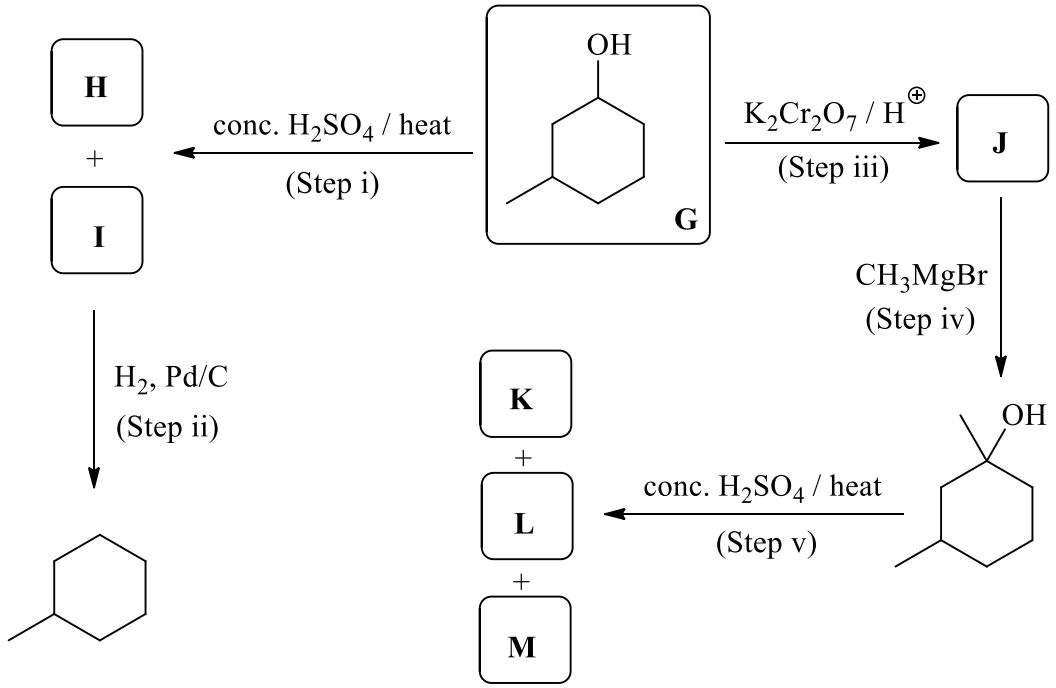
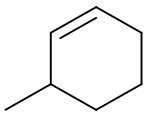
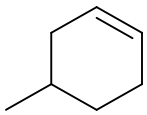
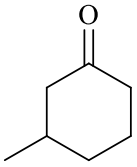
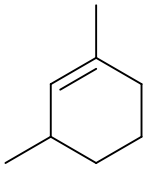
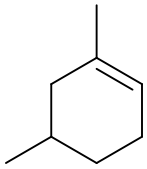
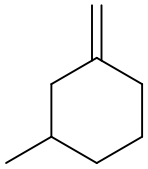
Marks 6

- Consider the following reaction sequences beginning with the secondary alcohol, **G**.



Suggest structures for compounds **H** – **M** in the reaction sequences above.

H 	**I** 	**J** 
K 	**L** 	**M** 

What approximate ratio **H** : **I** do you expect? Why?

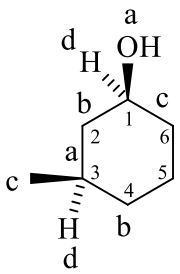
1 : 1. Both products are formed from a common carbocation intermediate. There is no real preference for which H^+ will be lost as both products (H and I) have the same degree of substitution (Saytsev's rule).

