OCR (A) Chemistry A-Level - Amines

Mark Scheme

Question	Key	Marks	Guidance
1	A	1	

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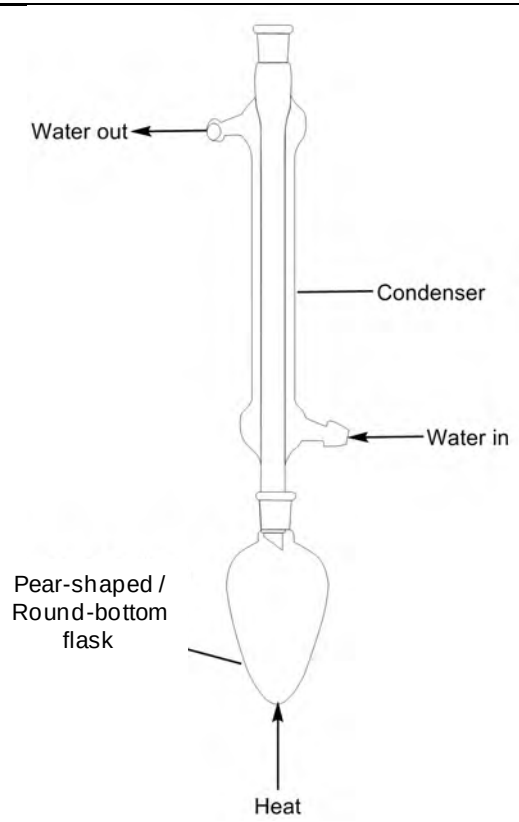
Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	 **Water flow AND condenser** Water in at bottom and out at top **AND** condenser ✓ **Flask and technique** Pear-shaped/round-bottom flask **AND** reflux ✓	**2**	1.2 × 2	**DO NOT ALLOW** conical flask, volumetric flask, beaker in place of round bottom/pear shaped flask

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		(ii)	**Diagram showing knowledge of filtration under reduced pressure** Diagram showing Buchner flask *must have **ONE** side arm* **AND** Buchner/Hirsh funnel on top of flask ✓ *Labels not required* --- **Further details:** • Funnel sealed or stoppered to flask **AND** • Apparatus capable of filtering under reduced pressure **AND** • Label for setup from side arm to indicate reduced pressure **AND** • Label for Buchner flask **OR** Buchner/Hirsh funnel ✓ *ALLOW slips in spelling of 'Buchner'*	**2**	2.3 2.7	Labels **NOT** required for diagram **ALLOW** diagram of a conical flask with a filtering setup above **AND** Side arm either in conical flask **OR** between flask and filter paper of funnel **IGNORE** absence of seals --- **MUST** imply some type of seal between filter setup and flask. **ALLOW small** gaps Examples of suitable labels (may have arrow from side arm or tube attached) • to pump • to vacuum • air out • suction • reduced pressure • etc. For Buchner flask and Buchner funnel **DO NOT ALLOW** just 'flask **OR** 'funnel' *Flask and funnel used in normal filtration*

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	(b)	(i)	***Comparison of branching and points of contact*** e.g. $CH_3CH_2CH_2NH_2$ has longer chain / straight chain / no branches **AND** e.g. $CH_3CH_2CH_2NH_2$ has more points of contact / more surface interaction (between molecules) ✓ ***Relative strength of force*** e.g. $CH_3CH_2CH_2NH_2$ has stronger/more induced dipole(–dipole) interactions **OR** London forces ✓ --- ***Hydrogen bonds*** $CH_3CH_2CH_2NH_2$ **OR** $(CH_3)_2CHNH_2$ have hydrogen/H bonds **OR** $(CH_3)_3N$ has no hydrogen/H bonds ✓ ***Relative strength of force*** Hydrogen bonds are stronger than London forces /permanent dipole interactions ✓ --- ***Comparison of energy required to break force*** e.g. More energy to break/overcome London forces/intermolecular forces in $CH_3CH_2CH_2NH_2$ **OR** More energy is needed to break H bonds (than London forces) ✓	**5 → 4 max** 1.2 2.1 1.2 2.1	**ANNOTATE WITH TICKS AND CROSSES, etc.** --- **ALLOW ORA** throughout **ALLOW** 'The straighter the chain, the more points of contact ….' **IGNORE** comparison using 'primary', 'secondary' and 'tertiary'. *Comparison of branching is required.* For London forces, • **ALLOW** induced dipole(–dipole) interactions • **IGNORE** IDID **OR** van der Waals' forces/VDW **DO NOT ALLOW** $CH_3CH_2CH_2NH_2$ has more electrons *(number of electrons are the same)* **DO NOT ALLOW** 'more energy to break covalent bonds **ALLOW** little energy is required to break London forces (compared with H bonds)

