<table>
<tr><td>7.1</td><td colspan="3">This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.</td></tr>
<tr><td></td><td colspan="2">How to choose the level</td><td>Requirements for communication for higher mark</td><td>Stages</td></tr>
<tr><td>Level 3
5-6 marks</td><td>All three stages are covered and explanation of each stage is generally correct and virtually complete – leads to all four compounds being distinguished</td><td></td><td>• Answer communicates whole process coherently with logical progression
• Chemical tests (appear to) start with all compounds rather than selected compounds
• Chemical tests reagents and observations are complete and correct
• Chemical tests leave two compounds to be distinguished by spectroscopy
• Enough detail is given about the spectroscopy to distinguish these two compounds</td><td rowspan="4">Stage 1
Carries out a test-tube reaction to identify a compound (or to split the compounds into two groups).
1a reagent
1b observation with correct deduction

Stage 2
Carries out a second test-tube reaction to identify a second compound.
2a reagent
2b observation with correct deduction

Stage 3
Uses spectroscopy to distinguish two compounds.
3a suitable technique
3b data that will distinguish compounds

See next page for indicative content</td></tr>
<tr><td>Level 2
3-4 marks</td><td>All three stages are covered but the explanations of each stage may be incomplete or may contain inaccuracies</td><td>Two stages covered and explanations are generally correct and virtually complete</td><td>• Answer is mainly coherent
• Chemical tests reagents and observations are complete and correct
• Enough detail is given about the spectroscopy to distinguish these two compounds (if spectroscopy included)</td></tr>
<tr><td>Level 1
1-2 marks</td><td>Two stages covered but the explanations of each stage may be incomplete or may contain inaccuracies</td><td>One stage covered and explanation is generally correct and virtually complete</td><td>• Chemical tests reagents and observations are complete and correct (if awarded level 1 for one chemical test stage)
• Enough detail is given about the spectroscopy to distinguish these two compounds (if spectroscopy included)</td></tr>
<tr><td>0 marks</td><td colspan="2">Nothing valid to warrant a mark</td><td></td></tr>
</table>

Possible test tube reactions

Tollens' reagent [or Fehling's / Benedict's]

Identifies butanal – silver mirror (or black ppt) [or orange/brick/red ppt with Fehling's]

(No reaction with other compounds)

Acidified potassium dichromate

Reacts with butanal and butan-2-ol – goes green

(No reaction with other compounds)

Sodium *(not on specification but may be mentioned)*

Reacts with butan-2-ol and 2-methylpropan-2-ol – fizzes

(No reaction with other compounds)

Examples of incomplete/incorrect reagents include "Tolling's solution", no acid with potassium dichromate, wrong oxidation state for Cr in potassium dichromate if stated.

Examples of incomplete/incorrect observations include silver precipitate with Tollens', green ppt with acidified potassium dichromate

Possible spectroscopic methods for a pair

IR (infra-red) spectroscopy

If different functional groups: need to identify wavenumber and bond of key functional group signal (e.g. (alcohol) O-H 3230-3550 or C=O 1680-1750 (cm^{-1})).

If same functional group, need idea of using fingerprint region to look for match to known compounds / comparing region to samples in a database

Mass spectrometry

If different, can use different M_r values with values of M_r given

butanone 72(.0), 2-methylpropan-2-ol = 74(.0), butan-2-ol = 74(.0), butanal = 72(.0)

If compounds have same M_r, then would have to use idea that fragmentation patterns would be different *(not on specification but may be mentioned)*