Question	Answer	Marks
3(a)(i)	**M1** acidified / H^+ $Cr_2O_7^{2-}$ / (potassium / sodium) dichromate OR manganate(VII) / MnO_4^- / $KMnO_4$ **M2** (heat under) reflux	**2**
3(a)(ii)	nucleophilic addition	**1**
3(a)(iii)	yellow / orange / red ppt / solid	**1**
3(a)(iv)	it does not have four different (groups of) atoms attached to (central) carbon OR it does not have a chiral carbon / centre OR it has two identical / COOH groups attached to (central) carbon OR mirror image is super(im)posable	**1**
3(a)(v)	**M1** hydrolysis **M2** esterification / condensation	**2**
3(b)(i)	**M1** no. of mol $O_2 = \frac{1.00\times10^5\times1.06\times10^{-3}}{(8.31\times850)}$ **M2** no. of mol of nitroglycerine = $4\times0.0150 = 0.0600$ (mol) **M3** mass of nitroglycerine = $0.0600\times227 = 13.6(2)$ (g)	**3**
3(b)(ii)	$1.06\times29 = 30.7(4)$ dm^3	**1**
3(c)(i)	$C_5H_8O_2$	**1**

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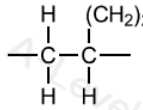
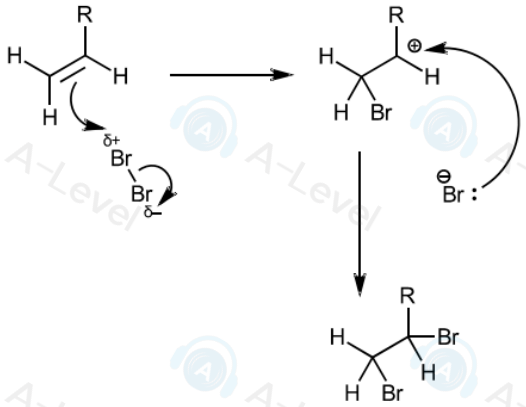
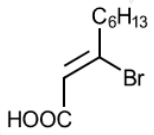
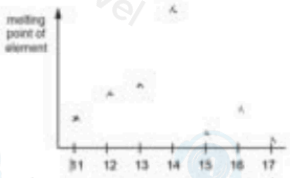
Question	Answer	Marks
3(c)(ii)		**1**
3(c)(iii)	 **M1** curly arrow from C=C double bond to Br **M2** correct dipole in Br_2 **AND** curly arrow from Br—Br to $Br^{\delta-}$ **M3** correct intermediate **AND** curly arrow from lone pair on Br^- to C^+ **M4** correct product	**4**

Question	Answer	Marks
3(d)(i)	**M1**  **M2** (two) different groups on each C atom in the C=C / end of the C=C double bond **M3** no / restricted rotation about C=C	**3**
3(d)(ii)	H_2 / hydrogen	**1**
3(d)(iii)	**M1 / M2** *absorptions seen in both spectra (any two):* (same) both show an absorption at 1680–1730 (cm^{-1}) because of C=O (same) both show an absorption at 1040–1300 (cm^{-1}) because of C–O (same) both show an absorption at 2500–3000 (cm^{-1}) because of RCO_2–H / O–H in RCO_2H / carboxyl(ic acid) **M3** *absorption only seen in spectrum of* **T***:* (different) **T** shows an absorption at 1500–1680 (cm^{-1}) because of C=C (different) **T** shows an absorption at 3000–3100 (cm^{-1}) because of (C=)C–H	**3**

Question	Answer	Marks
3(a)	**M1** rates of forward and reverse / backward reactions are equal **M2** no change in measurable properties **OR** concentration of reactants **AND** products remain constant	**2**
3(b)(i)	**M1** change to appearance of the mixture: (goes) darker red / more red **M2** change to relative concentration of $Fe^{3+}(aq)$: decreases **M3** change to the value of equilibrium constant, K_c: constant / none	**3**

Question	Answer	Marks
3(b)(ii)	Method 1 **M1** conc of initial conc of Fe^{3+} and SCN^- = 0.0020 ($mol\ dm^{-3}$) **M2** at equilibrium the conc of Fe^{3+} and SCN^- are (M1 – 0.000423) **M3** use 0.000423 ÷ (**M1** – 0.000423)^2 to calculate K_c = 170(.089) **M4** units = $mol^{-1}\ dm^3$ **OR** $dm^3\ mol^{-1}$ Method 2 **M1** no mol $FeSCN^{2+}$ = $4.23 \times 10^{-4} \times 25 / 1000 = 1.0575 \times 10^{-5}$ **M2** no mol Fe^{3+} and SCN^- are (5×10^{-5} – **M1**) = 3.9425×10^{-5} **M3** 0.000423 ÷ (**M2** × 1000 / 25)^2 = 170(.089) **M4** units = $mol^{-1}\ dm^3$ **OR** $dm^3\ mol^{-1}$	**4**

Question	Answer	Marks
2(a)(i)	M M M C C C C	1
2(a)(ii)	All 3 points correct scores two marks Any 2 points scores one mark • *nuclear charge increases OR increasing proton number* e.g. 17 / C*l* has a greater nuclear charge • *describe the similarity in shielding between the two elements* e.g. they have almost the same shielding • *describe the overall effect in terms of greater nuclear attraction for (outer) electrons* e.g. (outer) electrons are attracted more (strongly) to the nucleus	2
2(a)(iii)	**M1** describes the difference between 1st IE of elements 15 and 16 (P and S) in terms of either: spin-pair repulsion (in element 16 / S) **OR** electron pair repulsion (in element 16 / S) **M2** describes the location of the electron pair in the (3)p orbital which repel each other	2
2(a)(iv)	(+)1 (+)2 (+)3 (+)4 (+)5 (+)6	1
2(a)(v)	**M1** (anions have) same number of electrons (but increasing proton number) **M2** increasing proton number / nuclear charge AND increasing attraction of nucleus for (outer) electrons **OR** (outer) electrons attracted more (strongly) to the nucleus AND because of increasing proton number / nuclear charge	2
2(b)		2