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Mark Scheme (Results)

June 2014

International GCE Chemistry (6CH01/01R)
Unit 1: 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

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Section A (multiple choice)

Question Number	Correct Answer	Reject	Mark
1	A		1

Question Number	Correct Answer	Reject	Mark
2	D		1

Question Number	Correct Answer	Reject	Mark
3	B		1

Question Number	Correct Answer	Reject	Mark
4	D		1

Question Number	Correct Answer	Reject	Mark
5	A		1

Question Number	Correct Answer	Reject	Mark
6	D		1

Question Number	Correct Answer	Reject	Mark
7	B		1

Question Number	Correct Answer	Reject	Mark
8	C		1

Question Number	Correct Answer	Reject	Mark
9	B		1

Question Number	Correct Answer	Reject	Mark
10	A		1

Question Number	Correct Answer	Reject	Mark
11	A		1

Question Number	Correct Answer	Reject	Mark
12	C		1

Question Number	Correct Answer	Reject	Mark
13	A		1

Question Number	Correct Answer	Reject	Mark
14	C		1

Question Number	Correct Answer	Reject	Mark
15	C		1

Question Number	Correct Answer	Reject	Mark
16(a)	B		1

Question Number	Correct Answer	Reject	Mark
16(b)	C		1

Question Number	Correct Answer	Reject	Mark
16(c)	B		1

Question Number	Correct Answer	Reject	Mark
17	C		1

Question Number	Correct Answer	Reject	Mark
18	D		1

Section B

Question Number	Acceptable Answers	Reject	Mark
19(a)(i)	B **acceleration** **(1)** C **deflection** **(1)** Allow B ions are accelerated/ accelerating C ions are (being) deflected	B just electric field C just magnetic field	2

Question Number	Acceptable Answers	Reject	Mark
19(a)(ii)	(A_r for K) = (39 x 0.9322) + (40 x 0.0012) + (41 x 0.0666) or a correct fraction using percentages **(1)** = 39.1344 = 39.13 **(1)** Correct answer without working scores 2 Max 1 if not to 2 decimal places Second mark dependent on first IGNORE Units of any kind (e.g. 'g', 'g mol^{-1}', 'amu', etc.)		2

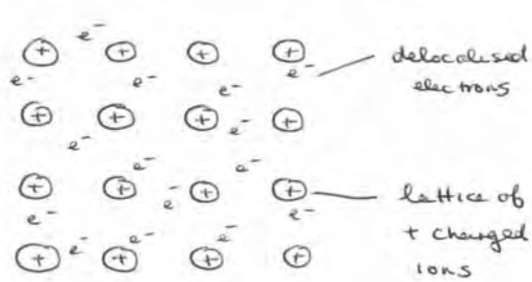
Question Number	Acceptable Answers	Reject	Mark
19(a)(iii)	see table below		1

Isotope	Electrons	Protons	Neutrons
^{39}K	19	19	20
^{41}K	19	19	22

Question Number	Acceptable Answers	Reject	Mark
19(a) (iv)	($1s^2$) $2s^2 2p^6$ $3s^2 3p^6$ $4s^1$ Fully correct Ignore additional $1s^2$		1

Question Number	Acceptable Answers	Reject	Mark
19(a)(v)	(Position in the Periodic Table) depends upon atomic number / proton number OR Ar (atom) has (one) fewer proton(s) (than K atom) OR K (atom) has (one) more proton(s) (than Ar atom) OR K has atomic number 19 (whereas) Ar has atomic number 18 OR Ar has 18 protons, K has 19 protons IGNORE 'Elements are not arranged in order of (relative) atomic mass' IGNORE Mention of numbers of electrons / numbers of shells (of electrons) IGNORE Arranged in vertical groups in accordance to properties / argon is a noble gas		1

Question Number	Acceptable Answers	Reject	Mark
19(a) (vi)	One fewer shell of electrons **(1)** Electrons in the ion are held more tightly OR Same number of protons attracting fewer electrons OR Less repulsion between (remaining) electrons **(1)** IGNORE References to effective nuclear charge / charge density		2

