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Mark Scheme (Results)

Summer 2015

GCE Chemistry (6CH01/01)
The Core Principles of Chemistry

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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, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Section A (multiple choice)

Question Number	Correct Answer	Reject	Mark
1	B		1

Question Number	Correct Answer	Reject	Mark
2	C		1

Question Number	Correct Answer	Reject	Mark
3	D		1

Question Number	Correct Answer	Reject	Mark
4	C		1

Question Number	Correct Answer	Reject	Mark
5	B		1

Question Number	Correct Answer	Reject	Mark
6(a)	C		1

Question Number	Correct Answer	Reject	Mark
6(b)	A		1

Question Number	Correct Answer	Reject	Mark
6(c)	A		1

Question Number	Correct Answer	Reject	Mark
7(a)	C		1

Question Number	Correct Answer	Reject	Mark
7(b)	B		1

Question Number	Correct Answer	Reject	Mark
8	D		1

Question Number	Correct Answer	Reject	Mark
9	D		1

Question Number	Correct Answer	Reject	Mark
10	B		1

Question Number	Correct Answer	Reject	Mark
11	A		1

Question Number	Correct Answer	Reject	Mark
12	D		1

Question Number	Correct Answer	Reject	Mark
13	B		1

Question Number	Correct Answer	Reject	Mark
14(a)	D		1

Question Number	Correct Answer	Reject	Mark
14(b)	B		1

Question Number	Correct Answer	Reject	Mark
15	A		1

Question Number	Correct Answer	Reject	Mark
16	A		1

TOTAL FOR SECTION A = 20 MARKS

Section B

Question Number	Acceptable Answers	Reject	Mark
17(a)	(Atoms/elements/isotopes with) the same number of protons (and electrons) **and** different numbers of neutrons ALLOW answers in terms of bromine isotopes, 35 protons **and** 44 or 46 neutrons. IGNORE different number of nucleons IGNORE same atomic number but different mass number		1

Question Number	Acceptable Answers	Reject	Mark
17(b)(i)	(High energy) **electrons** are 'fired' at/ **Electrons** bombard/Use of an '**electron** gun' (1) (result in) loss of electron/electrons (thus forming an ion) This can be shown in an equation $X + e \rightarrow X^+ + 2e$ OR $X \rightarrow X^+ + e$ (1) Stand alone marks	Magnetic field (0) Forms an anion	2

Question Number	Acceptable Answers	Reject	Mark
17(b)(ii)	Magnet/Magnetic field/Electromagnet	Electric field Magnetic shield Magnetic radiation	1

Question Number	Acceptable Answers	Reject	Mark
17(b)(iii)	Particles (of gas/air) will interfere with the movement of the **ions**/collide with the **ions**/deflect **ions** OR Additional peaks will be detected/peaks at incorrect m/e IGNORE references to chemical reactions	Atoms for ions	1

Question Number	Acceptable Answers	Reject	Mark
17(c)	**Marking point 1** Twin peaks of about the same height at 79 and 81 (1) **Marking point 2** Twin peaks of about the same height at 158 and 162 (1) **Marking point 3** Peak at 160 (1) **Marking point 4** Peak at 160 approximately twice the height of the peaks at 158 and 162 (1) IGNORE **Small** peak at 80 which could be due to Br_2^{2+} (79-81) In MPs 1 and 2 penalise height difference once only		4

Question Number	Acceptable Answers	Reject	Mark
17(d)	$\left(\frac{47 \times 79) + (53 \times 81)}{100}\right) = 80.06$ (1) (answer =) 80.1 (1) Correct final answer without working scores (2) No TE on incorrect expression	Incorrect units of mass/%	2

Question Number	Acceptable Answers	Reject	Mark
17(e)	The (m/e) value would be **halved**	Peak half as high	1

