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Mark Scheme (Results)
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GCE

GCE Chemistry (6246) Paper 2

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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 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.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)	$CH_3COOH + C_2H_5OH \rightleftarrows CH_3COOC_2H_5 + H_2O$ **(1)**	CH_3CO_2H $\rightarrow$ CH_3CH_2 for C_2H_5	$CH_3OCOC_2H_5$	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)	catalyst /speed up reaction **(1)**		dehydrating agent	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)	flask with still head **(1)** condenser and a receiver **(1)** thermometer at correct place **(1)** penalty of (1) if apparatus sealed or open at the wrong place or doesn't work for some other reason.			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(d)	mol ethanoic acid = $\frac{12.6(0)}{60}$ = 0.21 **(1)** (mol ethyl ethanoate = 0.21) theoretical mass ethyl ethanoate = 0.21 x 88 = 18.48 g or 18.5g **(1)** % yield = $\frac{10.60}{18.48}$ x 100 = 57 **(1)** Allow 57.29 or 57.36 or 57.4 OR Theoretical mol ethanoic acid = $\frac{12.60}{60}$ = 0.21**(1)** (mol ethyl ethanoate = 0.21) actual moles of ethyl ethanoate = $\frac{10.6}{88}$ = 0.12 **(1)** % yield = $\frac{0.12}{0.21}$ x100 = 57 **(1)** Allow 57.1 or 57.14 CQ ON FORMULAE IN (a) but these must be possible compounds. IGNORE S.F.			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)(i)	$C_2H_5OH + CH_3COCl \rightarrow CH_3COOC_2H_5 + HCl$ **(1)**	CH_3CH_2 for C_2H_5 $\rightleftarrows$	$CH_3OCOC_2H_5$	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)(ii)	Reaction with ethanoic acid reaches equilibrium/is reversible OR Reaction with ethanoyl chloride is not reversible/goes to completion **(1)**		Reaction with ethanoic acid is incomplete	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)(i)	(Phenyl benzoate) must be soluble in the hot solvent and less/almost insoluble in cold solvent **(1)**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)(ii)	to remove **insoluble/un-dissolved** impurities **(1)**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)(iii)	to remove solid from soluble impurities **(1)**		Just 'collect the product'.	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)(iv)	to wash away remaining solution/soluble impurities /remove surface impurity. **(1)**			1

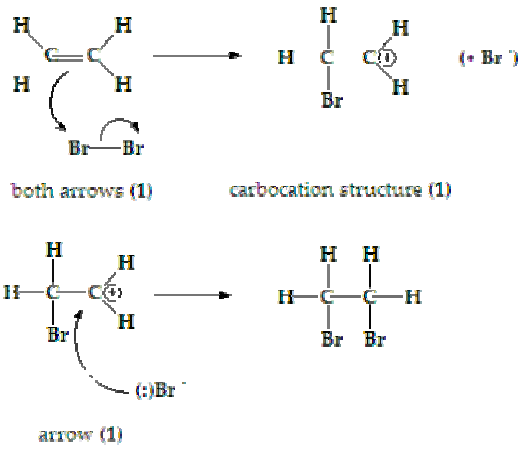
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)(v)	measure melting temperature **(1)** check value same as data book/sharp melting point **(1)** OR Use gas-liquid chromatography **(1)** Showing only one peak **(1)**		Mix with known sample and measure melting temperature. Any other instrumental method.	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)	ionic lattice **(1)** Na^+ ions have 6 nearest neighbours of Cl^- ions and vice-versa / 6:6 co-ordination **(1)**	Labelled sketch can score both marks but must have some 3D extension.		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)	electrostatic attractions (in solid NaCl) overcome **(1)** by the attractions between the ions and dipoles in water **(1)** ; this can be shown in a diagram. OR Water has a high dielectric constant/relative permittivity **(1)** which reduces the forces of attraction between ions in the solution **(1)**	Attractions overcome by solvation of ions scores **(1)** only		2

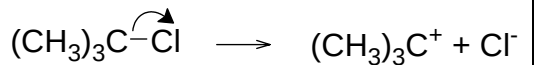
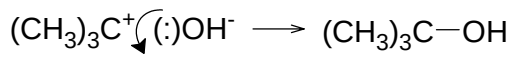
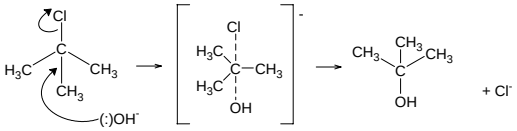
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)	$NaCl(s)\ (+aq) \rightarrow Na^+(aq) + Cl^-(aq)$ $Na^+(g) + Cl^-(g)\ (+aq)$ Cycle **(1)** Arrows labelled with names or values **(1)** *Check arrow direction agrees with label/sign of the value* ΔH_{soln} = -406-364-(-771) = +1 (kJ mol^{-1}) **(1)** **+** sign not essential		Negative value	3

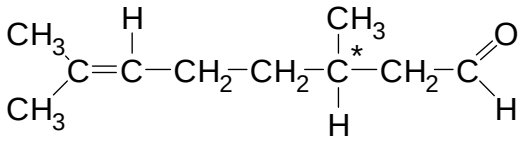
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)	sodium hydroxide/NaOH **(1)** hydrogen /H_2 **(1)** anode $2Br^- \rightarrow Br_2 + 2e^{(-)}$ OR $2Br^- - 2e^{(-)} \rightarrow Br_2$ **(1)** or halved.		H Br	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(e)(i)		 as intermediate lone pair not essential, arrow can start at – on Br^- and go to + on C		3

