F324 TEST 3 MARK SCHEME

1. (a) R_f value is distance moved by a component/spot/solute divided by distance moved by solvent. **(1)**

Retention time is the time between injection and emergence (or detection) of a component. **(1)** 2

(b) (i) Partition / adsorption **(1)** 1

(ii) Role of gas: carrier gas / mobile phase / to carry to sample through the chromatography column **(1)**

Role of liquid: stationary phase **(1)** 2

(iii) Trace with two peaks drawn **(1)** 1

(iv) Measure **area** under each peak **(1)**

Find total area **(1)**

% = (area of one peak/total area) × 100% **(1)** 3

[9]

2. (i) **A** C_3H_6 **(1)** **B** C_4H_8 **(1)** 2

(ii) **A** $CH_3CH{=}CH_2$ (or displayed) ('sticks' penalised once) 1

(iii) $C_3H_5^+$ **(1)** for formula and **(1)** for charge 2

[5]

3. (a) (i) Molecular ion peak: the peak caused by the unfragmented molecule / the peak with the highest m/e value / the peak that tells you the Mr. 1

Base peak : peak with the greatest (relative) intensity / peak representing most stable/abundant fragment
NOT the tallest / biggest / most common peak 1

(ii) The molecular ion is too unstable / will have been completely fragmented / may not carry a positive charge 1
NOT peak too small to be seen / too little ion present

(b) IR spectrum:

C=O peak at approx 1650 cm^{-1} (1680-1750 cm^{-1}) 1

broad O-H peak at value(s) between 2500-3300 cm^{-1} 1

ignore any references to C-O peak at 1000 – 1300 cm^{-1}

mass spectrum:

Fragment with m/e = 31 is CH_2OH^+ 1

Fragment at m/e = 45 is $COOH^+$ 1

penalise missing + sign once only

(c) 2 proton peak at δ = 3.3-4.3 – singlet (-CH_2-) 1

1 proton peak at δ = 1.5-5.5 – singlet (-OH) 1

1 proton peak at δ = 11.0-11.7 – singlet (-COOH) 1

(ranges of chemical shift (δ) values taken from data sheet)

- penalise each error once only
- ignore peak areas/heights unless incorrectly labelled

Labelled diagram of the structure of G proposed by the student may be used to provide evidence for the positioning of peaks on the sketched spectrum.

Both OH and COOH protons disappear on shaking with D_2O 1

[11]

4. (a) (i) Find the m /e of …. **(1)**

... the peak furthest to the right / with highest m /e or mass **(1)** 2

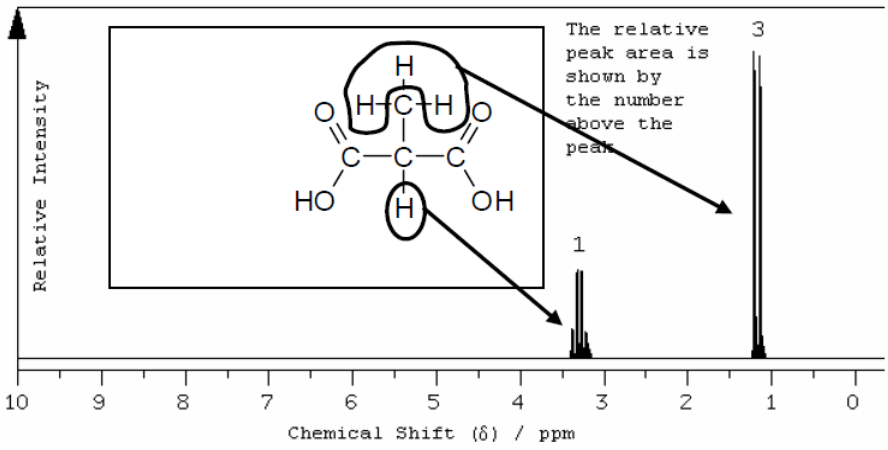
allow attempts to cater for the ^{13}C peak

$C_2H_3O_2$ /empirical formula has M_r = 59 **(1)**

so M_r of molecular formula is $^{118}/_{59}$ = 2 /twice the empirical formula **(1)** 2

(b) (i) OH peak disappears (with D_2O / on the second spectrum) 1

(ii)



peak at 3.3ppm identifed as due to the CH ✓ — assignment must be for this structure (not just R-CH_3 etc)

peak at 1.2ppm identified as due to the CH_3 ✓

protons (and not the carbon) on the groups are identified ✓ — can be by Ha, Hb etc

relative peak areas / numbers above the peaks show … the number of (equivalent) protons in each group / three protons on one carbon and one on the other carbon ✓ **AW**

quadruplet / 1:3:3:1 splitting (of the peak at 3.3ppm) shows… three protons on the neighbouring/adjacent carbon ✓

doublet / 1:1 splitting (of the peak at 1.2ppm) shows … one proton on the neighbouring /adjacent carbon ✓ **[6]**

(iii) no of peaks: one **(1)**

splitting: none **(1)**

all four protons equivalent / in the same environment **(1)** 3

if the wrong structure is chosen allow ecf for:
*two peaks **(1)**,*
*splitting **(1)(1)** (as last 2 marks for part (ii))*

[14]