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Mark Scheme (Results)
January 2008

GCE

GCE Chemistry (6245) Paper 1

Edexcel Limited. Registered in England and Wales No. 4496750
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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.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(i)	Cr [Ar] $3d^5 4s^1$ **and** Cr^{3+} [Ar] $3d^3$ OR $4s^1 3d^5$ **and** $3d^3$ OR $3D^5 4S^1$ **and** $3D^3$ OR $4S^1 3D^5$ **and** $3D^3$ OR $3d_5 4s_1$ **and** $3d_3$ OR $4s_1 3d_5$ **and** $3d_3$ OR $3D_5 4S_1$ **and** $3D_3$ OR $4S_1 3D_5$ **and** $3D_3$ ALLOW $1s^2 2s^2$…etc for [Ar] provided it is complete and correct			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(ii)	octahedral **(1)** 6 electron pairs around Cr (ion) **(1)** these repel to a position of minimum repulsion / maximum separation **(1)**	diagram for name 6 bonds, could be drawn on diagram	 bonds/atoms repelling	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(iii)	(gelatinous) green ppt **(1)** (dissolves) to green solution **(1)**	green solid any shade of green		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(iv)	$[Cr(H_2O)_6]^{3+} + 3OH^- \rightarrow Cr(OH)_3(H_2O)_3 + 3H_2O$ OR $[Cr(H_2O)_6]^{3+} + 3OH^- \rightarrow Cr(OH)_3 + 6H_2O$ **(1)** $Cr(OH)_3(H_2O)_3 + 3OH^- \rightarrow [Cr(OH)_6]^{3-} + 3H_2O$ OR $Cr(OH)_3 + 3OH^- \rightarrow [Cr(OH)_6]^{3-}$ **(1)** Ignore state symbols	equations with NaOH eg 3NaOH on LHS $3Na^+$ on RHS If $3H_2O$ is missing from RHS of both equations, allow **(1)** for both correct Cr species on RHS	$Cr^{3+}(aq)$	2

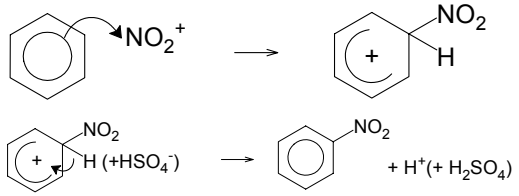
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)(i)	**Reactant (1)** **Product (1)** Formula of a: Formula of a: primary alcohol → aldehyde primary alcohol → carboxylic acid secondary alcohol → ketone aldehyde → carboxylic acid		molecular formulae names with no formulae COH for aldehyde, unless structure shown as well	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)(ii)	$E\,cell^{\theta}$ for MnO_4^- reacting with Cl^- = (+) 0.15 (V) **(1)** $E\,cell^{\theta}$ for $Cr_2O_7^{2-}$ reacting with Cl^- = - 0.03 (V) OR E^{o}_{cell} for Cr^{3+} reacting with Cl_2 = (+)0.03(V)**(1)** MnO_4^- will oxidise Cl^-/HCl so HCl cannot be used OR $2MnO_4^- + 16H^+ + 10Cl^- \rightarrow 2Mn^{2+} + 8H_2O + 5Cl_2$ so HCl cannot be used **(1)** $Cr_2O_7^{2-}$ will not oxidise Cl^-/HCl so HCl can be used **(1)**			4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)(iii)	oxidation number of Cr remains at **+6** ALLOW this mark if the oxidation numbers are written under the species in the equation		gain or loss of electrons oxidation number does not change if it is not specified or is incorrect	1

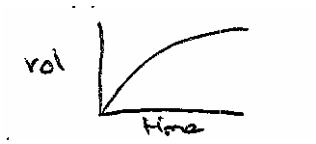
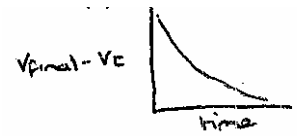
2.	ACCEPT NAMES OR FORMULAE FOR REAGENTS IF BOTH ARE GIVEN, BOTH MUST BE CORRECT. CONDITION MARKS ARE ONLY AVAILABLE FOR CORRECT REAGENTS

