Mark Schemes

Practice Paper 2A

Section A

1	B	9	B
2	D	10	D
3	A	11	C
4	D	12	C
5	B	13	D
6	C	14	A
7	A	15	C
8	A		

Section B

16 a) The part of a molecule responsible for its reactions ✓

b) i) Oxidising agent ✓

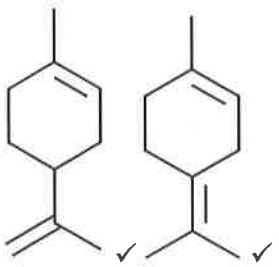
ii) $C_{10}H_{18}O + [O] \rightarrow C_{10}H_{16}O + H_2O$ Organic product correct ✓ Rest of equation correct ✓

iii) For each mark both the peak AND the bond must be mentioned
Peak at 1630–1820 shows C=O formed ✓
No (broad) peak at 3200–3600 shows O–H / alcohol group has reacted / been oxidised ✓
No (very broad) peak at 2500–3300 shows no carboxylic acid O–H has formed ✓

c) E/Z isomerism caused by restricted rotation (around a C=C bond) ✓
Must be two different groups on each side of the double bond AND this is only true for double bond B / double bond A has two CH_3 groups on one side ✓

d) Same molecular formula ✓ but different structural formula ✓

e)

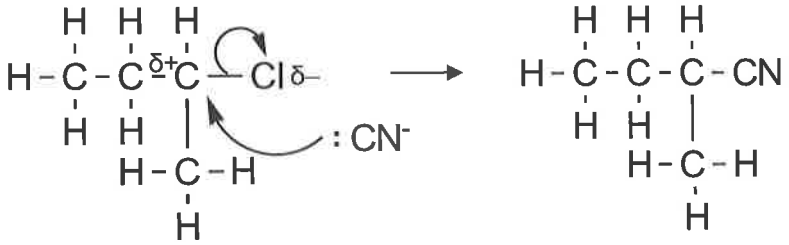


17 a) 2-methylbutan-1-amine ✓ (IGNORE spaces / incorrect use of hyphen)

b) $CH_3CH_2CH(CH_3)CH_2NH_2$ ✓

c) Excess ✓ ethanolic ammonia ✓ (Excess ammonia scores 1 mark only)

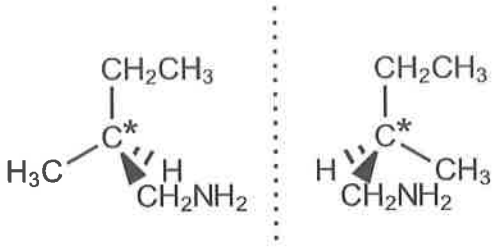
d) i)



Arrow from CN– nucleophile to carbon ✓
Chlorine leaving from correctly drawn chloroalkane ✓
Correct product of the reaction drawn ✓
Mechanism: nucleophilic substitution ✓

ii) Nickel AND H_2 ✓ (ACCEPT $LiAlH_4$)

e)

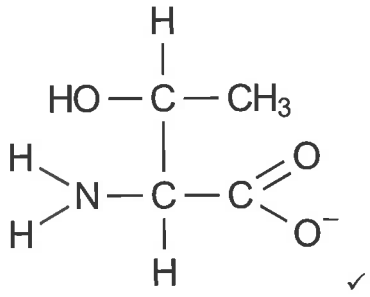


f) i) M_r of CH_3Cl = 50.5
Moles = $\frac{3}{50.5}$ = 0.05941
Moles amine product = 0.05941 ÷ 2 = 0.02970
Product M_r = 115
Theoretical mass of amine product = 115 × 0.02970 = 3.416 g ✓
Percentage yield = $\frac{\text{Actual Mass}}{\text{Theoretical Mass}}$ × 100 = $\frac{3.00}{3.416}$ × 100 = 87.8 % ✓ (ALLOW 88 %)

ii) The product is basic, and so reacts with / neutralises acidic SiO_2 ✓

iii) Tetrachloromethane is symmetrical ✓ so dipoles cancel out ✓

18 a)



b) Protons on N–H and O–H undergo exchange with D_2O ✓
Can be identified because their peaks disappear if the NMR is run in D_2O ✓

c)

Environment	Integration	Approximate shift	Splitting
A	1	3.5–4.2	Multiplet
B	3	0.9–2.0	Doublet

✓ for each column filled (ALLOW shift values rather than ranges, +/- 0.1 either side of the range.

d) Four peaks ✓
✓✓ for all four of the following correct, ✓ for three out of four correct. Must be clear which peak corresponds to which carbon

- Peak in range 160–220 (C=O)
- Peak in range 50–90 (C–O)
- Peak in range 30–70 (C–N)
- Peak in range 0–50 (C–C)

19 a) $C_8H_{14}O_4$ ✓

b) i) $C_8H_{18}O_4 + 2NaOH \rightarrow C_6H_8O_4Na_2 + 2CH_3OH$
✓ for formation of $2CH_3OH$ ✓ for rest of equation
Hydrolysis ✓

ii)

LEVEL OF RESPONSE QUESTION	
Level 3: (5–6 marks)	Answer is structured in an entirely ordered manner. The main stages of both purification and identification are identified and described correctly.
Level 2: (3–4 marks)	Answer is mostly structured in an ordered manner. Most of the practical stages are included, with correct descriptions of some of them.
Level 1: (1–2 marks)	Answer has limited structure. One or two correct steps are identified with limited detail.
0 marks	No creditworthy response.

