks]

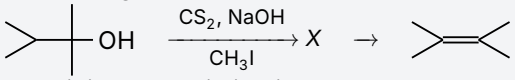
Write the products (major/minor) in the following reaction sequence :



2024

CSE 2024 · Q2(b)(ii) Structure of X; name; proof of syn-elimination [5 marks]

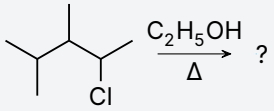
(ii) Predict the structure of *X* in the following reaction:



Name the above reaction. Justify that it is a *syn*-elimination. 5

IFoS 2024 · Q2(b)(iii) Rearrangement during solvolytic elimination [5 marks]

(iii) Complete the following reaction and justify the formation of the major product with emphasis on intermediate formed in situ :

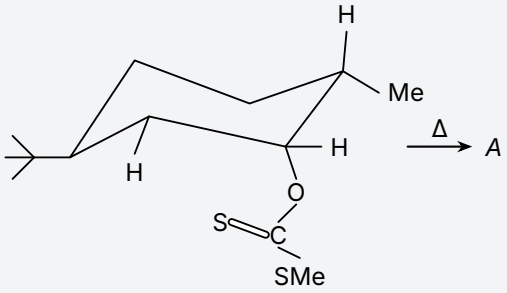


IFoS 2024 · Q2(c) Hofmann elimination; Chugaev elimination [15 marks]

(i) Define Hofmann product. Explain the formation of the major product with the help of Newman projection formulae by taking the example given below : 10

$$CH_3CH_2-CH(\overset{+}{N}(CH_3)_3)-CH_3 \xrightarrow[\Delta]{(CH_3)_3COK} ?$$

(ii) Predict the major product and identify the reaction given below by giving its name : 5



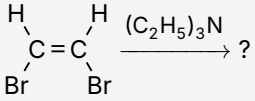
2023

CSE 2023 · Q3(c) Regioselectivity of Hofmann elimination by Newman projections [10 marks]

Explain the regioselectivity of a Hoffmann elimination reaction with the help of Newmann projection formula.

IFoS 2023 · Q1(e) Dehydrobromination through an ion pair [5 marks]

Complete the following reaction. Also indicate the name of the mechanism involved in the formation of product(s).



IFoS 2023 · Q4(b) Rates of alkoxide-induced elimination [5 marks]

The following compounds undergo elimination reaction in the presence of C_2H_5ONa/C_2H_5OH at 55 °C. Arrange them in decreasing order of elimination behaviour rate.

CH_3CH_2Br	$(CH_3)_3CBr$	$CH_3CHBrCH_3$	$CH_3CH_2CH_2Br$
I	II	III	IV

2022

CSE 2022 · Q2(b)(iii) Alkenes from 2-chloro-2,3-dimethylpentane with sodium ethoxide [5 marks]

(iii) Give the structures of alkenes expected after dehydrohalogenation of 2-chloro-2,3-dimethylpentane by sodium ethoxide. 5

CSE 2022 · Q3(c)(i) $Cl_2CH–CF_3$ with ethoxide: product and energy profile [10 marks]

(i) Assign the structure of the product with proper justification of kinetic aspects using energy profile diagram:

$Cl_2HC-CF_3 \xrightarrow{EtO^-}$ Product 10

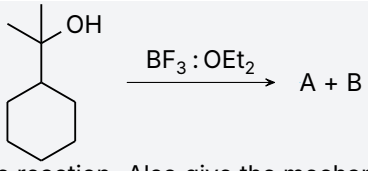
IFoS 2022 · Q2(a) Two eliminations from a meso dibromide [10 marks]

Indicating the stereochemistry of the products, complete the following reactions with their mechanisms:

meso-2,3-dibromobutane $\xrightarrow{I^\ominus}$? meso-2,3-dibromobutane $\xrightarrow{^\ominus OEt}$?

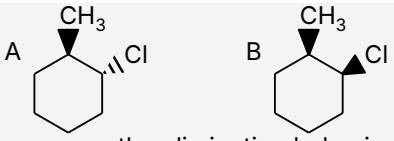
2021

CSE 2021 · Q1(c) 2-Cyclohexylpropan-2-ol with $BF_3 \cdot OEt_2$: products A and B [10 marks]



Write the products A and B in the above reaction. Also give the mechanism of their formation. Which one of these is the major product and why?

