M1. (a) Cyclohexane evolves 120 kJ mol^{-1}

$\therefore$ (expect triene to evole) 360 kJ mol^{-1} **(1)** or 3 × 120

360 – 208 = 152 kJ **(1)** NOT 150

152 can score first 2

*QofL: benzene lower in energy / <u>more</u> (stated) stable **(1)***
Not award if mentions energy required for bond breaking

*due to <u>delocalisation</u> **(1)** or explained*

4

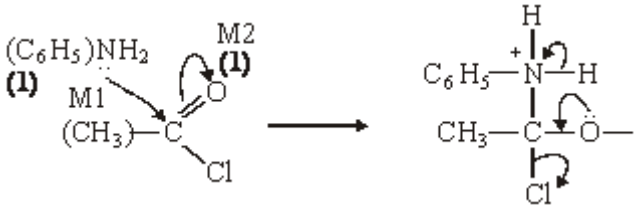
(b) (i) phenylamine weaker **(1)**

if wrong no marks

lone pair on N (less available) **(1)**
delocalised into ring **(1)** or "explained"

3

(ii) addition – elimination **(1)**



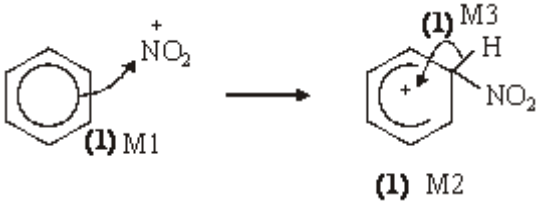
*structure **(1)** M3*
*3 arrows **(1)** M4*

N-phenyl ethanamide **(1)**

6

(iii) conc HNO_3 **(1)**
conc H_2SO_4 **(1)**

$HNO_3 + 2H_2SO_4 \rightarrow {}^{+}NO_2 + H_3O^{+} + 2HSO_4^{-}$ **(1)**



6

(iv) peptide / amide **(1)**

NaOH (aq) **(1)**

HCl conc or dil or neither

H_2SO_4 dil NOT conc

NOT just H_2O

2

Notes

(a)
- 360 or 3 × 120 or in words **(1)**;
- 152 NOT 150 **(1)**; (152 can get first two marks)
- **Q of L** benzene more stable but not award if ΔH values used to say that more energy is required by benzene for hydrogenation compared with the triene or if benzene is only compared with cyclohexene **(1)**;
- delocalisation or explained **(1)**

(b) (ii) or N-phenylacetamide or acetanilide

mechanism: if shown as substitution can only gain M1

if CH_3CO+ formed can only gain M1

lose M4 if Cl^- removes H^+

be lenient with structures for M1 and M2 but must be correct for M3

 alone loses M2

(iii) **No marks for name of mechanism in this part**

if conc missing can score one for both acids (or in equation)

allow two equations

allow $HNO_3 + H_2SO_4 \rightarrow NO^{2+} + HSO_4^- + H_2O$

ignore side chain in mechanism even if wrong

arrow for M1 must come from niside hexagon

arrow to NO_2^+ must go to N but be lenient over position of +

+ must not be too near “tetrahedral” Carbon

horseshoe from carbons 2-6 but don’t be too harsh

(iv) reagent allow NaOH

HCl conc or dil or neither
H_2SO_4 dil or neither but not conc
not just H_2O

[21]

M2.A

[1]