OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

AS Level Chemistry A

H032/02 Depth in chemistry

PRACTICE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

This document consists of 18 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **6(a)** and **7**.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

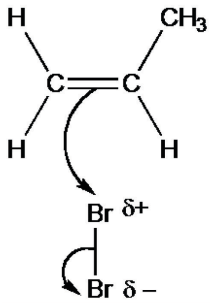
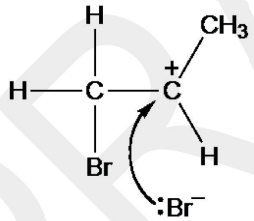
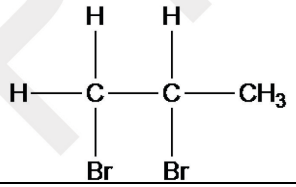
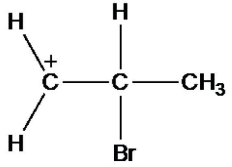
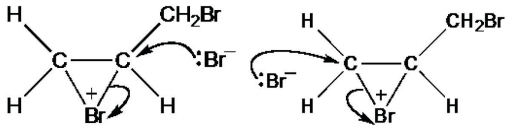
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

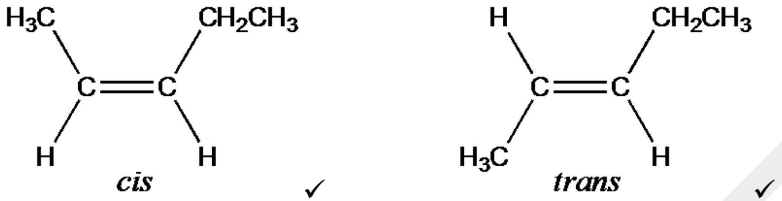
You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)		volumetric flask **AND** (graduated) pipette ✓	1	**ALLOW** graduated flask **IGNORE** burette
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **IF** answer = 73.9 or 73.93 (g mol^{-1}) award 3 marks for calculation n(NaOH) = (25.25/1000) × 0.120 = 3.03×10^{-3} (mol) ✓ n(acid in 250 cm^3 flask) = $3.03 \times 10^{-3} \times 10 = 3.03 \times 10^{-2}$ (mol) ✓ molar mass of unknown acid = $2.24/3.03 \times 10^{-2} = 73.9$ (g mol^{-1}) ✓	3	**If there is an alternative answer, check to see if there is any ECF credit possible using working below**
	(c)		Repeat titration until (two) titrations are concordant / agree within 0.1 cm^3 ✓ Calculate mean titre from concordant titres ✓	2	**IGNORE** just 'repeat the titration (needs qualifying).
			Total	6	

Question			Answer	Marks	Guidance
2	(a)	(i)	Overlap of orbitals directly between the bonding atoms ✓	1	**ALLOW** a correct diagram
		(ii)	120° **AND** trigonal planar ✓	1	**ALLOW** planar triangle
	(b)	(i)	Curly arrow from double bond to Br of Br–Br ✓ Correct dipole shown on Br–Br **AND** curly arrow showing breaking of Br–Br bond ✓  Correct carbocation with + charge on C with 3 bonds **AND** curly arrow from Br^- to C^+ of carbocation ✓  Correct product: ✓  	4	Curly arrow must start from bond and go to correct atom **DO NOT ALLOW** partial charges on C=C bond **ALLOW** carbocation on terminal CH_2  **DO NOT ALLOW** δ+ on C of carbocation. Curly arrow must come from a lone pair on Br^- **OR** from the negative sign of Br^- ion (then lone pair on Br^- ion does not need to be shown) **ALLOW** formation of bromonium intermediate and curly arrows, i.e: 

