F324 TEST 1 MS

1. Discussion of the π-bonding

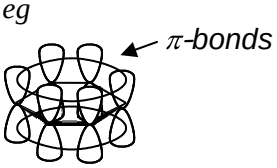
p-orbitals overlap **(1)**

above and below the ring **(1)**

(to form) π-bonds / orbitals **(1)**

any of the first three marks are available from a labelled diagram

eg



(π-bonds / electrons) are <u>delocalised</u> **(1)**

***4** marks*

Other valid points – any two of:

- ring is planar /
- C-C bonds are equal length / have intermediate length/strength between C=C and C-C /
- σ-bonds are between C-C and/or C-H
- bond angles are 120° 6

MAX 2** out of **4** marks **(1)(1)

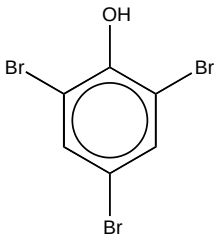
Quality of written communication

two or more sentences with correct spelling, punctuation and grammar 1

[7]

2. (i) $C_6H_5NO_2$ **(1)** 1

(ii)



1

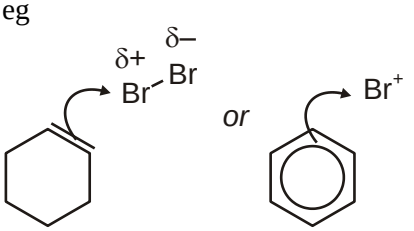
[2]

3. (a) (i) **bromine as an electrophile**
an electrophile accepts an electron pair **(1)**
***NOT** a lone pair*

bromine is polarised/has + charge (centre)/dipole on Br-Br/Br^+ shown in diagram **(1)**

appropriate diagram showning a curly arrow from a double/ π bond to the $Br^{\delta+}$/Br^+ **(1)**

eg



3

(ii) **comparison of reactivity of cyclohexene and benzene**
benzene is (more) stable / more energy required **(1)**

benzene (π) electrons are delocalised **(1)**

benzene has lower electron/- charge density **(1)**

so bromine is less polarised /attracted to it /
benzene is less susceptible to electrophiles **(1)**

ora for cyclohexene 4

quality of written communication mark for any **two** of the the terms:

delocalised/localised, π-electrons/bonds/system, electron density, dative covalent, activation/stabilisation energy, halogen carrier, heterlytic fission, addition/substitution, polarity used appropriately **(1)** 1

(b) (i) iodobenzene because …

Br is more electronegative than I **(1) ora**

so the I atom will be positive /δ^+ /the electrophile **(1)** 2

(ii) $C_6H_6 + IBr \rightarrow C_6H_5I + HBr$ **(1)**
or ecf giving $C_6H_5Br + HI$ 1

[11]

4. nitration stage
(conc) H_2SO_4 **(1)**
(conc) HNO_3 **(1)**
equation – e.g.: $C_6H_5CH_3 + HNO_3 \rightarrow C_6H_4(CH_3)NO_2 + H_2O$ **(1)**
intermediate – name or unambiguous structure **(1)**
4 marks

reduction stage
tin/iron **(1)**
HC*l* **(1)**
equation – e.g.: $C_6H_4(CH_3)NO_2 + 6[H] \rightarrow C_6H_4(CH_3)NH_2 + 2H_2O$
or with H^+ also on left to give $C_6H_4(CH_3)NH_3^+$ **(1)**
3 marks

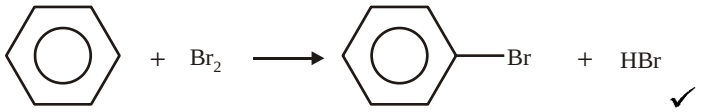
allow other suitable reducing agents:

Quality of Written Communication mark for a well organised answer with the two stages clearly distinguished and sequenced **(1)**
1 mark

8

[8]

5. (a)

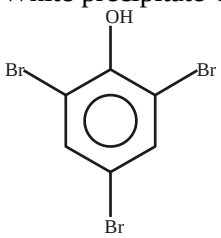


✓

ALLOW *$C_6H_6 + Br_2 \longrightarrow C_6H_5Br + HBr$*
DO NOT ALLOW *multiple substitution*
DO NOT ALLOW *Br^+*

