

M1.(a) Reagent

Acidified
 $K_2Cr_2O_7$

Acidified
 $KMnO_4$

I_2 / NaOH

Named
RCOOH with HCl or H_2SO_4

Named
RCOCl

*Allow names including potassium permanganate
Wrong or no reagent CE = 0*

1

P (ketone)
no reaction
no reaction
Yellow ppt
no reaction
no reaction

*Penalise incorrect formulae or incomplete reagent, such as
 $K_2Cr_2O_7$ or acidified dichromate, but mark on.*

1

S (2° alcohol)
(orange to) green
(purple to) colourless
no reaction
fruity or sweet smell
Misty fumes

*Allow no change or nvc but penalise nothing or no
observation*

*If 2 reagents added sequentially or 2 different reagents used
for P and S then CE = 0*

1

(b) Tollens'
silver mirror / solid

1

Fehling's / Benedicts
red ppt

1

(c) **G**
P

If not P then no marks for clip

1

5 OR five

1

(d) $C_4H_{12}Si$

Must be molecular formula

Wrong substance CE = 0 for clip

1

Any **two** from

- One or single peak OR all (four) carbon atoms are equivalent or one environment

1

- upfield from others or far away from others or far to right
- non toxic OR inert
- low boiling point or volatile or easy removed from sample

*Ignore and don't credit single peak linked to 12 equivalent H
or has a peak at $\delta = 0$*

but use list principle for wrong statements

1

1

(e) Figure 1 is **R**

If not R cannot score M2

M1

1

90–150 (ppm) or value in range is (two peaks for) C = C / alkene

M2

1

Figure 2 is **T**

If not T cannot score M4 or M5

M3

1

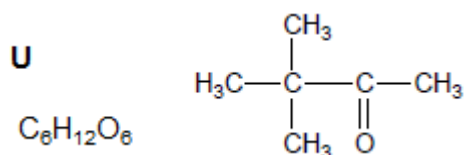
50-90 (ppm) or value in range is C—O or alcohol or ether

M4

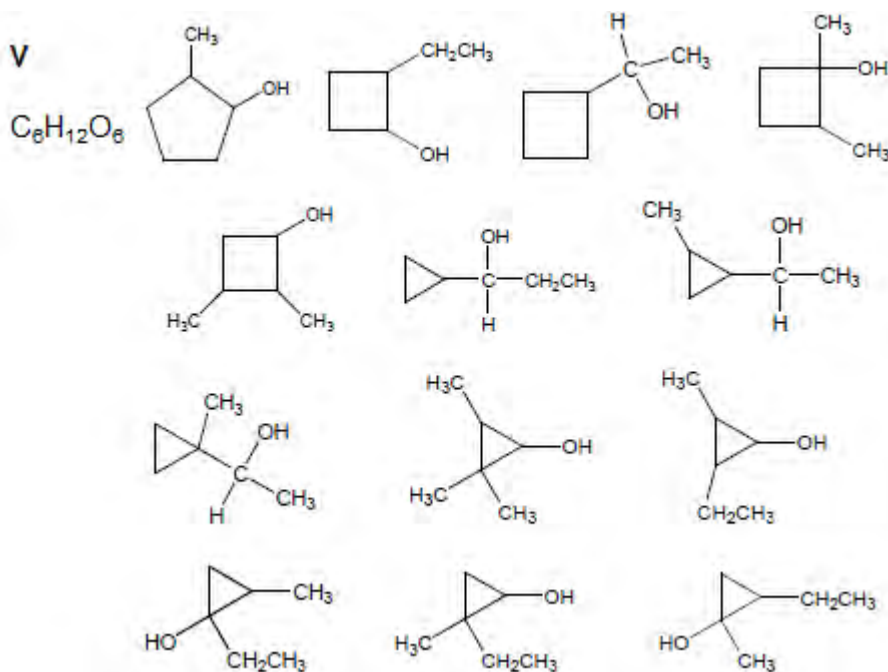
two peaks (so not S which would have only one)

M5

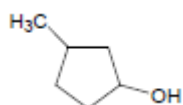
(f)



Answers include



Not allow S



because V must be an isomer of S

[17]

M3.(a) (i) Single / one (intense) peak / signal **OR** all H or all C in same environment **OR**
12 equiv H or 4 equiv C

Do not allow non-toxic or inert (both given in Q)

Any 2 from three

Ignore peak at zero

OR

Upfield / to the right of (all) other peaks **OR** well away from others **OR**
doesn't interfere with other peaks

Ignore cheap

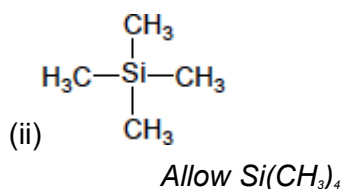
Ignore non-polar

OR

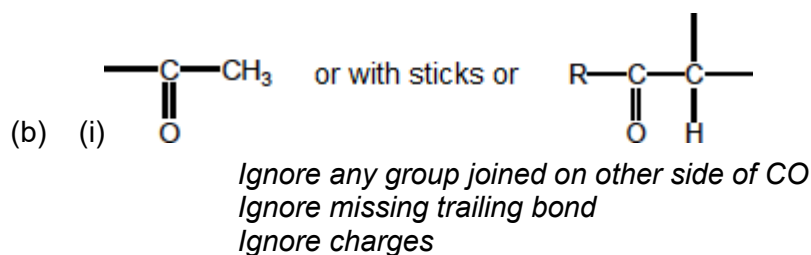
Low bp **OR** volatile **OR** can easily be removed

