



A' Level Chemistry

Year 2

Unit 15: Amines

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.



Grade Accelerator

Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs



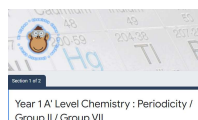
Condensed Notes

Keywords & Definitions
Key Concepts
Application
Key Skills

Quizlet

Quizlet Classes

Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker



Online Forms

Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.



1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!

2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**



If you struggle with the questions in the pack, **STOP!** and complete some more revision.



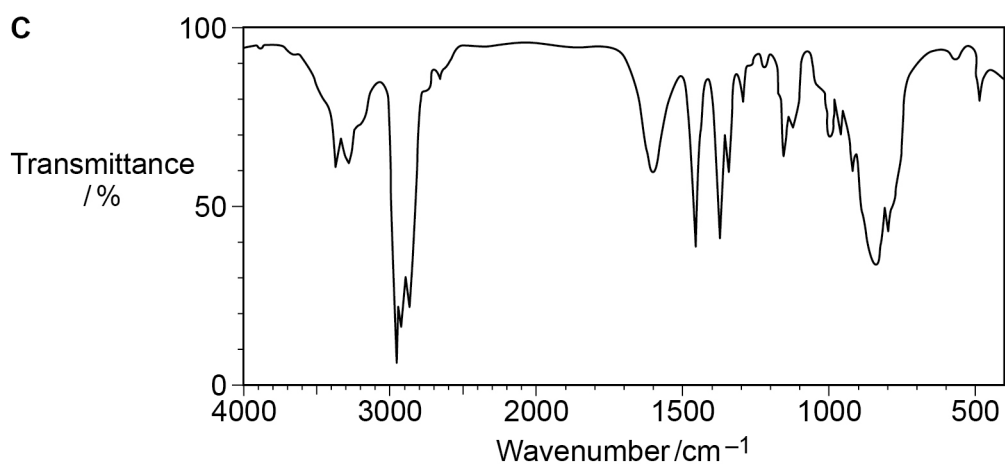
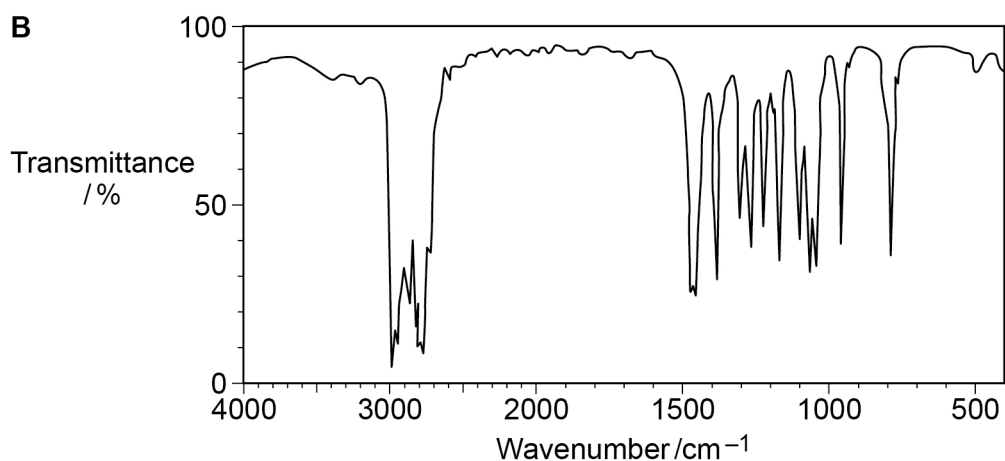
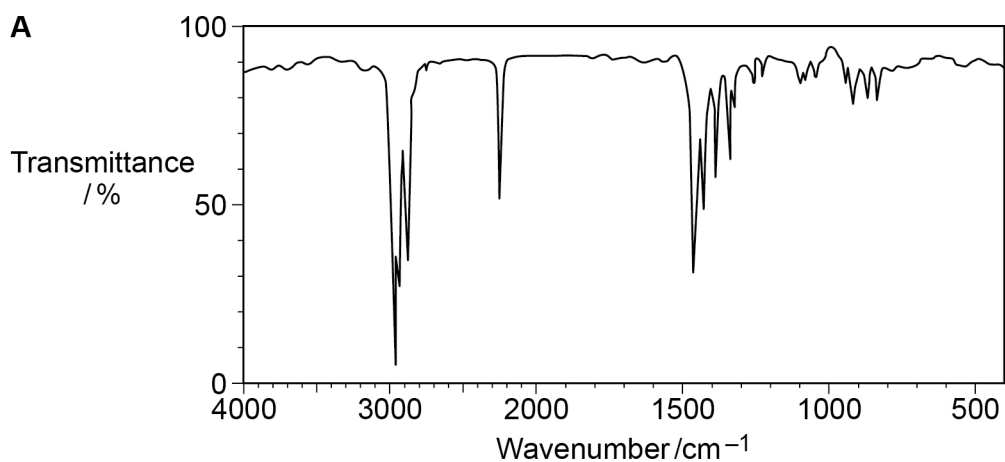
If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