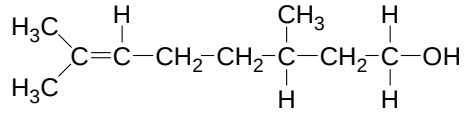
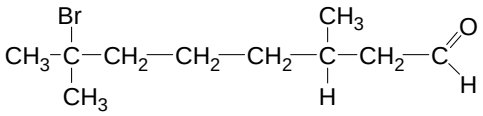
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(e)(ii)	initial attack (on ethene) is by an electrophile/$Br^{\delta+}$ **(1)** no Cl^+ / $Cl^{\delta+}$ available as the electrophile (so no dichloroethane formed) **(1)** then (nucleophilic) attack by Br^- **(1)** Cl^- can replace Br^- (as nucleophile, so 1-bromo-2-chloroethane is formed) **(1)**			4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(i)	$[(CH_3)_3CCl]$ increases by 1.5 while $[OH^-]$ remains constant, rate increases by 1.5 OR In expts A and B, $[(CH_3)_3CCl]$ increases by 1.5 and rate increases by 1.5 **(1)** so first order **(1)** $[OH^-]$ zero order, with some explanation **(1)**			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(ii)	 (1) arrow (1) both ions  (1) arrow Must be S_N2 mechanism if 1st order wrt OH^- in (i)**:**  each arrow (1) x 2 intermediate (1)		S_N1 mechanism if $[OH^-]$ first order	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(i)	 (1)			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(ii)	**alkene** (aqueous) bromine **(1)** orange to colourless**(1)** OR (aqueous) potassium manganate(VII) (ignore alkaline/acid) **(1)** purple to colourless/brown **(1)** **aldehyde** any one matching pair from: reagent **(1)** observation **(1)**: Fehling's solution blue (soln) to red/brown ppt Tollens' reagent silver mirror or black ppt	 Benedict's, same observation. Ammoniacal $AgNO_3$, same obs.	 Purple to green. 2,4 DNP	4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(iii)	(with $NaBH_4$)  (1) (with HBr)  (1)			2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(iv)	$C_{10}H_{18}O + 14O_2 \rightarrow 10CO_2 + 9H_2O$ **(1)** Ignore any state symbols Moles citronellal = 1.0/154 **(1)** $= 6.49 \times 10^{-3}$ Moles $CO_2 = 10 \times 6.49 \times 10^{-3}$ **(1)** $= 6.49 \times 10^{-2}$ Volume $CO_2 = 24 \times 6.49 \times 10^{-2}$ $= 1.56\ dm^3$ **(1)** allow 1.6 Allow cq from incorrectly balanced equation. Ignore sf OR 154g citronellal gives $240 dm^3$ CO_2 **(1)** Vol CO_2 from 1 g = 240/154 **(1)** $= 1.56\ dm^3$ **(1)**			4

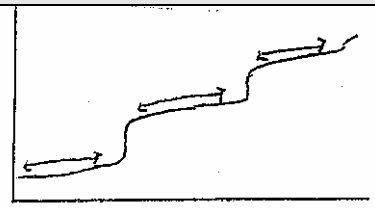
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)	silicon - giant atomic/ giant covalent /giant molecular/macromolecular **(1)** phosphorus **and** chlorine – (simple) molecular **(1)** covalent bonds broken in Si are stronger than intermolecular/dispersion/ Van der Waals'/ London/ induced dipole forces **(1)** phosphorus is P_4 and chlorine is Cl_2 **(1)** P_4 has more electrons (per molecule) so stronger dispersion (etc) forces **(1)**			5

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)	PCl_4^+ tetrahedral **(1)** PCl_6^- octahedral **(1)** 4 or 6 pairs of electrons as far apart as possible to minimise repulsion **(1)**	correct 3-D diagrams		3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(c)	name of any **specific** alcohol **(1)** $ROH + PCl_5 \rightarrow RCl + HCl + POCl_3$ **(1)** [R must apply to the specific alcohol] OR name of any **specific** carboxylic acid **(1)** $RCOOH + PCl_5 \rightarrow RCOCl + HCl + POCl_3$ **(1)** [R must apply to the specific acid]	equation with 'R' if mark lost for not giving a specific example	Just 'alcohol' Just 'acid'	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)	$PCl_5 \rightleftarrows PCl_3 + Cl_2$ eqm moles: 0.33 0.67 0.67 **(1)** mole fraction: $\frac{0.33}{1.67}$ $\frac{0.67}{1.67}$ $\frac{0.67}{1.67}$ **(1)** partial pressures: $\frac{0.33 \times 4}{1.67}$ $\frac{0.67 \times 4}{1.67}$ $\frac{0.67 \times 4}{1.67}$ **(1)** = 0.79 =1.605 =1.605 $K_p = \frac{pPCl_3 \times pCl_2}{pPCl_5}$ **(1)** = 3.26 **and** atm**(1)** OR $PCl_5 \rightleftarrows PCl_3 + Cl_2$ 1/3 2/3 2/3 eqm moles **(1)** 0.2 0.4 0.4 mole fraction **(1)** 0.8 1.6 1.6 partial press **(1)** $K_p = \frac{pPCl_3 \times pCl_2}{pPCl_5}$ **(1)** = 3.2 atm **(1)**	If eqm moles PCl_5 = 0.67 and PCl_3=Cl_2=0.33 answer = 0.5 and can score last 3 marks If 1.6 used here then final answer is 3.24		5

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(e)(i)	$H_3PO_4 + 2NaOH \rightarrow Na_2HPO_4 + 2H_2O$ **(1)** OR $H_3PO_4 + 2OH^- \rightarrow HPO_4^{2-} + 2H_2O$ **(1)**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(e)(ii)	 any point between ⟷			1