Ignore mention of solubility

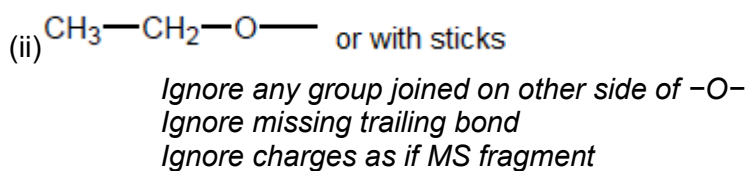
2



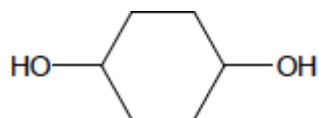
1



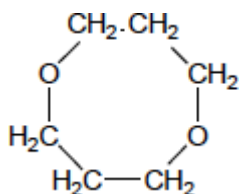
1



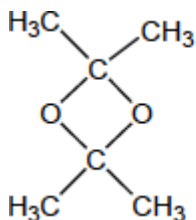
1



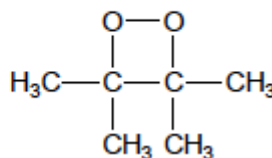
OR



Allow



OR



1
[11]

- M4.(a) (i) CDCl_3 or CD_2Cl_2 or C_6D_6 or CCl_4
Not D_2O Allow CD_3Cl

1

- (ii) 4 or four

1

- (iii) Triplet or 3 or three

1

- (iv) 1,4-dichloro-2,2-dimethylbutane

Do not penalise different or missing punctuation or extra spaces.

Spelling must be exact and order of letters and numbers as here.

1

- (b) (i) 3 or three

1

(ii) 190-220 (cm⁻¹)

Allow a single number within the range.

OR *a smaller range entirely within this range.*

1

(iii) hexane-2,5-dione

Do not penalise different or missing punctuation or extra spaces.

Spelling must be exact and order of letters and numbers as here.

NB so must have middle e

1

[7]

M5.IR

Extended response

Absorption at 3360 cm⁻¹ shows OH alcohol present

Deduction of correct structure without explanation scores maximum of 4 marks as this does not show a clear, coherent line of reasoning.

M1

1

NMR

There are 4 peaks which indicates 4 different environments of hydrogen

Maximum of 6 marks if no structure given OR if coherent logic not displayed in the explanations of how two of OH, CH₃ and CH₂CH₃ are identified.

M2

1

The integration ratio = 1.6 : 0.4 : 1.2 : 2.4

The simplest whole number ratio is 4 : 1 : 3 : 6

M3

1

The singlet (integ 1) must be caused by H in OH alcohol

M4

1

The singlet (integ 3) must be due to a CH₃ group with no adjacent H

M5

1

Quartet + triplet suggest CH₂CH₃ group

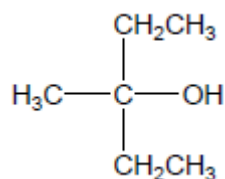
M6

1

Integration 4 and integration 6 indicates two equivalent CH₂CH₃ groups

M7

1



M8

1

[8]

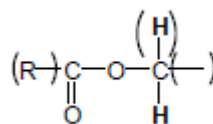
M6.(a) M1 Ester 1

If Ester 2, can score M3 only.

1

M2

peak at $\delta = 4.1$ due to



When marking M2 and M3, check any annotation of structures in the stem at the top of the page.

1

- M3 ($\delta = 4.1$ peak is) quartet as adjacent / next to / attached to CH₃ 1
- M4 Other spectrum quartet at $\delta = 2.1-2.6$ (or value in this range) 1
- (b) M1 Quaternary (alkyl) ammonium salt / bromide 1
- M2 CH₃Br or bromomethane
Penalise contradictory formula and name. 1
- M3 Excess (CH₃Br or bromomethane)
Mention of acid eg H₂SO₄ OR alkali eg NaOH loses both M2 and M3. 1
- M4 Nucleophilic substitution
*Can only score M3 if reagent correct.
Ignore alcohol or ethanol (conditions) or Temp.* 1

(c)

	Bromine (penalise Br but mark on)	Acidified KMnO ₄ (Penalise missing acid but mark on)
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Wrong reagent = no marks.

If bromine colour stated it must be red, yellow, orange, brown or any combination, penalise wrong starting colour.

1

Benzene	no reaction / colour remains	no reaction / colour remains / no (visible)
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	/ no (visible) change	change
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*Ignore 'clear', 'nothing'.
Allow colour fades slowly.
Allow 'nvc' for no visible change.*

1

cyclohexene	(Bromine) decolourised	(Acidified KMnO_4) decolourised
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1

[11]

M7.C

[1]