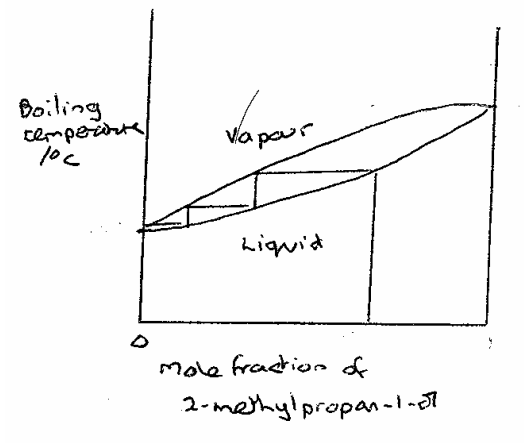
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)(i)	concentrated nitric acid **(1)** concentrated sulphuric acid **(1)** [penalise lack of "concentrated" once] temperature 40-60°C **(1)** stand alone	concentrated + formulae "c" for concentrated any temperature or range of temperatures within this range	 more than 40°C less than 60°C	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)(ii)	$HNO_3 + H_2SO_4 \longrightarrow H_2O + HSO_4^- + NO_2^+$ **(1)** Can be shown in two stages OR $HNO_3 + 2H_2SO_4 \longrightarrow H_3O^+ + 2HSO_4^- + NO_2^+$ **(1)**  Curly arrow from ring towards (space between C in ring and) N in NO_2^+ **(1)** Correct intermediate **(1)** Curved arrow from C – H bond back into ring **(1)**	arrow to or from charges Kekule structures if HSO_4^- is used in the last step, arrow must come from O curly arrow from within ring		4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)	tin and **conc** hydrochloric acid **(1)** IGNORE heat or any stated temperature reduction OR loss of oxygen and gain of hydrogen **(1)**	Fe or Zn and **conc** HCl H_2 + Pt/Ni/Pd	$LiAlH_4$ redox	2

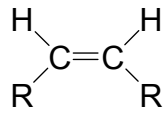
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)	sodium nitrite/ $NaNO_2$ **and** hydrochloric acid/HCl (aq) **(1)** 0-10°C **(1)** benzene diazonium chloride **(1)**	sodium nitrate(III) dilute or concentrated acid any temperature or range of temperatures within this range	just "HCl" temperature value qualified by "below"/ "above"	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)	collect gas in gas syringe/over water in graduated apparatus or diagram **(1)** measure volume of gas at regular time intervals **(1)** label volume and time on axes **(1)** sketch including horizontal finish/final volume **(1)**  1st half life is time taken to half final volume, 2nd half life is time from half to ¾ these could be shown on graph **(1)** Half live**s** constant (therefore 1st order**)** **(1)** STAND ALONE ALTERNATIVE FOR LAST 4 MARKS measure final volume and calculate (V_{final}-V_t) **(1)** Label (V_{final}-V_t) and time on axes **(1)** sketch **(1)**  find at least 2 half lives, first order if half lives are constant **(1)** **OR** collect gas in gas syringe/over water in graduated apparatus or diagram **(1)** find volume of gas after fixed time and calculate rate = vol/time **(1)** repeat for different values of [X] **(1)** label rate and [X] on axes **(1)** sketch straight line **(1)** rate proportional to [X], so first order **(1)** Mass loss method could be applied to any of above	If [BDC] measured only the following marks are available: Label [BDC] and time on axes **(1)** Sketch **(1)** find at least 2 half lives, first order if half lives are constant **(1)** For pH method only the following marks are available: use a pH probe **(1)** measure pH at regular time intervals **(1)** half lives constant **(1)** If candidate mixes answers, mark them as if separate and award the highest mark		6

