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Mark Scheme Summer 2009

GCE

GCE Chemistry (8CH01)

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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.

Using the mark scheme

1 / means that the responses are alternatives and either answer should receive full credit.

2 ( ) 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.

3 [ ] words inside square brackets are instructions or guidance for examiners.

4 Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

5 OWTTE means or words to that effect

6 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.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

· show clarity of expression

· construct and present coherent arguments

· demonstrate an effective use of grammar, punctuation and spelling.

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.

6CH01/01

Section A

Question Number	Correct Answer	Reject	Mark
1	A		**1**

Question Number	Correct Answer	Reject	Mark
2	C		**1**

Question Number	Correct Answer	Reject	Mark
3	C		**1**

Question Number	Correct Answer	Reject	Mark
4	B		**1**

Question Number	Correct Answer	Reject	Mark
5	D		**1**

Question Number	Correct Answer	Reject	Mark
6	B		**1**

Question Number	Correct Answer	Reject	Mark
7	B		**1**

Question Number	Correct Answer	Reject	Mark
8	D		**1**

Question Number	Correct Answer	Reject	Mark
9	A		**1**

Question Number	Correct Answer	Reject	Mark
10	A		**1**

Question Number	Correct Answer	Reject	Mark
11	B		**1**

Question Number	Correct Answer	Reject	Mark
12	A		**1**

Question Number	Correct Answer	Reject	Mark
13	C		**1**

Question Number	Correct Answer	Reject	Mark
14	B		**1**

Question Number	Correct Answer	Reject	Mark
15	A		**1**

Question Number	Correct Answer	Reject	Mark
16	B		**1**

Question Number	Correct Answer	Reject	Mark
17	D		**1**

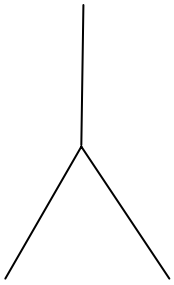
Question Number	Correct Answer	Reject	Mark
18	C		**1**

Question Number	Correct Answer	Reject	Mark
19	C		**1**

Question Number	Correct Answer	Reject	Mark
20	D		**1**

Section B

Question Number	Correct Answer	Reject	Mark
21 (a)(i)	Easier to transport / easier to store / less space / less volume needed for storage / easier to handle / easier to transfer *IGNORE* references to "safety" **Accept** Denser/cheaper to transport OWTTE	Just "cost"	**1**

Question Number	Correct Answer	Reject	Mark
21 (a)(ii)	**skeletal formula (1)**  **Name**: butane **(1)** Stand alone **skeletal formula (1)**  **Name**: methylpropane **OR** 2-methylpropane **(1)** *IGNORE* incorrect punctuation [e.g. extra/missing hyphens, etc.] Stand alone *IGNORE* displayed formulae if also given with skeletal formulae if 2 correct displayed formulae are given **max** 1 out of 2 for the structures		**4**

Question Number	Correct Answer	Reject	Mark
21 (a)(iii)	(Structural) isomers		**1**

Question Number	Correct Answer	Reject	Mark
21 (b)(i)	$Cl_2 \rightarrow Cl^{\bullet} + Cl^{\bullet}$ / $Cl_2 \rightarrow 2Cl^{\bullet}$ **(1)** (U.V.) light / sunlight **(1)** Must show the dots $^{\bullet}$ *IGNORE* any subsequent propagation steps in (b)(i)	 heat alone	**2**

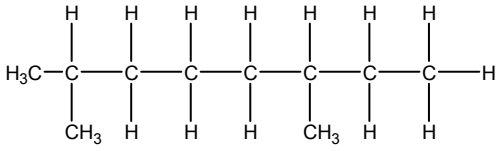
Question Number	Correct Answer	Reject	Mark
21 (b)(ii)	$C_3H_8 + Cl^{\bullet} \rightarrow C_3H_7^{\bullet} + HCl$ **(1)** $C_3H_7^{\bullet} + Cl_2 \rightarrow C_3H_7Cl + Cl^{\bullet}$ **(1)** Must show the dots $^{\bullet}$		**2**

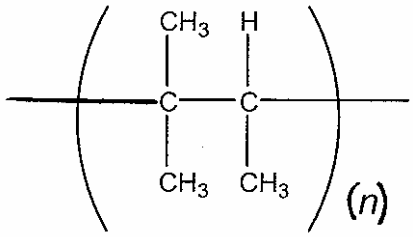
Question Number	Correct Answer	Reject	Mark
21 (b)(iii)	$C_3H_7^{\bullet} + Cl^{\bullet} \rightarrow C_3H_7Cl$ **OR** $Cl^{\bullet} + Cl^{\bullet} \rightarrow Cl_2$ **OR** $C_3H_7^{\bullet} + C_3H_7^{\bullet} \rightarrow C_6H_{14}$ Must show dots in termination step		**1**

Question Number	Correct Answer	Reject	Mark
21 (c)(i)	Alkene / triene **Accept** Diene Carbon-carbon double bond		**1**

