Mark Scheme (Results)

Summer 2007

GCE

GCE Chemistry (6245) Paper 01

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

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.

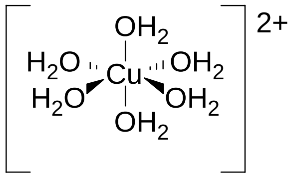
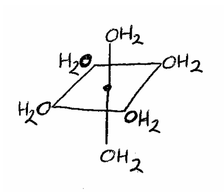
6245/01

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
1	(a)	(i)	effervescence **(1)** COOH present/acid/ acidic/contains H^+ **(1)** [if wrong gas is identified second mark is lost]	bubbles, fizzing	Gas/CO_2 evolved Just 'acid-base reaction'	**(2)**
		(ii)	Decolourises **(1)** OR brown/orange/yellow to colourless compound contains C=C / unsaturated **(1)** white precipitate so is a phenol **(1)**	 Alkene Activated benzene ring/OH on benzene ring	"clear" used instead of "colourless" Just 'double bond'	**(3)**
	(b)	(i)	Four **(1)** (Two) cis/trans (or geometric), and (two) chiral/optical isomers/ enantiomers **(1)** **OR** **Two** cis-trans/geometric isomers **(1)** **Two** optical isomers/enantiomers **(1)** **OR** cis-trans/geometric isomers and optical isomers/enantiomers **(1 only)**	Correct description of the idea of cis-trans or optical isomerism without the name	Rotates plane of plane-polarised light	**(2)**
		(ii)	Molecule has a chiral centre/chiral carbon/carbon with four different groups **(1)** having non-superimposable **mirror** images **(1)**		Asymmetric carbon atom/chiral **molecule**	**(2)**

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(c) QWC*	NaOH (solution) **(1)** **acidify** with /add **excess** HNO_3 **(1)** [If HCl is added here, only the NaOH mark can score] add silver nitrate (solution) **(1)** white precipitate **(1)** soluble in **dilute/aqueous** ammonia **(1)** If no NaOH max **(4)** If HNO_3 added only before NaOH, or no acid is added at all, then can score **3rd**, **4th** and **5th** marks If order of addition is NaOH, $AgNO_3$, HNO_3 can score **(5)** If no NaOH and no HNO_3, can score last 3 marks If any reagent other than silver nitrate, including ammoniacal silver nitrate, is used only the **1st** and **2nd** marks can score	W identified as secondary halogenoalkane **(1)** so no NaOH needed **(1)** for first two marks Neutralise with nitric acid "dilute and concentrated ammonia"	just "add HNO_3" "Concentrated ammonia" alone	**(5)**
		Total 14 marks			

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
2	(a)	(i) QWC*	Both orders correct **(1)** Expt 1 + 2: as [B] doubles rate x4 so second order (wrt B) OR As [B] doubles with [A] constant rate x4 so second order (wrt B) **(1)** Expt 1 + 3: as [A] doubles rate x2 so first order (wrt A) OR As [A] doubles with [B] constant rate x2 so first order (wrt A) **(1)** Omission of experiment numbers or failure to refer to constant concentration of the other reagent penalise once only			**(3)**
		(ii)	rate = k [A] $[B]^2$ Can use upper or lower case "k"	Must be consequential on (i)		**(1)**
		(iii)	$k = \dfrac{0.000195}{0.10 \times 0.10^2} = 0.195$ **(1)** $mol^{-2}\,dm^{6}\,s^{-1}$ **(1)** [IGNORE s.f. in answer] [If wrong experiment chosen only unit mark available]	Both marks consequential on (ii), but rate equation must include k		**(2)**

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(b)	(i) QWC*	Increasing T means molecules have/collide with greater energy **(1)** so a greater **proportion** /more **of** the molecules collide with/have $E \geq E_a$/the activation energy **(1)** so a greater proportion **of the collisions** are successful OR more **of the collisions** are successful/more successful collisions in a given time **(1)**			**(3)**
		(ii)	(at least) two steps **(1)** Simultaneous collision of three particles is unlikely OR valid mechanism e.g. $A+B \rightarrow AB$ fast $AB + B \rightarrow AB_2$ slow OR $A+B \rightarrow AB$ slow $AB + B \rightarrow AB_2$ fast **(1)**	Accept number more than two		**(2)**
	(c)		Value of slope = $- 1.2 \times 10^4$ Negative sign **(1)** Value **(1)** Multiply by -8.31 **(1)** Divide by 1000 to give 104 (kJ mol^{-1}) **(1)** [units not essential but penalise wrong units] Correct answer with some working **(4)** Correct answer with no working **(3)** Penalise -1 mark if final answer is negative IGNORE sig figs	Any number between $- 1.15 \times 10^4$ and $- 1.25 \times 10^4$ inclusive allow 95.5 – 104 consequential on slope		**(4)**
						Total 15 marks