Question Number	Acceptable Answers	Reject	Mark
19(b)	Regular lattice of singly-positively charged (potassium) ions **(1)** Delocalised electrons / sea of electrons / mobile electrons **(1)** e.g.  Accept other regular arrangements Unlabelled diagram max (1)		2

Question Number	Acceptable Answers	Reject	Mark
19(c)(i)	**First mark:-** Makes mention of energy/enthalpy/(heat) energy/heat (change) AND to remove an electron **(1)** **Second mark:** one mole/1 mol **(1)** **Third mark:** Makes mention of **gaseous atom(s)** **(1)** **ALTERNATIVE ANSWER** Energy change per mole for **(1)** $X(g) \rightarrow X^{+}(g) + e^{(-)}$ **(2)** One mark for species One mark for correct state symbols Mark independently IGNORE any references to standard conditions	"Energy **given out**…" for first mark **Just** 'gaseous element'/ 'gaseous substance'	3

Question Number	Acceptable Answers	Reject	Mark
19(c)(ii)	Potassium is E **(1)** Alkali metals always have the lowest first ionization energy in their period OR It follows a noble gas/ an element with very high first ionization energy OR Ionization energy falls (significantly) at the start of a (new) period / Ionization energy falls (significantly) after **D** **(1)**		2

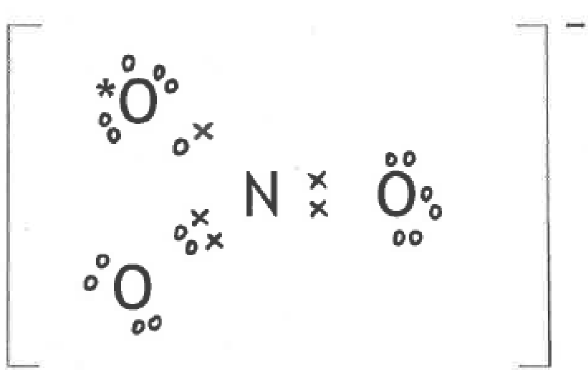
Total for Q19 = 16 marks

Question Number	Acceptable Answers	Reject	Mark
20(a)	**1st Mark** Mol CuO = (5.60/79.5) = 0.07044 / 0.0704 / 0.070 / 0.07 **(1)** **2nd Mark** Mol of nitric acid = (50 x 2.50/1000) = 0.125 **(1)** **3rd Mark** Reacting ratio =2:1 and nitric acid less than double moles of copper oxide/ Reacting ratio =2:1 and copper oxide more than half of moles of nitric acid OR moles acid needed to react with all CuO = (2 x 0.070 =) 0.140 which is more than 0.125 OR 0.125 mol nitric acid can only react with 0.0625 mol CuO **(1)**		3

Question Number	Acceptable Answers	Reject	Mark
20(b)	**1st Mark** Moles product = 0.5 x 0.125 =0.0625 **(1)** Allow TE from moles HNO_3 **2nd Mark** Theoretical yield = (0.0625 x 295.6 =) 18.475 g **(1)** Allow ECF on multiplying moles product by 295.6 **3rd Mark** % yield = (12.52/18.475 x 100) = 67.767 / 67.8 / 68 **(1)** **Alternative route for 2nd and 3rd Marks** mol product = (12.52 / 295.6) = 0.04235 **(1)** % yield = (0.04235/0.0625 x 100 = 67.767 / 67.8/ 68 **(1)** TE from (a) If moles of product taken as 0.125, final answer = 33.88% which scores **(2)** TE for calculation based on moles of copper(II) oxide which gives an answer between 60.128% and 60.506% **max(2)**	4.24% scores **(0)** overall	3

Question Number	Acceptable Answers	Reject	Mark
20(c)	Some product remains in solution/ some product does not crystallize Allow loss of material on transferring, if explained, such as Crystals remain in / on filter paper 'Spitting' (of solution on heating) IGNORE References to impure reactants	Incomplete reaction Just experimental error 'solution evaporates'	1