Question Number	Acceptable Answers	Reject	Mark
17(f)(i)	Any two from: Sample kept sealed/ tamper-proof (1) Sample stored and labelled clearly (1) Sample stored in preservative/sample tested immediately after being taken (1) Sample kept under temperature control (1) Monitor sample is being taken from named competitor (1) Check that other non-banned substances do not give similar mass spectrometry result (1) Analysis repeated (to confirm result)/ Multiple samples taken/ Sample divided into two and tested at different times/ locations (1) Container/equipment sterile/cleaned (1) Run a control sample/ compare to a sample without drugs (1) Sampling to take place immediately after event (1) Precautions need to be **actions/activities** that are carried out and not just a statement that something must or must not happen but **how** this is ensured or prevented There will likely be other suggestions in addition to those given above which can be given credit if they are reasonable actions	References to medication being taken Just 'no contamination'	2

Question Number	Acceptable Answers	Reject	Mark
17(f)(ii)	Health concerns/depression/bursts of anger/ acts of violence/heart attack/strokes/liver damage/masculine features in women/ harmful side effects Allow any suitable health concern	Just 'Fear of being banned/prosecuted' Just 'side effects'	1

Question Number	Acceptable Answers	Reject	Mark
17(g)	Any suitable use such as: RAM/RMM calculations/Relative isotopic mass calculations/Space probes/ Pharmaceutical purity/testing of new pharmaceuticals/Age of rocks from Helium content/ Identification of unknown substances/ Carbon dating/Radioactive dating	Alcohol testing C-12 dating	1

TOTAL FOR QUESTION 17 = 16 MARKS

Question Number	Acceptable Answers	Reject	Mark
18(a)	C_nH_{2n} ALLOW any letter for n	C_2H_{2n} C_nH_{2n+2}	1

Question Number	Acceptable Answers	Reject	Mark
18(b)	Either one of the following options: $CH_2CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$ 1,2-dibromoethane OR $CH_3CHCH_2 + Br_2 \rightarrow CH_3CHBrCH_2Br$ 1,2-dibromopropane **Marking Point 1** Correct reactant – ethene or propene (1) **Marking Point 2** Correct product from the number of carbon atoms in the reactant (1) **Marking Point 3** Correct name from the number of carbon atoms in the reactant (1) IGNORE punctuation on product ALLOW displayed/ skeletal formulae Penalise molecular formula of product only No TE on name if product incorrect		3

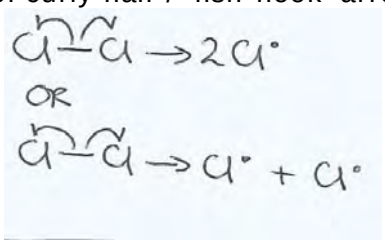
Question Number	Acceptable Answers	Reject	Mark
18(c)(i)	(Error 1) the dipole on the chlorine molecule should be the other way round (1) (Error 2) the arrow should be going from the double bond (to the chlorine)/electrons move from the double bond to the chlorine (1) (Error 3) the chlorine should have a **negative** charge (and a lone pair) (1)	Chlorine molecule	3

Question Number	Acceptable Answers	Reject	Mark
18(c)(ii)	Because **tertiary** carbocation is more stable (than a primary carbocation) OR the positive carbon has more **positively-inductive**/ **electron-releasing** alkyl groups (to help stabilization than the other carbon of the double bond) IGNORE references to carbon only having three bonds or being electron deficient	Just Secondary carbocation	1

Question Number	Acceptable Answers	Reject	Mark
18(d)	 OR  (1)  (1)		2

Question Number	Acceptable Answers	Reject	Mark
18(e)	Same molecular formula/same number of atoms/same amount of each element but different (Structural) arrangement (of atoms)/ structure/ structural formulae/ displayed formulae/ skeletal formulae	 'in space'	1

Question Number	Acceptable Answers	Reject	Mark
18(f)(i)	Ultraviolet (radiation)/ UV (radiation) / (Sun) light	High temperature	1

Question Number	Acceptable Answers	Reject	Mark
18(f)(ii)	Cl-Cl →2Cl● OR Cl-Cl →Cl● + Cl● (1) Correct use of curly half / 'fish-hook' arrows (1)  Curly half arrows can start from anywhere on the bond and extend beyond the Cl The half arrows can be above or below the bond or a combination of the two.		2

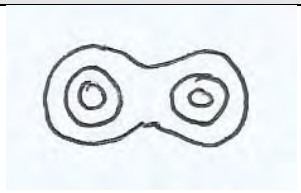
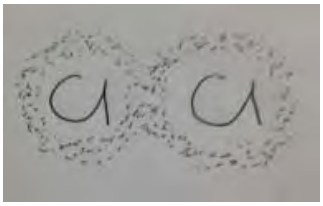
Question Number	Acceptable Answers	Reject	Mark
18(f)(iii)	(First propagation step) $C_4H_8 + Cl\bullet \rightarrow HCl + C_4H_7\bullet$ (1) (Second propagation step) $C_4H_7\bullet + Cl_2 \rightarrow C_4H_7Cl + Cl\bullet$ (1) The position of ● is not essential Penalise lack of ● once only	Reference to H/ H● scores (0)	2

Question Number	Acceptable Answers	Reject	Mark
18(f)(iv)	Homolytic/ homolytic fission/ homolytic bond fission		1

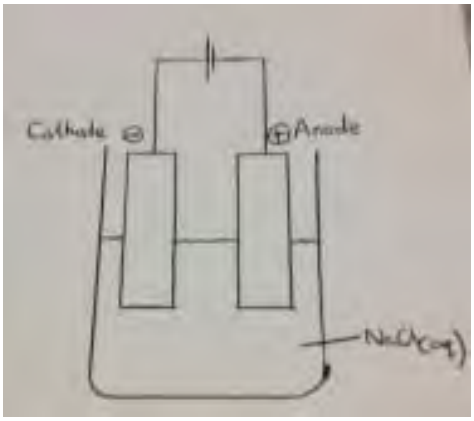
Question Number	Acceptable Answers	Reject	Mark
18(f)(v)	**Marking point 1** **Two** free radicals are combining/reacting with each other/suitable termination equation (1) **Marking point 2** The product is a stable species/No free radicals produced/ The product is not a free radical/ Concentration of free radicals decreases / lowers the number of radicals (1)		2

Question Number	Acceptable Answers	Reject	Mark
18(g)	Further substitution/polysubstitution can occur OR Other products such as $C_4H_6Cl_2$/ $C_4H_5Cl_3$ **COMMENT:** ALLOW Forms C_4Cl_8		1

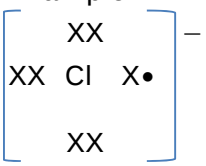
(TOTAL FOR QUESTION 18 =20 MARKS)

Question Number	Acceptable Answers	Reject	Mark
19(a)	 Drawing must have at least 1 circle around each chlorine atom OR  Random dots to indicate electron density around both chlorine atoms and a concentrated area between the atoms		**1**

Question Number	Acceptable Answers	Reject	Mark
19(b)	(Electrostatic) **attraction** between oppositely charged ions IGNORE comments on the formation of ions		**1**

Question Number	Acceptable Answers	Reject	Mark
19(c)	**Marking point 1** Either Diagram of U-tube / beaker with electrodes and sodium chloride solution OR Diagram of microscope slide with electrodes attached and either filter paper soaked in sodium chloride solution or dampened/wet filter paper on the top of the slide with the sample added (in the centre) (1) **Marking point 2** Suitable circuit (1) If electrodes labelled ± or named they must be consistent with the cell For example the following would not score this marking point:  **Marking point 3** Ammeter/ light bulb showing conductivity OR Chlorine (gas) evolved/ Test for chlorine/hydrogen (gas) evolved/Test for hydrogen (1) ALLOW any other reasonable electrolysis apparatus that would work to show ionic bonding. For MP3 if the electrode at which the gas is	Sodium electrode Sodium formed	**3**

	evolved is stated then it must have the correct sign or charge, although it is not necessary to name or give a sign for the electrode, ie chlorine at the electrode with a positive sign and hydrogen at the electrode with a negative sign. Use of other ionic compounds can only score MP2		

Question Number	Acceptable Answers	Reject	Mark
19(d)(i)	Correct dot and cross diagram with charge Example  ALLOW all dots or all crosses IGNORE any sodium dot and cross diagram		**1**

Question Number	Acceptable Answers	Reject	Mark
19(d)(ii)	(Isoelectronic example) $S^{2-}/S^{-2}/P^{3-}/P^{-3}$	$Si^{4-}/K^{+}/Ca^{2+}$/Ar	**1**

