Name ..... Class: .....

Start Time ..... End Time ..... Time Taken .....

Time allowed: 45 minutes

INSTRUCTIONS TO CANDIDATES

- This document is designed to be used as a practice test.
- Complete the test under exam conditions in one sitting.
- Optional: Before marking it, go through the paper with a set of notes and improve your answers.
- Mark the test using the mark scheme make corrections on the paper.
- Complete the table on the next page.
- Improve your notes so that they better reflect your weaknesses.
- Make a note of your strengths and weaknesses for future revision.

Success Criteria	Questions in Paper	Mark	Out of	%	Rank Order
Formation of hydroxynitrile – practicalities	1a		2		
Formation of hydroxynitrile – mechanism	1b, 2a		5		
Nucleophilic Substitution	3a		4		
Formation of hydroxynitrile - enantiomers	2b		5		
Polymerisation	2d, 3a, 3b, 3c		5		
Elimination	2c		2		
Total			23		

Q1.

(b) **M1** toxic / poisonous

allow *can produce toxic fumes/gas / corrosive*

1

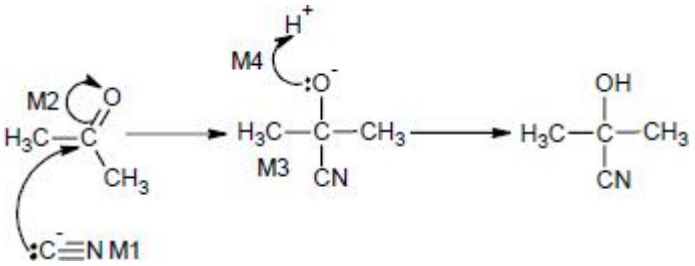
M2 HCN weak / [CN^-] too low **ORA**

allow *KCN dissociates to provide CN^-/nucleophile*

allow *KCN dissociates better/more than HCN*

1

(c)



M1 cyanide ion with lone pair on C and negative charge and curly arrow from lone pair to C of C=O

not *if K−CN bond shown breaking*

1

M2 Curly arrow from = to O

not *if dipole incorrect*

1

M3 intermediate anion

new bond must be to C of CN

1

M4 curly arrow from lone pair on O to H^+

allow *curly arrow to H of HCN*

1

[11]

Q2.

(a) nucleophilic addition

both words needed

NOT any additional names

1

(b) **M1** racemic (mixture) / racemate

1

M2 planar (around) carbonyl / C=O

M2 *NOT molecule is planar*

Allow flat for planar

1

M3 (equal chance of) attack from each side (by CN^-)

1

M4 a correct structure of 2-hydroxypropanenitrile

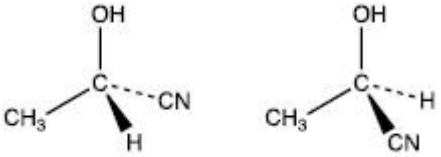
M4 *any correct 2D or 3D structure*

1

M5 correct 3D representations of both isomers, e.g.

M5 *must show at least one wedge bond and one dash bond in each structure and any bonds in the plane cannot be at 180º to each other*

second structure could be drawn as mirror image of first ***or*** *with same orientation with two groups swapped round, e.g.*



Allow ECF for second structure from incorrect first structure, providing molecule is chiral

1

(c) **M1** conc H_2SO_4 or conc H_3PO_4

M1 *Allow conc to come from conditions line*

1

M2 heat / 170°C

M2 *depends on attempt at correct reagent in* ***M1***

Allow high temperature / hot / 100-300°C / 373 – 573 K / reflux

Ignore references to pressure

Ignore warm

NOT ethanolic / alcoholic

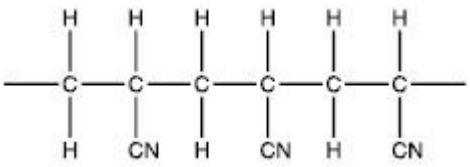
1

Alternative answer

M1 Al_2O_3

M2 *pass vapour over hot* Al_2O_3

(d)



MUST show trailing bonds

Ignore any brackets or n

NOT C–N or C=N if CN group displayed

Allow structures with CN on either C in each of the three units

Allow $–CH_2–CH(CN)–CH_2–CH(CN)–CH_2–CH(CN)–$

1

[9]

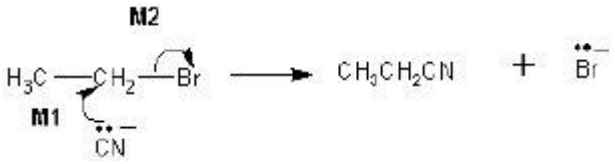
Q3.

(a) Electron pair donor
OR
Species which uses a pair of electrons
to form a co-ordinate / covalent bond.

QoL
Credit "lone pair" as alternative wording

1

(b)



M1 Must show an arrow from the lone pair of electrons on the carbon atom of the negatively charged cyanide ion to the central C atom.

M2 Must show the movement of a pair of electrons from the C-Br bond to the Br atom. Mark M2 independently.

Award full marks for an S_N1 mechanism in which M1 is the attack of the cyanide ion on the intermediate carbocation.

Penalise M1 if covalent KCN is used

Penalise M2 for formal charge on C or incorrect partial charges

Penalise once only for a line and two dots to show a bond.

Max 1 mark for the wrong reactant or "sticks"

2

(c) Ethylamine / $CH_3CH_2NH_2$ is a nucleophile
OR
Ethylamine could react further
OR
Ethylamine could make secondary / tertiary amines
OR
To make reaction with ammonia more likely
OR
To minimise further substitution
OR
The idea of releasing free amine from the salt
OR
The idea of removing a proton from the intermediate alkylammonium ion
OR
The idea that ammonia acts both initially as a nucleophile and then as a base

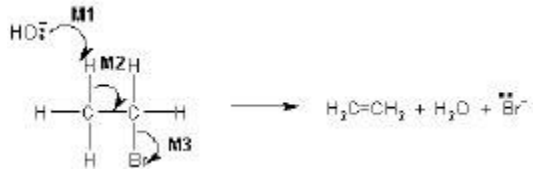
Do not credit a simple reference to the equation or the

mechanism requiring two moles of ammonia.

1

(d) **Elimination**

Credit "base elimination" but NOT "nucleophilic elimination"
No other prefix.



1

M1 Must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to the correct H atom

M2 Must show an arrow from the correct C-H bond to the C-C bond and should only be awarded if an attempt has been made at M1

M3 Is independent.

Award full marks for an E1 mechanism in which M2 is on the correct carbocation.

<u>Mechanism</u>
Penalise M1 if covalent KOH

Penalise M3 for formal charge on C or incorrect partial charges

Penalise once only for a line and two dots to show a bond.

*Max 2 marks **for the mechanism** for wrong reactant or "sticks"*

3

[8]