

**M1.** X is CH<sub>3</sub>CN or ethanenitrile or ethanonitrile or methyl cyanide or cyanomethane or ethyl nitrile or methanecarbonitrile

**Not ethanitrile**

*but contradicton of name and structure lose marks*

1

Y is CH<sub>3</sub>CH<sub>2</sub>NH<sub>2</sub> or ethylamine or aminoethane or ethanamine

1

Step 1: reagent KCN not HCN/HCl  
condition (aq)/alcohol - only allow condition if reagent correct or incomplete

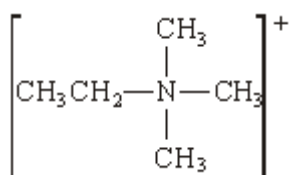
2

Step 2: reagent H<sub>2</sub> LiAlH<sub>4</sub> Na Zn/Fe/Sn Not NaBH<sub>4</sub>  
condition Ni/Pt/Pd ether ethanol HCl

2

Z is an amine or aminoalkane or named amine even if incorrect name for Z secondary (only award if amine correct)

1



(Br<sup>-</sup>) + can be on N or outside brackets as shown

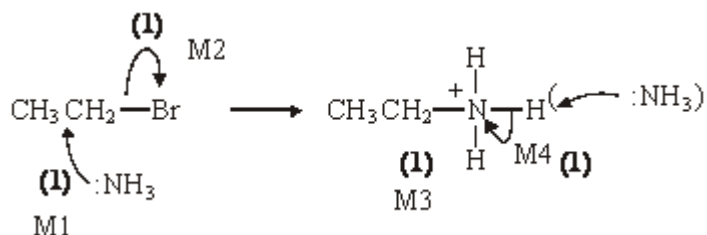
1

nucleophilic substitution

1


**M2.** (a)

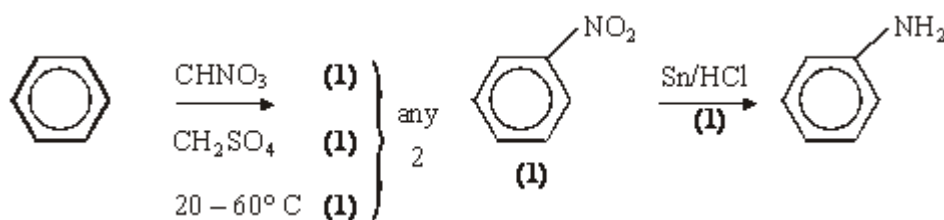
[9]



Further reaction / substitution / formation of 2° / 3° amines etc (1)  
use an excess of NH<sub>3</sub> (1)

6

(b)  repels nucleophiles (such as NH<sub>3</sub>) (1)



5

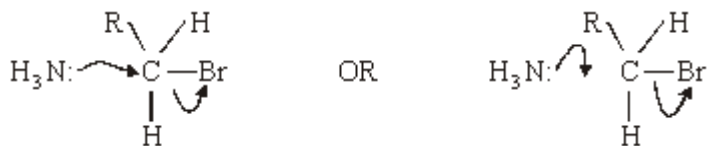
### Notes

- (a) allow S<sub>N</sub>1  
penalise: Br<sup>-</sup> instead of NH<sub>3</sub> removing H<sup>+</sup> for M4  
not contamination with *other amines* (this is in the question) not diamines
- (b) allow because NH<sub>3</sub> is a nucleophile or benzene is (only) attacked by electrophiles or C-Br bond (in bromobenzene) is stronger / less polar or Br lp delocalized
- HNO<sub>3</sub> / H<sub>2</sub>SO<sub>4</sub> without either conc scores (1) allow 20 – 60° for (1) (any 2 ex 3)
- allow name or structure of nitrobenzene
- other reducing agents: Fe or Sn with HCl (conc or dil or neither)  
not conc H<sub>2</sub>SO<sub>4</sub> or conc HNO<sub>3</sub>  
allow Ni/H<sub>2</sub>  
Not NaBH<sub>4</sub> or LiAlH<sub>4</sub>
- ignore wrong descriptions for reduction step e.g. hydrolysis or hydration

[11]

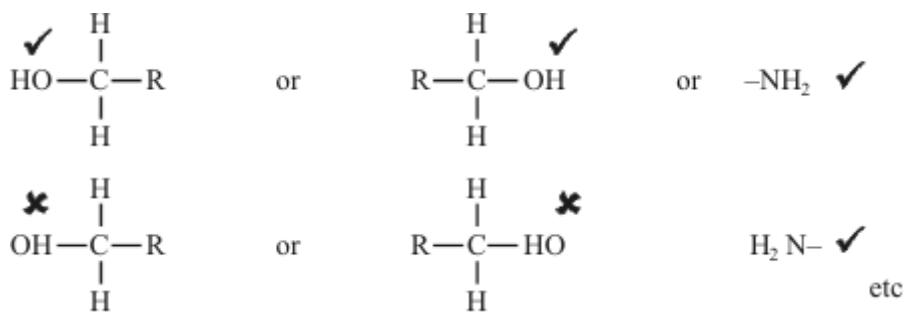
### Organic points

- (1) Curly arrows: must show movement of a pair of electrons,  
i.e. from bond to atom or from lp to atom / space  
e.g.



(2) Structures

penalise sticks (i.e.  $\begin{array}{c} | \\ -\text{C}- \\ | \end{array}$ ) once per paper



Penalise once per paper

allow  $\text{CH}_3-$  or  $-\text{CH}_3$  or  $\begin{array}{c} \text{CH}_3 \\ | \end{array}$  or  $\text{CH}_3$   
 or  $\text{H}_3\text{C}-$