Question Number	Acceptable Answers	Reject	Mark
20(d)(i)	Covalent bond: (shared pair of electrons using) one electron from each atom **(1)** Dative covalent bond: (shared pair of electrons using) two electrons from same atom **(1)**		2

Question Number	Acceptable Answers	Reject	Mark
20(d)(ii)	Double bond between N and one oxygen atom **(1)** Single bond **between N and O*** **(1)** Dative single bond between N and one O atom **(1)**  **Max 2 if any lone pair electrons are missing from any of the three oxygen atoms.**		3

Total for Q20 = 12 marks

Question Number	Acceptable Answers	Reject	Mark
21(a)	(Contains) **only** (C—C) single bonds/ **only** σ bond(s) OR (Contains) no (C=C) double bond(s)/no triple bond(s) OR Cannot undergo addition (reactions) ALLOW Has maximum number of hydrogen atoms / has maximum amount of hydrogen /can form no more bonds / no pi-bonds. IGNORE references to alkanes **(1)** (Compound of) carbon and hydrogen **ONLY/ENTIRELY/PURELY** **(1)**	 "**Mixture** of carbon and hydrogen only"	2

Question Number	Acceptable Answers	Reject	Mark
21(b)(i)	Measure mass (of cylinder) before and after (burning)		1

Question Number	Acceptable Answers	Reject	Mark
21(b)(ii)	Energy transferred = (100 x 4.18 x 27.1 =) 11327.8 (J) / 11.328 **kJ** Ignore SF except 1 SF		1

Question Number	Acceptable Answers	Reject	Mark
21(b)(iii)	Mol propane = 0.33/ 44 = 0.0075 **(1)** ΔH_c = (– 11.3278/ 0.0075) = (– 1510.4) = –1510 (kJ mol^{-1}) **(1)** Sign and 3SF **(1)** Allow TE from b(ii)		3

Question Number	Acceptable Answers	Reject	Mark
21(b)(iv)	Incomplete combustion Allow carbon monoxide forms soot forms Ignore references to specific heat capacity of the apparatus or evaporation **of propane**	Evaporation of water Transfer losses Not under standard conditions Not all the fuel burns	1

Question Number	Acceptable Answers	Reject	Mark
21(c)(i)	$C_3H_8(g)$ + **5**$O_2(g)$ → $3CO_2(g)$ + $4H_2O(g)$ + 6490 kJ mol^{-1} 3C**(g)** + 8H(g) + **10** O (g) Balancing **and** state symbol required		1

Question Number	Acceptable Answers	Reject	Mark
21(c)(ii)	Z = (6x C=O + 8xO-H = 4830 + 3712) = (+)8542 (kJ mol^{-1})		1

Question Number	Acceptable Answers	Reject	Mark
21(c)(iii)	ΔH_X = 6490 - 8542 = -2052 (kJ mol^{-1}) Allow TE from 21(c)(ii)		1

Question Number	Acceptable Answers	Reject	Mark
21(c)(iv)	Bond energy calculation based on $H_2O(g)$ OR $\Delta H_c^{\ominus}$ based on $H_2O(l)$ Allow Bond energy varies with environment/ mean bond energies do not equal actual bond energies for these reactants Ignore reference to standard conditions		1

Total for Q21 = 12 marks

Question Number	Acceptable Answers	Reject	Mark
22(a)	UV light/ ultraviolet light/ (sun) light / UV radiation IGNORE References to heat and or pressure.		1

Question Number	Acceptable Answers	Reject	Mark
22(b)	Species/ particle with **unpaired electron** Allow atom	Single electron	1

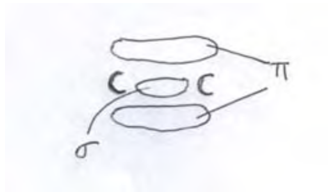
Question Number	Acceptable Answers	Reject	Mark
22(c)(i)	Cl-Cl bond is weaker than a C-H bond / breaks more easily than a C-H bond OR Reverse argument		1

