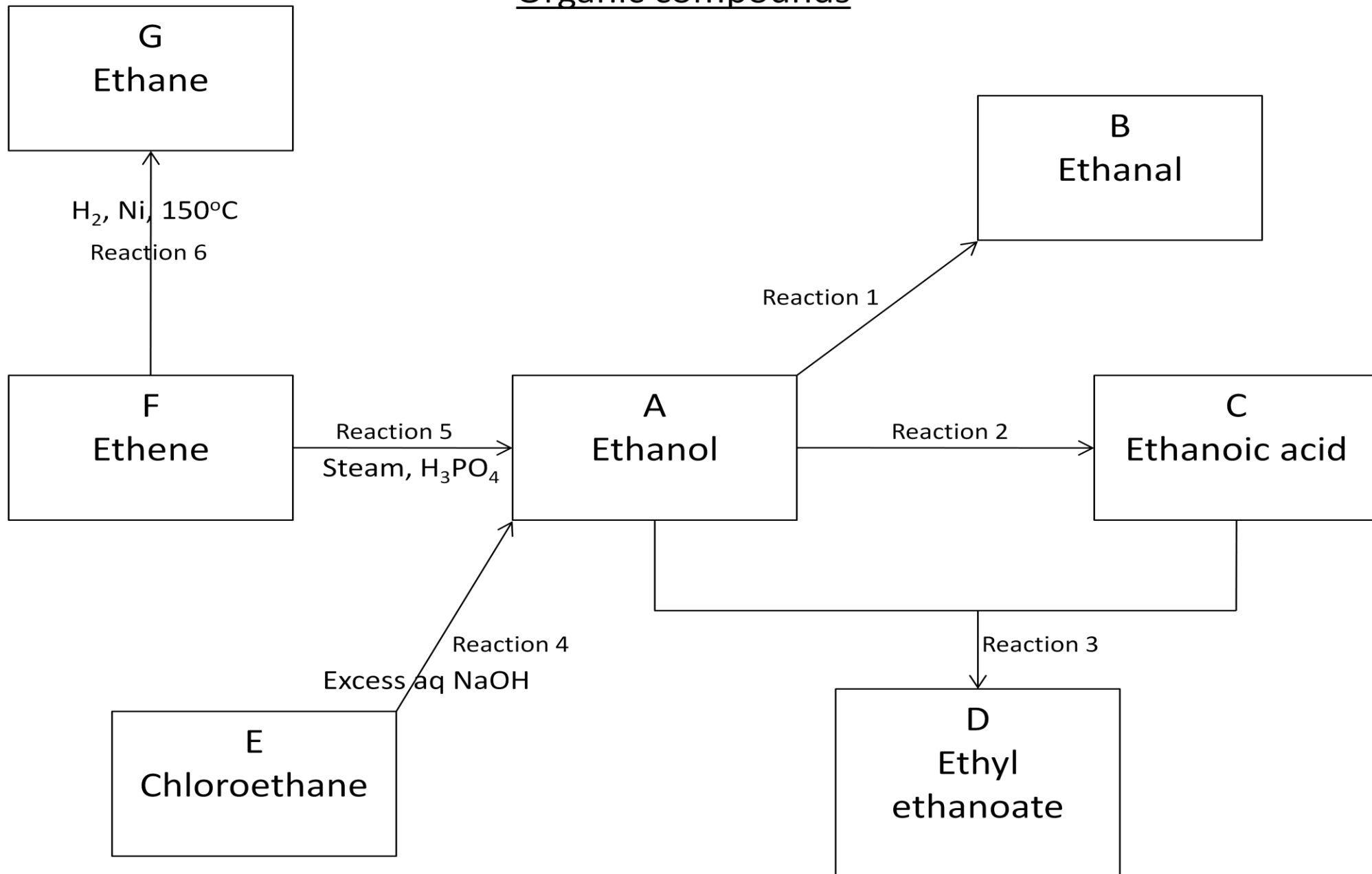


## Organic compounds



## Answer the following questions: /58

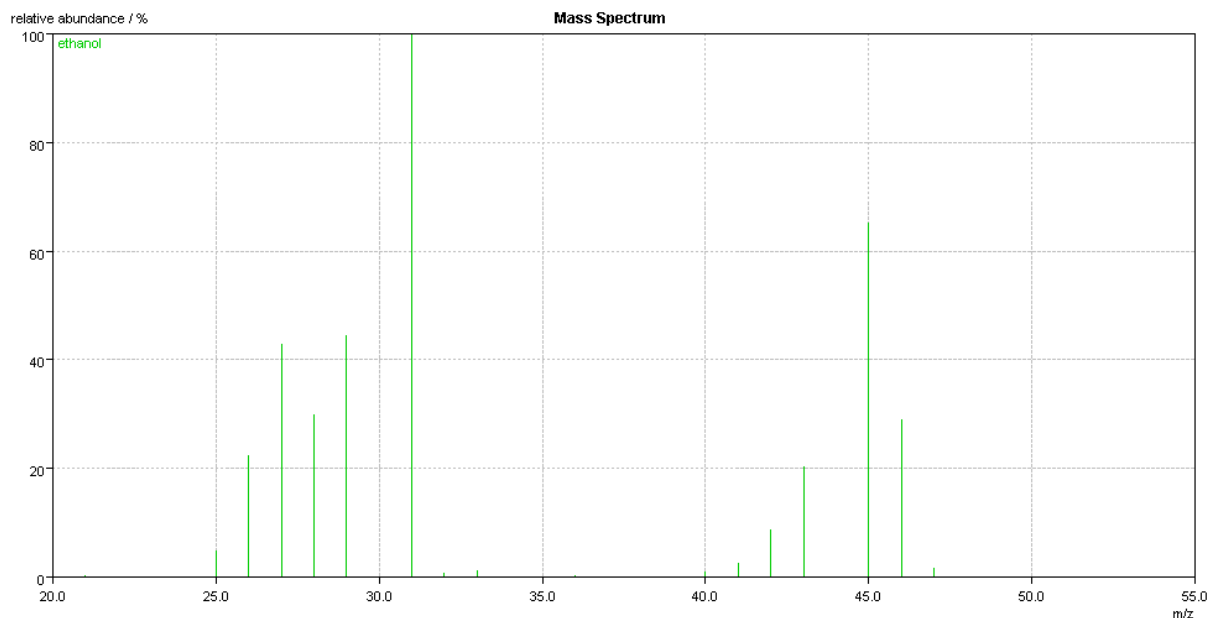
1. Identify compound A. Show your working and justify your answers. [7]

### Composition:

C 52.17%; H 13.04%; O 34.78%

Ef =  $C_2H_6O$  [1]

### Mass spectra



### Infra red spectrum



Use the information above to identify compound A: **Ethanol,  $CH_3CH_2OH$**  [1]

