Mark schemes

Q1.

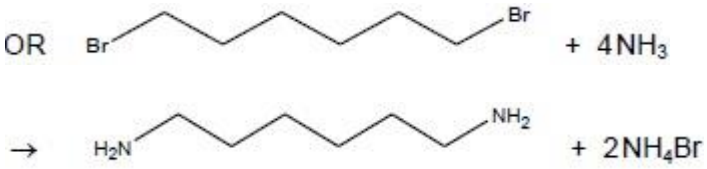
C

$[(C_2H_5)_2N(CH_3)_2]^+ Br^-$

[1]

Q2.

(a) $Br\text{-}(CH_2)_6\text{-}Br + 4\ NH_3 \rightarrow H_2N\text{-}(CH_2)_6\text{-}NH_2 + 2\ NH_4Br$

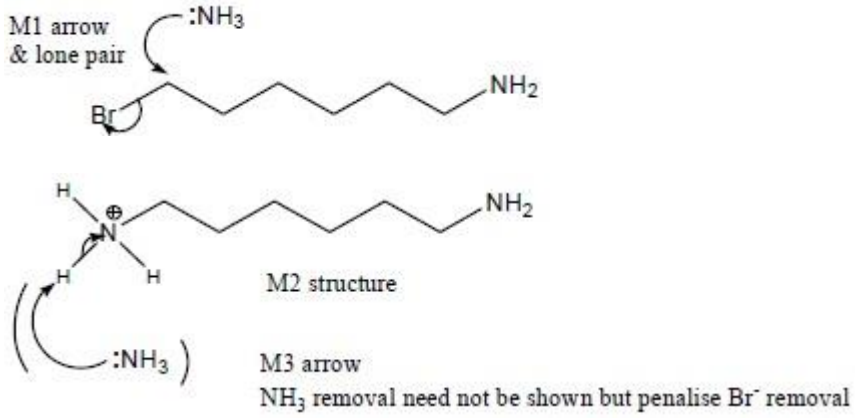
OR 

M1 *both organic compounds correct (not molecular formulae)*

Allow one correct structural formula and the other correct molecular formula of type $XC_6H_{12}X$

M2 *balanced*

2

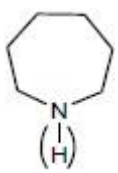
(b) 

Or with structural formulae, $Br(CH_2)_6NH_2$ *etc*
Allow S_N1

Penalise incorrect partial charges in ***M1***

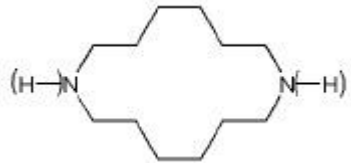
3

Impurity



(or as structural formula)

Allow



1

(c) **M1** Stage 1 reagent KCN or NaCN

*Not HCN this loses **M1** and **M2***

*Any mention of acid loses **M1** & **M2***

1

M2 Stage 1 condition aqueous alcohol

***M2** dependent on correct **M1** (allow condition if only CN^- ions)*

1

M3 Stage 2 reagent & condition H_2 and Ni or Pt or Pd

***M3** only accessible if a cyanide is used in stage 1*

1

Allow $LiAlH_4$ (in dry ether) – acidic/aqueous = CE, but allow followed by acid.

NOT $NaBH_4$ NOT Sn/HCl or Fe/HCl

Ignore heat and reflux and pressure

Apply list principle to incorrect reagents/conditions

(d) In 3-aminopentane

Allow converse for ammonia

Lone pair on N more available or Lone pair on N accepts H^+ better

Or greater stability of protonated N

1

because of alkyl electron pushing /inductive effect

Mark independently

1

(e) No carbon (atom is) attached to 4 different groups

Allow central carbon has two alkyl groups

Allow symmetrical molecule

1

[12]

Q3.

D

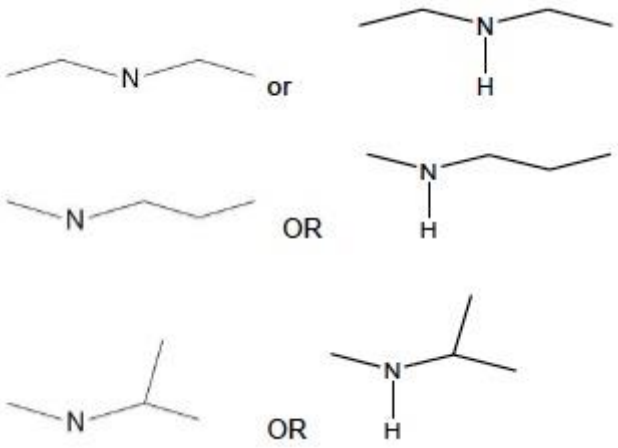
[1]

Q4.