What type of reaction is occurring in Step i?	**Elimination (E1)**
What type of reaction is occurring in Step ii?	**Addition**
What type of reaction is occurring in Step iii?	**Oxidation**
What type of reaction is occurring in Step iv?	**Nucleophilic addition (A_N)**

What is the systematic name for **G**?	**Marks 6**
3-methylcyclohexanol	

How many configurational stereoisomers of **G** are there?	**4**

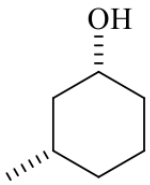
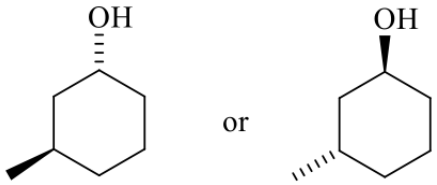
Assign the absolute configuration of stereoisomer $\mathbf{G_1}$ below. Show your working.



C_1: (*S*)- Around C_1, the order of priorities is:
a: O > b: C_2(C,H,H) > c: C_6(C,H,H) > d: H
To distinguish between C_2 and C_6, compare next C in chain
b: C_3(C,C,H) > c: C_5(C,H,H)
Looking down C_1–H bond, a →b→c is anticlockwise

C_3: (*R*)- Around C_3, the order of priorities is:
a: C_2(C,H,H) > b: C_4(C,H,H) > c: C_{methyl}(H,H,H) > d: H
As C_2 and C_4 are equivalent, C_1 > C_5 is used to prioritise them. Looking down C_3–H bond, a →b→c is clockwise

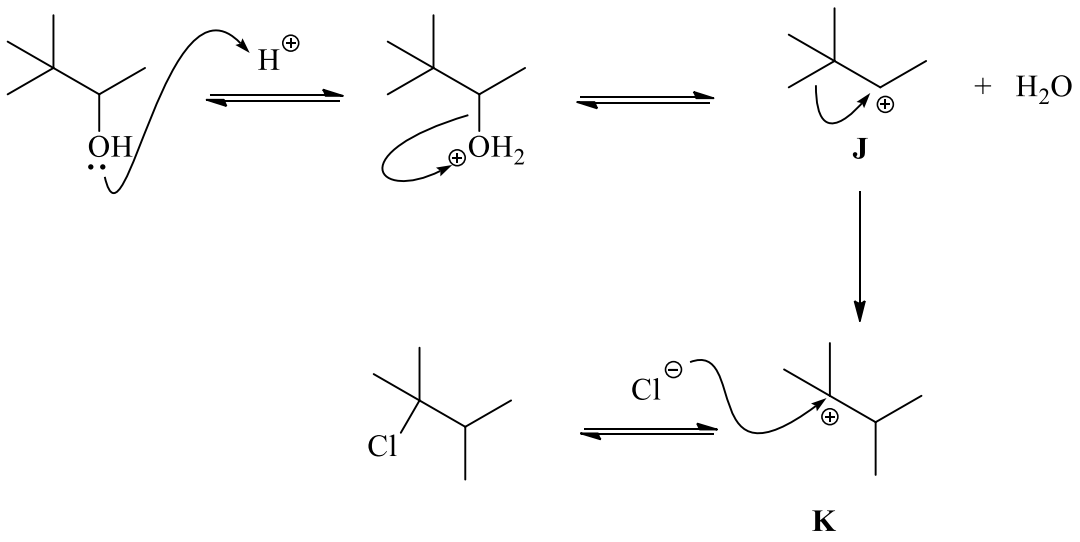
Draw $\mathbf{G_2}$ (the enantiomer of $\mathbf{G_1}$) and $\mathbf{G_3}$ (a diastereomer of $\mathbf{G_1}$)

$\mathbf{G_2}$ (enantiomer of $\mathbf{G_1}$)	$\mathbf{G_3}$ (diastereomer of $\mathbf{G_1}$)
	

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

- Apply your understanding of curly arrows to complete a mechanism for the following S_N reaction:

