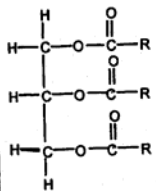
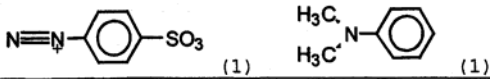
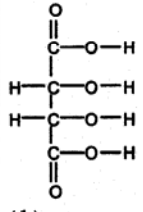
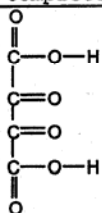


2 a i	(secondary) amine, alkene, ketone/carbonyl	3
2 a ii	16	1
2 a iii	Idea of groups across double bond (1);	1
2 a iv	lack of free rotation at double bond (1)	1
2 b i	d block/transition metal	1
2 b ii	$\text{Co}^{2+} + 2\text{OH}^- \rightarrow \text{Co}(\text{OH})_2$ 2+ on Co (1) rest correct (1) $2\text{Al}(\text{OH})_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2\text{O}$ Al_2O_3 (1); Rest correct (1)	4
2 c i	Idea of quantity being made and then process started again (1);	1
2 c ii	Small amounts needed/ difficulties of getting precise quantities (1)	1
2 c iii	Release of HCl (1); Acidic gas/ Irritant (1)	2
2 d i	SiCl_4 , PCl_3 , PCl_5 , S_2Cl_2 , SCl_2 element (1); formula (1)	2
2 d ii	$M_r \text{AlCl}_3 = 133.5$ (1); Amount of $\text{AlCl}_3 = (4.5 / 133.5 \text{ (ecf)}) (= 0.0337 \text{ mol})$ (1); $M_r \text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 238$ (1); Mass of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 0.0337 \times 238 \text{ (ecf)} = 8.0 \text{ g}$ (1); 2 sig figs (mark separately) (1)	5
2 e i	indigo is more purple/yellow/green / indigo is lighter (1); it reflects more red/other frequencies ora / more components of white light reflected (1);	2
2 e ii	two energy levels (1); electrons excited / absorb energy to be promoted to higher energy level (not awarded if "drop back" included in the answer) (1); plus 2 from: difference corresponds to red/non-blue colours; being absorbed from visible light; blue light reflected (not emitted); or one from: band absorption in compound (1); caused by vibrations in each level (1); blue light higher energy than red (1); energy levels close because of complex structure of molecule (1) $E = hv$ (1) Any of these shown on a diagram should score	4
2 f i	 <p style="text-align: center;">not necessarily full structural glycerol stem correct (1); completely correct</p>	2
2 f ii	They have (carbon-carbon) double bonds	1
2 f iii	bromine water/solution/aqueous (1) decolorised (1)	2

3 a i	Red (1); Acid contains H^+ /fully ionised(1); pushes equilibrium to left (1)	3
3 a ii	SO_3^- /sulphonate	1
3 b i	incomplete reaction/ionisation /equilibrium (with water) (1);	1
3 b ii	$pK_a = -\log K_a$	1
3 b iii	$K_a = \frac{[H^+]}{[red form]}$ [yellow form] 2 marks if correct. one if wrong way up	2
3 b iv	If [yellow] = [red], $K_a = [H^+]$ (1); ($pK_a = pH$) $pH = 3.7$ (1)	2
3 c i		2
3 c ii	sodium hydroxide allow NaOH / below 5°C (1)	1
3 d i	benzenesulphonic acid (1);	1
3 d ii	concentrated (1) sulphuric acid (1); (heat under) reflux (1)	3
3 d iii	electrophilic (1); substitution (1)	2

4 a i	$C_2H_3O_3$ (2) Molecular formula $C_4 H_6 O_6$ scores (1)	2
4 a ii	 <p>carboxylic acid groups correct (1); fully correct (1)</p>	2
4 a iii	(1) for each central carbon atom ringed	2
4 a iv	$C_4H_6O_6 + 2NaOH \rightarrow C_4H_4O_6Na_2 + 2H_2O$ or with structural formula ionic representations of salt. Left-hand side correct (1); Idea of a salt formed (1); Completely correct (1)	3
4 a v	 <p>not necessarily full structural Reaction at central -OH groups (1); completely correct (1)</p>	2
4 b i	Amount = $12.0 \times 0.100/1000$ (1) = 1.20×10^{-3} mol (1)	2
4 b ii	Amount of H^+ in 100 cm^3 wine = 4.80×10^{-3} mol i.e. factor of four (1) Amount of tartaric acid = 2.4×10^{-3} mol i.e. divide by two (1) Mass of tartaric acid = $2.4 \times 10^{-3} \times 150 = 0.36\text{g}$ multiply by 150 (1)	3
4 c i	aldehyde	1
4 c ii	HCN	1
4 c iii	nucleophilic (1); addition (1)	2
4 c iv	$H^+(aq)/H_2O$ Reflux	1
4 d	Identified as ethanoic acid (name or structural formula) (1) Plus six marks from the following, TWO from each spectrum Mass spectrum M_r /relative molecular mass = 60; Fragment identified (eg loss of CH_3 at 45, loss of OH at 43); i.r. two from O-H; C=O; C-O n.m.r two from: two H environments ; ratio 3:1; Identify 2.0 peak as CH_3CO .	7

