Mark Scheme (Results)

Summer 2017

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 2C

Pearson Edexcel Level 1/Level 2 Certificate
in Chemistry (KCH0 2C)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. 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 or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. 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

Summer 2017
Publications Code 4CH0_2C_1706_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td>C (4)

The only correct answer is C

A is not correct because there are 4 elements shown not 2

B is not correct because there are 4 elements shown not 3

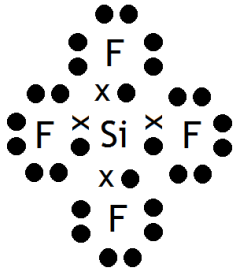
D is not correct because there are 4 elements shown not 5</td><td></td><td>1</td></tr>
<tr><td>(b)</td><td>2 NaOH + (1) H_2SO_4 → (1) Na_2SO_4 + 2 H_2O</td><td>Accept fractions and multiples</td><td>1</td></tr>
<tr><td>(c)</td><td><table>
<tr><td>brine is a solution of sodium chloride in water</td><td>✓</td></tr>
<tr><td>the temperature used in the contact process is greater than 1000˚C</td><td></td></tr>
<tr><td>an equation for the contact process is $SO_2 + H_2O \rightarrow H_2SO_4$</td><td></td></tr>
<tr><td>the reactions in the diaphragm cell are displacement reactions</td><td></td></tr>
<tr><td>the catalyst used in the contact process is vanadium(V) oxide</td><td>✓</td></tr>
</table></td><td>3 ticks with 2 correct scores 1

3 ticks with 1 correct scores 0

4 or 5 ticks scores 0</td><td>2</td></tr>
<tr><td></td><td></td><td>Total</td><td>4</td></tr>
</table>

Question number	Answer	Notes	Marks
2 (a)	**D (3 periods and 8 groups)** **The only correct answer is D** A is not correct because there are 3 periods and 8 groups shown not 2 periods and 4 groups B is not correct because there are 3 periods and 8 groups shown not 3 periods and 4 groups C is not correct because there are 3 periods and 8 groups shown not 2 periods and 8 groups		1
(b)	**B (2)** **The only correct answer is B** A is not correct because there are 2 noble gases shown not 1 C is not correct because there are 2 noble gases shown not 3 D is not correct because there are 2 noble gases shown not 4		1

Question number	Answer	Notes	Marks
(c)	**C (MgF_2)** **The only correct answer is C** A is not correct because MgF is not the correct formula for magnesium fluoride B is not correct because Mg_2F is not the correct formula for magnesium fluoride D is not correct because Mg_2F_2 is not the correct formula for magnesium fluoride		1
(d)	**M1** $(28 \times 0.922) + (29 \times 0.047) + (30 \times 0.031)$ OR 28.109 **M2** 28.1	**ACCEPT** $\frac{(28 \times 92.2) + (29 \times 4.7) + (30 \times 3.1)}{100}$ Answer must be to one decimal place Correct final answer with no working scores 2	2

Question number	Answer	Notes	Marks
(e)		**M1** all four Si-F bonding pairs **M2** all 24 non-bonding electrons **M2** DEP on **M1** **ALLOW** any combination of dots and crosses If overlapping/touching circles used both electrons must be within the overlapping/touching area **IGNORE** inner shell electrons even if incorrect	2

Question number	Answer	Notes	Marks
2 (f) (i)	**M1** intermolecular forces (of attraction) / forces (of attraction) between molecules	**ALLOW** intermolecular bonds/van der Waals forces/London forces/dispersion forces/instantaneous dipole-induced dipole forces	2
	M2 stronger in $SiCl_4$ /weaker in SiF_4	**ACCEPT** more energy is required to overcome the forces in $SiCl_4$ (or reverse argument) **M2** DEP on **M1** **ACCEPT** attraction between $SiCl_4$ molecules is greater (than that between SiF_4 molecules) or reverse argument for 2 marks Award 0/2 if any reference to breaking covalent bonds	
(ii)	**M1** SiO_2 has strong covalent bonds (that must be broken)	**ACCEPT** strong intramolecular bonds/forces **ACCEPT** strong bonds between the atoms **REJECT** any mention of intermolecular forces or ionic bonding	2
	M2 (whereas) $SiCl_4$ has weak intermolecular forces (of attraction must be overcome)	**ALLOW** intermolecular bonds/van der Waals forces/London forces/dispersion forces/instantaneous dipole-induced dipole forces **ACCEPT** more energy required to break covalent bonds in SiO_2 than is required to overcome intermolecular forces (of attraction) in $SiCl_4$ for 2 marks	
		Total	**11**

