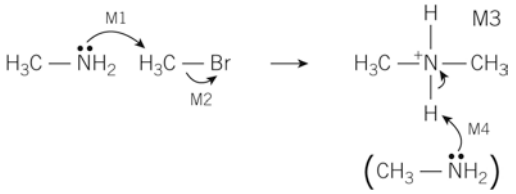
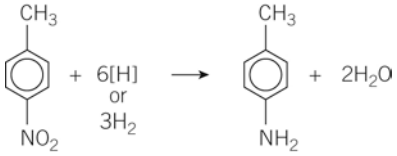
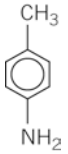
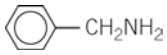
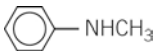
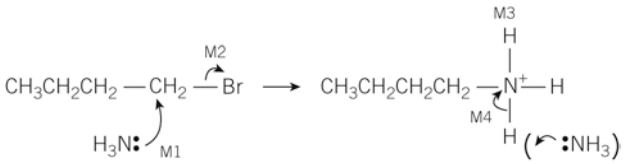
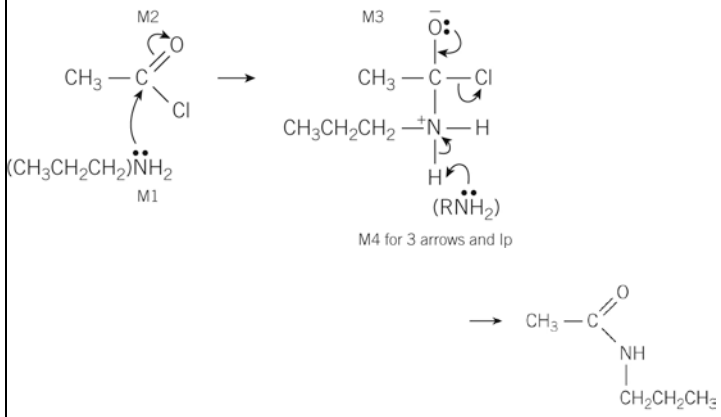
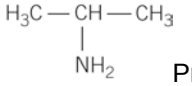
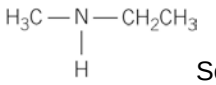
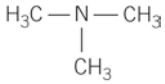
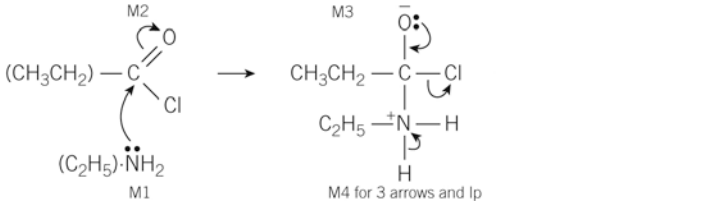
Question number	Answer	Marks	Guidance
1 (a)	Dimethylamine	1	
1 (b)	nucleophilic substitution 	5	The curly arrow must be from the lone pair. Marks 1 and 2 are for the curly arrows if shown (M1 and M2). Mark 3 is for the structure of the intermediate. Mark 4 is to show the removal of the H^+. You do not need to show the reagent here. Final mark is for the name of the mechanism.
1 (c)	quaternary ammonium salt surfactant / detergent / fabric softener or conditioner/ hair conditioner	1 1	
2 (a)	Sn or Fe/HCl Sn or Fe/H_2SO_4 **OR** H_2/Ni can be used as the reducing agent. 	2	Do not accept dilute or conc. for these 2 acids or you cannot have HNO_3 at all. Do not accept $NaBH_4$/ $LiAlH_4$ or Na/C_2H_5OH.
2 (b)		1	NH_3^+ is also acceptable.
2 (c)	G:  H: 	2	Do not accept the correct answers incorrectly labelled.
3 (a)	Nucleophilic substitution 	5	Mark 1, Mark 2 and Mark 4 are for the curly arrows (M1, M2 and M4). Mark 3 is for the structure of cation. Final mark is for the name of the mechanism.

3 (b)	**Step 1**: $CH_3CH_2CH_2Br + KCN \rightarrow CH_3CH_2CH_2CN + KBr$ (or CN^-) (or Br^-) **Step 2** $CH_3CH_2CH_2CN + 2H_2 \rightarrow CH_3CH_2CH_2CH_2NH_2$	3	Do not accept HCN here. Accept 4[H] instead of $2H_2$.
3 (c)	There is a lone pair (on N); R group increases electron density on N / has positive inductive effect	1 1	
3 (d)	$CH_3CH_2N(CH_3)_2$	1	
4 (a)	$CH_3CH_2CH_2Br$	1	Allow Cl instead of Br.
4 (b)	CH_3CH_2CN	1	
4 (c)	nucleophilic substitution or from $CH_3CH_2CH_2Br$ gives less pure produce because further substitution occurs The impurity can be any one of $(CH_3CH_2CH_2)_2NH$ $(CH_3CH_2CH_2)_3N$ $(CH_3CH_2CH_2)_4N^+Br^-$	3	Also accept 'have salts including NH_4Br as impurities'.
5 (a)	(nucleophilic) addition-elimination  Allow wrong amine in M1 but penalise in M3 Allow C_3H_7 in M3 Minus sign on NH3 loses M1 (but not M4 if NH3 also shown here)	1 4	• Allow attack by $:NH_2CH_2CH_2CH_3$ • M2 not allowed independent of M1, but allow M1 for correct attack on C+ • + rather than δ+ on C=O loses M2 • If Cl lost with C=O breaking, max 1 for M1 • M3 for correct structure with charges but lone pair on O is part of M4 • 3 arrows in M4 can be shown in two separate steps. • If M3 drawn twice, mark first answer eg ignore missing + if missed off second structure • Only allow M4 after correct / very close M3 • For M4, ignore RNH_2 removing H^+ but lose M4 for Cl^- removing H^+ in mechanism, • but ignore HCl shown as a product.

	N-propylethanamide must be this name even if wrong amine used	1	NOT N-propylethaneamide
5 (b)	 Primary  Secondary  Tertiary	1 1 1	Label and structure must both be correct for each type to score the mark. Penalize wrong number of carbons but otherwise correct, first time only Not allow ambiguous $C_3H_7NH_2$ BEWARE No mark for the original amine $CH_3CH_2CH_2NH_2$ Allow C_2H_5
6 (a)	(nucleophilic) addition-elimination  N-ethylpropanamide	1 4 1	minus on NH2 loses M1 M2 not allowed independent of M1, but allow M1 for correct attack on C+ +C=O loses M2 only allow M4 after correct or very close M3 lose M4 for Cl^- removing H^+ in mechanism, but ignore HCl as a product Not N-ethylpropaneamide
6 (b)	CH_3CN or ethan(e)nitrile or ethanonitrile for each step wrong or no reagent loses condition mark Step 1 Cl_2 uv or above 300 °C Step 2 KCN aq and alcoholic (both needed) Step 3 H_2/Ni or $LiAlH_4$ or Na/C_2H_5OH	1 1 1 1 1 1	not ethanitrile but allow correct formula with ethanitrile contradiction loses mark wrong or no reagent loses condition mark allow uv light / (sun)light / uv radiation not CN^- but mark on NOT HCN or KCN + acid, and this loses condition mark NOT $NaBH_4$ Sn/HCl (forms aldehyde!) ignore conditions

7 (a)	Phenylamine accepts a proton/H^+	1	
7 (b)	It is an ionic salt so it dissolves in a polar solvent like water.	1	