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(b) (ii)	**FIRST CHECK MOLECULAR FORMULA and STRUCTURE** **IF** molecular formula = $C_5H_{13}N$ **AND** correct structure **AND** evidence of ideal gas equation → **6 marks** Correct up to 87 **AND** $C_5H_{13}N$ → **5 marks** Correct up to 87 → **4 marks** --- ***Rearranging ideal gas equation*** $n = \frac{pV}{RT}$ ✓ ***Unit conversion AND substitution into*** $n = \frac{pV}{RT}$**:** • $R = 8.314$ ***OR*** 8.31 • $V = 72(.0) \times 10^{-6}$ • T *in K:* 373 *K* *e.g.* $\frac{1.00 \times 10^5 \times 72.0 \times 10^{-6}}{8.314 \times 373}$ ✓ ***Calculation of n*** $n = 2.32 \times 10^{-3}$ (mol) ✓ ***Calculation of M*** $M = \frac{0.202}{2.32 \times 10^{-3}} = 87$ ✓ ***Molecular formula*** $C_5H_{13}N$ ✓ **Molecular formula required**	**6**	2.2×4 3.2	**IF** $n = \frac{pV}{RT}$ is omitted, **ALLOW** when values are substituted into rearranged ideal gas equation. Calculator: $n = 2.321740325 \times 10^{-3}$ from 8.314 *From 8.31,* $n = 2.322857889 \times 10^{-3}$ **ALLOW** elements in any order **ALLOW** molecular formula = $C_3H_9N_3$ **ALLOW** other molecular formulae of an amine that has $M = 87$, e.g. C_4H_9NO

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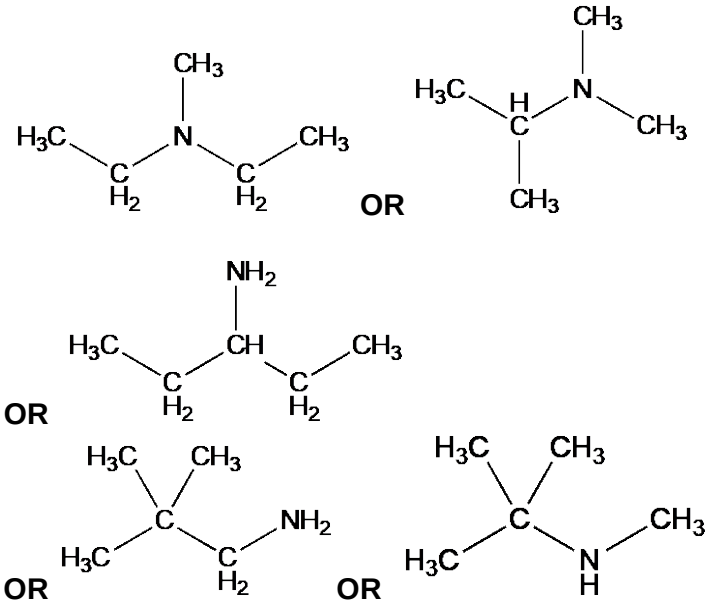
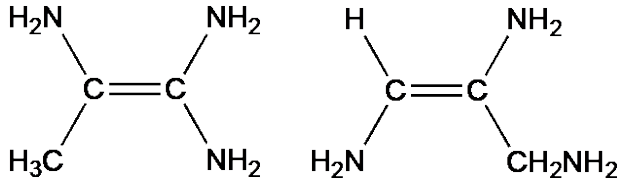
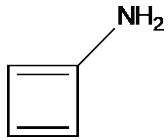
	Structure of amine A from $C_5H_{13}N$ ✓ 		3.2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **ALLOW** structures below from molecular formula = $C_3H_9N_3$  **ALLOW ECF** but only if structure has calculated M_r **AND** has 3 peaks in ^{13}C NMR spectrum.
	Use of 24000	3 marks max possible for use of 72.0 cm^3 **OR** 0.720 dm^3 by **ECF** **Calculation** e.g. $n = \frac{72.0}{24000} = 3.00 \times 10^{-3}$ **No mark** (*calculation much simpler*) $M = \frac{0.202}{3.00 \times 10^{-3}} = 67.3$ **OR** 67 ✓ **ECF** **Molecular formula** = C_4H_5N ✓ **ECF** **Structure**  ✓ **ECF**			

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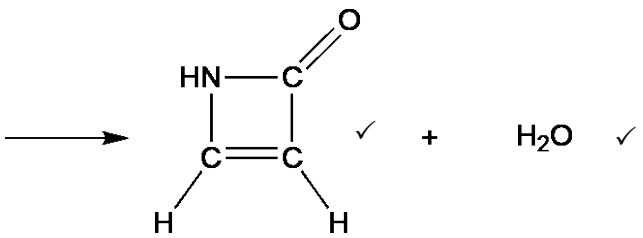
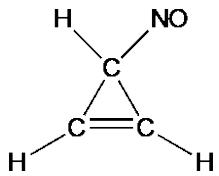
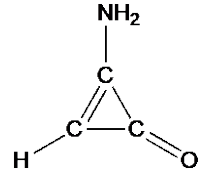
(c)	 ✓ + H_2O ✓ **Organic product** and **water** marked **independently**. *1st mark* correct organic product **OR** water **IGNORE** balancing numbers *2nd mark* **BOTH** products **AND** correctly balanced.	**2**	3.2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **ALLOW**   **NOTE**: For **ECF**, any structure must have correct number of bonds to C, H, O and N **DO NOT ALLOW** structure of dimer *Question states molecular formula = C_3H_3NO*
	Total	**16**		