Mass spec: Molecular ion peak = 46,  $M_r = 46$   $M_f = C_2H_6O$  [1]

Molecular ion =  $C_2H_6O^+$  [1] fragment 29 =  $CH_3CH_2^+$  [1]

IR spec: Peak at 3400 – indicates OH [1] No peak at 1700, no C=O [1]

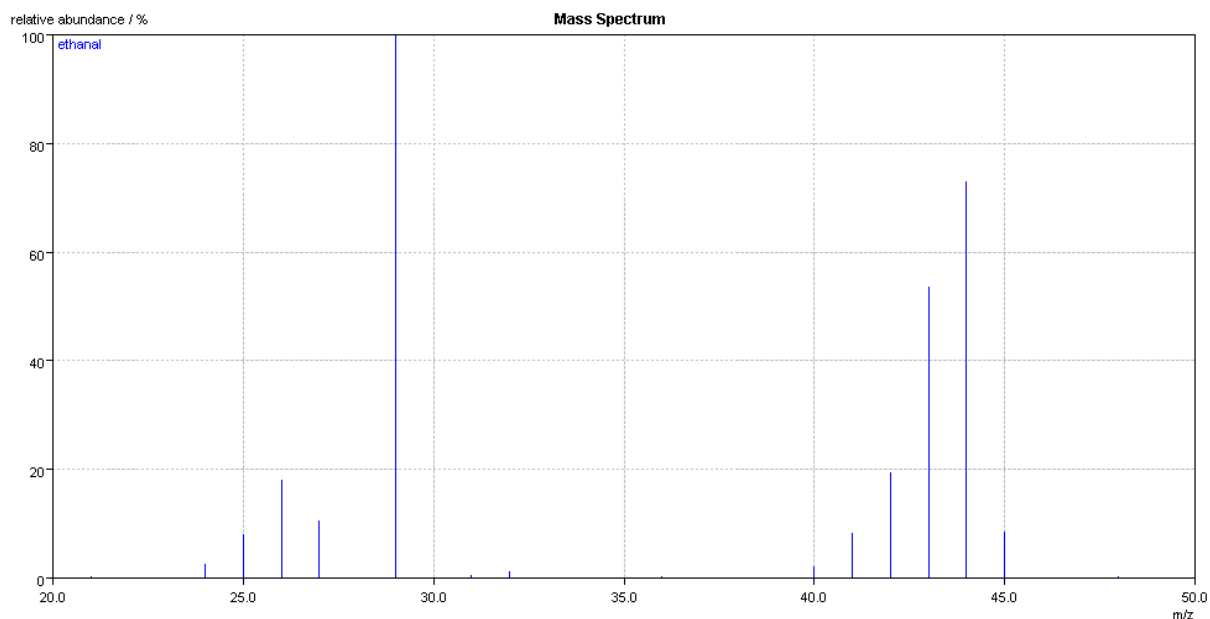
2. Identify compound B. Show your working and justify your answers. [8]

