



Pearson



## Mark Scheme (Results)

June 2018

BTEC Level 3 National in Applied  
Science

Unit 5: Principles and Applications of  
Science II – Chemistry (31627H1C)



## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at [www.edexcel.com](http://www.edexcel.com) or [www.btec.co.uk](http://www.btec.co.uk) for our BTEC qualifications.

Alternatively, you can get in touch with us using the details on our contact us page at [www.edexcel.com/contactus](http://www.edexcel.com/contactus).

If you have any subject specific questions about this specification that require the help of a subject specialist, you can speak directly to the subject team at Pearson. Their contact details can be found on this link: [www.edexcel.com/teachingservices](http://www.edexcel.com/teachingservices).

You can also use our online Ask the Expert service at [www.edexcel.com/ask](http://www.edexcel.com/ask). You will need an Edexcel username and password to access this service.

## **Pearson: helping people progress, everywhere**

Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

June 2018

Publications Code 31627H\_1806\_MS

All the material in this publication is copyright

© Pearson Education Ltd 2018

# 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.

Question Number	Answer	Additional Guidance	Mark						
1a	D 109.5°		1						
1b	A 2-bromobutane		1						
1ci	$  \begin{array}{c}  \text{H} \quad \text{CH}_3 \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{CH}_3 \\    \quad   \\  \text{Br} \quad \text{Br}  \end{array}  $ <p style="text-align: right;">(2)</p> <p>Or</p> $\text{CH}_2\text{BrCBr}(\text{CH}_3)_2 \quad (2)$ <p>Br on C-1 and C-2 atoms (1)</p> <p>Rest of molecule correct (1)</p>	allow any combination of displayed / shortened structural formulae	2						
1cii	electrophilic (1) addition (1)		2						
1ciii	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 30%;"><math>\sigma</math> (sigma)</th> <th style="width: 30%;"><math>\pi</math> (pi)</th> </tr> </thead> <tbody> <tr> <td>C</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> </tbody> </table>		$\sigma$ (sigma)	$\pi$ (pi)	C	1	1		1
	$\sigma$ (sigma)	$\pi$ (pi)							
C	1	1							
1d	<p>Explanation linking any three from:</p> <ul style="list-style-type: none"> <li>• Only a single (carbon to carbon) bond in ethane / ethene has a double (carbon to carbon) bond (1)</li> <li>• (Carbon to carbon bond in ethane is) longer (1)</li> <li>• (Carbon to carbon bond in ethane is) weaker / easier to break (1)</li> <li>• (Carbon to carbon bond in ethane needs) less energy to break (1)</li> <li>• More electrons are shared between the two carbon atoms in ethene (1)</li> <li>• Stronger attraction (between the carbon atoms in ethene) (1)</li> </ul> <p>Accept any other appropriate response</p>	<p>Allow only sigma in ethane / sigma and pi in ethene/ C=C in ethene</p> <p>Allow ORA throughout</p>	3						
total			10 marks						

Question Number	Answer	Additional Guidance	Mark
2a	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$  Chemical formulae of chloride (on LHS) and chlorine (on RHS) (1)  Balancing of species, electrons and charges (1)	allow $2\text{Cl}^- - 2\text{e}^- \rightarrow \text{Cl}_2$  Ignore state symbols  Allow multiples	2
2b	Award one mark for each of the following up to a maximum of 4 marks: <ul style="list-style-type: none"> <li>• Membrane keeps chlorine (gas) separate from {hydrogen (gas) / sodium hydroxide} (1)</li> <li>• Chlorine will not be able to react with {hydrogen / sodium hydroxide} (1)</li> <li>• Membrane allows {Na<sup>+</sup> / positive ions / cations} to pass through (1)</li> <li>• Membrane does not allow {Cl<sup>-</sup> / negative ions / anions} to pass through (1)</li> <li>• The sodium hydroxide solution is not contaminated with chloride ions (1)</li> <li>• This gives sodium hydroxide solution that is has {higher purity/ fewer impurities} (1)</li> </ul>	Allow to keep {gases / products} separate  Allow to prevent {gases / products} from reacting  Allow sodium ions  Allow chloride ions  Do not allow keep sodium chloride separate from sodium hydroxide  Allow pure / not impure	4
total			6 marks

Question Number	Answer	Additional Guidance	Mark
3a	Award one mark for each of the following up to a maximum of 3 marks: <ul style="list-style-type: none"> <li>• Speeds up a reaction (1)</li> <li>• Provides an alternative pathway/route (1)</li> <li>• (With a) lower activation energy (1)</li> <li>• (Transition metals) change oxidation state / gain and lose electrons / have a variable oxidation state (1)</li> <li>• Returns to original oxidation state at end of reaction (1)</li> <li>• Provide a surface for the reaction to take place on (1)</li> </ul>		3
3b	<ul style="list-style-type: none"> <li>• Lone pair of electrons donated / dative covalent bond (1)</li> <li>• From water / ligand / oxygen (atom) to vanadium(III) (ion) (1)</li> </ul>		2
total			5 marks