Marks **3**

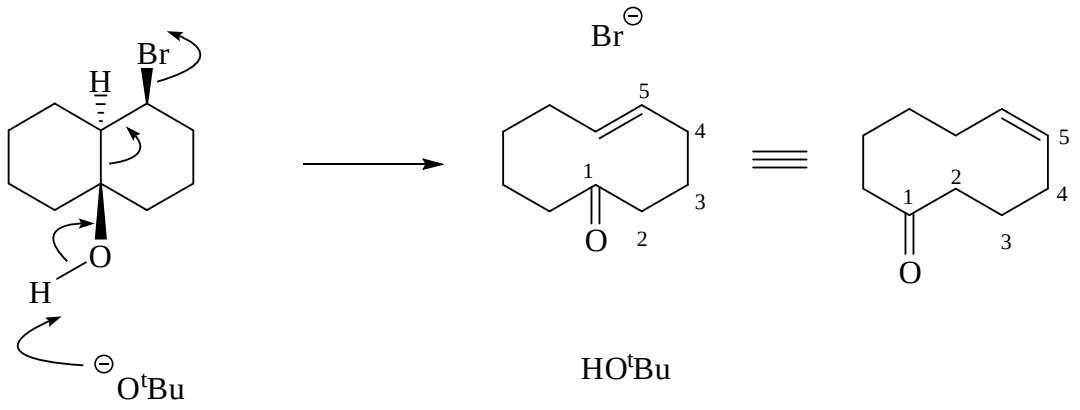


Why does the rearrangement step (**J** → **K**) occur?

K (the tertiary carbocation) is more stable than **J** (the secondary carbocation) as it is more substituted and hence more stabilised by hyperconjugation.

Marks 3

- Add curly arrows to complete the mechanism of the unusual E2 reaction shown below, the Grob Fragmentation. (Note that KO^{t}Bu is potassium *tert*-butoxide, a strong base.)

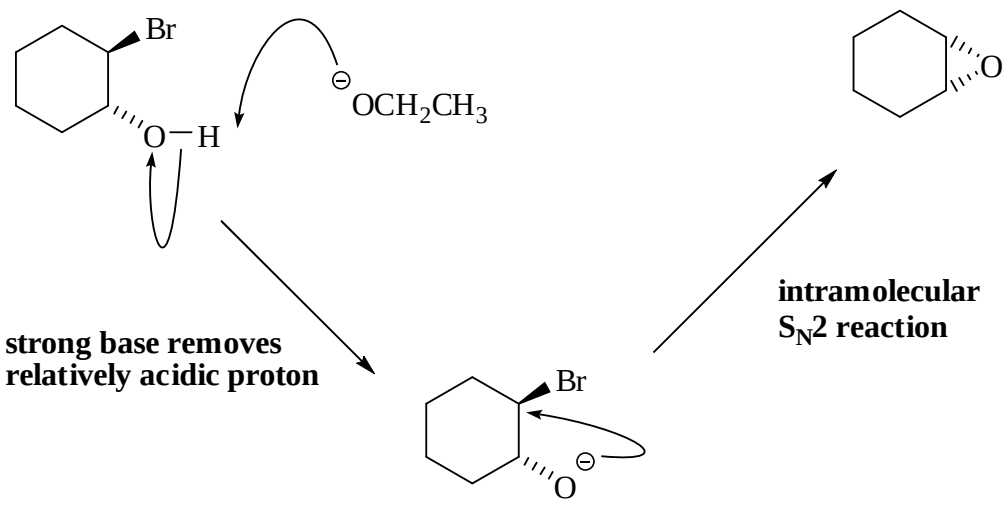


Explain briefly why the relative stereochemistry of the OH and Br groups in the starting material is important in this reaction.

The groups must have an antiperiplanar alignment in order that the orbitals overlap correctly to form the new bonds.

