

# Mark Scheme (Results) Summer 2007

GCE

## GCE Chemistry (6242) Paper 01

## General Guidance on Marking

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.

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

### Using the mark scheme

The mark scheme gives you:

- 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.

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.

- 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 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.

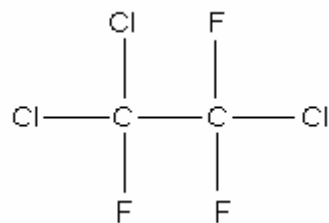
Full marks will be awarded if the candidate has demonstrated the above abilities.

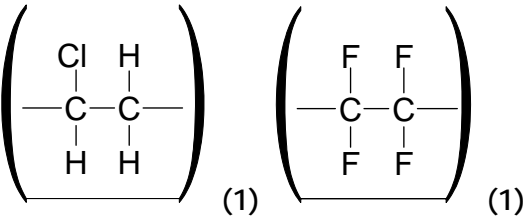
Questions where QWC is likely to be particularly important are indicated (QWC\*) in the mark scheme BUT this does not preclude others.

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
1.	(a) titanium OR Ti	graphite /C		(1)
	(b) $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ OR $\text{Cl}^- \rightarrow \frac{1}{2} \text{Cl}_2 + \text{e}^-$  there does not have to be a negative charge on the e  IGNORE state symbols	$2\text{Cl}^- - 2\text{e}^- \rightarrow \text{Cl}_2$ OR $\text{Cl}^- - \text{e}^- \rightarrow \frac{1}{2} \text{Cl}_2$		(1)
	(c) oxidation because chloride (ions)/Cl <sup>-</sup> /chlorine ions lose electrons OR oxidation because chloride (ions)/Cl <sup>-</sup> /chlorine ions lose 2 electrons OR oxidation because chloride (ions)/Cl <sup>-</sup> /chlorine ions lose 1 electron OR oxidation because ox no. chlorine/Cl goes up( by 1) OR oxidation because ox. no chlorine/Cl goes from -1 to 0		chlorine/Cl/Cl <sub>2</sub> /it loses electrons  just 'loss of electrons'	(1)
	(d) Cations  OR positive (ions)	Na <sup>+</sup> / sodium (ions)  OR H <sup>+</sup> /hydrogen (ions)		(1)
	(e) Hydrogen / H <sub>2</sub>  OR sodium hydroxide / NaOH / hydroxide ions/OH <sup>-</sup>  OR both of these	H <sub>2</sub> + 2OH <sup>-</sup> OR H <sub>2</sub> + OH <sup>-</sup>	H 2H <sup>+</sup> + 2e <sup>-</sup> → H <sub>2</sub>	(1)

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
(f)	$2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$ OR $\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \frac{1}{2}\text{Cl}_2 + \frac{1}{2}\text{H}_2$  all species correct (1)  balancing (1) only if all species correct	$2\text{Cl}^- + 2\text{H}_2\text{O} \rightarrow 2\text{OH}^- + \text{Cl}_2 + \text{H}_2$  Or half the above equation		(2)
(g)	treatment of (drinking) water OR to kill bacteria in water/swimming pools OR sterilisation of water OR as a disinfectant OR in production/manufacture/making of any one of: PVC bleaches herbicides insecticides/pesticides HCl/hydrochloric acid/hydrogen chloride named solvents bromine titanium paper chloroethene poly(chloroethene)	as a bleach OR in bleach	water purification OR swimming pools OR cleaning anything OR anything else	(1)
<b>Total 8 marks</b>				

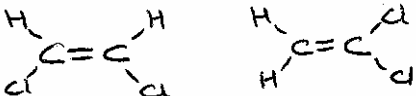
	EXPECTED ANSWER		ACCEPT	REJECT	MARK
2	(a)	(i)		“Fl” for fluorine	(1)
		(ii)	UV (photon) too low energy to break C-F bond	C-F or C-Cl as an ionic bond OR C-Cl bond is weaker OR any reference to difference in polarity or difference in electronegativity OR references to hydrogen bonding/van der Waals forces	(1)



		EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(iii)	neutral particles with an unpaired electron OR neutral species with an unpaired electron OR atoms/molecules with an unpaired electron (1)  uv radiation (1) stand alone OR uv light OR sunlight	Higher frequency than visible light	ions/elements/substances with.....  “unbonded electron/ free electron/ lone electron/ single electron” instead of “unpaired electron”  homolytic fission OR description of atoms taking electron from covalent bond OR just “high frequency light”	(2)
(b)	(i)	 <p style="text-align: center;">(1)                      (1)</p> brackets are not required  If extension bonds are missing from both, give total 1 mark if all other atoms and bonds are correct	more than one repeat unit may be drawn but one repeat unit must then be clearly labelled or indicated by brackets, but only penalise this once	-C=C- OR “Fl” for fluorine	(2)

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
(ii)	<p><u>PVC</u> (1)</p> <p>electrical insulation  pipes  gutters/drainpipes  window frames / door frames  flooring  waterproof clothing/waterproof footwear  artificial leather (for clothing, handbags etc)  rigid drink bottles  toys  fixtures for interiors of aeroplanes  car seats / dashboards  fencing / railings / decking / gates  roofing membrane  cladding (for houses) / fascia boards  wallcovering  credit cards</p> <p><u>PTFE</u> (1)</p> <p>burette taps  non-stick coating on saucepans  plumbers tape  Goretex lining  ski coating  cable insulation  catheter tubing  sewing thread / fibres (for socks) / hosiery  tubing and piping in the semiconductor industry  wiper blades  leashes and collars  harnesses / belts  bicycle lubricants  as a fabric protector  coating for machine parts  weatherproofing outdoor signs</p>		<p>packaging  buckets  bowls  plastic bags  clothing  for either polymer</p>	(2)


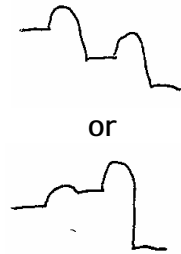
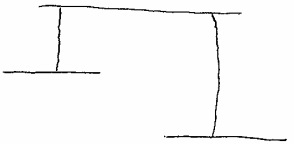
Total 8 marks

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
3.	(a)	Ignore missing hyphens or addition of commas in both names  propan-2-ol (1) alcohol (1) ignore secondary / 2 <sup>y</sup> / 2 <sup>o</sup>  3-methylpentane (1) alkane (1) ignore branched	2-propanol OR propane-2-ol	2-hydroxypropane primary OR tertiary OR OH  2-ethylbutane	(4)
	(b)	(i)  OR trans isomer OR CHCl=CHCl (1)    CH <sub>2</sub> =CCl <sub>2</sub> (1)		Molecules where the double bond is not shown	(2)
		(ii) 1,2-dichloroethene OR structure (cis or trans) (1)  as it has different atoms/functional groups on both (π bonded) C OR restricted/limited rotation about C=C OR the π bond restricts rotation (1) 2 <sup>nd</sup> mark conditional on the correct identification  Ignore “each carbon has the same two groups” in combination with any correct answer.	“both” if both cis and trans of 1,2 isomer and no 1,1 isomer is drawn in (i)  no rotation about C=C/ π bond	No free rotation about C=C/ π bond  Just “each carbon has the same two groups”	(2)
	(c)	(i) electrophilic addition			(1)
		(ii) nucleophilic substitution		Nucleophilic substitution	(1)
	(d)	C <sub>5</sub> H <sub>10</sub>			(1)

Total 11 marks





	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	<p>(b)</p>  <p>CH<sub>4</sub> + (2)Cl<sub>2</sub> and C + (4)HCl at correct levels (1)</p> <p>ΔH correct / -219 (1)</p> <p>activation energy hump (does not need to be labelled) (1)</p> <p><u>Explanation:</u></p> <p>Reaction/it has a high activation energy (1)</p> <p>IGNORE reactants/methane and chlorine are kinetically stable in combination with high activation energy</p> <p>uv provides energy to break Cl-Cl bonds (1)</p> <p>OR</p> <p>Cl radicals are produced in the presence of uv</p> <p>IGNORE any references to thermodynamic stability</p>	 <p>double headed arrow</p>	<p>Activation energy hump shown as straight lines</p>  <p>Reactants and products</p> <p>-ΔH</p> <p>UV provides the reactants with energy to overcome the E<sub>a</sub></p>	<p>(5)</p>