Question Number	Acceptable Answers	Reject	Mark
22(c)(ii)	$CHCl_3 + \bullet Cl \rightarrow \bullet CCl_3 + HCl$ **(1)** $\bullet CCl_3 + Cl_2 \rightarrow CCl_4 + \bullet Cl$ **(1)** Max (1) if 2 equations based on methane.		2

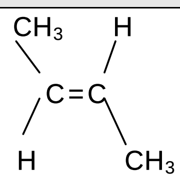
Question Number	Acceptable Answers	Reject	Mark
22(c)(iii)	$\bullet CCl_3 + \bullet Cl \rightarrow CCl_4$		1

Question Number	Acceptable Answers	Reject	Mark
22(d)	100% as only one product / 100% as no by product(s) / 100% as no waste product (formed)	**Just** “atom economy is **high(er)**” / no mention of 100%	1

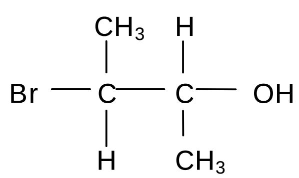
Total for Q22 = 7 marks

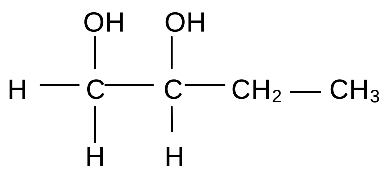
Question Number	Acceptable Answers	Reject	Mark
23(a)(i)	σ bond between C atoms **(1)** π bond above and below σ bond **(1)**  Max (1) if diagram is unlabelled.		2

Question Number	Acceptable Answers	Reject	Mark
23(a)(ii)	Good overlap of s orbitals in sigma bonds (1) p orbitals are parallel so poor overlap when π bonds form (1) OR Overlap of orbitals in sigma bond is along the line between the two nuclei (1) whereas, in the π bond, there is sideways overlap (1) Can be shown on a diagram		2

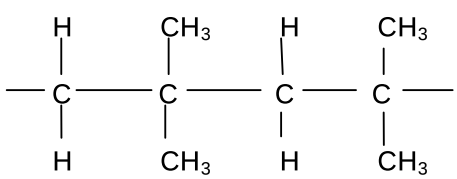
Question Number	Acceptable Answers	Reject	Mark
23(b)(i)	 *E*-but-2-ene Allow angles of 90^{o} between C=C and other bonds. Allow displayed or skeletal formula		1

Question Number	Acceptable Answers	Reject	Mark
23(b)(ii)	One C on the double bond has two of the same atoms/ two hydrogen atoms attached to it OR C on one end of double bond is not attached to two different atoms or groups Ignore references to restricted rotation about the C=C double bond		1

Question Number	Acceptable Answers	Reject	Mark
23(b)(iii)	(Bromine water goes from brown/ red-brown / yellow/ orange to) colourless OR (Bromine water is) decolorised **(1)**  Accept any orientation Allow addition of two Br atoms Allow un-displayed CH_3 and OH groups Allow skeletal or structural formula **(1)**	To ‘clear’ Molecular formula	2

Question Number	Acceptable Answers	Reject	Mark
23(c)	(Colour change purple/ purple-pink / pink to) colourless OR ($KMnO_4$ is) decolorised **(1)**  Accept any orientation Allow un-displayed CH_2CH_3 and OH groups, skeletal or structural formula **(1)**	To clear Molecular formula	2

Question Number	Acceptable Answers	Reject	Mark
23(d)(i)	(2-) methylprop(-1)ene	2- methylprop-**2**-ene	1

Question Number	Acceptable Answers	Reject	Mark
23(d)(ii)	 Allow methyl groups on C2 and C3 Allow complete polymer formula with square brackets and n		1

Question Number	Acceptable Answers	Reject	Mark
23(e)	Not sustainable as (polybutene) not made from a renewable resource / Not sustainable as made from non-renewable resource / not sustainable as made from crude oil / Not sustainable as crude oil is not renewable / Not sustainable as crude oil finite resource **IGNORE** References to non-biodegradability / long-lasting in use		1

Total for Q23 = 13 marks

TOTAL FOR PAPER = 80 MARKS

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