Composition:

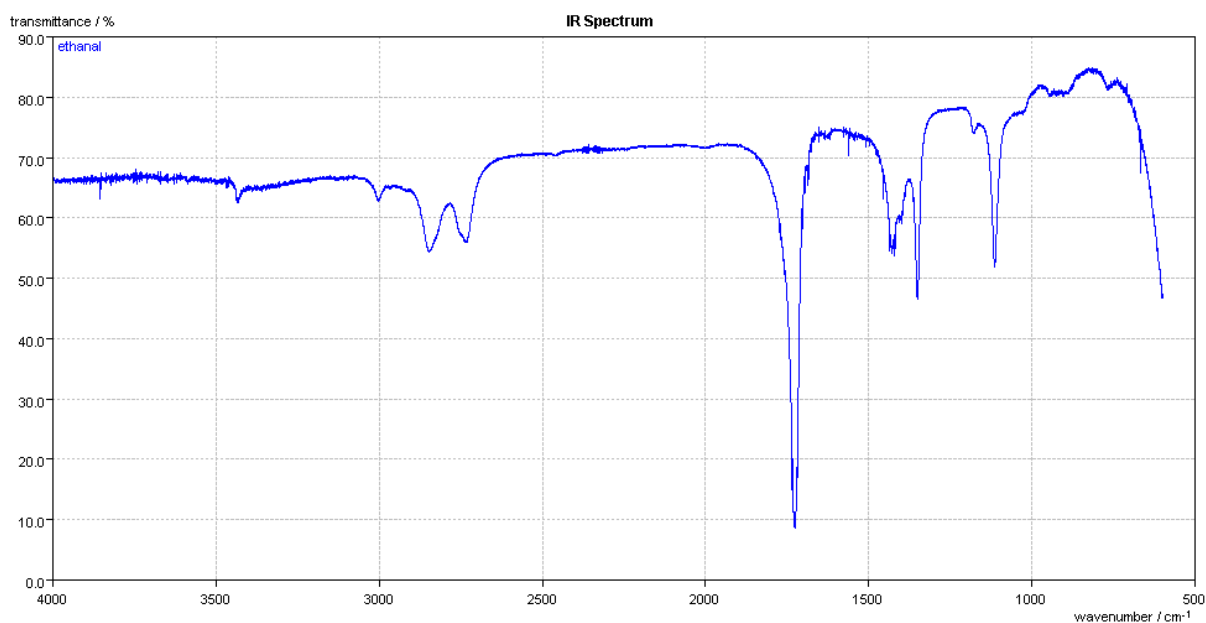
C 54.55% H 9.09% O 36.36%

$E_f = C_2H_4O$  [1]

Mass spectra



Infra red spectrum



Use the information above to identify compound B: **Ethanal, CH<sub>3</sub>CHO** [1]

Mass spec: Molecular ion peak = 44, Mr = 44 Mf = C<sub>2</sub>H<sub>4</sub>O [1]

Molecular ion = C<sub>2</sub>H<sub>4</sub>O<sup>+</sup> [1] fragment 29 = CHO<sup>+</sup> [1]

IR spec: No peak at 3400 – no OH [1] Peak at 1700, C=O [1]

Therefore an aldehyde as A is a primary alcohol [1]

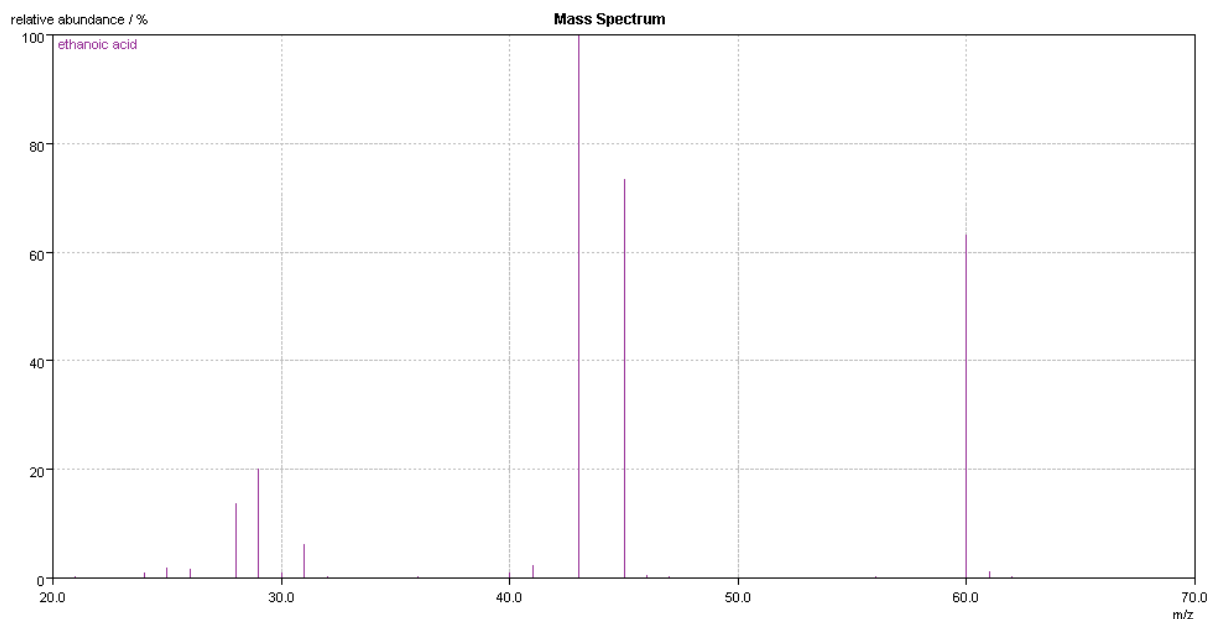
3. Identify compound C. Show your working and justify your answers. [8]

Composition:

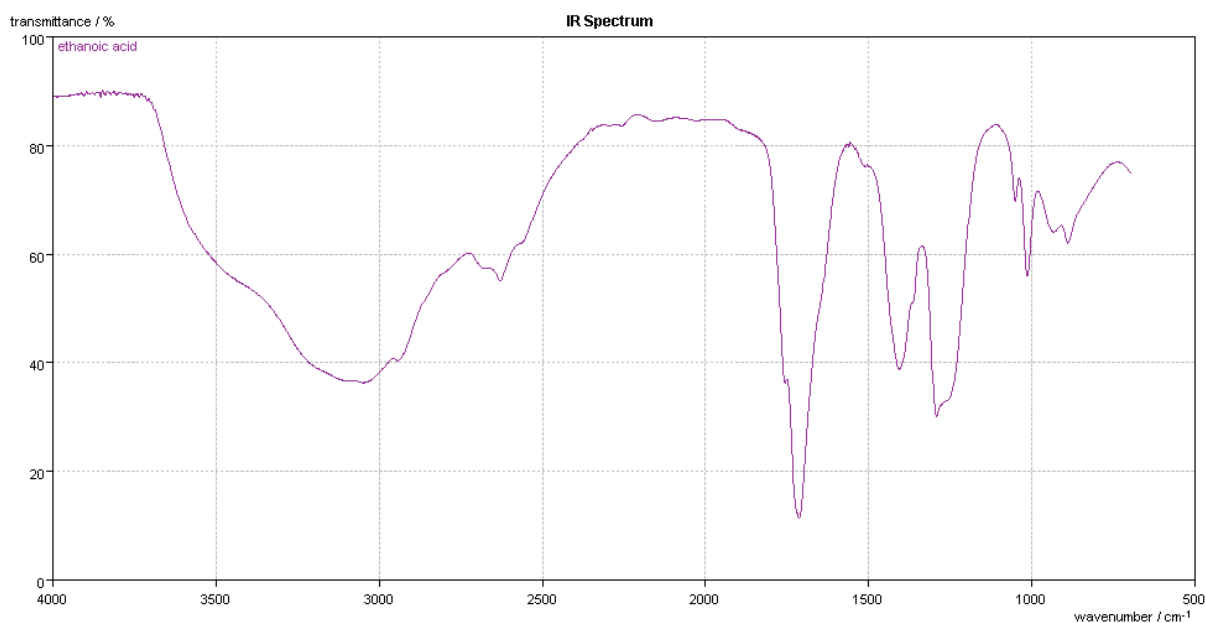
C 40.00%; H 6.67%; O 53.33%

Ef = CH<sub>2</sub>O [1]

Mass spectra



Infra red spectrum



Use the information above to identify compound C: **Ethanoic acid, CH<sub>3</sub>COOH** [1]

Mass spec: Molecular ion peak = 60, Mr = 60 Mf = C<sub>2</sub>H<sub>4</sub>O<sub>2</sub> [1]

Molecular ion = C<sub>2</sub>H<sub>4</sub>O<sub>2</sub><sup>+</sup> [1] fragment 45 = COOH<sup>+</sup> [1]

IR spec: Peak at 3400 – OH [1] Peak at 1700, C=O [1]

Therefore a carboxylic acid as A is a primary alcohol [1]

Questions:

4. This question is about reaction 1:

a. Write a balanced chemical reaction. [1]



b. 2.30g of A reacted with an excess of the oxidising mixture to produce 2.00g of B. Calculate the % yield for this reaction. [5]

$$\text{Limiting reagent} = \text{Ethanol} \quad [1] \quad \text{Moles ethanol} = 2.3/46 = 0.0500 \quad [1]$$

$$\text{Maximum moles of ethanal that could be made} = 0.0500 \quad [1]$$

$$\text{Actual moles of ethanal} = 2.00/44 = 0.0455 \quad [1]$$

$$\% \text{ yield} = (0.0455/0.0500) \times 100 = 91\% \quad [1]$$

c. Calculate the atom economy. [1]

$$\text{Atom economy} = (44/62) \times 100 = 71.0\% \quad [1]$$

d. What is the oxidising mixture and state any colour changes you would see. [3]

Sodium dichromate [1] sulphuric acid [1] Orange – green [1]

e. How would you make B? Explain how this is different from reaction 2. [2]

Distil aldehyde off as it is formed [1] you would reflux first to make C [1]

5. This question is about reaction 3:

a. Write a balanced chemical reaction. [1]



b. 2.30g of A reacted with 3.50g of C. 4.00g of D was made. Calculate the % yield for this reaction. [6]

$$\text{Moles A / CH}_3\text{CH}_2\text{OH} = 2.3/46 = 0.0500 \quad [1] \quad \text{Limiting reagent} \quad [1]$$

$$\text{Moles C / CH}_3\text{COOH} = 3.5/60 = 0.0583 \quad [1]$$

$$\text{Moles D / CH}_3\text{COOCH}_2\text{CH}_3 \text{ that could be made} = 0.0500 \quad [1]$$

$$\text{Moles D / CH}_3\text{COOCH}_2\text{CH}_3 \text{ actually made} = 4.00/88 = 0.0455 \quad [1]$$

$$\% \text{ yield} = (0.0455/0.0500) \times 100 = 91.0 \quad [1]$$

c. Calculate the atom economy.