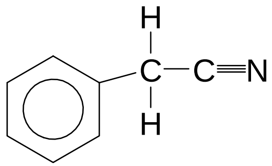
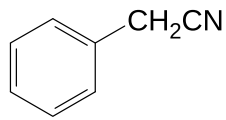
			EXPECTED ANSWER	ACCEPT	REJECT	MARK
3	(a)	(i)	uses E^0 values to find $E_{reaction}$ = (+) 1.57 (V) **(1)** $Zn + 2NO_3^- + 4H^+ \rightarrow Zn^{2+} + 2NO_2 + 2H_2O$ **(1)**	 Equation with equilibrium sign	- 1.57 Equation with Zn on the right	**(2)**
		(ii)	$E_{reaction}$ for the production of hydrogen is (+) 0.76 (V) **(1)** smaller than reaction in (i) so is less likely **(1)** OR NO_3^- being the oxidised form of a redox couple with a more positive $E^{\ominus}$ than $E^{\ominus}$ $H^+/½ H_2$ **(1)** is a stronger oxidising agent than H^+ **(1)**			**(2)**
		(iii)	hexaaquacopper(II) **(1)**  OR  **(1)** Both marks stand alone [IGNORE charge] [IGNORE how H_2O ligand is bonded to central cation]	hexaquacopper(II)	formula	**(2)**

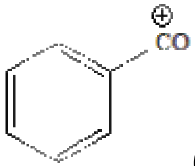
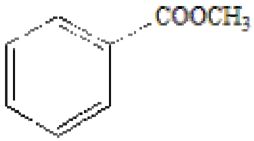
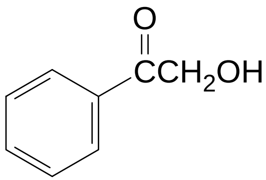
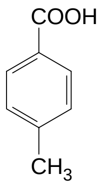
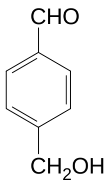
			EXPECTED ANSWER	ACCEPT	REJECT	MARK
		(iv)	**ligand** exchange/replacement/substitution **(1)** $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightleftharpoons CuCl_4^{2-} + 6H_2O$ **(1)** OR $[Cu(H_2O)_6]^{2+} + 4HCl \rightleftharpoons CuCl_4^{2-} + 4H^+ + 6H_2O$ **(1)**	ALLOW $\rightarrow$ Accept $H_2CuCl_4 + 2H^+$ for $CuCl_4^{2-} + 4H^+$		**(2)**
	(b)	(i)	E^o for the reaction is **–** 0.39 (V) (so not feasible) [value is required].	Cu^{2+} being the oxidised form of the redox couple with the more negative E^{θ}, will not oxidise I^-		**(1)**
		(ii)	CuI is a solid (so conditions are not standard) **(1)** Equilibrium is pulled over/moves to favour the r.h.s. **(1)**		Just 'conditions not standard'	**(2)**
		(iii)	$[Cu(NH_3)_4]^+$ OR $[Cu(NH_3)_4(H_2O)_2]^+$	$[Cu(NH_3)_2]^+$	$[Cu(NH_3)_6]^+$ Any 2+ complex	**(1)**
		(iv)	(atmospheric) oxygen **(1)** oxidises Cu^+ to Cu^{2+} **(1)**		Air for oxygen	**(2)**

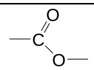
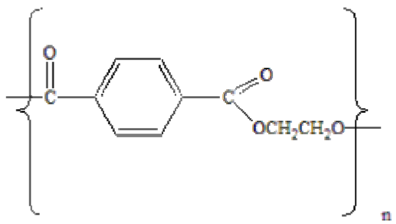
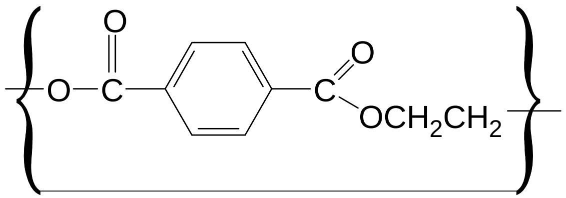
			EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(c)	(i)	starch **(1)** blue-black/blue/black to colourless **(1)**		Clear for colourless	**(2)**
		(ii)	(If added too early) insoluble complex/black solid formed, making titre too low OR (If added too early) insoluble complex/black solid formed, removes iodine from solution OR (If added too early) insoluble complex/black solid formed, causes inaccurate titre. OR (If added too early) insoluble complex/black solid formed, not all the iodine is titrated.			**(1)**
		(iii)	Amount thiosulphate = $0.01655\ dm^3 \times 0.1\ mol\ dm^{-3}$ **(1)** = amount Cu^{2+} in $25.0\ cm^3 = 1.655 \times 10^{-3}$ mol **(1)** amount of Cu^{2+} in $250\ cm^3 = 1.655 \times 10^{-3} \times 10$ **(1)** mass of Cu (in sample) = $1.655 \times 10^{-2} \times 63.5$ **(1)** = 1.051 g % Cu in brass = $1.051 \times 100/1.5 = 70$ % **(1)** [IGNORE sf] [mass of 1.051g with working scores **(4)**; correct answer with no working scores **(3)**.] Mark consequentially			**(5)**
			Total 22 marks			

