Mark schemes

Q1.

(a) Tick in carbonyl box only

1

(b) Peak at 2220-2260 cm^{-1} (for C≡N) disappears

If both C≡N disappears and N-H appears without wavenumbers scores 1

M1

Peak at 3300-3500 cm^{-1} (for N-H) appears

M2

Fingerprint region different

M3

(c) Integration ratio 2:2:3

If no link between delta value and oxygen and chlorine, then can award 1 mark for correct explanation of splitting of all 3 peaks

M1

Peak at 3.95 triplet (integration 2) Cl-CH_2 next to CH_2

M2

Peak at 3.65 triplet (integration 2) O-CH_2 next to CH_2

If no explanation of splitting, then can award 1 mark for 3 correct links between delta value and oxygen and chlorine M1

M3

Peak at 3.35 singlet (integration 3) O-CH_3 no adjacent H

M4

Structure CH_3-O-CH_2CH_2Cl

M5

[9]

Q2.

(a)

This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.	
Level 3 **5-6 marks**	All stages are covered and each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3.
Level 2 **3-4 marks**	All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR two stages are covered and are

	generally correct and virtually complete. Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3.
Level 1 **1-2 marks**	Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order.
0 marks	Insufficient correct chemistry to gain a mark.

Indicative Chemistry content

Stage 1:
1a $CDCl_3$ or CCl_4 solvent
1b TMS as reference / calibration / standard / peak at 0 (ppm)
1c Inert (so unlikely to react with the sample allow if inert tied to either TMS or $CDCl_3$ or CCl_4)

Stage 2 CCl_4 or **$CDCl_3$ as solvent:**
2a (Both) have no H (atoms so give no signals in spectrum) tied to either $CDCl_3$ or CCl_4
2b CCl_4 non polar (- good solvent for non-polar organic molecules)
2c $CDCl_3$ polar covalent molecule (– good solvent for polar organic compounds)

Stage 3 TMS as reference:
3a (Lots (12) of equivalent H to) give one signal / single environment
3b Signal in an area away from other typical H signals / peak upfield from others
OR
(Low electronegativity of Si shifts) signal right
3c Easy to remove / volatile / low bp

6

(b) **M1** *x* – doublet

1

M2 *y* – quartet

1

M3 *z* – doublet

Allow similar words eg double, quadruplet

Allow numbers

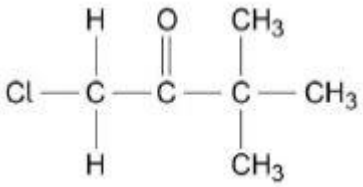
Allow diagrams with correct numbers of lines

1

(c) H attached to both C-Cl and adjacent to C=O so doesn't fit with data in table B

1

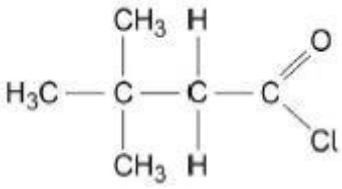
(d) **M1**



Allow abbreviated structural formulae

1

M2



1

[12]

Q3.

(a) 4 peaks

1

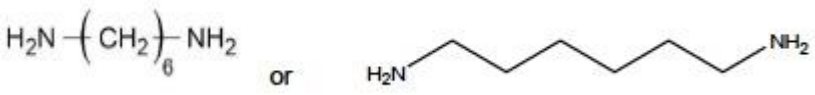
Triplet

1

Two H on adjacent C

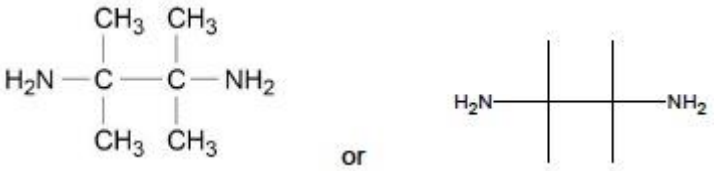
M3 dependent on correct M2

1

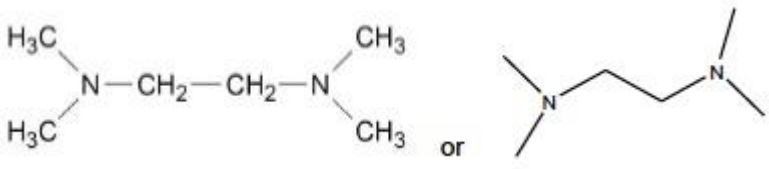
(b) 

Not –C_6H_{12}–

1

(c) 

1

(d) 

Not –C_2H_4–

1

[6]

Q4.

C

[1]

Q5.

D

[1]

Q6.

(a)

1×AO1

1

(b) **S**

1

R

1

Q

1

(c) (Isomer **T**)

signals due to OH (alcohol) at 3230−3350 and C=O at 1680−1750

1

OH and C=O (functional groups) separated in molecule.

Allow not a carboxylic acid.

1

(Isomer U)

(only) signal for OH (alcohol) at 3230−3350

1

2 × OH groups present / diol / OH & cyclo(ether) structure.

Allow OH but not C=O.

1

(Isomer V)

signals due to OH (acid) at 2500−3000 (and C=O at 1680−1750)

carboxylic acid group / −COOH present.

1
1

(d) 2:2:2:3:3

Any order.

1

(e) (The quartet at δ=3.5 is for a CH_2 group) next to **−O−CH$_2$ OR** shifted significantly downfield by electronegative O

1

(is a quartet) because of an adjacent CH_3 group / couple with 3 adjacent protons

1

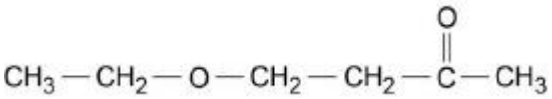
(singlet at δ=2.2 is for a CH_3 group) attached to  C**H$_3$ OR** shifted downfield by electronegative C=O

1

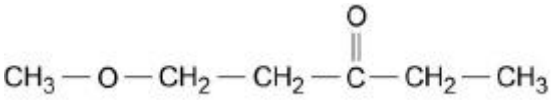
(is a singlet) because there are no adjacent protons / no coupling.

1

(f)



Allow 1 mark for:



2

[17]

Q7.

C

[1]