Question	Answers	Mark	Additional Comments/Guidance
11.1	(Strength depends on availability of) <u>lone pair on N</u> (atom)	M1	Or F is most basic and E is least basic
	E N (next to ring): (lp) <u>delocalised</u> into ring	M2	
	(lp) less available (to donate to or to accept a H ⁺)	M3	
	F or G : N (next to alkyl): (positive) inductive effect/electrons pushed to N	M4	
	(lp) more available (to donate to or to accept a H ⁺)	M5	
	order of increasing base strength E<G<F	M6	
11.2	Intermediate compounds Product of step 1 C ₆ H ₅ CH ₂ Cl Product of step 2 C ₆ H ₅ CH ₂ CN	1 1	Allow C ₆ H ₅ CH ₂ Br In steps 2 and 3, only allow marks for reagents/conditions if intermediate compounds are correct or close.
	Reagents/conditions Step 1 Cl ₂ & UV	1	Allow Br ₂ & UV
	Step 2 KCN alcoholic & aq (both reqd)	1	Ignore temperature
	Step 3 H ₂ / Ni or Pt or Pd	1	Allow LiAlH ₄ in (dry) ether – (with acid CE, followed by acid allow) Not NaBH ₄ and not Sn/HCl or Fe/HCl
Total		11	

1 0

This question is about amines.

1 0 . 1

The infrared spectra **A**, **B** and **C** are those of a primary amine, a tertiary amine and a nitrile, but not necessarily in that order.

Give the letter of each compound in the correct box.

[1 mark]

primary amine	tertiary amine	nitrile



1 0 . 2 There are **three** secondary amines that contain four carbon atoms per molecule.

Draw the skeletal formulas of these **three** secondary amines.

[2 marks]

1 0 . 3 Primary amines can be prepared by the reaction of halogenoalkanes with ammonia or by the reduction of nitriles.

Justify the statement that it is better to prepare primary amines from nitriles rather than from halogenoalkanes.

[2 marks]

1 0 . 4 Draw the structure of a primary amine with four carbon atoms that **cannot** be formed from a nitrile.

[1 mark]

Turn over ►



1 0 . 5

A student dissolves a few drops of propylamine in 1 cm³ of water in a test tube.

Give an equation for the reaction that occurs.

Describe what is observed when Universal Indicator is added to this solution.

[2 marks]

Equation _____

Observation _____

1 0 . 6

Phenylamine can be prepared by a process involving the reduction of nitrobenzene using tin and an excess of hydrochloric acid.

Give an equation for the reduction of nitrobenzene to form phenylamine. Use [H] to represent the reducing agent.

Explain why an aqueous solution is obtained in this reduction even though phenylamine is insoluble in water.