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
4	(a)		Reagent: chloromethane/CH_3Cl **(1)** Catalyst: (anhydrous) aluminium chloride/$AlCl_3$/Al_2Cl_6 **(1)** OR equivalent bromides Mark independently	Bromomethane/ CH_3Br/iodomethane/ CH_3I iron(III) chloride/ bromide	 iron	**(2)**
	(b)	(i)	(free) radical substitution			**(1)**
		(ii)	$Cl_2 \rightarrow 2Cl^{\bullet}$ **(1)** $PhCH_3 + Cl^{\bullet} \rightarrow PhCH_2^{\bullet} + HCl$ **(1)** $PhCH_2^{\bullet} + Cl_2 \rightarrow PhCH_2Cl + Cl^{\bullet}$ **(1)** any one of: $2\ PhCH_2^{\bullet} \rightarrow PhCH_2CH_2Ph$ $PhCH_2^{\bullet} + Cl^{\bullet} \rightarrow PhCH_2Cl$ $2\ Cl^{\bullet} \rightarrow Cl_2$ **(1)** [IGNORE curly arrows] If the initiation or propagation steps are wrong, only the termination step can score consequentially on any two of their radicals.		Dot must not be on Ph penalise once P instead of Ph penalise once	**(4)**

	EXPECTED ANSWER			ACCEPT	REJECT	MARK
		(iii)	flask and vertical condenser – need not be shown as separate items **(1)** [Ignore direction of water flow; penalise sealed condenser] gas entry **into liquid** in flask **(1)** [allow tube to go through the side of the flask, but tube must not be blocked by flask wall] heating from a electric heater/heating mantle/sand bath/water bath/oil bath **(1)** diagram or words labelling of diagram not necessary [IGNORE uv source]	Allow the gas to be bubbled down a tube coaxial with the condenser bore.	Bubbling gas into a beaker OR other vessel without a condenser **0 (out of 3)** Just 'heat', Bunsen	**(3)**

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(c)	(i)		 $C_6H_5CH_2CN$	$PhCH_2CN$	**(1)**
		(ii)	hydrochloric acid / HCl (aq) OR dilute/aqueous sulphuric acid/H_2SO_4 (aq) **(1)** boil/heat (under reflux)/reflux **(1)** conditional on correct or nearly correct reagents i.e. "acid" or "H^+ " OR NaOH(aq) **and** boil **(1)** Acidify **(1)**		HCl alone Conc sulphuric acid Warm	**(2)**
		(iii)	ethanol and (conc) sulphuric acid **(1)** heat/warm/boil/reflux **(1)** conditional on presence of ethanol *OR* PCl_5 /PCl_3/$SOCl_2$ **(1)** Add ethanol **(1)** conditional on first mark PCl_5 **and** ethanol **(1)** only PCl_5 **in** ethanol **(0)**	Formulae or names throughout	Alcohol for ethanol Dilute sulphuric acid Alcohol for ethanol	**(2)**

	EXPECTED ANSWER			ACCEPT	REJECT	MARK
	(d)	(i)	<u>Ion at 105 is</u>  **(1)** <u>**X** is</u>  OR  **(1)**	$C_6H_5CO^+$ $C_6H_5COOCH_3$ / $C_6H_5CO_2CH_3$ / $C_6H_5COCH_2OH$	C_6H_5CO $C_7H_5O^+$	**(2)**
		(ii)	 OR  **(1)** Side-chain(s) oxidised to COOH **(1)** [N.B. one of the side-chains must be capable of being oxidised to COOH to get 2^{nd} mark]			**(2)**

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(e)	(i)	PCl_5 /Phosphorus pentachloride/phosphorus(V) chloride OR PCl_3/ Phosphorus trichloride/phosphorus(III) chloride OR $SOCl_2$/Thionyl chloride/sulphur oxide dichloride			**(1)**
		(ii)	At least one ester link/  fully shown **(1)** – stand alone remainder of structure **(1)**  OR  [no need for n or brackets] Check oxygen atoms carefully; must be four If more than one repeating unit is shown the repeat unit must be identified			**(2)**
		(iii)	(concentrated) acid/alkali **(1)** (ester link) would be hydrolysed OR polymer would react to form the monomers/alcohol and acid **(1)** conditional on 1^{st} mark	A named acid or alkali	Any substance that is not an acid or an alkali Hydrolysis to acid chloride	**(2)**
						Total 24 marks