Question			Answer	Marks	Guidance
		(ii)	Movement of a pair of electrons ✓	1	**ALLOW** movement of a lone pair
	(c)	(i)	One of the carbons of the C=C has two of the same groups attached/has two hydrogen atoms attached (so it can't show 2 different stereoisomers) ✓	1	**ALLOW** a stereoisomer must have 2 different groups attached to each carbon of the C=C double bond
		(ii)	1 mark each correct DIAGRAM ✓  ✓ ✓	2	**ALLOW** correct skeletal **OR** displayed formula **OR** mixture **BUT** must clearly show arrangement around C=C
	(d)		*E* isomer **AND** F takes priority over the carbon on the left hand side (as it has a higher atomic number) **AND** CH_2OH takes priority over the CH_3 group on the right hand side ✓	1	*E* with no explanation is insufficient
			Total	11	

Question			Answer	Marks	Guidance
3	(a)	(i)	**Boiling point of H_2S lower than H_2O** H_2O has hydrogen bonding ✓ Hydrogen bonding is stronger **OR** more energy required to overcome hydrogen bonding ✓ **Boiling point of H_2S lower than H_2Se** induced dipole–dipole interactions / London forces in H_2S are weaker ✓ H_2S has fewer electrons **OR** less energy required to overcome induced dipole–dipole interactions ✓	4	**ORA** throughout **DO NOT ALLOW** covalent bonds break **ALLOW** instantaneous–induced dipole interactions **ALLOW** dispersion forces **ALLOW** van der Waals' / vdW **IGNORE** permanent dipole–dipole **DO NOT ALLOW** covalent bonds break
		(ii)	Any value between 285 and 335 (K) ✓	1	Graph must show an extrapolation line
	(b)		MgO: giant ionic ✓ SO_2: simple molecular ✓ ionic bonds (in MgO) are (much) stronger than intermolecular bonds (in SO_2) ✓ ionic bonds (in MgO) need more energy to overcome/break (than intermolecular forces in SO_2) ✓	4	**ORA** throughout For intermolecular bonds **ALLOW** induced dipole–dipole interactions/London forces/permanent dipole–dipole interactions/van der Waals' forces **DO NOT ALLOW** hydrogen bonds **IGNORE** covalent bonds in SO_2 unless statement that they break: **CON**
			Total	9	

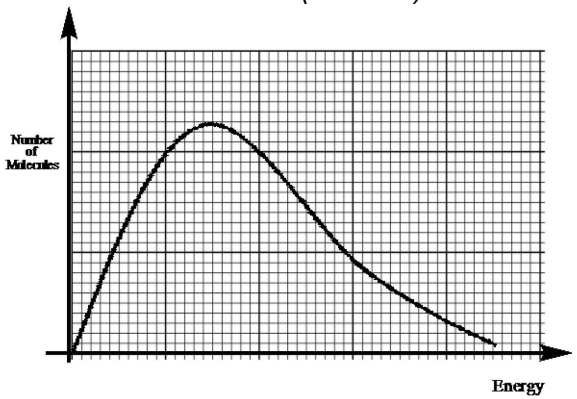
Question			Answer	Marks	Guidance
4	(a)	(i)	$Sr(s) + 2H_2O(l) \rightarrow Sr(OH)_2(aq) + H_2(g)$ **NOTE: ALL** state symbols required	1	**ALLOW** multiples
		(ii)	$n(Sr) = n(Sr^{2+}) = 0.200 / 87.6 = 2.28 \times 10^{-3}$ ✓ $[Sr^{2+}] = 2.28 \times 10^{-3} \times 1000/250 = 9.13 \times 10^{-3}$ (mol dm^{-3}) ✓	2	**ALLOW ECF**
		(iii)	Greater volume with Ca **AND** larger amount/more moles of Ca **OR** A_r Ca is smaller ✓ $n(Ca) = 0.200/40.1 = 0.005(0)$ (mol) ✓ volume H_2 with Sr = 55 cm^3 **AND** volume with Ca = 120 cm^3 **OR** 65 cm^3 more H_2 with Ca ✓	3	**ORA** **ALLOW** values up to calculator values **ALLOW** volumes ± 1 cm^3
	(b)		$Cl(g) \rightarrow Cl^+(g) + e^-$ Correct species, balanced **AND** correct state symbols ✓	1	**ALLOW** $Cl(g) - e^- \rightarrow Cl^+(g)$ **IGNORE** state symbols after electron
	(c)		**Group**: 2 ✓ **Justification**: Large increase between 2nd and 3rd ionisation energy values. ✓	2	**ALLOW** alkaline earth **No ECF** for justification (dependent on correct group)
			Total	9	

