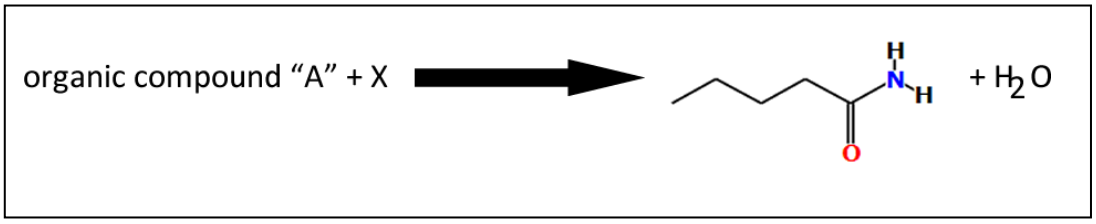
Revision-of alcohols, percentage yield, atom economy, chromatography and spectroscopy

1) Consider the two reactions shown below. They represent reactions that form iron.
   a) Calculate the percentage atom economy of each reaction.
      i. $Fe_2O_3(l) + 2Al(l) \rightarrow 2Fe\ (l) + Al_2O_3\ (l)$

      ii. $2Fe_2O_3(l) + 3C(s) \rightarrow 4Fe\ (l) + 3CO_2\ (l)$

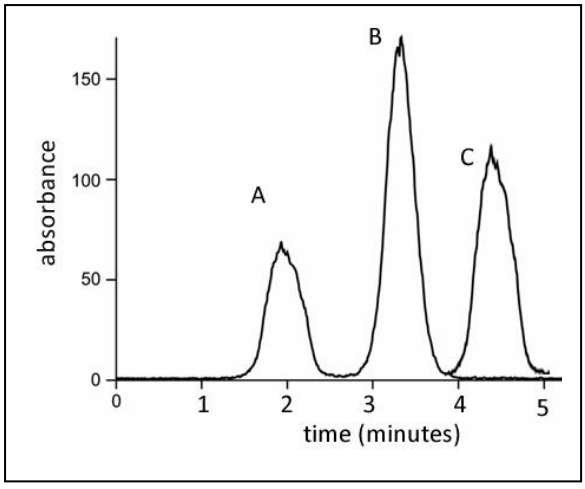
   b) Iron was produced using equation i. above. Calculate the percentage yield if 15.9 tons of Fe_2O_3 reacted with excess aluminium to produce 9.82 tons of iron.

2) Consider the reaction pathways shown below.



   a) Identify the type of reaction.
   b) Name compound X and A and draw their structural formulae.

3) A mixture of propanol, pentan-1-amine and propanoic acid is separated into its components using ***reversed phase*** HPLC. This technique uses a polar solvent with a non-polar stationary phase. The mixture is dissolved in acetone (CH_3COCH_3) before being placed in the column packed with beads covered with non-polar side chains. The chromatogram shown on the right is produced.

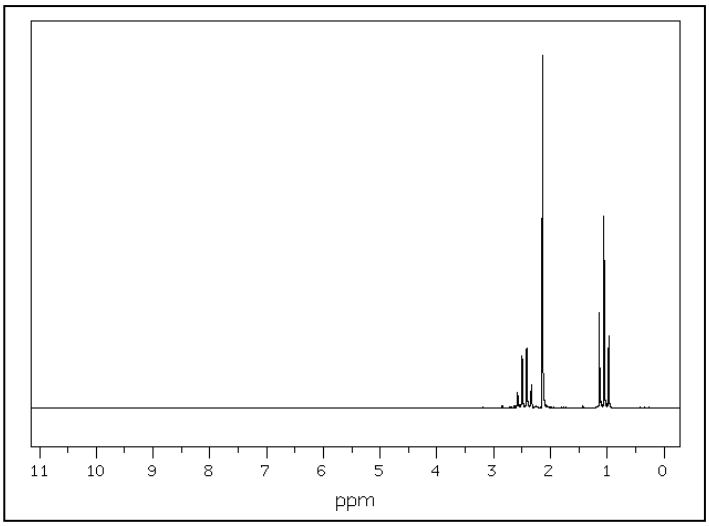


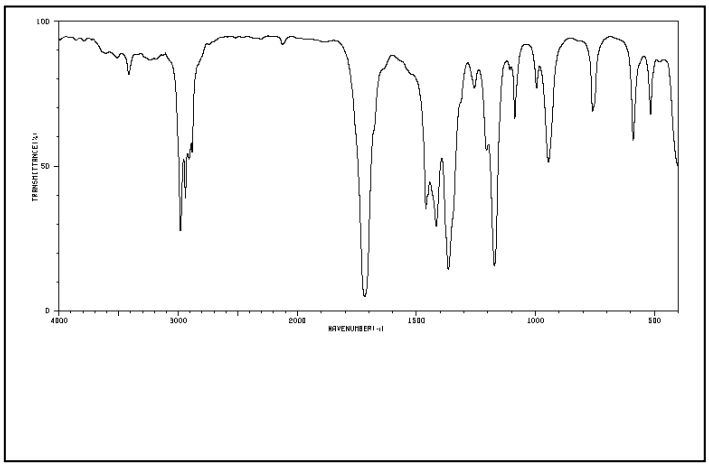
   a) Which molecule represents A, B and C? Explain

   b) What is the retention time of "C".

   c) Which compound is present in the mixture in the highest concentration? Explain

4) A compound with the molecular formula C_xH_8O was analysed using ^{1}HNMR, IR and mass spectrometry. The spectra are shown on the right.





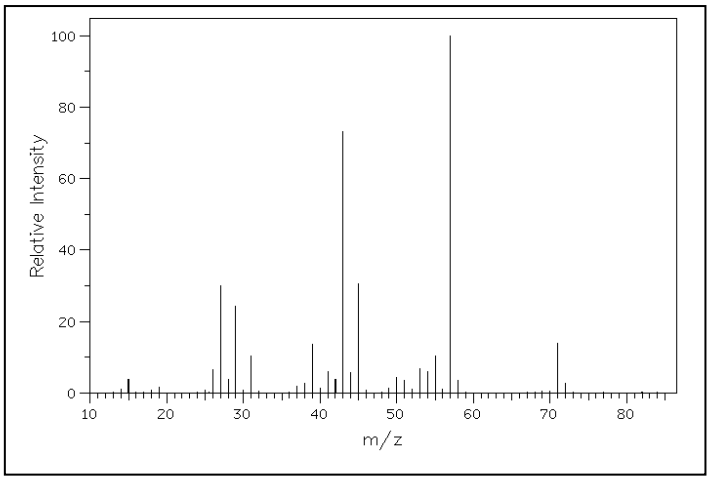
a) Find the value of x in the molecular formula C_xH_8O.

b) What can be deduced from the IR spectrum.

c) How many non-equivalent hydrogens are present in the molecule.

d) Draw the structural formula of the compound.

e) What fragment is responsible for the base peak in the MS?



f) What possible fragment is responsible for the peak at:
- 42 m/z
- 43 m/z