Question Number	Correct Answer	Reject	Mark
21 (c)(ii)	**From:** Red / brown / orange / yellow or combinations of these colours **To:** colourless *both colours needed*	 “clear” instead of colourless	**1**

Question Number	Correct Answer	Reject	Mark
21 (c)(iii)	Electrophilic **(1)** addition **(1)**		**2**

Question Number	Correct Answer	Reject	Mark
21 (c)(iv)	**Calculation:** 0.01 mol myrcene reacts with 0.03 mol H_2 **OR** 1 mol myrcene reacts with 3 mol H_2 **(1)** **Structural formula**: $(CH_3)_2CH(CH_2)_3CH(CH_3)CH_2CH_3$ **OR**  **(1)** **Accept** Fully displayed formula/skeletal formula Mark calculation and structural formula **independently**.		**2**

Question Number	Correct Answer	Reject	Mark
21 (d)	 repeat unit **(1)** continuation bonds shown (but these bonds do not have to cut through the brackets) **(1)** ***n* not essential** *IGNORE* the position of "*n*" relative to the repeat unit (e.g. can be written as a superscript)		**2**

Question Number	Correct Answer	Reject	Mark
22 (a)(i)			**3**

Energy change	**Letter**	**Δ*H*/kJ mol^{-1}**
Lattice energy for sodium chloride	**E**	-775
Enthalpy change of atomization of sodium	**C**	+109
Enthalpy change of atomization of chlorine	**A**	+121
First ionization energy of sodium	**B**	+494
First electron affinity of chlorine	**F**	
Enthalpy change of formation of sodium chloride	**D**	-411

6 correct letters **(3)**
5 or 4 correct letters **(2)**
3 or 2 correct letters **(1)**
1 or 0 correct letters **(0)**

Question Number	Correct Answer	Reject	Mark
22 (a)(ii)	Expression such as: D = C + B + A + F + E - 411 = + 109 + 494 + 121 + F + (- 775) F = - 411 - 109 - 494 - 121 + 775 **(1)** Answer: F = −360 (kJ mol^{-1}) **(1)** *Check empty box in 22(a)(i), as answer may be written there.* Answer must follow from working Correct answer only **(2)** Correct answer with some consistent working **(2)**		**2**

Question Number	Correct Answer	Reject	Mark
22 (b)(i)	(Bonding in NaCl) 100% ionic **OR** almost completely ionic **OR** no covalent character/(very) little covalent character	'Molecule' **(0)**	**1**

Question Number	Correct Answer	Reject	Mark
22 (b)(ii) QWC	AgI has (a degree of) covalent character **(1)** due to polarization or distortion (of the anion) **(1)**		**2**

Question Number	Correct Answer	Reject	Mark
22 (c) **QWC**	Any **two** of the following: • (outermost) electron further from the nucleus/atoms get bigger/more shells • (outermost) electron more shielded (by inner shells of e^-) • (force of) attraction between nucleus and (outermost) electron decreases (down the Group) **OR** (outermost) electron held less strongly (down the Group) **OR** (outermost) electron becomes easier to remove (down the Group) *IGNORE* any references to(effective) nuclear charge or more protons.	**"ions"** get bigger (down Group)	**2**

Question Number	Correct Answer	Reject	Mark
23 (a)			**3**

element	structure	bonding
sodium	**Giant**	**metallic**
silicon	**Giant (atomic)/ macromolecular/ giant molecular**	**covalent**
sulfur	**simple / small molecules** **OR** **(simple) molecular** **OR** **S_8 molecules**	**covalent or van der Waals' forces/ London forces/ intermolecular forces/dispersion forces/induced-dipole forces**

IGNORE the word "lattice" **OR** "crystalline"

6 boxes correct (3)
5,4 boxes correct (2)
3,2 boxes correct (1)
1,0 boxes correct (0)

Question Number	Correct Answer	Reject	Mark
23 (b)	**Si** : covalent bonds / many bonds/ strong bonds (between atoms) **(1)** **S** : weak forces /van der Waals' forces/London forces/dispersion forces/intermolecular forces/induced-dipole forces **(1)** (need to be overcome)	any reference to **intermolecular forces in Si** suggestion that covalent bonds are broken	**2**

Question Number	Correct Answer	Reject	Mark
23 (c) **QWC**	Cations/ions decrease in size (from Na^+ to Al^{3+}) **OR** charge increases/charge density on (cat)ions increases/ "**effective** nuclear charge" increases (from Na^+ to Al^{3+}) **(1)** more e^- (per atom in 'sea' of delocalized electrons) / more delocalized electrons **OR** (force of) attraction between (cat)ions/nucleus and (delocalised) electrons increases (from Na to Al) **(1)** *IGNORE* "nuclear charge increases"/ "increasing no. of protons"	**atoms** decrease in size any mention of "molecules"/ "covalent bonds"/ "van der Waals' forces"/ "ionic bonds" **(0)** overall	**2**