Question Number	Acceptable Answers	Reject	Mark
19(e)	**Marking point 1** Sodium conducts when solid (and liquid/molten) (1) **Marking point 2** Sodium chloride conducts when molten (and in solution but not as a solid) (1) **Marking point 3** Charge carriers in sodium are (delocalised) electrons but ions in sodium chloride OR Conductivity in sodium due to the movement of (delocalised) electrons but the movement of ions in sodium chloride (1)	Sodium in solution/dissolved	**3**

(TOTAL FOR QUESTION 19 = 10 MARKS)

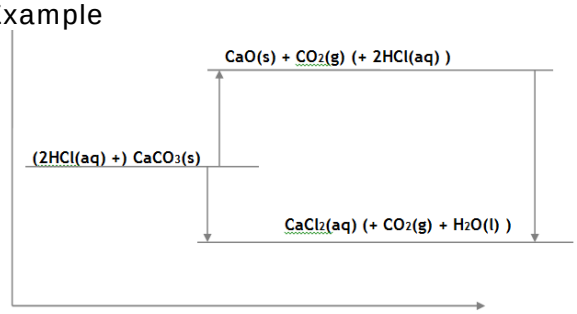
Question Number	Acceptable Answers	Reject	Mark
20(a)	(50 x 4.18 x 15.5 =) 3239.5 (J) IGNORE any sign given ALLOW 3.2395 kJ (units are essential for this answer)		**1**

Question Number	Acceptable Answers	Reject	Mark
20(b)	(1.46 ÷ 56.1 =) 0.026025.. (mol) (1) (ΔH = 3.2395 ÷ 0.026025 = −124.47…) −124 kJ mol^{-1} (1) OR (1.46 ÷ 56.1 =) 0.0260 (mol) (1) (ΔH = 3.2395 ÷ 0.0260 = −124.596154) −125 kJ mol^{-1} (1) ALLOW the use of CaO = 56 = (−124.255 kJ mol^{-1}) −124 kJ mol^{-1} ALLOW TE from answer to (a)	+ sign	**2**

Question Number	Acceptable Answers	Reject	Mark
20(c)(i)	Any three reasons from: Heat/energy loss (to the surroundings / to the apparatus)/ Lack of lid/no lid/ heat capacity of the cup not taken into account/heat capacity of the cup is not zero (1) Inaccuracy of thermometer/temperature readings (1) Impure CaO/Absorbed moisture from the air (1) Heat capacity is not 4.18/ the mass of solution is not 50 g/ density of solution is not 1 g cm^{-3} (1) IGNORE non-standard conditions/ stirring/human error/incomplete transfer of solid	Incomplete reaction Just 'heat lost to the thermometer'	**3**

Question Number	Acceptable Answers	Reject	Mark
20(c)(ii)	**Marking point 1** (Q=(250 x 4.18 x 25) = 26125(J) OR (26125 ÷ 1000 =) 26.125 (kJ) (1) **Marking point 2** (n = 26.125 ÷ 196.8 =) 0.132749 (mol) (1) **Marking point 3** Mass = (0.132749 x 56.1 =) 7.4472189 = 7.45 (g) (1) ALLOW (0.132749 x 56 =) 7.433944 = 7.43 (g) Correct answer alone scores 3 marks	7.5	3

Question Number	Acceptable Answers	Reject	Mark
20(d)(i)	**Marking point 1** Arrow downwards from $CaCO_3$ to the box, with 2HCl((aq)) alongside (1) **Marking point 2** Correct entities and states in box $CaCl_2(aq) + H_2O(l) + CO_2(g)$ (1) **Marking point 3** Correct use of Hess' Law ($\Delta H = \Delta H_{CaCO3} - \Delta H_{CaO}$) e.g. $-18.8 - -196.8 =$ (1) **Marking point 4** $\Delta H = +178$(kJ mol^{-1}) (1)		4

Question Number	Acceptable Answers	Reject	Mark
20(d)(ii)	Products on line below $CaCO_3(s)$ with both arrows going down from $CaCO_3$ and CaO Example  ALLOW the word 'products' for formulae		1

(Total for Question 20 = 14 marks)

TOTAL FOR SECTION B = 60 MARKS
TOTAL FOR PAPER = 80 MARKS