(a) C B A this order only

1

(b) Any three from

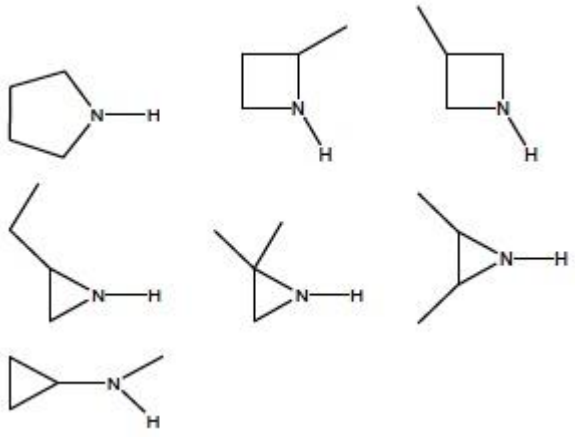


Must be skeletal *– allow with or without H on N*

All 3 correct score 2 (or one if not skeletal)

Any two correct score 1 (or zero if not skeletal)

Allow cyclic II° amines but NOT amines also containing other functional groups



2

(c) With halogenoalkane:

further reaction (of primary amines)

OR

Impure product/mixture of products/lower atom economy

Ignore bi-product / yield

1

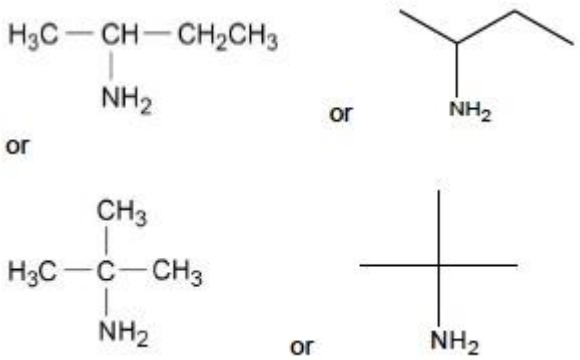
With nitriles

No further reaction

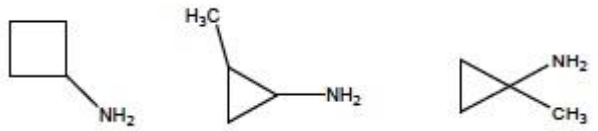
OR

Single product / higher atom economy

1

(d) 

Allow cyclic I° amines but NOT amines also containing other functional groups



1

(e) $CH_3CH_2CH_2NH_2 + H_2O \rightleftharpoons CH_3CH_2CH_2NH_3^+ + OH^-$

Allow simple arrow

Not C_3H_7

1

(green) turns blue

Allow blue-green, blue-purple

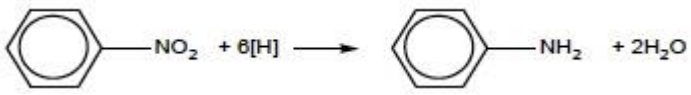
1

(f) $C_6H_5NO_2 + 6[H] \rightarrow C_6H_5NH_2 + 2H_2O$

Not H2

Not molecular formulae

OR



1

$C_6H_5NH_2$ present as ionic salt OR $C_6H_5NH_3^+$ (Cl^-) OR phenyl ammonium (chloride)

Allow present as an ion

But not phenylammonium hydroxide

1

[10]

Q5.

C

[1]

Q6.

(a) (Strength depends on availability of) lone pair on N (atom)

M1

E N (next to ring): (lp) delocalised into ring

M2

(lp) less available (to donate to or to accept a H^+)

M3

F or **G**: N (next to alkyl): (positive) inductive effect/electrons pushed to N

M4

(lp) more available (to donate to or to accept a H^+)

M5

order of increasing base strength **E**<**G**<**F**

*Or **F** is most basic **and E** is least basic*

M6

(b) Intermediate compounds

Product of step 1 $C_6H_5CH_1Cl$

Allow $C_6H_5CH_2Br$

Product of step 2 $C_6H_5CH_2CN$

In steps 2 and 3, only allow marks for reagents/conditions if intermediate compounds are correct or close.

Reagents/conditions

Step 1
Cl_2 & UV

Allow Br_2 & UV

Step 2
KCN alcoholic & aq (both reqd)

Ignore temperature

Step 3
H_2 / Ni or Pt or Pd

Allow $LiAlH_4$ in (dry) ether – (with acid CE, followed by acid allow)

Not $NaBH_4$ and not Sn/HCl or Fe/HCl

2

[11]

Q7.

C

[1]

Q8.

D

[1]