Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) Method 1

M1 %O = 27.1

$$\frac{61.0}{12.0} = 5.08 \qquad \frac{11.9}{1.0} = 11.9 \qquad \frac{27.1}{16.0} = 1.69$$

M2 3 7 1

M3 C_3H_7O = 59 which is half of M_r so MF = 2EF

OR

Method 2

M1 61% of 118 = 72.0 and 11.9% of 118 = 14.0

M2 72 + 14 = 86 so oxygen = 32 out of 118

OR 27.1% of 118 = 32.0

M3

$$\frac{72.0}{12.0} = 6 \qquad \frac{14.0}{1.0} = 14 \qquad \frac{32.0}{16.0} = 2$$

Method 3

Alternative using given molecular formula

M1 $C = \frac{12 \times 6}{118} \times 100 = 61.0\%$

M2 $H = \frac{14 \times 1}{118} \times 100 = 11.9\%$

M3 $O = \frac{16 \times 2}{118} \times 100 = 27.1\%$

3

(b) For this question, marks can be awarded either for a description of how the structure is derived or from the given structure itself. The maximum mark to be awarded is nine from the ten marks listed.

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Marks fall into three sections:

- Infrared evidence : two marks are available for use of the infrared evidence, (M1 and M10)
- Chemical evidence: one mark is available for use of the chemical evidence (M2)
- N.m.r. evidence: six marks are available for use of the n.m.r. evidence (M3 – M8 inclusive)

plus one mark (M9) for a completely correct structure.

Suggested procedure for marking

First look at the infrared spectrum: marks M1 and M10 may be scored there or in the written answer.

Then look for use of the acidified potassium dichromate(VI) evidence, (M2).

Then look at the final structure: this may lead to the award of marks M3 to M9 as shown on the structures below.

Beware contradictions, e.g. using the chemical evidence they may state that **R** is a primary or secondary alcohol but then draw a tertiary alcohol. This will lose M2 but may score M3.

The written 'evidence' frequently simply contains extracts from the Table **B** on the Data Sheet and, if only this is given, is unlikely to score many marks.

Described

Or drawn

M1 Infared peak/absorbance at 3400 (cm^{-1}) = O-H alcohol
(reference to ir spectrum needed)

Note: please check the spectrum

If peak at 3000 (cm-1) is identified as acid then cannot score M1 (contradiction)

M10 **Either** no peak between 1680-1750 (cm^{-1}) so no C=O or not aldehyde/acid
OR peak at 1000-1300 (cm^{-1}) so C–O present

Apply list principle to IR analysis for M10

M2 (Acidified potassium dichromate(VI) turns green) so primary alcohol or secondary alcohol or not tertiary alcohol

Ignore aldehyde here

Lose M2 if just tertiary alcohol in structure

M3 δ = 3.1 singlet or integration = 1 is O-H

Award M3 if structure has 1 O-H group only (can be primary, secondary or tertiary)

Lose M3 if more than one OH group shown

M4 two triplets at 1.4 & 3.8 = $–CH_2–CH_2–$

Allow $–CH_2–CH_2–CH_2–$

M5 δ = 3.8 means CH_2 attached to O (in ether NOT ester)

Allow $O–CH_2–CH_2–CH_2–C$

δ = 1.4 means CH_2 attached to C (but not to C=O)

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M6 δ = 1.1 (singlet) integration 6 = 2 × equivalent CH_3 on same C

–C(CH₃)₂–

M7 δ = 1.1 singlet so no H attached to $–C(CH_3)_2-$

R–C(CH₃)₂–R

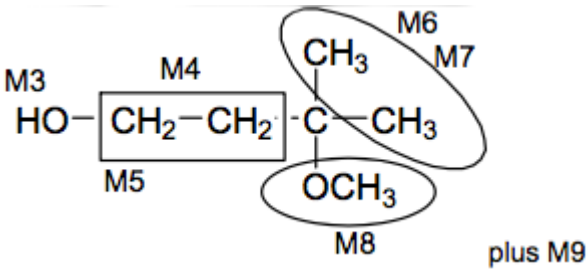
M8 δ = 3.2 singlet integration 3 = $-OCH_3$

–OCH₃

M9 For completely correct

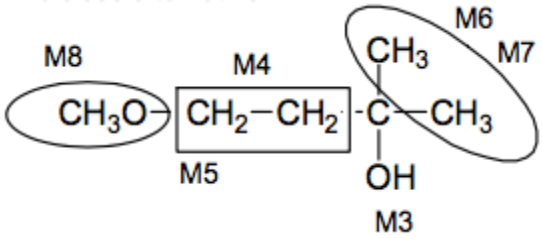
If no structure given then Max 8

R is



plus M9

This close alternative



would not score M9, but could score up to 8 marks

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Q2.

(a) $[Fe(H_2O)_6]^{2+} + 2NH_3 \rightarrow Fe(H_2O)_4(OH)_2 + 2NH_4^+$

Allow equation with OH^- provided equation showing formation of OH^- from NH_3 given

1

Green precipitate

1

$[Fe(H_2O)_6]^{2+} + CO_3^{2-} \rightarrow FeCO_3 + 6H_2O$

1

Green precipitate

effervescence incorrect so loses M4

1

(b) (i) Colourless / (pale) green changes to pink / purple (solution)

Do not allow pale pink to purple

1

Just after the end−point MnO_4^- is in excess / present

1

(ii) $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$

1

Moles $KMnO_4 = 18.7 \times 0.0205 / 1000 = (3.8335 \times 10^{-4})$

Process mark

1

Moles $Fe^{2+} = 5 \times 3.8335 \times 10^{-4} = 1.91675 \times 10^{-3}$

Mark for M2 × 5

1

Moles Fe^{2+} in 250 $cm^3 = 10 \times 1.91675 \times 10^{-3} = 0.0191675$ moles in 50 cm^3

Process mark for moles of iron in titration (M3) × 10

1

Original conc $Fe^{2+} = 0.0191675 \times 1000 / 50 = 0.383$ $\underline{\text{mol dm}^{-3}}$

Answer for moles of iron (M4) × 1000 / 50

Answer must be to at least 2 sig. figs. (0.38)

1

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