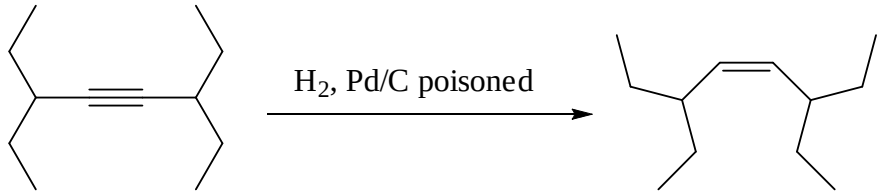
Marks 3

- Propose a structure for the product of the following reaction. Outline a mechanism for its formation, showing all curly arrows and intermediates.

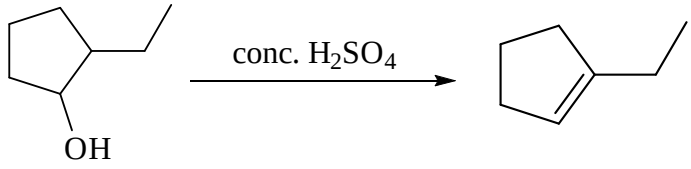


Marks 3

- Draw the structure(s) of the major organic product(s) formed in each of the following reactions. Give the names of the products where requested.



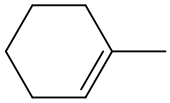
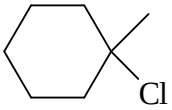
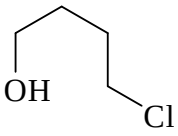
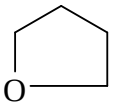
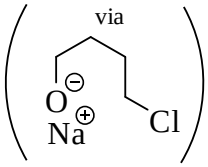
Name(s): (*Z*)-3,6-diethyloct-4-ene



THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

Marks 2

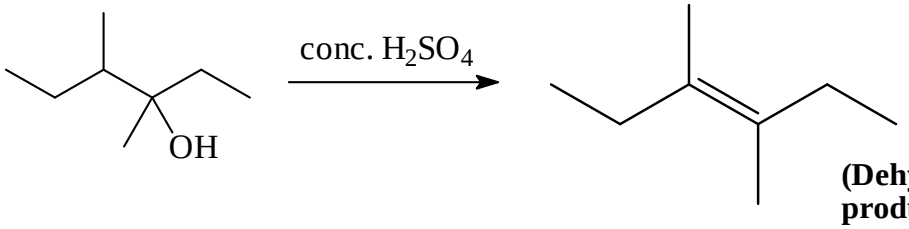
- Complete the following table.

Starting material	Reagents / Conditions	Major organic product(s)
	HCl CCl_4 (solvent)	
	Na	 

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

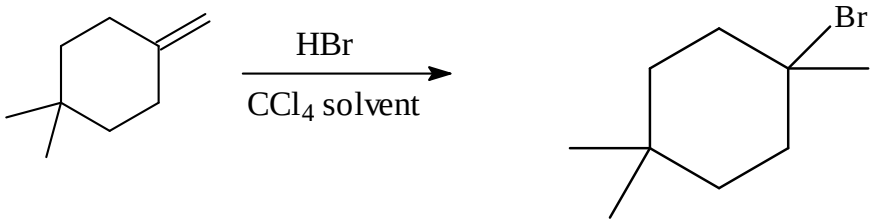
Marks 4

- Draw the structure(s) of the major organic product(s) formed in each of the following reactions. Give the names of the products where requested.



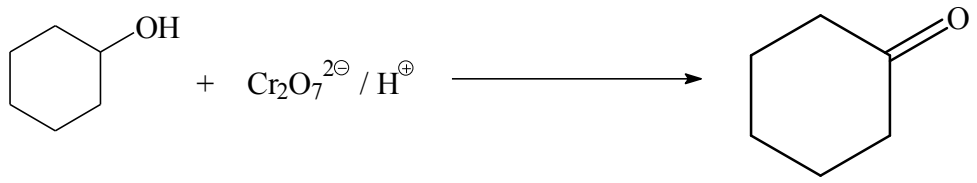
(Dehydration to produce most substituted double bond: Zeitsev's rule)