Question Number	Correct Answer	Reject	Mark
23 (d)(i) QWC	• Add MgO to acid/react MgO with acid/dissolve MgO in acid **(1)** *[NOTE:* mention of heating not required. **IGNORE** water bath/reflux] • Filter **(1)** • **Heat/boil** filtrate /$MgSO_4$ solution (until volume reduced by half) **(1)** • Leave to cool/leave to crystallise/evaporate slowly/leave to evaporate **(1)** (decant / filter / pick out crystals, then) Leave to dry/pat dry/dry between filter papers/put in an oven/put in a desiccator/dry the crystals **(1)** *IGNORE* any washing of crystals immediately prior to drying them	Just **"warm"** the filtrate/$MgSO_4$ solution Use of a **desiccant** (added to crystals)	**5**

Question Number	Correct Answer	Reject	Mark
23 (d)(ii)	Rinse with (plenty of) water /use a damp cloth or damp (paper) towel / add a (named) weak alkali (e.g. solid or aqueous sodium hydrogencarbonate)	Any named strong alkali/just "strong alkali"	**1**

Question Number	Correct Answer	Reject	Mark
23 (e)(i)	**Insoluble strontium sulfate/insoluble $SrSO_4$** (forms on the strontium carbonate)		**1**

Question Number	Correct Answer	Reject	Mark
23 (e)(ii)	$Sr^{2+}(aq) + SO_4^{2-}(aq) \rightarrow SrSO_4(s)$ species **(1)** state symbols **(1)** **2nd mark is cq on first mark** $Sr^{2+}(aq) + 2Cl^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq) \rightarrow SrSO_4(s) + 2Cl^-(aq) + 2Na^+(aq)$ scores **(1)** $SrCl_2(aq) + Na_2SO_4(aq) \rightarrow SrSO_4(s) + 2NaCl(aq)$ scores **(1)**		**2**

Question Number	Correct Answer	Reject	Mark
24 (a)(i)	$\frac{2.90}{58} = 0.05(00)$ (mol) correct answer only **(1)**		**1**

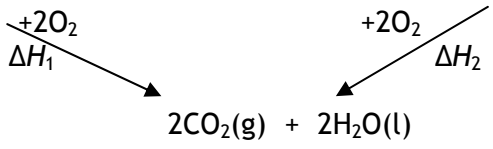
Question Number	Correct Answer	Reject	Mark
24 (a)(ii)	200 x 4.18 x **58.2** = 48655 (J) **OR** 48.655 kJ **(1)** for correct ΔT**(1)** *IGNORE* sf *IGNORE* signs at this stage		**2**

Question Number	Correct Answer	Reject	Mark
24 (a)(iii)	$-\frac{48655}{0.0500} = -973\ 100$ (J mol^{-1}) = −973 kJ mol^{-1} (3 s.f.) / −973000 J mol^{-1} (3 s.f.) answer **(1)** sign and units **(1)** [Do not award sign and units mark **if units given are just** "kJ" or **just** "J"] **three sig figs (1)** *CQ on (a)(i) & (ii)*		**3**

Question Number	Correct Answer	Reject	Mark
24 (b)(i)	Heat loss/energy loss **Accept** Incomplete combustion OWTTE *IGNORE* "experimental error"/ "departure from standard conditions"	Anything related to "average values" **(0)**	**1**

Question Number	Correct Answer	Reject	Mark
24 (b)(ii)	**Difference:** less exothermic / less negative *IGNORE* "higher" **if** written **with** less exothermic/less negative **Accept just** "lower"/ "less" **(1)** **Justification:** energy taken in to form gas/energy required to form gas/energy needed to form gas/takes heat in to form gas/heat required to form gas **Or reverse argument** **(1)** ***Mark these two points independently***	**Just** "higher" (**0)** **Just** "$H_2O(g)$ is not water's standard state"	**2**

Question Number	Correct Answer	Reject	Mark
24 (c)(i)	Enthalpy / energy / heat (energy) change (when) one mole of a substance/one mole of a compound **(1)** is formed from its elements (in their most stable states) **(1)** 298K / 25°C / a stated temperature **AND** 1 atm pressure/100 kPa **(1)** *IGNORE* any references to concentration	"energy required" **OR** "energy released" "one mole of **product(s)**" is formed from its **reactants** room temperature/rtp	**3**

Question Number	Correct Answer	Reject	Mark
24 (c)(ii)	Cycle or formula expression  $\Delta H^{\theta}_{f} = \Delta H_1 - \Delta H_2$ = (2 x - 394) + (2 x - 286) - (- 870) = **−490** (kJ mol^{-1}) • correct expression or cycle **(1)** • evidence for doubling **both** ΔH^{θ}_{c} [C] **and** ΔH^{θ}_{c} [H_2] **(1)** • answer **(1)** Correct answer with no working scores full marks		**3**