22. Analytical techniques

22.1 Infrared spectroscopy

Paper 2

Marking Scheme

Q1.

(c)(i)	**M1** deduce n = 12 (from **Y** – 1C (in methanol)) **M2** (100 × x) ÷ (1.1 × 100) = 12 (so) x = 13.2	**2**

(c)(ii)	<table><tr><th></th><th>observation on addition of 2,4–DNPH</th></tr><tr><td>**Y**</td><td>orange precipitate</td></tr><tr><td>**Q**</td><td>no precipitate</td></tr></table> Both correct for one mark	**1**
(c)(iii)	ROH + Na → RONa + 1 / 2H_2 (0.002 mol **Q** produced 0.002 mol H_2 gas so) 2 OH groups **M1** *answer indicates that OH group(s) in* ***Q*** *react with Na to produce the* H_2 *in the ratio 1 mol OH : ½ mol* H_2 **M2** *uses data to show 2OH groups*	**2**
(c)(iv)	**M1** **Y** will have absorption / peak / trough between 1670–1740 due to C=O (**Q** will not) **M2** **Q** will have absorption / peak / trough between 3200–3600 due to O-H (**Y** will not)	**2**

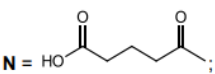
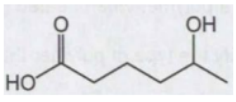
Q2.

(b)(i)	<table><tr><th>absorption</th><th>bond</th><th>functional group containing the bond</th></tr><tr><td>**A**</td><td>O–H</td><td>hydroxy(l) / alcohol</td></tr><tr><td>**B**</td><td>C=O</td><td>carbonyl</td></tr></table>	**1**

Q3.

(f)(i)	All three have a C—H **OR** CH **bond**	**1**
(f)(ii)	compound **A** **AND** absorption at 2200–2250 cm^{-1} indicates C≡N	**1**

Q4.

(b)	**N** =  ; **5-hh**  --- **M1** absorptions will overlap / be similar / the same / indistinguishable	**1**
	M2 both have some bonds in similar environments owtte	**1**

Q5.

(c)(i)	C=C (bond) / alkene **AND** (absorption within) 1500–1680 cm^{-1} (present in **E**'s IR spectrum only)	**1**
(c)(ii)	hydroxyl / alcohol **AND** (broad absorption within) 3200–3650 cm^{-1} (present in **F**'s IR spectrum only)	**1**
(c)(iii)	120.9 / 121	**1**

Q6.

(b)(v)	2200–2250 (cm^{-1} due to) C≡N / triple bond between C and N.	**1**

Q7.

(a)(i)	potassium/sodium dichromate [(VI)] / $K_2Cr_2O_7$ / $Na_2Cr_2O_7$ acidified **AND** (heat) under reflux	**2**
(a)(ii)	$C_2H_5OH + 2[O] \rightarrow CH_3CO_2H + H_2O$	**1**

Q8.

(e)	*Predict **two** differences, with reasons, between spectra of **Y**, $CH_3CH_2COCH_3$ and 2-methylbut-1-ene (shown)* *first difference* **M1** absence of peak/ absorption at 3100 (cm^{-1}) as no longer any =C–H present (in **Y**) *second difference* **M2** peak at 1650 (cm^{-1}) moves to the left to any value / range of values between 1670 and 1740) due to disappearance of C=C (in **Y**) and appearance of C=O (in **Y**) OR absence of peak at 1650 (cm^{-1}) as no longer any C=C present (in **Y**) AND appearance of peak (in **Y**) at (any value / range of values) between 1670-1740(cm^{-1}) due to C=O	**2**

Q9.

(d)(i)	X is C=O **AND** Z is C—O	**1**