Name(s): **(*E*)-3,4-dimethyl-3-hexene**

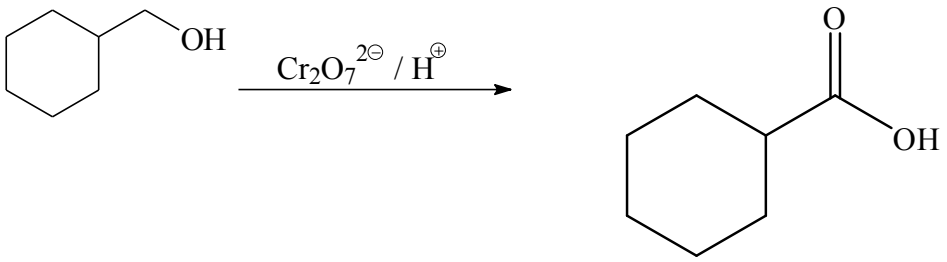


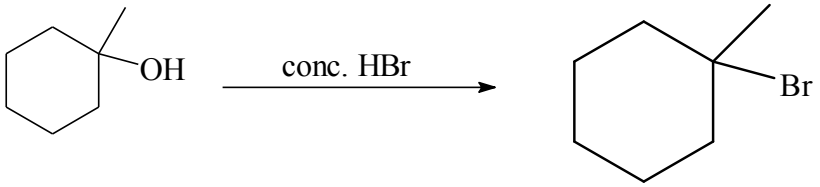
Name(s): 1-bromo-1,4,4-trimethylcyclohexane

• Draw the constitutional structure of the major organic product formed in the following reactions. Indicate the correct isomer where appropriate.	**Marks 1**



• Draw the constitutional formula of the major organic product formed in each of the following reactions.	**Marks 2**

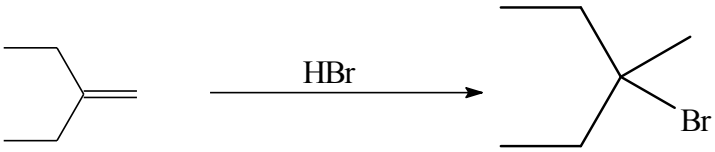




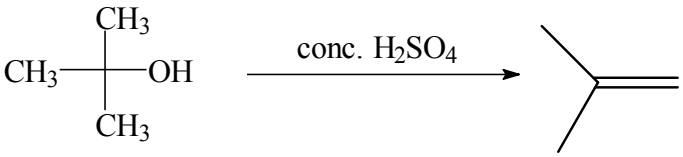
THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

- Draw the constitutional formula(s) of the major organic product(s) formed in each of the following reactions.

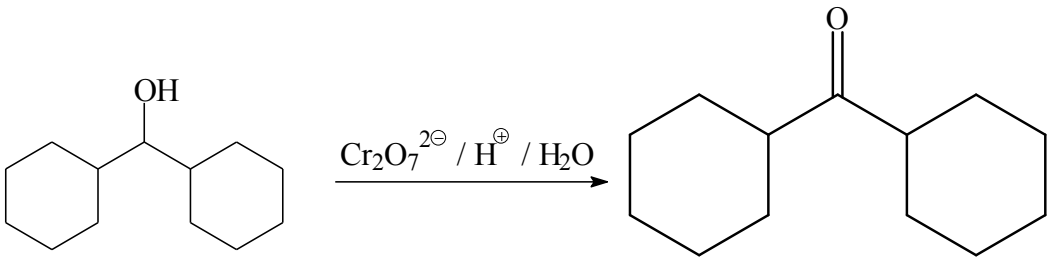
Marks 3



(Markovnikov addition of HBr with H adding to less substituted end of double bond)



(Dehydration)



(Oxidation of secondary alcohol to ketone)

- Use curly arrow notation to illustrate the mechanism of each of the following reactions. **5**