Mark Scheme (Results)

January 2019

BTEC Level 3 National in Applied Science
Unit 5: Principles and Applications of Science II – Chemistry (31627H/1C)

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Unit 5: Principles and Applications of Science II – sample marking grid

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

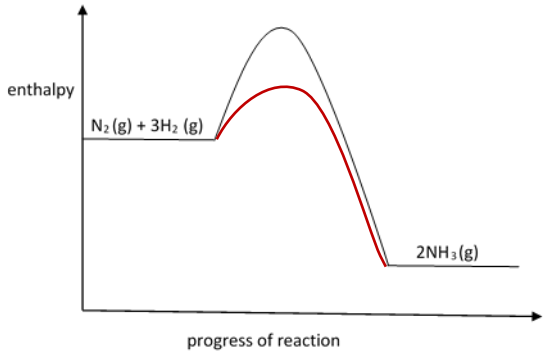
The marking grids have been designed to assess learner work holistically.
Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

Section B – Properties and uses of substances

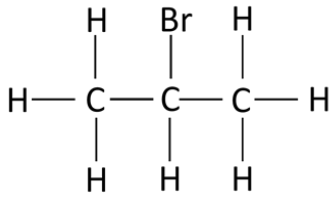
Question Number	Answer	Additional Guidance	Mark
1 (a)	D Al_2O_3		1
1 (b)(i)	B Cryolite		1
1 (b)(ii)	Award **one** mark for reason and **one** additional mark for appropriate expansion. dissolving lowers the melting point (1) less energy is required (by the process) / more (energy) efficient / cost reduction (1) OR melting point is high/over 2000°C (1) requires a large amount of energy / more (energy) efficient / cost reduction (1)	 Ignore reference to the solvent and aluminium Ignore ions can move / carry the electrical current Ignore speed / safety / environment	2
1 (c)	$Al^{3+} + 3e^- \rightarrow Al$ (2) Or MP1 – equation shows Al with positive charge <u>and</u> e (with negative charge) (1) MP2 – charge of 3+ on Al <u>and</u> 3 in front of e (1)	Allow "3+" written besides Al, but reject subscripts Allow e with no charge Max 1 mark if number of Al particles on LHS and RHS do not match	2

1 (d)	oxygen (forms at positive electrode / anode) (1) (the electrode) {burns/decomposes/disintegrates/ erodes}/ forms carbon dioxide (1)	Ignore reference to type of oxygen particle Reject oxide Allow reacts (with oxygen) Allow $C + O_2 \rightarrow CO_2$ (2)	2
		total	8 marks

Question Number	Answer	Additional Guidance	Mark
2 (a)		Curve must start at reactant level and finish on product level, maximum of curve must be lower than and within the uncatalysed curve	1
2 (b)	Identification point: speeds up the reaction / the rate of reaction increases (1) Any three explanation points from the following: the catalyst provides alternative pathway (of lower activation energy) (1) provides a surface for the particles to react upon (1) bonds within the reactant particles are weakened (1) so more particles have the necessary activation energy (1) leading to more successful collisions / reactions per unit time (1) the reaction can be performed at a lower temperature (1) this requires less energy / is more efficient / is cheaper / is more sustainable (1)	 Allow equilibrium reached quicker Ignore not used up or changes yield Ignore lowering activation energy Allow adsorption / desorption of molecules on catalyst Allow reduce energy use / save energy	4
		total	5 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	hydrogen is formed at the cathode/ hydrogen ions go to the cathode (1) chlorine is formed at the anode / chloride ions go to the anode (1) sodium hydroxide is left behind / is in the {solution/water} / remains in the cell (1) Accept other valid description.	Allow negative electrode Allow positive electrode Allow sodium hydroxide at the cathode / cathode compartment Ignore sodium hydroxide at the anode or at the membrane / diaphragm	3
3 (b)	The enthalpy change when 1 mole of ions in the gaseous / gas state are dissolved in water to infinite dilution under standard conditions (100 kPa and 298 K) (2) or gaseous / gas (1) 100 (1)		2
3 (c)	reverse sign of –760 in calculation (1) summation of –418 and –338 in calculation (1) evaluation (1) (+)4	Award all 3 marks for (+)4 Allow – –760 or (+)760 +760 – 418 – 338 (2) Allow 2 marks for –4 Allow 2 marks for (–)1516 (–) 840 (–) 680	3

3 (d)(i)	Conversion (1) 200 g water to 0.2 kg Substitution (1) 0.2 x 4.18 x 2.5 Evaluation (1) 2.09 (kJ)	Award all 3 marks for 2.09 (kJ) Allow correct conversion at any point in calculation Allow rounding to 2.1 Allow 2 marks for 2090 Max 2 marks for factor of 10 error Ignore sign	3
3 (d)(ii)	Award **one** mark for any of the following: (c) is kJ mol^{-1} and (d)(i) is kJ / different units used (1) literature values used for calculation in 3(c) are under standard conditions / at 25°C (but the practical is not) / different conditions used (1) literature values used for calculation are for 1 mole of sodium chloride (but the practical is not) (1)	ORA Ignore reasons based calculation or experimental error	1
		total	12 marks

Question Number	Answer	Additional Guidance	Mark
4 (a)	breaks the <u>bromine</u> bond / homolytic (bond) fission of bromine (molecule) (1) free radical(s) form / each (bromine) atom has {an unpaired / a single} electron (1)	Accept equation Br-Br → 2Br• (2) (1 mark for breaking Br-Br bond) (1 mark for bromine free radical being formed)	2
4 (b)(i)		Accept bromine pointing down on middle carbon	1
4 (b)(ii)	B It has an asymmetrical structure		1
4 (b)(iii)	A 1-bromopropane		1

4 (b)(iv)	Identification point: Carbocation A is less stable / carbocation B is more stable (1) Any **three** explanation points from the following: carbocation B has more alkyl groups than carbocation A (1) Alkyl branches {donate/ push} electrons to C+ (1) more electrons are donated to C+ in carbocation B (1) electrons (are negative so) {stabilise / balance / reduce} {positive charge / carbocation} (1) more chance of carbocation B reacting than carbocation A (1) ORA	Allow more methyl groups / R groups / carbons on C+ in carbocation B Allow A is a primary carbocation, B is a secondary carbocation	4
		total	9 marks

Question number	Indicative content
5	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content, but learners should be rewarded for other relevant answers. **Advantages of hydration** • All reactants used up to form ethanol • No waste product of CO_2 contributing to acid rain or global warming • Raw material water is readily abundant/easy to obtain • Higher temperature so quicker reaction • Inorganic catalyst so more resistant to high temperatures • Continuous reaction so is more efficient / recycle unused reactants • Purer product as no other product formed **Disadvantages of hydration** • Reversible reaction so will not get 100% yield of ethanol • Lower yield than by fermentation so less efficient • Ethene from crude oil / fossil fuels so non-renewable / environmental pollution • Cracking / fractional distillation of oil requires energy • Higher temperature so greater energy consumption / greater cost • Strong acid catalyst so safety considerations

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made. Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported. The discussion shows some structure and coherence
Level 2	3–4	Good analysis, interpretation and/or evaluation of the scientific information. Lines of argument mostly supported through the application of relevant evidence. The discussion shows a structure which is mostly clear, coherent and logical.
Level 3	5–6	Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information. Line(s) of argument consistently supported throughout by sustained application of relevant evidence. The discussion shows a well-developed structure which is clear, coherent and logical.

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