Question			Answer	Marks	Guidance
5	(a)		One mole of butane completely combusts in oxygen ✓	1	**ALLOW** One mole forms CO_2 and H_2O only
	(b)	(i)	CO is toxic ✓	1	**ALLOW** responses linked to effect of CO in blood
		(ii)	*Calculation*: *n*(butane) = 600/58.0 = 10.34 (mol) **AND** *n*(O_2) required = 6.5 × 10.34 = 67.2 (mol) ✓ *n*(O_2) consumed = 1.50 × 10^3 / 24.0 = 62.5 (mol) **OR** volume O_2 required for complete combustion = 67.2 × 24.0/1000 = 1.61 m^3 ✓ *Conclusion*: incomplete combustion / stove not safe to use **AND** 62.5 < 67.2 **OR** 1.61 > 1.50 ✓	3	using 1 : 6.5 ratio **ALLOW** number rounding to 67
	(c)		*Rearranging ideal gas equation to make n subject* $n = pV / RT$ ✓ *Substituting all values taking into account conversion of units* $n = \frac{(101\times10^3)\times(2.00\times10^{-3})}{8.314\times297}$ ✓ *n* = 0.0818 … (mol) ✓ number of C atoms in alkane = 0.0818/0.0117 = 7 alkane = C_7H_{16} ✓	4	**ALLOW** 3SF up to calculator value of 0.08180595142, correctly rounded **ALLOW ECF** from incorrect *n*

Question			Answer	Marks	Guidance
	(d)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **IF** answer = +215 (kJ mol^{-1}) award 2 marks **IF** answer = –215 (kJ mol^{-1}) award 1 mark --- RHS (–2877 + (2 × –2058) = (–)6993 (kJ mol^{-1}) ✓ ($\Delta_r H$ =) –6778 + (+6993) = +215 (kJ mol^{-1}) ✓	2	 **IGNORE** incorrect sign at this stage **Sign required** for final answer
			Total	11	

Question			Answer	Marks	Guidance
6	(a)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** All/most points covered and clearly linked. Must have points taken across all of the headings in the indicative points for Level 3. *The explanations show a well-developed line of reasoning linked to appropriate suggestions which is clear and logically structured. The compromises are relevant and well thought out and clearly linked to the explanations.* **Level 2 (3–4 marks)** Suggests correct conditions with explanations **OR** comments on compromises with reference to yield **AND** rate effect. *The explanations are linked to appropriate suggestions and show a line of reasoning with some structure. The compromises are relevant but may not be clearly linked to the explanation.* **Level 1 (1–2 marks)** Comments on conditions with some explanation **OR** comments on compromise with reference to yield **OR** rate. *The comments about yield/rate with explanation are basic and communicated in an unstructured way. The compromises may not be relevant with lack of reasoning.* **0 marks** No response or no response worthy of credit.	**6**	**Indicative scientific points may include** <u>Yield</u> • Increasing pressure increases yield of SO_3 • Decreasing temperature increases yield of SO_3 <u>Explanation</u> • (pressure) more moles/molecules on the reactant side **ORA** • (temp.) the forward reaction is exothermic **ORA** <u>Rate</u> • Increasing pressure increases rate • Increasing temperature increases rate <u>Compromise</u> • Choose a higher temperature which creates a reduced yield but in a shorter space of time **IGNORE** reference to increase pressure leading to safety/cost issues