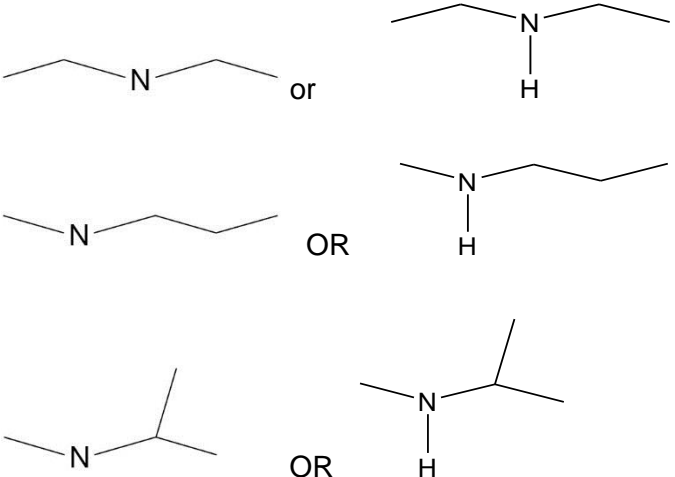
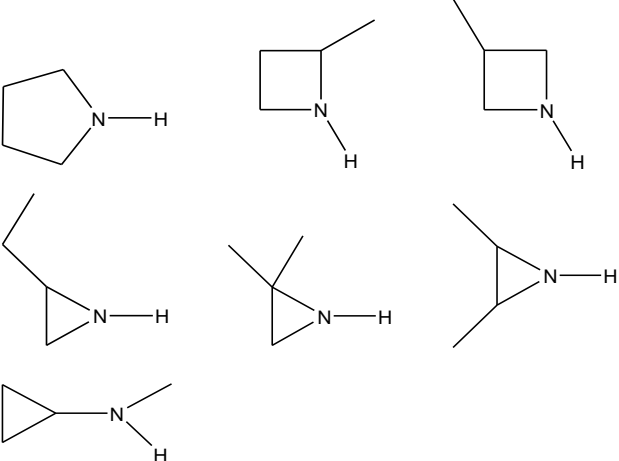
[2 marks]

Equation _____

Explanation _____

10



Question	Answers	Mark	Additional Comments/Guidance
A 10.1	<p><u>CBA</u> this order only</p>	1	
10.2	<p>Any three from</p>  <p> <chem>CCNCC</chem> or <chem>CCN(CC)C</chem> <chem>CCNCCC</chem> OR <chem>CCN(C)CC</chem> <chem>CCN(C)C</chem> OR <chem>CC(C)N(C)C</chem> </p>	2	<p>Must be skeletal – allow with or without H on N</p> <p>All 3 correct score 2 (or one if not skeletal) Any two correct score 1 (or zero if not skeletal)</p> <p>Allow cyclic 2° amines but NOT amines also containing other functional groups</p> 

Answer **all** questions in the spaces provided.

0 1

This question is about amines.

0 1 . 1

Give an equation for the preparation of 1,6-diaminohexane by the reaction of 1,6-dibromohexane with an excess of ammonia.

[2 marks]

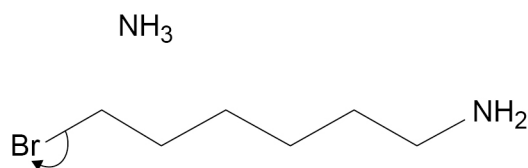
0 1 . 2

Complete the mechanism for the reaction of ammonia with 6-bromohexylamine to form 1,6-diaminohexane.

Suggest the structure of a cyclic secondary amine that can be formed as a by-product in this reaction.

[4 marks]

Mechanism



Cyclic secondary amine



0 1 . 3

1,6-Diaminohexane can also be formed in a two-stage synthesis starting from 1,4-dibromobutane.
Suggest the reagent and a condition for each stage in this alternative synthesis.

[3 marks]

Stage 1 reagent and condition

Stage 2 reagent and condition

0 1 . 4

Explain why 3-aminopentane is a stronger base than ammonia.