1

(b) (i) White precipitate **OR** white solid **OR** white crystals ✓



DO NOT ALLOW *colourless*
DO NOT ALLOW *white ppt <u>and</u> bubbles*

DO NOT ALLOW
$Br_3C_6H_2OH$ ***OR*** *2,4,6-tribromophenol* ***OR*** *tribromophenol*

2

(ii) 1,2-Dibromocyclohexane ✓

ALLOW *1,2dibromocyclohexane* ***OR*** *1-2dibromocyclohexane* ***OR*** *12dibromocyclohexane* ***OR*** *cyclo-1,2-dibromohexane*
DO NOT ALLOW *dibromocyclohexane* ***OR*** *$C_6H_{10}Br_2$* ***OR*** *structures*

1

(iii) **MUST** spell <u>delocalised/delocalized</u> or <u>localised/localized</u> correctly once in the answer to obtain all 5 marks

benzene <u>electrons</u> or <u>π-bonds</u> are delocalised ✓

ALLOW *diagram to show overlap of all 6 p-orbitals for delocalisation*
DO NOT ALLOW *benzene has delocalised structure or ring*

phenol a <u>lone</u> or <u>non-bonded</u> pair of electrons on the oxygen or the OH group is (partially) delocalised into the ring ✓

ALLOW *diagram to show movement of lone pair into ring for phenol*

cyclohexene electrons are localised **OR** delocalised between two carbons ✓

ALLOW *diagram or description of overlap of 2 adjacent p-orbitals for bonding in cyclohexene*
DO NOT ALLOW *cyclohexene has a C=C double bond*
IGNORE *slip if cyclohexene is written as cyclohexane but π-bonding correctly described*

benzene has a lower **electron density OR** phenol has a higher electron density **OR** cyclohexene has a higher electron density ✓

DO NOT ALLOW *charge density* ***OR*** *electronegativity instead of electron density*

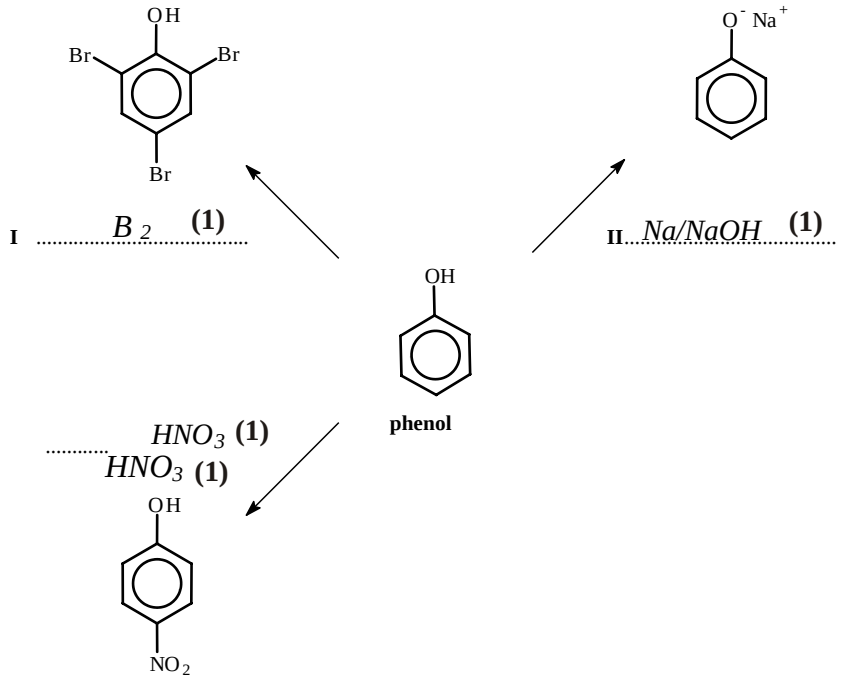
benzene cannot **polarise** or induce a dipole in Br_2 **OR** phenol can polarise the Br_2 **OR** cyclohexene can polarise Br_2 or the Br–Br bond ✓

ALLOW *$Br^{\delta+}$* ***OR*** *electrophile Br^+ as alternate to polarise*

5

[9]

6.



(do not allow a halogen carrier with the bromine)

(do not penalise use of a nitrating mixture)

3

[3]