Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

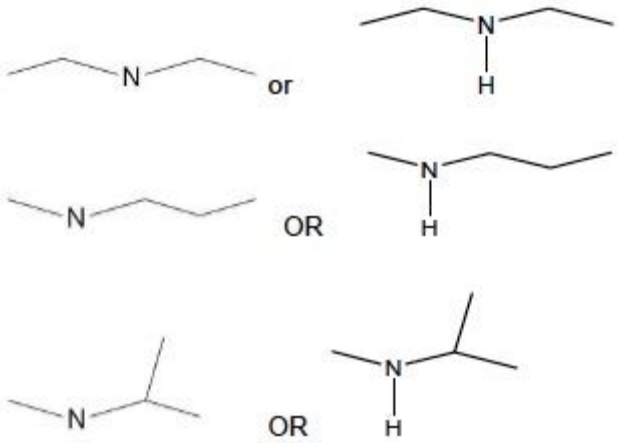
Mark Schemes

Q1.

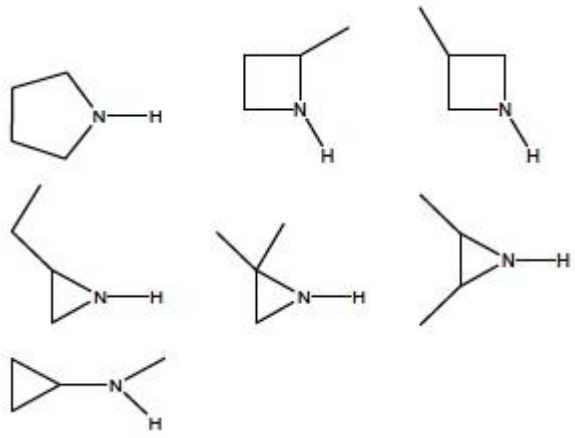
(a) C B A this order only

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

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Impure product/mixture of products/lower atom economy

Ignore bi-product / yield

1

With nitriles

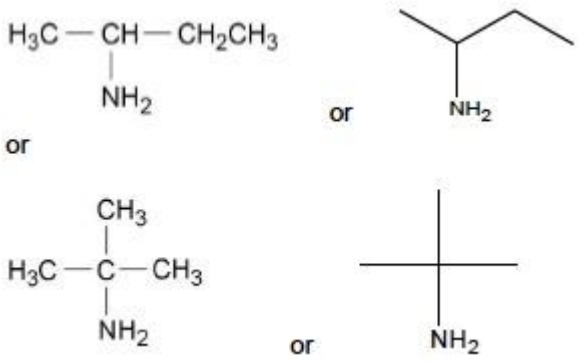
No further reaction

OR

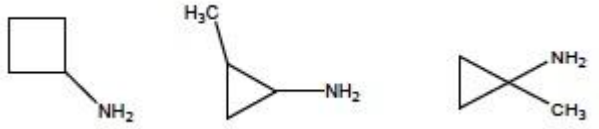
Single product / higher atom economy

1

(d)



Allow cyclic l^o 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

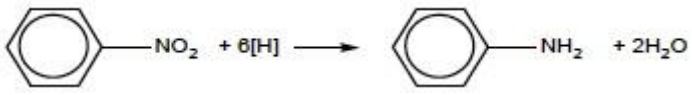
1

(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

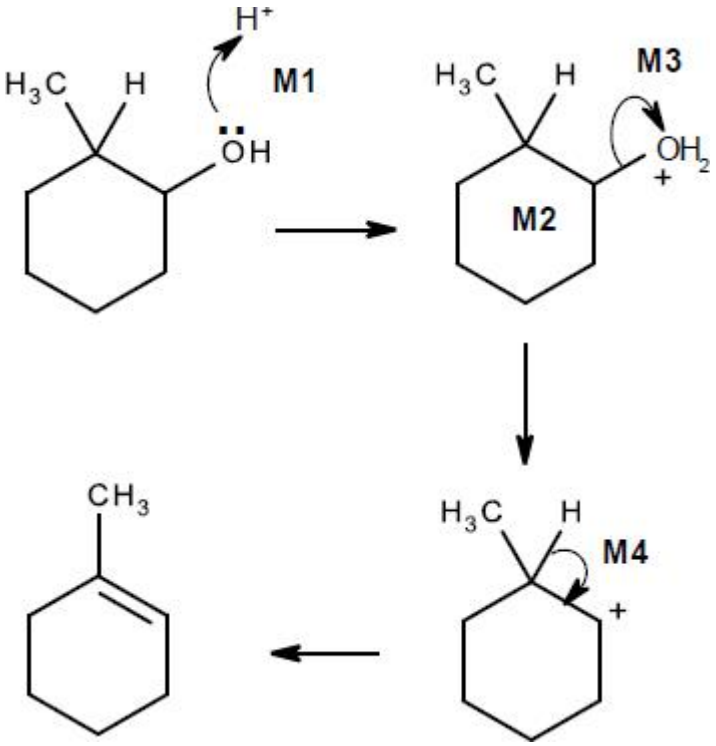
1

[10]

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Q2.

(a)



M1 curly arrow from lone pair on O to H^+

1

M2 correct structure of intermediate with + on O

1

M3 curly arrow from C-O bond to O

1

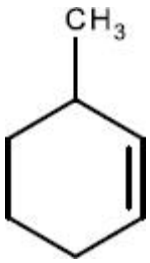
M4 curly arrow from correct C-H bond towards correct C-C bond

1

*Ignore other species that are drawn, but penalise any curly arrows to/from other species for **M1/3/4** as relevant (but allow attack by an anion of phosphoric acid on the H that is lost in **M4** in addition to the arrow specified)*

*for **M2**, the O of the $^+OH_2$ group must be bonded to the ring*

(b)



Any correct structural representation

1

(c) **M1** more stable (carbocation formed)

*For **M1** penalise more stable product*

1

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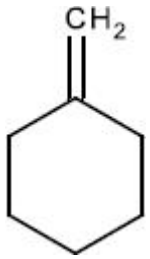
M2 changes from secondary to tertiary (carbocation)

*For **M2** allow explanation via inductive effect with more alkyl / C groups attached or inductive effect from methyl group as alternatives*

Allow 2^o or 2^y for secondary and 3^o or 3^y for tertiary

1

(d)



Any correct structural representation

1

(e) **M1** cyclohexene : van der Waals' <u>forces</u> (between molecules)

1

M2 cyclohexanol : hydrogen bonds (between molecules)

1

M3 phosphoric acid: hydrogen bonds (between molecules)

1

M4 idea that cyclohexene has weakest forces

1

M5 separated by (simple / fractional) <u>distillation</u>

1

M6 cyclohexene has lowest boiling point / boils off first

Extended response

Maximum of 5 marks for answers which do not refer to the van der Waals forces or hydrogen bonds being between molecules in some way

***M1** penalise reference to presence of other intermolecular forces*

***M1** allow vdW forces (on this occasion)*

***M1/2/3** penalise reference to breaking covalent bonds*

***M2 & M3** ignore reference to van der Waals and/or (permanent) dipole-dipole forces*

***M2** allow use of term H bonds (on this occasion)*

***M4** allow converse argument*

***M4 & M6** – allow correct comparison of cyclohexene forces and boiling point to one of the other two compounds if only one of cyclohexanol or phosphoric acid discussed*

[14]

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