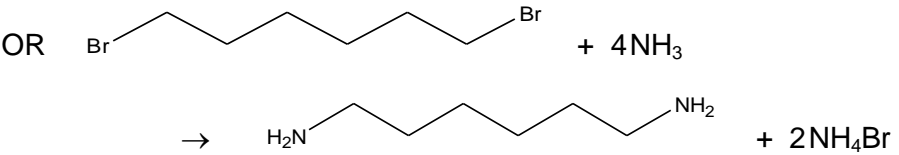
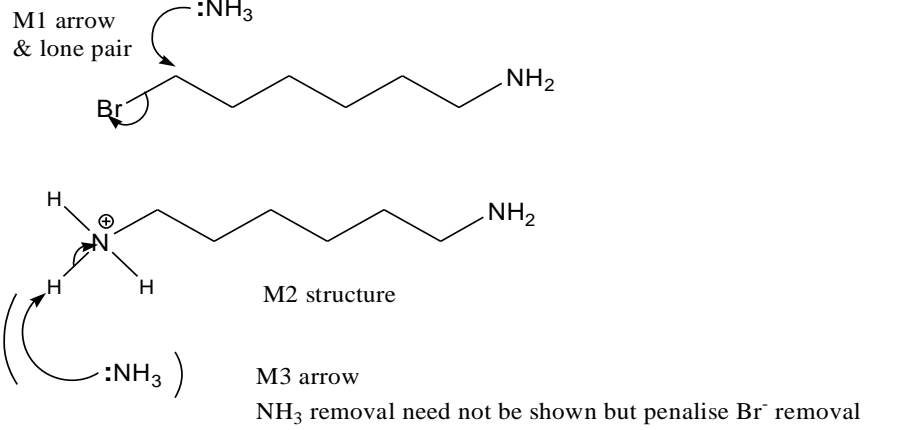
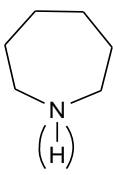
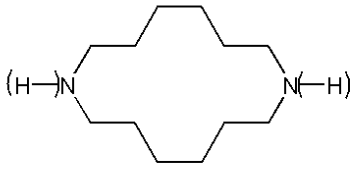
[2 marks]

0 1 . 5

Justify the statement that there are no chiral centres in 3-aminopentane.

[1 mark]

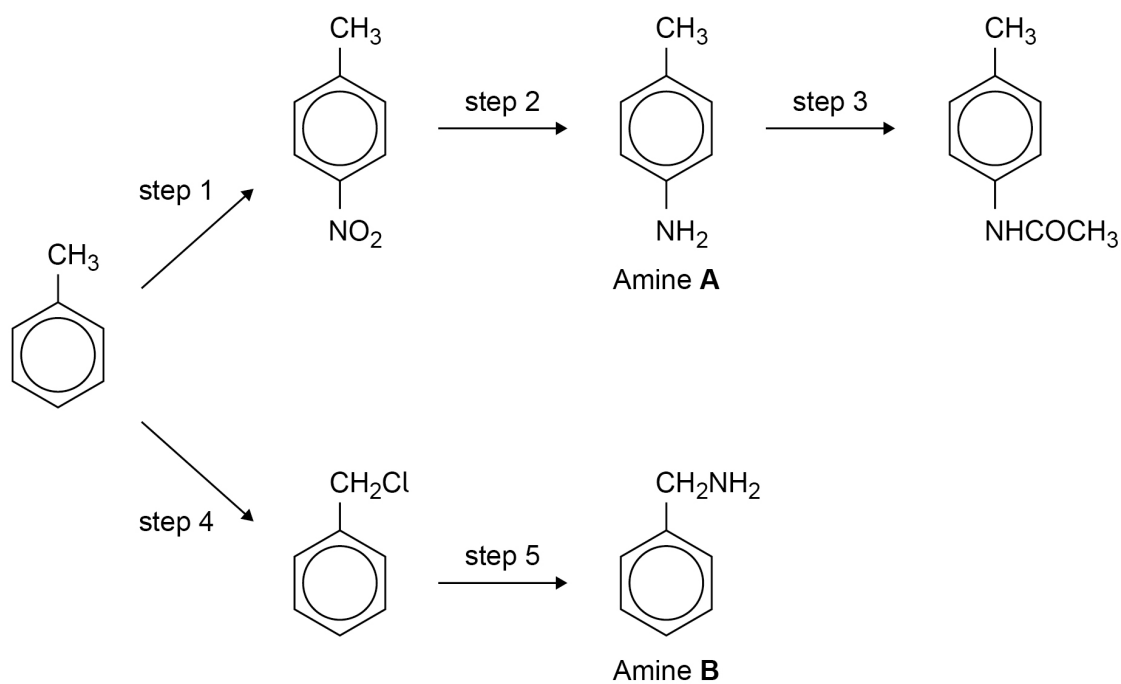
12**Turn over for the next question****Turn over ►**