$$\text{Atom economy} = (88/106) \times 100 = 83.0\% \quad [1]$$

6. This question is about compound E

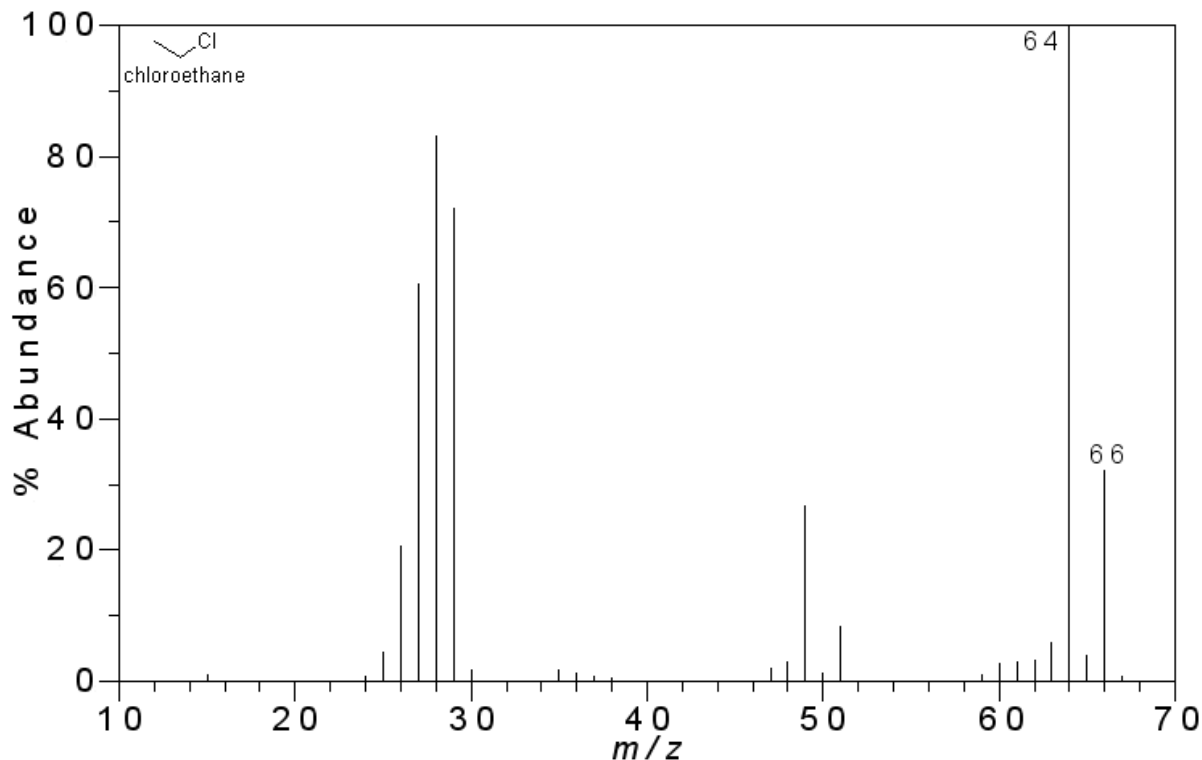
a. Identify compound E. Show your working and justify your answers. [1]

Composition:

C 37.21%; H 7.75%; Cl 55.04%

$E_f = C_2H_5Cl$  [1]

Mass spectra



b. Explain the relatively large molecular ion peaks at 64 and 66? [1]

Due to isotopes (of chlorine) [1]

c. Use your knowledge from unit 1 to explain the actual Mr of E [1]

There is a larger abundance of  $^{35}Cl$  than  $^{37}Cl$  [1]

7. Use your knowledge of organic chemistry to identify F and G. [2]

F = Ethene [1] G = Ethane [1]

8. Use your knowledge of organic chemistry to identify the types of reactions in reactions 4,5 and 6. [3]

4: Substitution [1] 5: Addition [1] 6: Addition [1]

9. Which of the reactions 4,5 and 6 will have the highest atom economy? Explain your answer. [2]

Reaction 5 and 6 [1] : They are addition reactions [1]

10. Pick one of the reactions, 1 – 6 to draw a mechanism. [5]

Must be reaction 5 or 6: Dipole on  $H_2$  or  $H_2O$  [1] Curly arrow from  $C=C$  to  $\square + H$  on  $H_2$  or  $H_2O$  [1] Curly arrow from  $H-H$  or  $O-H$  bond to  $\square - H$  or  $O$  [1] Correct carbocation [1] Curly arrow from LP on  $H$  or  $O$  to the positive  $C$  on the carbocation [1]