1. Which molecule is a secondary amine?
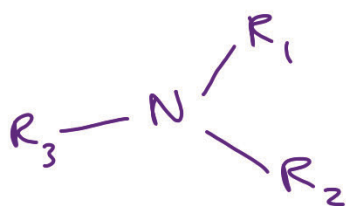
↳ 2 R groups and 1 H group

A   B   C   D

amide (B)   amide (C)

Your answer A

[1]
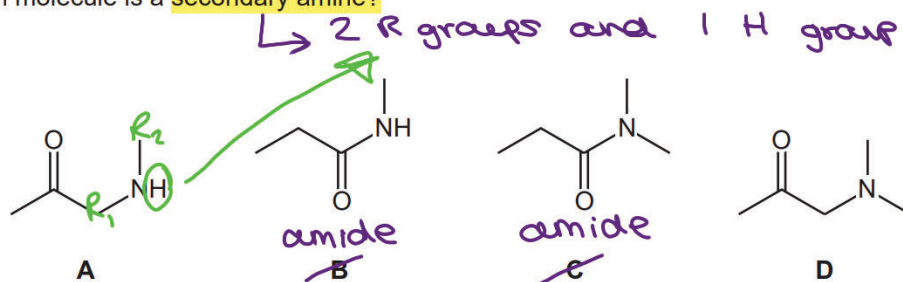
general formula of an amine:

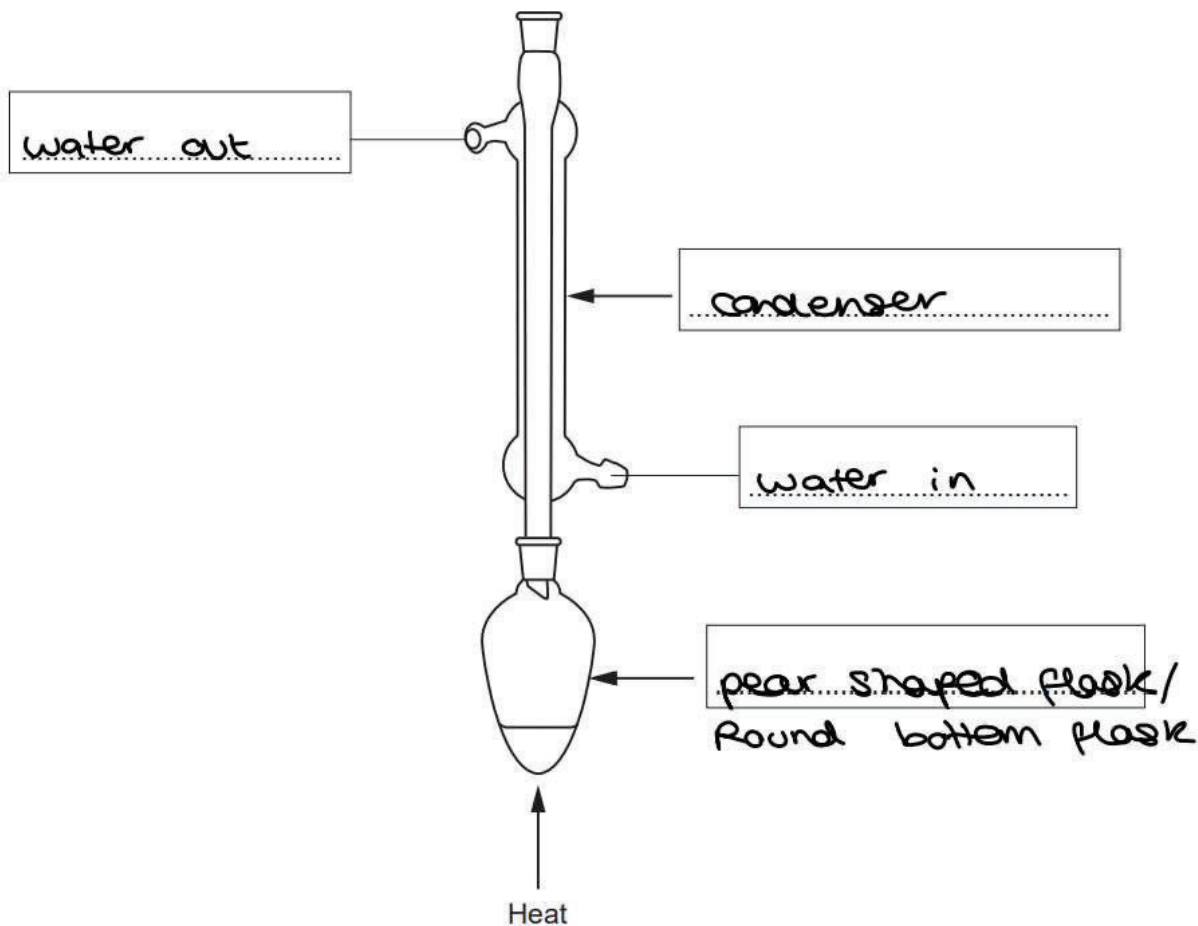$$R_3 - N \begin{array}{c} \nearrow R_1 \\ \searrow R_2 \end{array}$$

2. This question is about organic chemistry.

    (a) This part is about two practical techniques used in organic preparations.

