Mark Scheme (Results)

June 2019

Pearson BTEC Level 3 National Diploma in Applied Science

Unit 5: Principles and Applications of Science II (Chemistry)

Chemistry

SECTION B: PROPERTIES AND USES OF SUBSTANCES

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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.

BTEC Next Generation Mark Scheme Template

Applied Science Unit 5 Chemistry 1906

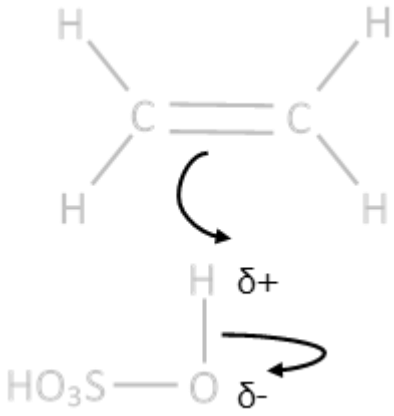
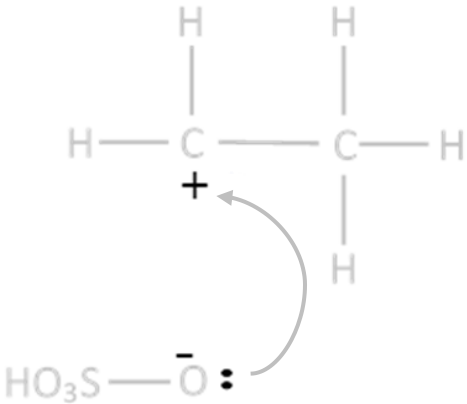
Question Number	Answer	Additional Guidance	Mark
1 (a)	Any **one** from: • lightweight / low density • malleable (can be shaped into the joint) • resistant to corrosion • non-toxic • high melting point • unreactive (in human body) • durable / resists fatigue • can resist high energy forces Accept any other valid response.	ignore conductivity, boiling point, ductile allow promote tissue / osseo integration, biocompatible	1
1 (b)(i)	**D** magnesium		1

1 (b)(ii)	Award **one** mark for an identification and **one** additional mark for an appropriate related expansion. Identification: {oxygen / nitrogen / water} in the air (1) Award **one** mark for any of the following expansion points: reacts with {titanium / titanium(IV) chloride} (1) makes titanium brittle (due to oxygen contaminants) (1) expansion mark is independent of identification marking point above **OR** Identification: argon is (an) inert (gas) (1) Award **one** mark for any of the following expansion points: (argon) does not react with {titanium / titanium(IV) chloride} (1) titanium is not oxidised (1)	ignore carbon dioxide allow "air" in place of named gases ignore references to reaction with carbon / chlorine throughout	2

1 (b)(iii)	Award **one** mark for any of the following up to a maximum of two marks: electrolysis • {reduces the ore directly to its metal / has fewer stages} (1) • {gives a higher yield} (1) • {uses a lower temperature / has a lower energy requirement} (1) • {will use fewer chemicals / forms fewer waste products} (1) • {will give a purer product} (1) • {has a higher atom economy} (1) ORA	ignore references to speed, equipment, cost throughout	2
		total	6 marks

Question Number	Answer	Additional Guidance	Mark
2 (a)	C 		1
2 (b)(i)	combustion	allow oxidation ignore reference to complete / incomplete	1
2 (b)(ii)	releases heat / energy (from the system to the surroundings) (1) the temperature (of the surroundings) will rise / increase (1)	ignore reference to enthalpy allow gets hotter / warmer	2
2 (b)(iii)	substitution into equation: $-3509 = \Delta U + (100 \times 0.21)$ (1) rearrangement of equation: $\Delta U = -3509 - (100 \times 0.21)$ (1) evaluation (1) -3530 (kJ)	full marks are awarded if correct answer shown without working (-3530) allow mark for rearrangement using symbols if values are not shown $\Delta U = \Delta H - p\Delta V$ allow ECF throughout POT error gains 2 marks maximum incorrect sign gains 2 marks maximum	3
		total	7 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	Award **one** mark for any of the following: • sulfur trioxide is not formed from {its elements / from sulfur (with oxygen)} (1) • one mole of sulfur trioxide is not formed / two moles of sulfur trioxide are formed (1) • reaction is not done under standard conditions (1) • it is {an equilibrium/a reversible reaction} (so would not go to completion) (1)	ignore references to equation showing combustion	1
3 (a)(ii)	**D** vanadium(V) oxide		1
3 (b)	summation of enthalpy of formation for SO_3 and H_2O: -395 -286 (1) difference between summation of SO_3 and H_2O, and the enthalpy of formation of sulfuric acid: (395 + 286) – 811 (1) evaluation (1) -130 (kJ mol^{-1})	full marks are awarded if correct answer shown without working (-130) -681 ignore sign max of 2 marks if signs are incorrect / 681 sign not reversed incorrect sign gains 2 marks maximum allow ECF throughout	3