Question Number	Answer	Additional Guidance	Mark
4a	$C_nH_{2n+2}$ (1)		1
4b	$C_3H_8 \rightarrow C_2H_4 + CH_4$ (2) or $C_2H_4$ (1) $CH_4$ (1)	allow multiples accept $CH_3CH_2CH_3 \rightarrow CH_2CH_2 + CH_4$	2
4c	Award one mark for each of the following up to a maximum of 2 marks: <ul style="list-style-type: none"> <li>• (Produces more product in) less time (1)</li> <li>• Use of lower temperature / less energy (1)</li> <li>• Conserves fossil fuels / energy (1)</li> <li>• Does not react with ethene to form undesired product / no unwanted side reactions (1)</li> <li>• Produces higher yields of alkanes (1)</li> <li>• Can reuse the catalyst (1)</li> <li>• Only requires small amounts of catalyst (1)</li> </ul> Any other valid point.	ORA for steam throughout	2
total			5 marks

Question Number	Answer	Additional Guidance	Mark
5a	(the enthalpy change) when 1 mole (of a substance) {is combusted / burnt} (1)  completely {in oxygen} (1)	Allow element / compound  Allow "excess"  Ignore reference to standard conditions / conditions	2
5bi	(298-273 =) 25 (1)	Accept any answer that would round to 25	1
5bii	award 5 marks for -127.3 seen alone  calculation for 4 mols of C / 4 $\Delta H$ (carbon): 4 x -393.7 (= - 1574.8) (1)  calculation for 5 mols of H <sub>2</sub> / 5 $\Delta H$ (hydrogen): 5 x - 285.8 (= - 1429) (1)  Summation of values: 4 $\Delta H$ (carbon) + 5 $\Delta H$ (hydrogen) (= -3003.8) (1)  Difference between values 4 $\Delta H$ (carbon) + 5 $\Delta H$ (hydrogen) - $\Delta H$ (butane) (= -1574.8 -1429 +2876.5) (1)  Evaluation: -127.3 correct answer (1)	Ignore sign  Ignore sign  ECF  ECF  Accept any value between -126.8 to -127.5  ECF	5



Question number	Indicative content	
5c	<p>Reaction 1</p> <ul style="list-style-type: none"> <li>• exothermic</li> <li>• energy is released to surroundings from system / energy lost as heat / temperature of surroundings will rise</li> <li>• products have less energy than reactants / lower energy (level) than reactants</li> <li>• (overall) negative enthalpy change / <math>\Delta H = -ve</math></li> <li>• more energy is released when forming bonds than used when breaking bonds</li> <li>• activation energy is less for reaction 1 than for reaction 2</li> <li>• reaction 1 would be expected to be faster</li> <li>• net output energy of reaction provides activation energy to continue reaction</li> </ul> <p>Reaction 2</p> <ul style="list-style-type: none"> <li>• endothermic</li> <li>• energy is absorbed by the system from the surroundings / heat transferred from the surroundings / temperature of surroundings will fall</li> <li>• products have more energy than reactants / higher energy (level) than reactants</li> <li>• (overall) positive enthalpy change / <math>\Delta H = +ve</math></li> <li>• less energy is released when forming bonds than used when breaking bonds</li> <li>• activation energy is greater for reaction 2 than for reaction 1</li> <li>• reaction 2 would be expected to be slower</li> <li>• net input of energy required to provide activation energy to continue reaction</li> </ul>	6
<p><b>Mark scheme (award up to 6 marks)</b> refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.</p>		

<b>Level</b>	<b>Mark</b>	<b>Descriptor</b>
	0	No awardable content
<b>Level 1</b>	1-2	<ul style="list-style-type: none"> <li>• Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made</li> <li>• Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported</li> <li>• The explanation shows some structure and coherence</li> </ul>
<b>Level 2</b>	3-4	<ul style="list-style-type: none"> <li>• Good analysis, interpretation and/or evaluation of the scientific information</li> <li>• Lines of argument mostly supported through the application of relevant evidence</li> <li>• The explanation shows a structure which is mostly clear, coherent and logical</li> </ul>
<b>Level 3</b>	5-6	<ul style="list-style-type: none"> <li>• Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information</li> <li>• Line(s) of argument consistently supported throughout by sustained application of relevant evidence</li> <li>• The explanation shows a well-developed structure which is clear, coherent and logical</li> </ul>

For more information on Edexcel qualifications, please visit our website  
[www.edexcel.com](http://www.edexcel.com)

Pearson Education Limited. Registered company number 872828  
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Ofqual  




Llywodraeth Cymru  
Welsh Assembly Government