Question	Answers	Additional Comments/Guidelines	Mark
01.1	$\text{Br}-(\text{CH}_2)_6-\text{Br} + 4\text{NH}_3 \rightarrow \text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2 + 2\text{NH}_4\text{Br}$ <p>OR</p> 	M1 both organic compounds correct (not molecular formulae) Allow one correct structural formula and the other correct molecular formula of type $\text{XC}_6\text{H}_{12}\text{X}$ M2 balanced	2
01.2	<p>M1 arrow & lone pair</p>  <p>M2 structure</p> <p>M3 arrow NH_3 removal need not be shown but penalise Br^- removal</p> <p>Impurity</p>  <p>(or as structural formula)</p>	Or with structural formulae, $\text{Br}(\text{CH}_2)_6\text{NH}_2$ etc Allow $\text{S}_{\text{N}}1$ Penalise incorrect partial charges in M1 allow 	3
			1

01.3	M1	Stage 1 reagent	KCN or NaCN	Not HCN this loses M1 and M2 Any mention of acid loses M1 & M2	1
	M2	Stage 1 condition	aqueous alcohol	M2 dependent on correct M1 (allow condition if only CN ⁻ ions)	1
	M3	Stage 2 reagent & condition	H ₂ and Ni or Pt or Pd	M3 only accessible if a cyanide is used in stage 1 Allow LiAlH ₄ (in dry ether) – acidic/aqueous = CE, but allow followed by acid. NOT NaBH ₄ NOT Sn/HCl or Fe/HCl Ignore heat and reflux and pressure Apply list principle to incorrect reagents/conditions	1
01.4	In 3-aminopentane <u>Lone pair on N</u> more available or <u>Lone pair on N</u> accepts H ⁺ better because of alkyl electron pushing /inductive effect			Allow converse for ammonia Or greater stability of protonated N Mark independently	1 1
	01.5	No carbon (atom is) attached to 4 different groups			Allow central carbon has two alkyl groups Allow symmetrical molecule

1 0

This question is about the reaction scheme shown.



1 0 . 1

State the reagents needed for step 1 and the reagents needed for step 2.

[3 marks]

step 1 _____

step 2 _____

1 0 . 2

Give the name of the mechanism for the reaction in step 3.

[1 mark]



1 0 . 3 Name the reagent for step 4.

State a necessary condition for step 4.

[2 marks]

Reagent _____

Condition _____

1 0 . 4 Amine **A** is formed in step 2 and amine **B** is formed in step 5.

Explain why the yield of **B** in step 5 is less than the yield of **A** in step 2.

[2 marks]

1 0 . 5 Explain why amine **B** is a stronger base than amine **A**.

[2 marks]

10

END OF QUESTIONS



Question	Answers	Additional Comments/Guidelines	Mark
10.1	Step 1 Conc HNO ₃ Step 1 Conc H ₂ SO ₄ Step 2 Sn and HCl	If conc missing in both allow 1 for HNO ₃ and H ₂ SO ₄ Allow Fe and HCl or Ni and H ₂	M1 M2 M3 (3 x AO1)

Question	Answers	Additional Comments/Guidelines	Mark
10.2	(nucleophilic) addition-elimination		1 (AO1)

Question	Answers	Additional Comments/Guidelines	Mark
10.3	Chlorine UV (light)	Allow Cl ₂ Allow sunlight / High temp (above 300°C)	M1 M2 (2 x AO1)

Question	Answers	Additional Comments/Guidelines	Mark
10.4	In Step 5 further substitution / gives other amine products In Step 2 only one amine		1 1 (2 x AO3)

Question	Answers	Additional Comments/Guidelines	Mark
10.5	In B Alkyl group is electron donating or positive inductive effect Lone pair <u>on N</u> more available	Or in A lone pair (on N partially) delocalised Lone pair <u>on N</u> less available	1 1 (2 x AO2)