Question Number	Acceptable Answers	Reject	Mark
1 (a)	**(IR spectrum of X)** peak at 3400 (cm⁻¹) **(1)** *MAY BE ANNOTATED ON SPECTRUM* *ALLOW* anything in the Data Booklet range which is 3200 to 3750 (cm⁻¹) **X** has an O-H (group) OR **X** is an alcohol **(1)** **(From the chemical information)** **X** is primary **or** secondary (alcohol) OR **X** is **not** tertiary (alcohol) OR **X** is any two from: butan-1-ol, butan-2-ol, (2)-methylpropan-1-ol **(1)** **Y** is an aldehyde **or** a ketone *ALLOW* " **Y** is a carbonyl" **(1)** *NOTE RE THIRD/FOURTH SCORING POINTS:* If just state that **X** is butan-1-ol with no justification **(0)** but then go on to state **Y** is butanal, give **(1)** CQ mark OR If just state that **X** is butan-2-ol with no justification **(0)** but then go on to state **Y** is butanone, give **(1)** CQ mark OR If just state that **X** is (2)-methylpropan-1-ol with no justification **(0)** but then go on to state **Y** is (2)-methylpropanal, give CQ mark **(1)** *NOTE:* **These Part (a) marks may be awarded from answers to either Part (a) or Part (b)**	X is a phenol **(0)**	4

1 (b)   **First two marks:**
QWC   **X** is $CH_3CH(OH)CH_2CH_3$ **(1)**

        Y is $CH_3COCH_2CH_3$ **(1)**

        These marks are stand alone

        NOTE: Two correct names, but no structural formulae for both scores **(1)** out of **(2)**

        If **X** identified as $CH_3CH_2CH_2CH_2OH$
        and
        and **Y** identified as $CH_3CH_2CH_2CHO$

        award (1) unless previously credited in (a)

        (NMR spectrum of X)

        Third mark:-
        hydrogen OR **H** in **five** (different) environments

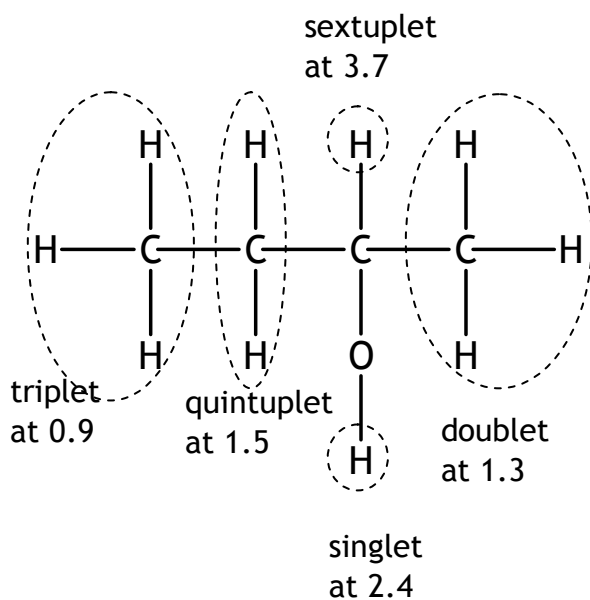   *(IGNORE* reference to butan-1-ol here)

        OR

        (so must be butan-1-ol or butan-2-ol and) **not**
        2-methylpropan-1-ol which has four
        peaks/hydrogen environments
                                    (1)
        NOTE: Candidates may annotate a structural or displayed formula to show that there are five environments. (For this mark, no details of splitting or chemical shifts are needed.)

sextuplet
at 3.7

triplet
at 0.9   quintuplet
at 1.5   doublet
at 1.3

singlet
at 2.4

        splitting pattern (2,6,1,5,3) consistent with
        butan-2-ol
        OR
        splitting pattern inconsistent with butan-1-ol
        (which is 3,6,5,3,1)   **(1)**

Fourth mark:-
splitting pattern (2,6,1,5,3) consistent with
butan-2-ol
OR
splitting pattern inconsistent with butan-1-ol
(which is 3,6,5,3,1)
OR
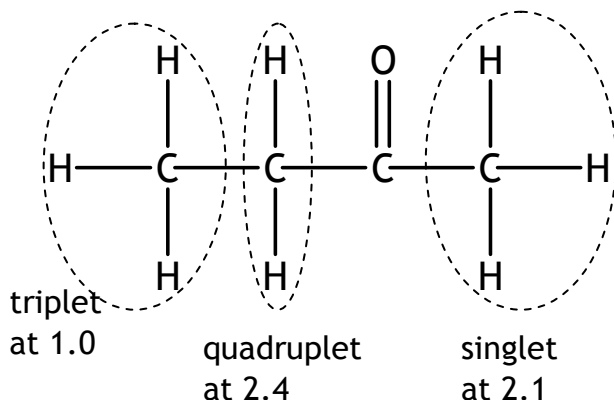assign peaks correctly quoting chemical shifts
from the spectrum

(1)

(NMR spectrum of Y)

Fifth mark:-
hydrogen OR **H** in **three** (different)
environments

(1)

NOTE: Candidates may annotate a structural or
displayed formula to show that there are three
environments. (For this mark, no details of
splitting or chemical shifts are needed.)

$$
\begin{array}{ccccccc}
 & H & & H & & O & & H \\
 & | & & | & & \parallel & & | \\
H & - C & - & C & - & C & - & C & - H \\
 & | & & | & & & & | \\
 & H & & H & & & & H
\end{array}
$$

triplet at 1.0   quadruplet at 2.4   singlet at 2.1

Sixth mark:-
splitting pattern (1,4,3) is consistent with
butanone
OR
splitting pattern is inconsistent with butanal
(which is 3,6,4,3)
OR
splitting pattern inconsistent with
2-methylpropanal (which is 2,8,2)
OR
assign peaks correctly quoting chemical shifts
from the spectrum

(1)