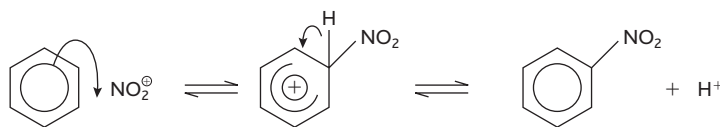




Student Book Unit 5 Test 2 Mark scheme (Chapters 2.3 to 2.5)

- 1 a Delocalised bonding in benzene (1)
 Benzene does not have three (localised) C=C bonds (1)
 Benzene ring has high stability (1)
 Less susceptible to addition (1) (max 2)

- b (i) Concentrated acids (1); lower than 60 °C (1) (2)
 (ii) $\text{HNO}_3 + 2\text{H}_2\text{SO}_4 \rightleftharpoons \text{NO}_2 + 2\text{HSO}_3^- + \text{H}_3\text{O}^+$ (1)
 or $\text{HNO}_3 + \text{H}_2\text{SO}_4 \rightleftharpoons \text{H}_2\text{NO}_3^+ + \text{HSO}_4^-$
 or $\text{HNO}_3 + \text{H}_2\text{SO}_4 \rightleftharpoons \text{NO}_2^+ + \text{HSO}_4^- + \text{H}_2\text{O}$
 Sulfuric acid donates H^+ to nitric acid (1) (2)
 (iii) (1) allow this mark also for H^+ at end (2)



(1) for plus charge and incomplete ring delocalisation

or equivalent using Kekulé forms – intermediate should have two double bonds only

- (iv) Addition destroys delocalisation substitution does not (1) (1)

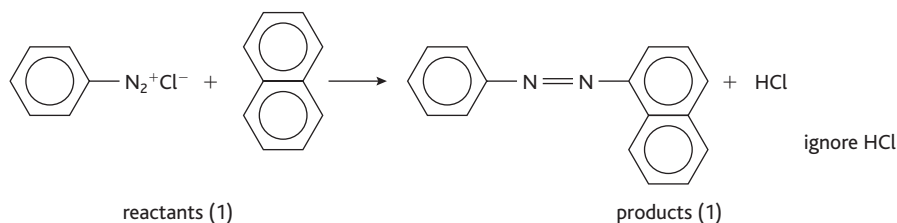
(Total 9 marks)

- 2 a Fume cupboard (1); gloves (1) (2)
safety requirements must be specific to question

- b $\text{C}_6\text{H}_5\text{NH} + \text{HCl} \rightarrow \text{C}_6\text{H}_5\text{NH}_3^+\text{Cl}^-$ (1) (1)
must have correct charges
ignore Cl^- if H^+ on left-hand side

- c (i) Too slow lower than 0 °C (1); product decomposes at higher than 5 °C (1)
 (ii) Exothermic (1); have to keep temperature below 5 °C (1) (4)

- d (2)



allow $-\text{N}^+\equiv\text{N}$ or $-\text{N}\equiv\text{N}^+$

but not $-\text{N}^+=\text{N}$ or $=\text{N}-\text{N}^+$

Cl^- not essential

(Total 9 marks)

- 3 a (i) Chlorine (1); sunlight / u.v. light (1); $\text{C}_6\text{H}_5\text{CH}_3 + \text{Cl}_2 \rightarrow \text{C}_6\text{H}_5\text{CH}_2\text{Cl} + \text{HCl}$ (1)
the first condition mark can be awarded if u.v. light / sunlight is mentioned in part (ii)
condition dependent on reagent
 allow $\text{C}_7\text{H}_8 + \text{Cl}_2$ etc.

- (ii) Fractional distillation (1); distil off methylbenzene and distil a sample of benzyl chloride / (chloromethyl) benzene at 179 °C (1) (5)

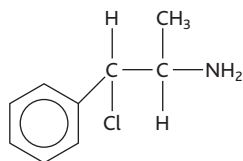
- b HCl (1); room temperature (1)
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_3^+\text{Cl}^-$ (1) (3)

(Total 8 marks)

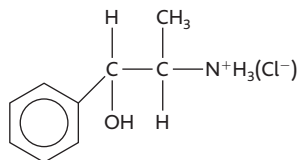


Student Book Unit 5 Test 2 Mark scheme (cont.)

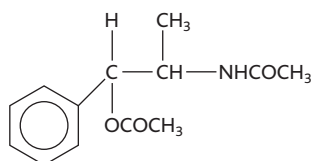
4 a (i) (1)



(ii) (1)

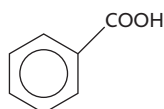


(iii) (2)



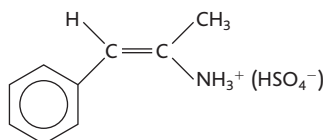
*if two structures are given each one should have one of the groups acylated (2)
if just the ring acylated then (1) – position does not matter
if the ring and one group acylated (2)*

(iv) (1)



*allow the sodium salt – charges not necessary
allow the anion*

(v) (1) (6)



*structure must be unambiguous
allow the free amine
not an ether or substitution of SO₃H*

b (i) Fume cupboard / open window (1); gloves (1)

(ii) Dissolve in minimum volume trichloromethane (1); boiling/hot solvent (1); hot filter (1)

cool (1); filter and dry crystals (1)

if give cool and filter (0) if nothing sensible given before

(iii) Melting temperature (1); sharp or compare with known value (1) (9)

(Total 15 marks)

5 a (i) Na in EtOH / LiAlH₄ / hydrogen (1); *not sodium borohydride*

Correct condition for reagent used (1); *i.e. room temp or warm for Na in EtOH / dry ether for LiAlH₄ / Pt or Ni catalyst for hydrogen*



using [H] or H₂ acceptable but if using hydrogen gas must show as H₂

(ii) Reagent: CH₃COCl (1); at room temperature (1);



b The reaction is used in the synthesis of paracetamol (1) (1)

(Total 7 marks)