Question			Answer	Marks	Guidance
	(b)	**(i)**	Time plotted along *x*-axis **AND** sensible scale that uses most of graph paper **AND** both axes labelled ✓ Points plotted accurately ✓ Correct curve of best fit ✓	**3**	
		(ii)	Evidence of tangent drawn correctly on the graph from the origin ✓ $(0.023/25) = 9.2 \times 10^{-4}$ (mol dm^{-3} s^{-1}) ✓	**2**	**ALLOW** answer between 8×10^{-4} and 1×10^{-3} **ALLOW** answer from line drawn through origin and data point at 50 s: $0.024/50 = 4.8 \times 10^{-4}$
		(iii)	(Differ) initial gradient steeper **AND** (Same) curve reaches same height ✓	**1**	Look on graph paper for this answer
	(c)	**(i)**	The catalyst/vanadium(V) oxide/V_2O_5 is solid while the reactants are gases, so the catalyst is in a different state from the reactants. ✓	**1**	
		(ii)	catalysts lower the energy demand for a reaction **OR** less combustion of fossil fuels and therefore lower carbon dioxide emissions **OR** Allows different reactions to take place with greater atom economy/less waste **OR** Allows less toxic chemicals to be used ✓	**1**	

Question			Answer	Marks	Guidance
		(iii)	*Boltzmann distribution (2 marks)*  Correct drawing of a Boltzmann distribution i.e. curve must start within the first small square nearest to the origin **AND** must not touch the *x*-axis at high energy ✓ axes labelled (number of) molecules and (kinetic) energy ✓ *Explanation (2 marks)* Catalyst (provides an alternative route) **AND** with a lower activation energy ✓ (With a catalyst) more molecules have energy above activation energy	**4**	Candidates do not need E_a on graph **IGNORE** a slight inflexion on the curve **DO NOT ALLOW** two curves **ALLOW** particles instead of molecules on *y*-axis **DO NOT ALLOW** enthalpy for *x*-axis label **DO NOT ALLOW** atoms instead of particles or molecules **ALLOW ECF** for the subsequent use of atoms (instead of molecules or particles) **ALLOW** annotations on Boltzmann distribution diagram **IGNORE** more molecules have enough energy to react (as not linked to E_a) **ORA** if states the effect with no catalyst **IGNORE** (more) successful collisions

Question	Answer	Marks	Guidance
	OR greater area under curve above the activation energy ✓		
	Total	**18**	

Question	Answer	Marks	Guidance
7*	*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Candidate provides a method for identifying the alcohols **AND** provides all supporting evidence from IR spectrum **AND** gives details of reagents and conditions and correct equations *The explanation is detailed and well structured. The information is clearly supported by details of reactions and evidence of oxidation product.* **Level 2 (3–4 marks)** Candidate provides a basic method **AND** provides some supporting evidence from IR spectrum **AND** gives details of reagents and conditions with some attempt at equations *The explanation has some structure. The information is supported by some details of reactions and evidence from IR spectrum.* **Level 1 (1–2 marks)** Candidate attempts to describe a basic method **AND** gives some supporting evidence from IR spectrum **OR** details of reagents and conditions with some attempt at equations *The explanation is basic and lacks structure. The information is supported by limited evidence from the reactions and oxidation*	**6**	**Indicative scientific points may include** **Identification of alcohols** Based on recognition of alcohols as primary, secondary and tertiary (stated or implied by method). Basic procedure involves reflux followed by use of IR to identify different oxidation products. **Reactions** • Stated reagents ($H^+/Cr_2O_7^{2-}$ and conditions (reflux) • equations using [O] including structural formulae $CH_3CH_2CHOHCH_3 + [O] \rightarrow CH_3CH_2COCH_3 + H_2O$ $CH_3CH_2CH_2CH_2OH + 2[O] \rightarrow CH_3CH_2CH_2COOH + H_2O$ **Identification of oxidation product** • IR: carboxylic acid from broad OH absorption and C=O • IR: carbonyl/ketone from C=O and no OH • tertiary alcohol from lack of C=O and OH peak in IR **OR** no colour change in reflux

Question			Answer	Marks	Guidance
			products and would not lead to identification. **0 marks** No response or no response worthy of credit.		
			Total	**6**	