IOG : Topic 21 Paper 2 practice

Option A — Modern analytical chemistry

A1. (a) identification/detection/concentrations of metal/metal ions; ***[1]***

(b) ***X*** *– Name:*
monochromatic light source;
X *– Function:*
produces radiation/light of the same frequency/wavelength as is absorbed by the species (being detected);

Y *– Name:*
atomizer;
Y *– Function:*
converts liquid sample into small droplets / converts metal ions into atoms;

Z *– Name:*
monochromatic detector;
Z *– Function:*
detects radiation/light of the same frequency/wavelength absorbed / converts photons into electric current/signal; ***[6]***

*If **X** and **Z** correct except that "monochromatic" missed both times, penalize once only.*

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A2. (a) *Compound:*
$CH_3–CH_2–CHO$;

Explanation: ***[1 max]***
only this compound would give 3 peaks / *OWTTE*;
only this compound has H–atoms in 3 different chemical environments / *OWTTE*;
only this compound has protons in ratio 3:2:1 in each environment / *OWTTE*
only this compound would give a peak in the 9.4–10 ppm region / *OWTTE*; ***[2]***

(b) triplet;
next to a carbon atom that is attached to two hydrogen atoms; ***[2]***
Apply ECF.
CH_3COCH_3: singlet; no neighbouring H–atoms
CH_2=CH–CH_2OH: correct multiplicity and explanation for any peak.

(c) (i) 1700–1750 cm^{-1} (>C=O); ***[1]***

(ii) 1610–1680 cm^{-1} (>C=C<) / 3200–3600 cm^{-1} (–O–H); ***[1]***

(d) $C_3H_6O^+$ **and** m/z = 58;
$C_2H_5^+$ **and** m/z = 29;
CHO^+ **and** m/z = 29;
CH_3^+ **and** m/z = 15; ***[2 max]***
Penalize missing + sign once only.

Option A — Modern analytical chemistry

A1. (a) (i) (2-)methylpropan-2-ol;
the (H atoms in the three) $-CH_3$ groups are responsible for the peak at 1.3 ppm;
the –**OH** hydrogen atom is responsible for the peak at 2.0 ppm; ***[3]***
Accept explanation with suitable diagram.

(ii) (2-)methylpropan-1-ol;
the first peak (at 0.9 ppm) is due to the (H atoms in the) two $-CH_3$ groups (bonded to the second carbon atom) / $(C\mathbf{H_3})_2CHCH_2OH$;
the peak at 3.4 ppm is due to the (H atoms in the) $-CH_2-$ group / $(CH_3)_2CHC\mathbf{H_2}OH$;
both of the peaks are split into a doublet as there is one H atom bonded on the adjacent carbon atom / *OWTTE*; ***[4]***
Accept explanations with suitable diagram.

(b) (i) butan-1-ol and butan-2-ol;

74: M^+ / $C_4H_{10}O^+$ / $CH_3CH_2CH_2CH_2OH^+$ **and** $CH_3CH_2CH(OH)CH_3^+$;

59: $C_3H_7O^+$ / $(M - CH_3)^+$ / $CH_2CH_2CH_2OH^+$ **and** $CH_2CH(OH)CH_3^+$/$CH_3CH_2CH(OH)^+$;

45: $C_2H_5O^+$ / $(M - C_2H_5)^+$ / $CH_2CH_2OH^+$ **and** $CH(OH)CH_3^+$; ***[4]***
Accept explained answers instead of formula

(ii) butan-1-ol;
CH_2OH^+ / $(M - C_3H_7)^+$; ***[2]***
Penalize missing + signs once only in parts (b) (i) and (ii).

(c) they all contain O–H;
they all contain C–H;
they all contain C–O; ***[2 max]***
*Award **[1max]** for the same functional groups/bonds.*