CSE 2021 · Q2(a) Elimination from trans- and cis-1-chloro-2-methylcyclohexane [20 marks]



Involving the stereochemical concept, compare the elimination behaviour of compounds A and B in the presence of base. Also give the product(s) of the reactions.

CSE 2021 · Q3(c)(i) meso-2,3-Dibromobutane with iodide and with ethoxide [5 marks]

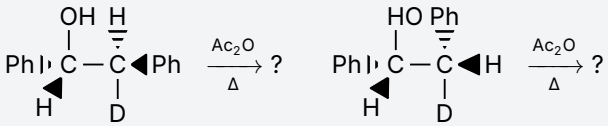
(i) meso-2,3-dibromobutane $\xrightarrow{I^-}$ A 5

$\downarrow \bar{O}Et$

B

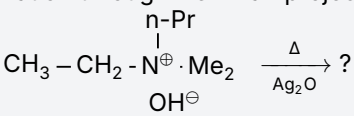
IFoS 2021 · Q1(c) Isotope-labelled acetate pyrolysis [5 marks]

Complete the following reactions with suitable mechanisms:



IFoS 2021 · Q2(c)(ii) Hofmann elimination [5 marks]

(ii) Write the product and explain its formation through Newman projection formula in the given reaction: 5



IFoS 2021 · Q2(d)(i) Elimination of 2-bromobutane [5 marks]

(i) Write the reaction of 2-Bromobutane with alcoholic KOH. Justify the stereochemistry of the major product formed. What is the J (coupling constant) of the olefinic protons? 5

2020

CSE 2020 · Q3(a) E2 of 2-fluoropentane: Hofmann orientation [15 marks]

Predict the major and minor products in the following reaction and give a suitable explanation:

$$CH_3CHFCH_2CH_2CH_3 \text{ (2-Fluoropentane)} + CH_3O^- \xrightarrow[CH_3OH]{}$$

IFoS 2020 · Q2(b) E2 of cis- and trans-2-phenylcyclohexyl tosylates with t-BuO ⁻ [10 marks]

Draw the conformational stereostructures of tosylate of *cis*-2-phenylcyclohexanol and tosylate of *trans*-2-phenylcyclohexanol. Which one would react more rapidly with *tert*-butoxide in *tert*-butyl alcohol and why? Identify the product(s) of elimination reaction of each one of these with *tert*-butoxide in *tert*-butyl alcohol by providing reaction mechanism.

2019

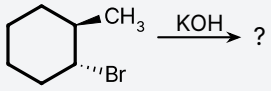
CSE 2019 · Q3(b) 1,5-Hexadiene from 2-methylpiperidine by two Hofmann eliminations [15 marks]

Using exhaustive methylation followed by Hofmann elimination, how would you synthesize 1,5-hexadiene from 2-methylpiperidine?

IFoS 2019 · Q2(c) E1 of 2-fluoropentane; E2 of a trans-1-bromo-2-methylcyclohexane [10 marks]

(i) When 2-fluoropentane undergoes an *E*1 reaction, is the major product the one predicted by Zaitsev's rule? Explain. 5

(ii) Write the structure of the major product formed in the following elimination reaction. Justify your answer:

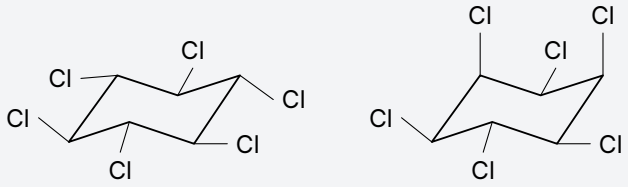


5

2018

CSE 2018 · Q6(c) E2 in hexachlorocyclohexanes: anti-periplanar requirement [10 marks]

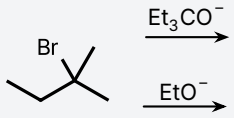
Explain what inferences about the type of reaction and stereochemistry can be gained from the observation that when each of *A* and *B* undergoes reaction with KOH in methanol the rate of reaction is very slow for *A* compared with that of *B* :