        (i) Complete the missing labels on the diagram and name the technique.

water out

condenser

water in

pear shaped flask/ Round bottom flask

Heat

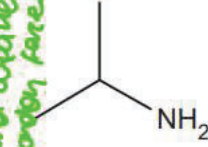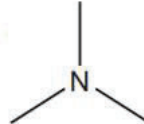Name of technique: Reflux .... [2]

    (ii) Draw a labelled diagram to show apparatus set up for filtration under reduced pressure (vacuum filtration).

buchner funnel

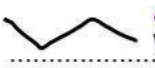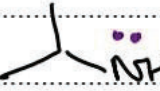rubber seal

to vacuum

buchner flask
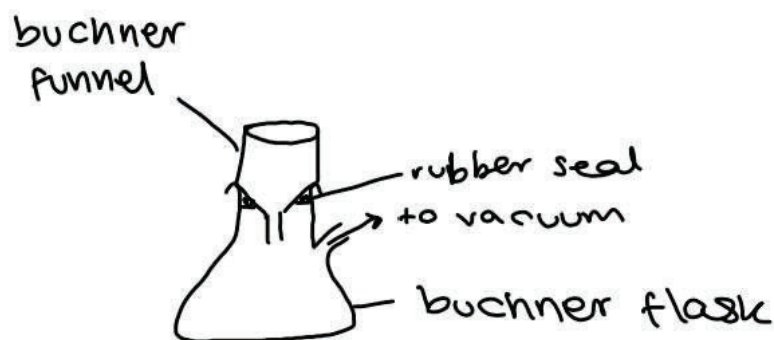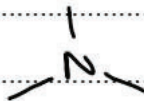
[2]

(b) This part is about amines.

(i) The table shows the structures and boiling points of three amines, which are structural isomers of C_3H_9N.

Amine	$CH_3CH_2CH_2NH_2$	$(CH_3)_2CHNH_2$	$(CH_3)_3N$
Skeletal formula	[structure with NH_2] *branching and weaker london forces*	[structure with NH_2] *hydrogen bond*	[structure with N]
Boiling point/°C	48–49 °C	33–34 °C	3–4 °C

Explain the difference in the boiling points of the three amines.

[handwritten answer:]

[structure] ‑NH₂   no branches / longer chain, more points of contact / more surface interactions so stronger induced dipole – dipole interaction (london forces)

non – hindered N lone pairs

[structure] ṄH₂   and   [structure] ṄH₂ can form hydrogen bonds

[structure] N   can't form H bonds

H bonds are stronger than london forces so more energy is needed to break H bonds.

[4]

(ii) Amine **A** is a liquid at room temperature and pressure.

When vaporised, 0.202g of the amine produces 72.0cm³ of gas at 1.00×10^5 Pa and 100°C. The ¹³C NMR spectrum of amine **A** has 3 peaks.

Determine the molecular formula of **A** and suggest a possible structure for amine **A**.
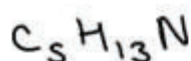
$$n = \frac{PV}{RT}$$

$R = 8.314$
$V = 72 \times 10^{-6} \, m^3$
$T = 373 \, K$
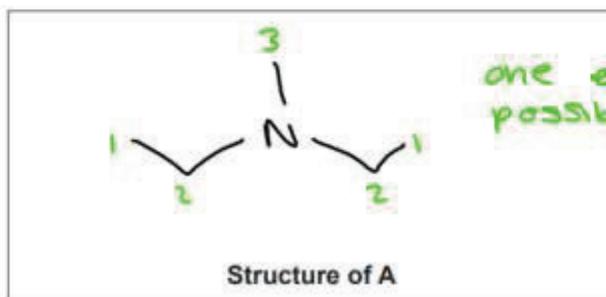$P = 1 \times 10^5 \, Pa$

$$n = \frac{1 \times 10^5 \times 72 \times 10^{-6}}{8.314 \times 373} = 2.32 \times 10^{-3} \, mol$$

$C_5 H_{13} N$

$$\frac{0.202}{2.32 \times 10^{-3}} = 87$$

mass / mol × RFM

Molecular formula of **A** ......$C_5 H_{13} N$......
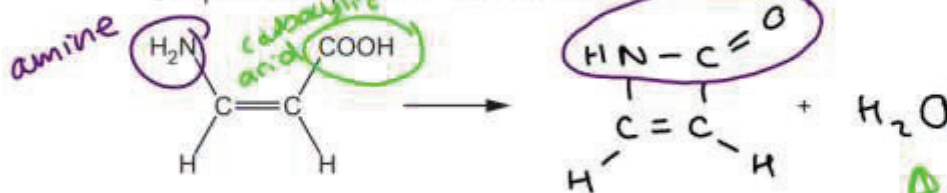
3
|
1 ⌄⌄N⌄⌄ 1
  2   2

one example of possible structure

Structure of A

[6]

(c) The amino acid Z−$H_2NCH=CHCOOH$ can react to form a cyclic compound with the molecular formula C_3H_3NO and one other product.

Complete the equation for this reaction.

amide

amine H_2N carboxylic acid $COOH$ $HN-C \overset{O}{\underset{}{=}}$
       C=C   →   C = C   + H_2O
      H   H   H   H

[2]

look at what is missing from reactant