	EXPECTED ANSWER		ACCEPT	REJECT	MARK
	(c)	(i) Q W C	Stand alone marks  Lower yield / less hydrogen produced (1) IGNORE any reference to rate  More (gaseous) molecules on rhs / fewer (gaseous) molecules on lhs (1)		Equilibrium move left / reverse reaction favoured, if no reference to yield  (2)
		(ii) Q W C	Higher yield / more hydrogen produced (1) - if this is only explained in general terms of increasing rate of the reaction, do not award the mark  (Forward) reaction is endothermic / absorbs heat (1)		If forward reaction is exothermic (0 out of 2)  (2)
		(iii)	No effect		(1)
					Total 12 marks

	EXPECTED ANSWER		ACCEPT	REJECT	MARK
5.	(a) Q W C	<p>enthalpy / energy / heat change when 1 mol of a substance (1)</p> <p>is burnt in excess/burns completely in air/oxygen (1)</p> <p>conditions of 1 atm/ 100 kPa/101 kPa pressure and specified temperature/298 K (1)</p>	<p>Heat / energy / enthalpy released</p> <p>Both “element and compound” instead of substance</p> <p>Complete combustion with air/oxygen OR Reacts completely with air/oxygen</p>	<p>Energy etc required</p> <p>“Reactant” instead of substance</p> <p>Reacts with oxygen</p> <p>Room temperature</p>	(3)
	(b)	(i) <p><u>Bottom box</u></p> $2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$ balance and state symbols (1) <p><u>Left arrow label</u></p> $2\Delta H_c C + 3\Delta H_c H_2$ OR $(2 \times -394) + (3 \times -286)$ (kJ) units not essential OR -788-858 OR -1646 kJ (1) <p><u>right arrow label</u></p> $\Delta H_c \text{C}_2\text{H}_5\text{OH}$ OR -1371 (kJ) (1)			(3)
		(ii) <p><math>\Delta H_f \text{C}_2\text{H}_5\text{OH} = (2 \times -394) + (3 \times -286) - (-1371)</math> (1)</p> <p>= -275 (kJ mol<sup>-1</sup>) (1)</p> <p>OR</p> <p>1 mark for their left hand arrow minus their right hand arrow</p> <p>1 for correct consequential sign and answer</p>		Wrong unit negates last mark (but allow kJ)	(2)

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
(c)	<p>Step 1  <math>I_2</math> / iodine (1)            (moist red) phosphorus (1) IGNORE any solvent or heat</p> <p>Step 2            KCN /potassium cyanide            OR            NaCN / sodium cyanide (1)</p> <p>IGNORE any solvent or heat</p>	<p><math>PI_3</math> (1)</p> <p><math>CN^-</math> / cyanide ions</p>	<p>Iodide  <math>PI_5</math></p> <p>cyanide / HCN</p>	(3)
Total 11 marks				

	EXPECTED ANSWER			ACCEPT	REJECT	MARK
6.	(a)	(i)	$4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$	Multiples or half		(1)
		(ii)	Platinum OR Pt (1) IGNORE Rh OR rhodium		Rb OR rubidium in combination with Pt/platinum	(1)
		(iii)	(lowered rate because) particles / molecules have less (kinetic) energy (1) Q W C fewer molecules have energy $> E_a$ (1)  smaller proportion of collisions result in reaction/are successful OR fewer of the collisions result in reaction/are successful (1)  IGNORE the effect on the yield	fewer (of the) collisions have energy $> E_a$	fewer successful collisions per unit time  just "Fewer successful collisions"  "fruitful"/"effective" instead of successful	(3)
	(b)	cool NO/ the mixture (1)  (then) react with (excess) air / oxygen (1)  to form $\text{NO}_2/\text{N}_2\text{O}_4$ OR nitrogen dioxide/dinitrogen tetroxide (1)  react with water OR $4\text{NO}_2 + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{HNO}_3$ OR $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$ OR $3\text{N}_2\text{O}_4 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3 + 2\text{NO}$ OR $2\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$ (1)  any equation on its own must be correct		add/mix with (excess) air /oxygen  $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2/\text{N}_2\text{O}_4$ (or half this) scores 2 <sup>nd</sup> and 3 <sup>rd</sup> marks  dissolves/absorbed into/mixes with/ pass into water if there is an attempted equation to show a reaction with $\text{NO}_2/\text{N}_2\text{O}_4 + \text{H}_2\text{O}$ on LHS and $\text{HNO}_3$ on RHS	oxidised if air/oxygen not mentioned	(4)

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(c) making any one of: fertilisers explosives nylon flares rocket propellants dyes ammonium nitrate  OR  in metal processing		any item from the 'making' list on its own OR in fertilisers etc	(1)
				Total 10 marks