Indicative Content
Purification

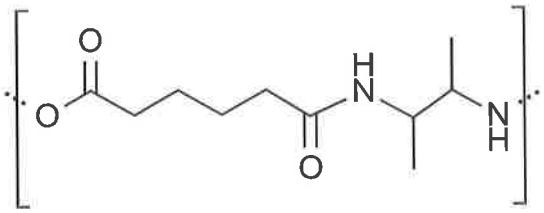
- Dissolve in the minimum amount of a hot solvent
- Filter while hot
- Allow to cool to form crystals
- Filter the crystals
- Use of reduced pressure filtration / Buchner apparatus

Identification

- Add a small quantity to a sealed glass tube / melting point tube
- Heat in melting point apparatus
- Record temperature at which the solid just melts
- Repeat to get a more accurate value
- Compare value to database to determine the identity of the acid

c) i) Condensation (polymerisation) ✓

ii)



Correct amide bond ✓ rest of monomer correct ✓

iii) Any three from:

- Doesn't use up finite natural resources ✓
- Can sell the product to make a profit ✓
- Doesn't take up landfill space ✓
- Avoids release of greenhouse gases from burning the unused material ✓

d) i) $SOCl_2$ / thionyl chloride ✓

ii) More reactive / reaction occurs faster / doesn't require an acid catalyst / occurs at a lower temperature / is not reversible ✓

20 a)

LEVEL OF RESPONSE QUESTION	
Level 3: (5–6 marks)	Answer is structured in an entirely ordered manner. The contribution of all three pieces of evidence is included in the answer, and discussion relating to this evidence is mostly correct.
Level 2: (3–4 marks)	Answer is mostly structured in an ordered manner. The contribution of two pieces of evidence is included in the answer, and discussion relating to this evidence contains only a few omissions or incorrect statements.
Level 1: (1–2 marks)	Answer has limited structure. Answer includes vague reference to the significance of two of the pieces of evidence, or a thorough account of the significance of one piece of evidence.
0 marks	No creditworthy response.

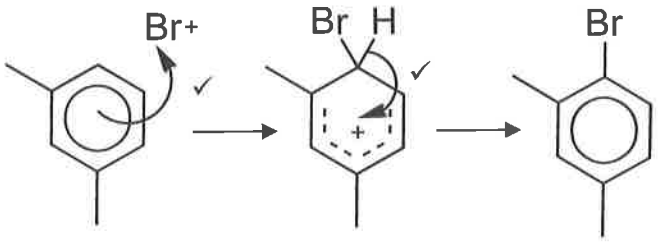
Indicative Content

- Bond lengths all the same within the ring
- Shows the structure does not contain alternating double and single bonds (which would mean different bond lengths)

- Benzene does not react with electrophiles such as bromine (without a catalyst)
- Alkenes do react with electrophiles such as bromine
- Shows that benzene has an added stability OR a reduced electron density

- Enthalpy of hydrogenation would be expected to be 3×-120 kJ $mol^{-1} = -360$ kJ mol^{-1} if benzene was three isolated double bonds
- Shows that the benzene ring has additional stability

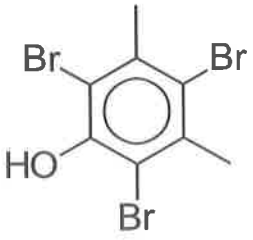
b) $FeBr_3 + Br_2 \rightarrow FeBr_4^- + Br^+$ ✓



✓ ✓ ✓ intermediate

$H^+ + FeBr_4^- \rightarrow FeBr_3 + HBr$ ✓

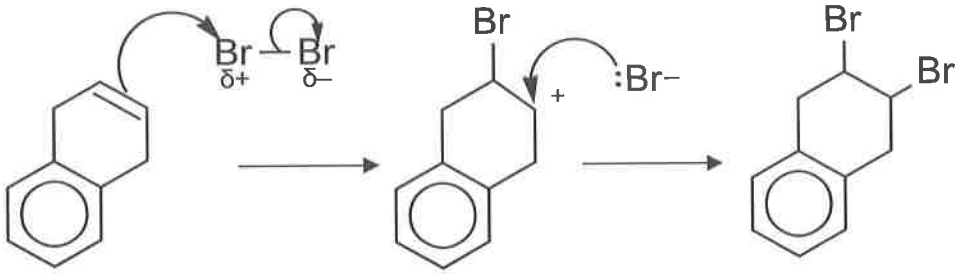
c) Lone pair from the oxygen is delocalised into the ring ✓
Increased electron density in the ring increases reactivity ✓
Major product is:



✓

d) The nitro group is 3(,5) directing AND substitution would occur at one of the adjacent carbons ✓

21 a) Use of bromine water ✓
Colour change from orange to colourless ✓



First two arrows correct ✓ Correct structure of intermediate ✓ Addition of Br^- to intermediate ✓

b) (Formula is $C_{10}H_{14}N_2$) so $M_r = 162$ ✓
C $\frac{10\times12}{162} \times 100$ H $\frac{14\times1}{162} \times 100$ N $\frac{2\times14}{162} \times 100$ ✓
C 74 % H 9 % N 17 % ✓ (Correct final answer scores 3 marks, MAX 2 if answers not given to the nearest whole number)

c) C reacts / produces hydrogen with sodium OR turns universal indicator red AND aliphatic alcohols do not ✓
C does not react with metal carbonates AND carboxylic acids do react / produce carbon dioxide ✓

d) Add 2,4-DNP (with methanol and sulfuric acid) ✓
Yellow/orange precipitate observed ✓

e) C AND 10 peaks ✓