Question number	Answer	Notes	Marks
3 (a)	electrons	**ACCEPT** e^- or e	1
(b)	not (chemically) reactive / does not react (with the electrolytes/with the products of electrolysis)	**ALLOW** unreactive **ALLOW** non-reactive **IGNORE** references to full outer shell of electrons	1
(c)	**M1** $PbBr_2$ needs to be molten/liquid/melted **M2** so that the ions can flow/move/are mobile	**ACCEPT** solid $PbBr_2$ does not conduct **ACCEPT** the ions cannot flow/move/are not mobile in the solid **IGNORE** references to carry charge **REJECT** references to electrons moving	2
(d) (i)	(positive) chlorine AND oxygen (negative) hydrogen	**ACCEPT** Cl_2 for chlorine and O_2 for oxygen **ACCEPT** names in any order **ACCEPT** H_2 If both name and formula given, mark name only	2
(ii)	**M1** $2Cl^- \rightarrow Cl_2 + 2e^{(-)}$ **M2** $2H_2O \rightarrow 4H^+ + O_2 + 4e^{(-)}$ **M3** $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ **MARK EQUATIONS INDEPENDENTLY OF ANSWERS GIVEN IN 3(d)(i)**	**ACCEPT** $2Cl^- - 2e^{(-)} \rightarrow Cl_2$ **ALLOW** $4OH^- \rightarrow 2H_2O + O_2 + 4e^{(-)}$ **ALLOW** $2H^+ + 2e^{(-)} \rightarrow H_2$ **ACCEPT** multiples/fractions in half-equations	3
(e)	**M1** n[Cu] = 0.04(0) ÷ 2 OR 0.02(0) (mol) **M2** mass[Cu] = 1.3 (g) **OR M1** x 63.5 correctly evaluated	 **ACCEPT** 1.27 (g) **ACCEPT** 1.28 (g) using 64 instead of 63.5 Correct final answer with no working scores 2	2
		Total	**11**

Question number	Answer	Notes	Marks
4 (a) (i)	**M1** A **and** B **and** C **M2** (they/all) contain only carbon and hydrogen (atoms)	**ACCEPT** formulae copied from table **ACCEPT** C and H **ACCEPT** words with same meaning as only, eg solely, exclusively, just etc **ACCEPT** particles/elements in place of atoms **REJECT** ions/molecules/compounds in place of atoms **REJECT** element/mixture in place of they/all **REJECT** H_2 **IGNORE** D has Cl/another element as well	2
(ii)	**M1** B **M2** (because) it shows all the bonds (in the molecule)	**ACCEPT** converse argument about (all) the others	2

Question number	Answer	Notes	Marks
4 (b)	**(reaction 1):** **Any two from:** **M1** (it produces) pure(r) ethanol/alcohol/product **M2** (it is a) fast(er) (reaction) **M3** (it has a) greater atom economy **M4** no carbon dioxide produced (so less pollution) **(reaction 2):** **Any two from:** **M5** (it) uses renewable/sustainable resources / does not use finite resources **M6** (it) uses atmospheric pressure / (it) does not need high pressure / (it) works at low pressures **M7** (it) works at low/just above room temperature / (it) does not need much heat (energy)	**IGNORE** more concentrated **ALLOW** does not need further processing **IGNORE** no waste products **ALLOW** no greenhouse gas produced **ACCEPT** can be used in countries with no oil reserves/with available land /with suitable climate to grow sugar cane **ALLOW** 30 to 40 °C **ACCEPT** thermal energy **IGNORE** references to batch and continuous processes **IGNORE** references to lower cost	4

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>4 (c) (i)</td><td>but-2-ene</td><td>ACCEPT 2-butene or 2-butylene

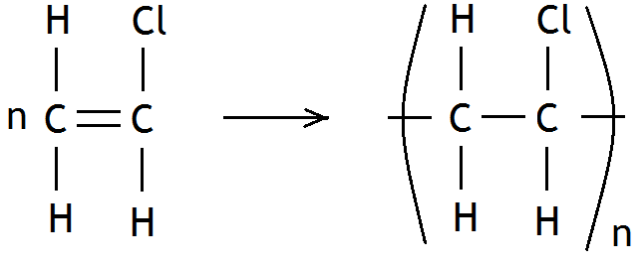
ACCEPT butene or butylene or but-1-ene for 1 mark</td><td>2</td></tr>
<tr><td>(ii)</td><td>colourless</td><td>IGNORE clear
IGNORE starting colour even if incorrect</td><td>1</td></tr>
<tr><td>(d) (i)</td><td>M1 (compounds/molecules that have the) same molecular formula/contain the same number of each type of atom

M2 (but have) different structural formulae</td><td>ACCEPT both have molecular formula C_4H_8
REJECT elements for compounds/molecules once only