3 (c)(i)	**Step 1**  (2) if fully correct diagram not seen as above then award maximum of **one** mark for any one of the following: δ+ on H, δ- on O (1) **OR** curly arrow from double bond to (space above) H atom (1) **OR** curly arrow from O-H bond to O atom (1)	ignore other dipoles and lone pairs of electrons ignore clockwise / anticlockwise direction of curly arrows reject straight arrows reject arrow head pointing to H-O bond reject arrow from H atom to O atom	2
3 (c)(ii)	**Step 2**  (2) if fully correct diagram not seen as above then award maximum of **one** mark for any one of the following: positive charge on C (1) **OR** negative charge on O (1) **OR** lone pair of electrons on O and at start of curly arrow (1)	ignore other charges and lone pairs of electrons allow charges to be drawn anywhere around the C and O atoms respectively reject δ+ reject δ-	2

3 (d)	$Ca(OH)_2 + H_2SO_4 \rightarrow$ **$CaSO_4$ + $2H_2O$** (2) formulae of the products correct (1) balanced equation (1)	accept $Ca(OH)_2$ + **2**H_2SO_4 $\rightarrow$ **$Ca(HSO_4)_2$ + $2H_2O$** (2) Allow correct multiples in balancing	2
total			11 marks

Question Number	Answer	Additional Guidance	Mark
4 (a)	Award **one** mark for an identification and **two** additional marks for an appropriate related expansion. Identification: • a double bond is shorter than a single bond (1) Award up to **two** marks for the explanation of difference in length for any of the following: • there are more electrons {between the two carbon atoms / in a double bond} (1) • the electrons are attracted more strongly by the two nuclei (1) • (additional) sideways overlap between p orbitals in double bond (1) • this pulls the two carbon atoms closer together (1) expansion marks are independent of identification marking point above (but with no contradictory statements) ORA Accept any other valid response.	ignore any reference to bond strength ignore reference to pi and sigma bonds allow {overlap of p orbitals} to form pi bond / above and below the carbon atoms	3

4 (b)	Award **one** mark for an identification and **one** additional mark for an appropriate related expansion. general formula of alkenes in C_nH_{2n} (1) (if n = 6 then) C_6H_{12} (1) benzene has same number of hydrogens as carbons / general formula of benzene is C_nH_n (1) benzene does not have 12 hydrogen atoms / benzene does not have two hydrogens for every carbon (1)	allow if benzene were an alkene it would be C_6H_{12} for 2 marks allow {two / double the number of} hydrogens {for each/per} carbon ignore references to more / less / does not match throughout	2
4 (c)	**B** 120°		1

4 (d)	Award up to **four** marks for the description of sp^2 hybridisation for any of the following: • s and p orbitals (involved) • <u>one</u> s orbital and <u>two</u> p orbitals • s and p mix / combine / merge (to form orbital) • electron excitation / promotion / movement (from s to p orbital) • each orbital holds one / unpaired / single electron • energy level of s (orbital) increases • energy level of p (orbital) decreases • (hybrid) orbitals are all the same energy • one / spare p orbital {is unchanged / stays the same} • <u>three</u> (sp^2 hybrid) orbitals are formed • (hybrid orbitals are all the) same shape / same size / identical • hybrid orbitals are at an angle of 120^o to each other / arranged in a trigonal planar shape Accept any other valid response.	ignore reference to number in front of s and p, or subshells allow s and p form (new) orbital ignore rearrange, overlap, join allow hybrid orbital / s orbital / p orbital allow credit for annotated diagrams eg electron-in-boxes, bond angles	4
		total	10 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. **Purification and extraction steps:** • Bayer process is used • bauxite is ground up / crushed • reacted with an alkali / NaOH • conditions are concentrated alkali, under pressure, high temperature • a slurry forms • alumina and silica dissolve, iron(III) oxide does not dissolve • impurities / red mud filtered off • solution cooled and seeded with aluminium hydroxide / acid added to solution • aluminium hydroxide precipitates / crystallises, silica remains dissolved • aluminium hydroxide filtered off • aluminium hydroxide heated in a kiln to produce alumina **Chemical principles:** • alumina is amphoteric / has acid-base character / equations shown • $Al_2O_3 + 6OH^- + 3H_2O \rightarrow 2Al(OH)_6^{3-}$ or similar equation for reaction with sodium hydroxide • alumina and acidic oxides {react with / dissolve} in alkali, basic oxides {do not react / are insoluble} in alkali • link conditions to increase rate of reaction (ie increase surface area of bauxite, high concentration of alkali, high temperature / pressure) • filtration to remove insoluble / soluble {impurities/product} • aluminium hydroxide added to act as nucleus for precipitation / crystallisation • $Al(OH)_6^{3-} + 3H^+ \rightarrow Al(OH)_3 + 3H_2O$ or similar equation for addition of acid • heating evaporates off water / $2Al(OH)_3 \rightarrow Al_2O_3 + H_2O$ or similar

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	• Demonstrates adequate knowledge of scientific facts/concepts with generalised comments made. • Generic statements may be presented rather than linkages being made between extraction and use with properties so that lines of reasoning are unsupported or partially supported. • The explanation shows some structure and coherence.
Level 2	3–4	• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific knowledge facts/concepts to provide the discussion being presented. • Lines of argument mostly supported through the application of relevant evidence. • The explanation shows a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts/concepts to provide the discussion being presented. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence. • The explanation shows a well-developed structure which is clear, coherent and logical.

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