A *B*

IFoS 2018 · Q4(b) 2-Bromo-2-methylbutane with Et_3CO^- and with EtO^- [5 marks]

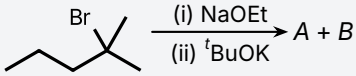
Write the structure of the major product in the following two reactions and justify their formation:



2017

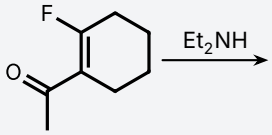
CSE 2017 · Q1(b) E2 of 2-bromo-2-methylpentane: Zaitsev and Hofmann [10 marks]

Write the structure of products A and B and mention the major/minor products in each of these conversions [(i) and (ii)] with justification.



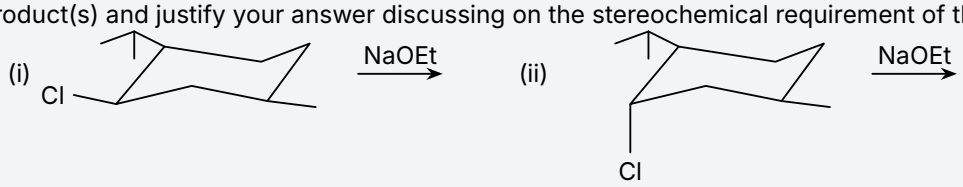
CSE 2017 · Q1(c) Diethylamine and 2-fluoro-1-acetylcyclohexene: addition–elimination [10 marks]

Write the product of the following reaction and depict the mechanistic pathway for its formation.



CSE 2017 · Q4(d) E2 of menthyl and neomenthyl chlorides: anti-periplanar requirement [10 marks]

Predict the product(s) and justify your answer discussing on the stereochemical requirement of the reactions.



IFoS 2017 · Q2(b) Saytzeff versus Hofmann: 2-bromobutane and the 2-butyltrimethylammonium ion [10 marks]

Write down the names and the structures of the predominant products for the following elimination reactions:

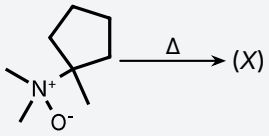
(i) $CH_3CH_2-CHCH_3$ (Br) $\xrightarrow{EtO^-}$?

(ii) $CH_3CH_2-CH(\overset{\oplus}{N}Me_3)-CH_3$ $\xrightarrow{EtO^-}$? 10

2016

CSE 2016 · Q5(b) Cope elimination of an amine oxide [10 marks]

Write the major product (*X*) in the reaction given below and explain its formation:

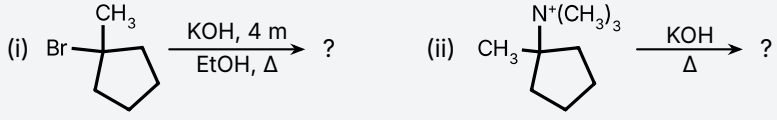


CSE 2016 · Q5(e) E2 of 3-bromo-2,3-dimethylpentane: Saytzeff products [10 marks]

Write various products formed from the reaction of 3-bromo-2,3-dimethylpentane with alcoholic KOH. Indicate the relative yield of the products.

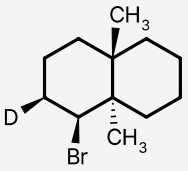
IFoS 2016 · Q1(f) Saytzeff and Hofmann eliminations [5 marks]

Write the products formed in the following reactions :

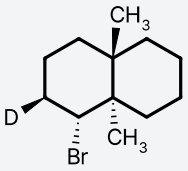


IFoS 2016 · Q2(b) E2 in a locked trans-decalin and in locked 1,2-dibromocyclohexanes [10 marks]

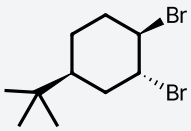
On attempted E_2 reaction, A reacted much faster than B, while C reacted much faster than D. Explain with writing the product of the reaction in each case.



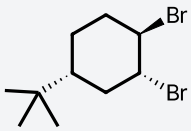
A



B



C



D