ACCEPT different structures /different displayed formulae / atoms arranged differently</td><td>2</td></tr>
<tr><td>(ii)</td><td><table><tr><td>addition</td><td>✓</td></tr><tr><td>dehydration</td><td></td></tr><tr><td>hydration</td><td>✓</td></tr><tr><td>oxidation</td><td></td></tr><tr><td>reduction</td><td></td></tr></table></td><td>3 ticks with 2 correct scores 1

3 ticks with 1 correct scores 0

4 or 5 ticks scores 0</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
4 (e) (i)	poly(chloroethene)	Do not penalise missing brackets or spaces in name **ACCEPT** polyvinyl chloride	1
(ii)		**M1** displayed formula of chloroethene (on left) **M2** at least one correct repeat unit drawn as a displayed formula **and** continuation bonds **M3** balancing using n (or equivalent) on left and n on right **M3** DEP on **M1** and **M2** **ACCEPT** n anywhere before the monomer and anywhere after the brackets, but not before	3
		Total	**19**

Question number	Answer	Notes	Marks
5 (a) (i)	$CH_3OH + O_2 \rightarrow CO + 2\,H_2O$ **M1** all formulae correct **M2** correctly balanced	**ACCEPT** multiples and fractions **M2** DEP on **M1**	2
(ii)	thermal energy/heat (energy) lost to the surroundings/environment	**ACCEPT** lost to atmosphere/beaker/thermometer **ACCEPT** evaporation of water/methanol	1

Question number	Answer	Notes	Marks
5 (b) (i)	**M1** (Q =) 125 × 4.2 × 36		2
	M2 = 18 900 (J) /19 000 (J)	**ACCEPT** answer in kJ if unit included Correct final answer with no working scores 2 **ALLOW** one mark for 1.5 x 4.2 x 36 = 226.8 **ALLOW** one mark for 126.5 x 4.2 x 36 = 19 126.8	
(ii)	**M1** mass[CH_3OH] = 84.7 – 83.2 **OR** 1.5 (g)		4
	M2 n[CH_3OH] = 1.5 ÷ 32 **OR** 0.046875 (mol)	**ACCEPT** any number of sig fig except 1, eg 0.047	
	OR M1 ÷ 32		
	M3 ΔH = 18 900 ÷ **M2** OR 403 200 (J/mol)	**ACCEPT M2** from (b)(i) ÷ **M2** from (b)(ii) **ACCEPT** any number of sig fig	
	M4 ΔH = – 400 (kJ/mol)	**ACCEPT** any number of sig fig, eg 403, 403.2	
		Negative sign must be included	
		(+) 400/403/403.2 etc scores 3	
		Mark CSQ throughout	
		Correct final answer with no working scores 4	

Alternative Method

Question number	Answer	Notes	Marks
5 (b) (ii)	**M1** mass[CH_3OH] = 84.7 – 83.2 **OR** 1.5 (g) **M2** 18 900 ÷ 1.5 OR 12 600 **OR** 18 900 ÷ **M1** **M3** ΔH = 12 600 x 32 **OR** 403 200 (J) **M4** ΔH = – 400 (kJ/mol)	 **ACCEPT** any number of sig fig except 1, eg 0.047 **ACCEPT M2** from (b)(i) ÷ **M2** from (b)(ii) **ACCEPT** any number of sig fig **ACCEPT** any number of sig fig, eg 403, 403.2 Negative sign must be included (+) 400/403/403.2 etc scores 3 **Mark CSQ throughout** Correct final answer with no working scores 4	4

Question number	Answer	Notes	Marks
5 (b) (iii)	**M1** oxygen/other reactant missing from methanol **M2** product level / carbon dioxide and water above reactant level	 **ACCEPT** product level should be below reactant level **ACCEPT** answers shown on diagram **IGNORE** references to activation energy **IGNORE** references to missing x-axis	2

Question number	Answer	Notes	Marks
5 (c)	**Route 1:** **M1** Σ(bonds broken) = (412 × 3) + 360 + 463 + (496 × 1.5) OR 2803 (kJ/mol) **M2** Σ(bonds made)= (743 x 2) + (463 x 4) OR 3338 (kJ/mol) **Route 2:** **M1** Σ(bonds broken) = (412 × 3) + 360 + (496 × 1.5) OR 2340 (kJ/mol) **M2** Σ(bonds made) = (743 x 2) + (463 x 3) OR 2875 (kJ/mol) **M3** Correct calculation of **difference** between **M1** and **M2** **M4** If **M2** > **M1** final answer must be negative If **M2** < **M1** final answer must be positive	 **IGNORE** negative sign **IGNORE** negative sign **IGNORE** sign Expected final answer is -535 Positive sign not required If a clear statement is made that the reaction is exothermic, then sign can be negative Correct final answer with no working scores 4	4
		Total	**15**

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom