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)

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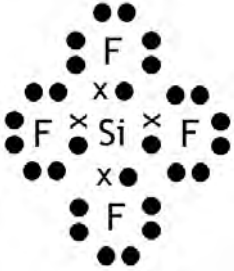
General Marking Guidance

- 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, t**he team leader must be consulted.

- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Notes	Marks
1 (a)	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		1
(b)	2 NaOH + (1) H_2SO_4 → (1) Na_2SO_4 + 2 H_2O	Accept fractions and multiples	1
(c)	<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 $SO_2 + H_2O$ → 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>	3 ticks with 2 correct scores 1 3 ticks with 1 correct scores 0 4 or 5 ticks scores 0	2
		Total	4

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 $\dfrac{(28 \times 92.2) + (29 \times 4.7) + (30 \times 3.1)}{100}$ 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

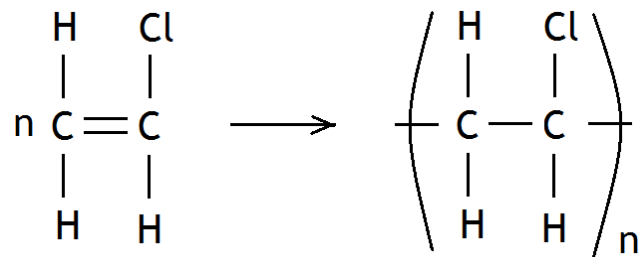| Question number	Answer	Notes	Marks
2 (f) (i)	M1 intermolecular forces (of attraction) / forces (of attraction) between molecules	ALLOW intermolecular bonds/van der Waals forces/London forces/dispersion forces/instantaneous dipole-induced dipole forces	2
	M2 stronger in $SiCl_4$ /weaker in SiF_4	ACCEPT 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	ACCEPT formulae copied from table	2
			M2 (they/all) contain only carbon and hydrogen (atoms)	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	
		(ii)	M1 B		2
			M2 (because) it shows all the bonds (in the molecule)	ACCEPT converse argument about (all) the others	

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

Question number			Answer	Notes	Marks
4	(c)	(i)	but-2-ene	ACCEPT 2-butene or 2-butylene ACCEPT butene or butylene or but-1-ene for 1 mark	2
		(ii)	colourless	IGNORE clear IGNORE starting colour even if incorrect	1
	(d)	(i)	M1 (compounds/molecules that have the) same molecular formula/contain the same number of each type of atom M2 (but have) different structural formulae	ACCEPT both have molecular formula C_4H_8 REJECT elements for compounds/molecules once only ACCEPT different structures /different displayed formulae / atoms arranged differently	2
		(ii)	<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>	3 ticks with 2 correct scores 1 3 ticks with 1 correct scores 0 4 or 5 ticks scores 0	2

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)	$CH_3OH + O_2 \rightarrow CO + 2H_2O$ 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) OR M1 ÷ 32	ACCEPT any number of sig fig except 1, eg 0.047	
	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		2
			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	

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