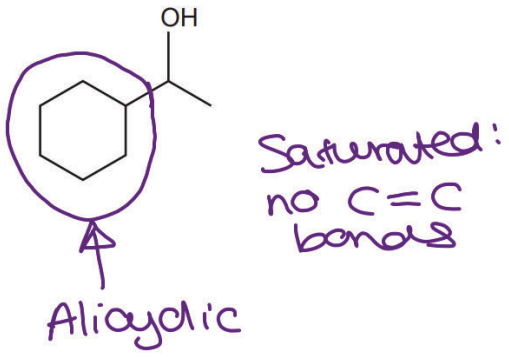
1. How can the molecule below be described?



A Aromatic and alicyclic

B Aliphatic and unsaturated

C Aromatic and unsaturated

D Alicyclic and saturated

Your answer [D]

[1]

2. Which type of reaction has the greatest atom economy?

   A Substitution

   B Hydrolysis

   C Elimination

   D Addition

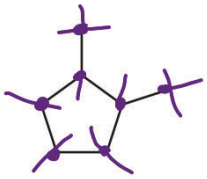
   RFM of desired product / RFM of reactants × 100

   100% atom economy as no by-products created

   Your answer D

   [1]

3. What is the molecular formula of the compound below?



A C_7H_{10}

B C_7H_{12}

C C_7H_{14}

D C_7H_{16}

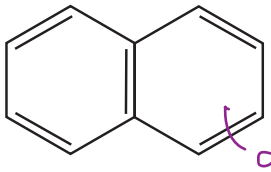
C_7H_{14}

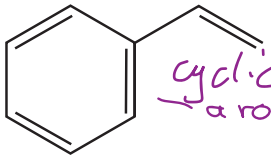
Your answer C

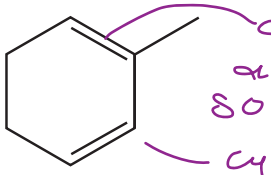
[1]

4. Which structure represents an alicyclic compound?

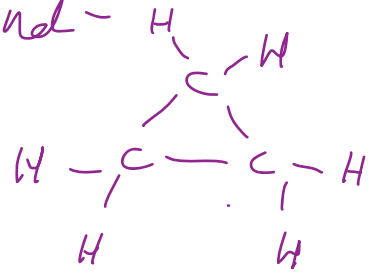
ali cyclic
↓ aliphatic (non-aromatic)
↘ ring structure

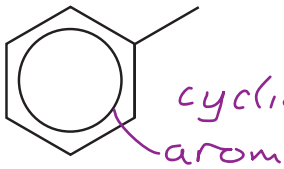
~~A~~ 
cyclic but aromatic

~~B~~ 
cyclic but aromatic

(C) 
C=C not delocalised across whole ring so not aromatic
cyclic

· cyclopropane is the simplest alicyclic compound –



~~D~~ 
cyclic but aromatic

Your answer C

[1]

planar = flat

5. Which molecule is **not** planar?

A C_2H_4

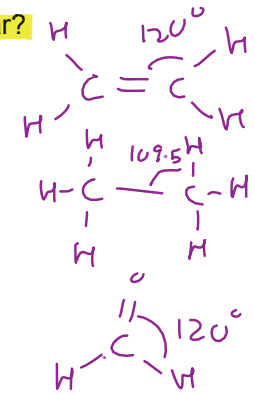
B C_2H_6

C H_2CO

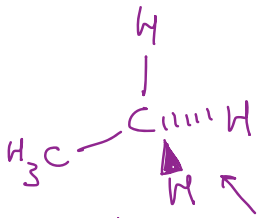
D HCN

Your answer B

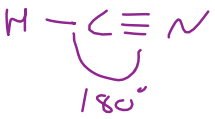
[1]



→ tetrahedral

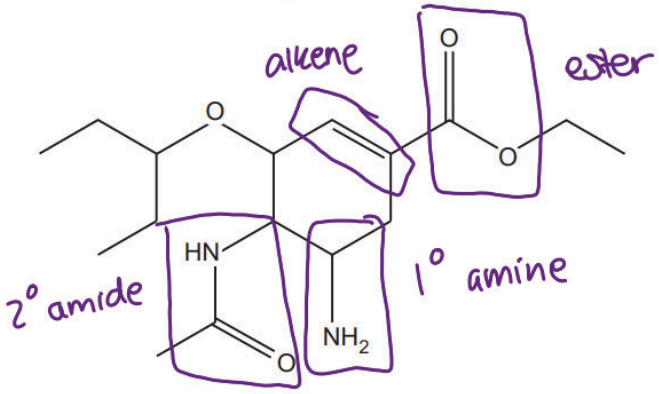


not planar



- multiple bonds on C-centre increase likelihood of planarity.

6. The structure of a compound used to treat influenza is shown below.



Which functional group(s) is/are in a molecule of the compound?

1 Ester

2 Secondary amide

3 Ketone

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer B

[1]

7. This question is about reaction mechanisms.

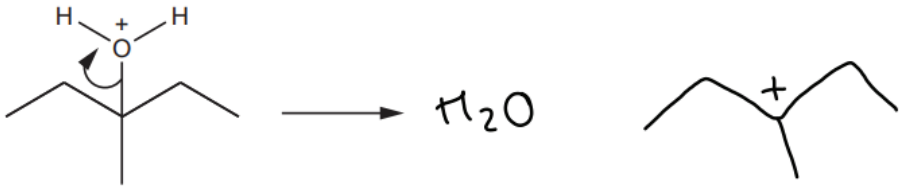
(a) Chemists use curly arrows in reaction mechanisms.

(i) What does a curly arrow show in a reaction mechanism?

movement of an electron pair

[1]

(ii) Draw structures to show the products in the reaction mechanism below.



[2]

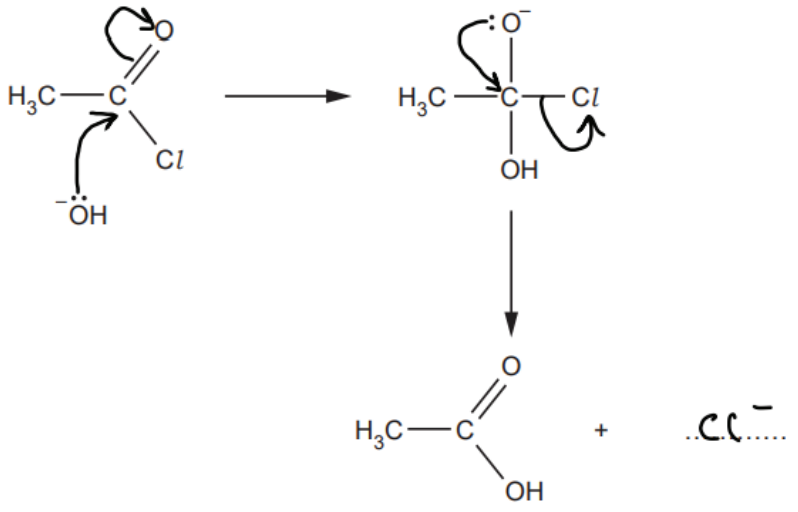
(iii) Use the mechanism in **(ii)** to explain what is meant by **heterolytic fission**.

heterolytic: one atom receives both electrons.

Fission: breaking of a covalent bond. [2]

(b) An incomplete reaction mechanism is shown below.

(i) Complete the mechanism by adding curly arrows and any missing species.



[4]

(ii) What is the role of OH^- in this mechanism?

nucleophile [1]

8. What is the number of alicyclic structural isomers of C_5H_{10}?

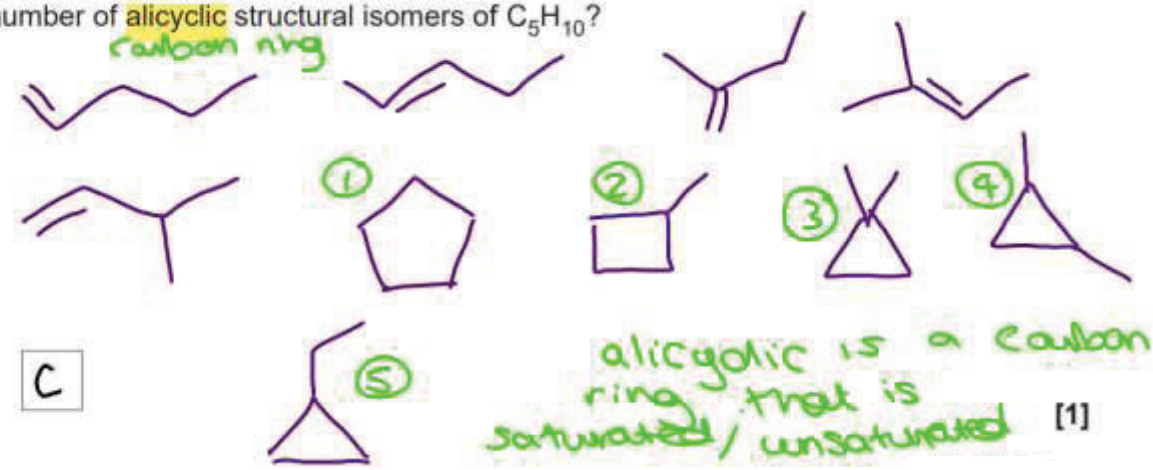
carbon ring

A 3

B 4

C 5

D 6



Your answer C

alicyclic is a carbon ring that is saturated / unsaturated

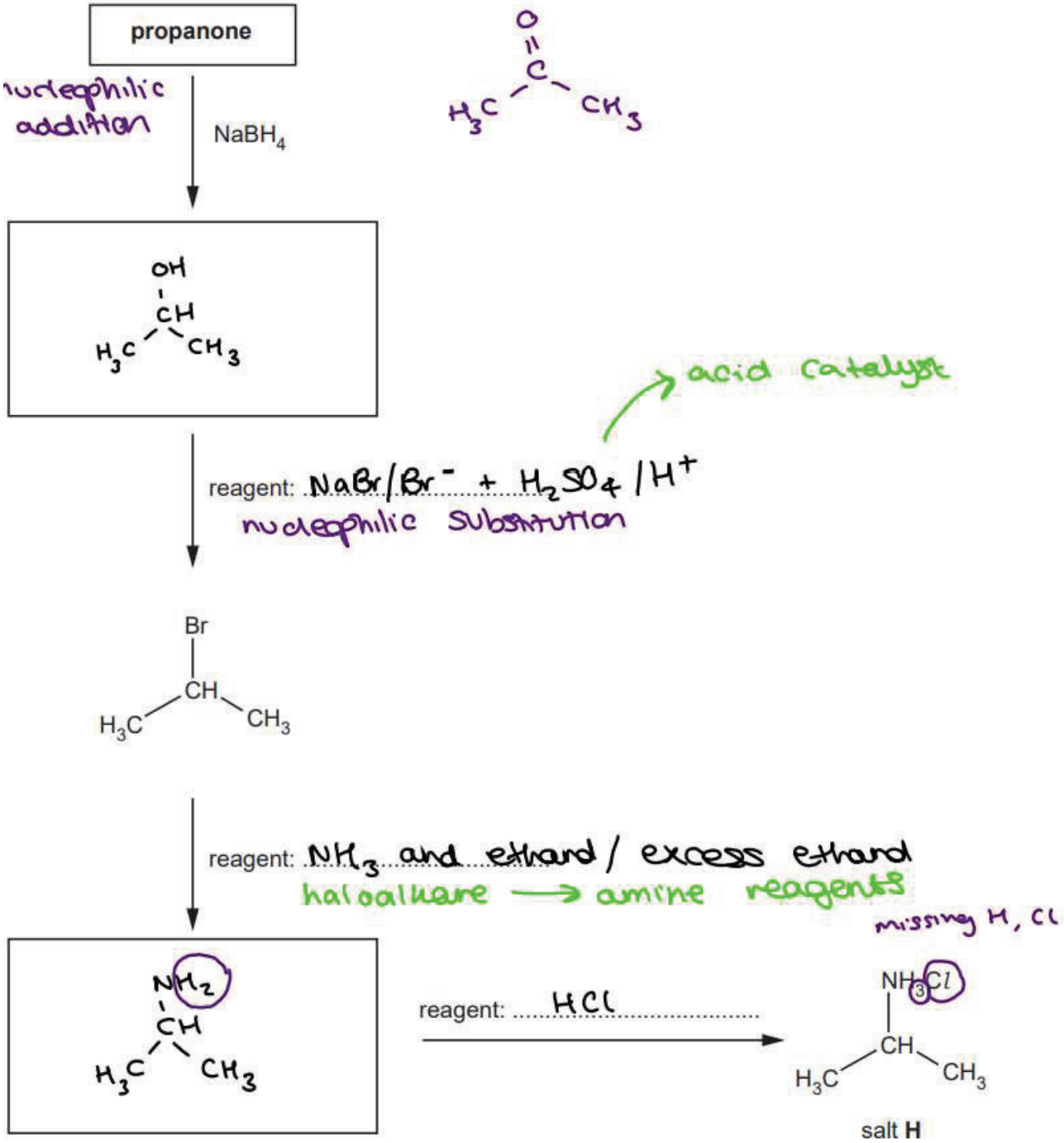
[1]

9. This question is about organic compounds containing nitrogen.

(a) Salt **H**, $(CH_3)_2CHNH_3Cl$, is used in the manufacture of garden weedkillers.

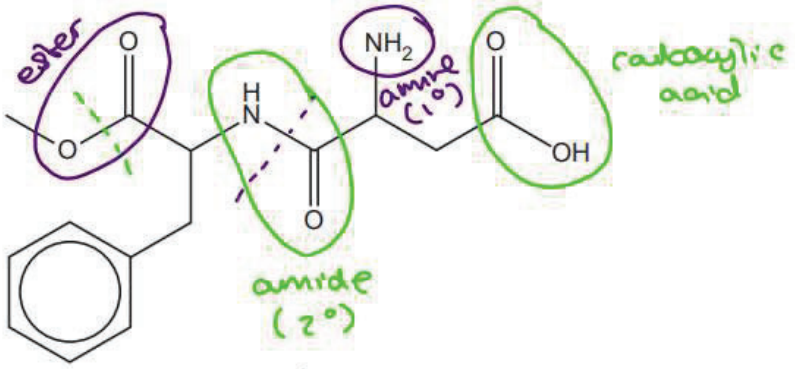
The flowchart shows the synthesis of the salt **H** from propanone.

Complete the flowchart.
Show structures for organic compounds.



[5]

(b) Aspartame, shown below, is an artificial sweetener commonly used as a sugar substitute.



aspartame

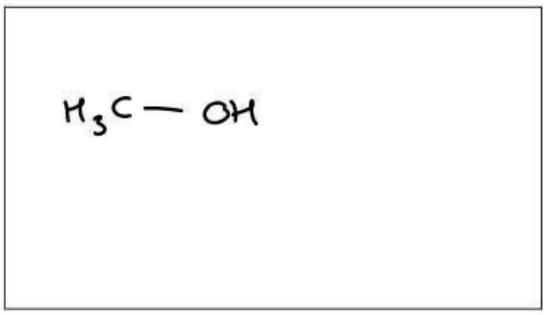
(i) Aspartame contains several functional groups.

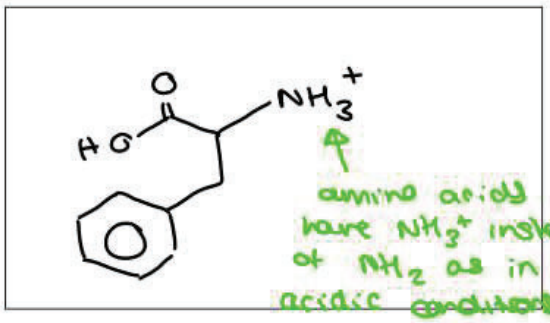
Apart from the benzene ring, name the functional groups in aspartame.

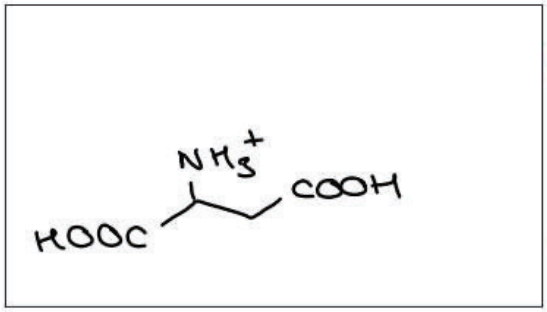
- ester
- amide (2°)
- amine (1°)
- carboxylic acid [3]

(ii) A sample of aspartame is hydrolysed with aqueous acid.

Draw the structures of the **three** organic products of the complete **acid hydrolysis** (H+) of aspartame.







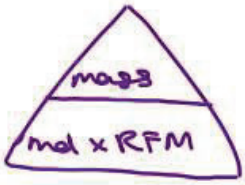
acid hydrolysis:
ester → alcohol + carboxylic acid
amide → amine + carboxylic acid

[4]

(iii) Some people are concerned that aspartame, $C_{14}H_{18}N_2O_5$, may have adverse health effects.
Research shows that the safe maximum daily intake of aspartame is 1.7×10^{-4} mol kg^{-1}.

- A typical UK adult has a mass of 75 kg.
- A can of a diet drink contains 167 mg of aspartame.

How many cans of this diet drink is it safe for a typical adult to drink in one day?



$(14 \times 12) + 18 + (14 \times 2) + (5 \times 16)$
$= 294$ g mol^{-1}

$\frac{0.167\text{g}}{294} = 5.68 \times 10^{-4}$ mol in 1 can

$1.7 \times 10^{-4} \times 75 = 0.01275$ mol per day

$\frac{0.01275}{5.68 \times 10^{-4}} = 22.4$ cans

Number of cans = 22 **[3]**