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)	 vapour and liquid lines reasonably drawn with no maximum or minimum **(1)** Sloping up to the right **(1)** areas labelled **(1)**	If diagram slopes up to left, could still score other two marks If 109°C labelled at lower temp than 82°C, can only score liquid and vapour mark	Straight liquid or vapour line	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)	draws more than 1 tie line, starting at 0.75, connected by verticals (and heading correctly towards the lower bp component) **(1)** states that (equilibrium) vapour is richer in the more volatile component / propan-1-ol **(1)** STAND ALONE describes repeated distillations (with correct reference to tie lines) **(1)** give rise to (first) distillate of pure propan-1-ol / 2-methylpropan-1-ol left in the flask **(1)**			4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)	Ester(s) **(1)**	triester(s) triglyceride(s)	Ether(s) lipid(s)	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)(i)	Any example e.g. **(1)**  [R can be any group/atom other than hydrogen, R can be the same or different] both hydrogen atoms on the same side OR both larger groups on the same side **(1)**			2

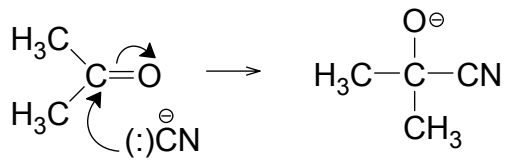
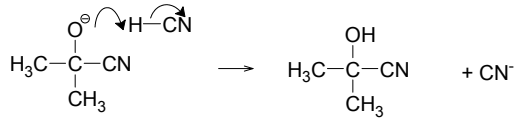
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)(ii)	saturates pack more closely together than unsaturates (due to cis isomers) **(1)** saturates have higher/stronger dispersion/Van der Waals' forces than unsaturates (so more energy is required to melt) **(1)**		breaking single / double / σ / π bonds	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(c)(i)	3 RCOONa / $RCOO^-$ Na^+ **(1)** $CH_2OHCH(OH)CH_2OH$ **(1)**	RCO_2Na Full structural formulae	Covalent bond shown between O and Na. RCOOH $C_3H_8O_2$	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(c)(ii)	Making/manufacture of: soap/soapy detergents or soap production **(1)**		saponification	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)(i)	Any one from: <table><tr><th>Reagent (1)</th><th>2-methylpropan-2-ol obs (1)</th><th>propanoic acid obs(1)</th></tr><tr><td>$NaHCO_3$</td><td>no change</td><td>effervescence</td></tr><tr><td>Na_2CO_3</td><td>no change</td><td>effervescence</td></tr><tr><td></td><td></td><td></td></tr></table> Observation marks conditional on correct reagent IGNORE references to heat	Answer involving formation of an ester, identified by smell, for either acid or alcohol Description of test for CO_2 instead of effervescence		3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)(ii)	Any one from: <table><tr><th>Reagent (1)</th><th>Propanal obs (1)</th><th>Propanone obs (1)</th></tr><tr><td>Fehlings'</td><td>blue to red ppt</td><td>no change</td></tr><tr><td>Tollens'</td><td>silver mirror/ppt</td><td>no change</td></tr><tr><td>$Cr_2O_7^{2-}/H^+$</td><td>orange to green/blue/ brown</td><td>no change</td></tr><tr><td>I_2 + NaOH</td><td>no change</td><td>yellow ppt</td></tr></table> Observation marks conditional on correct reagent IGNORE references to heat	Benedicts Ammoniacal $AgNO_3$ MnO_4^-/H^+ with correct colour changes		3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(e)(i)	 Each arrow **(1)** **(1)**  **(1) both arrows**	CN^- or ^-CN arrows start from negative charge on O or C arrow to H^+ or to HCN in 2nd step		4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(e)(ii)	higher $[H^+]$ **(1)** (so) lower $[CN^-]$ and rate slower **(1)**			2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(i)	electrode – platinum/Pt **(1)** Fe^{2+} and Fe^{3+} **(1)** 1 mol dm^{-3} **(1)** conditional on both ions being present			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(ii)	to bring the solutions to the same potential/connect solutions without setting up a p.d. **(1)**	to allow the movement of ions OR to complete the circuit	to allow flow of electrons	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(iii)	(saturated) potassium chloride OR (saturated) potassium nitrate **(1)**	Formulae Sodium nitrate or chloride		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(iv)	x – 0.34 = 0.43 **(1)** x = +0.77 V **(1)** Correct answer with some working **(2)**			2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(v)	$Fe^{3+} + e^- \rightarrow Fe^{2+}$ OR $Fe^{3+} + e^- \rightleftarrows Fe^{2+}$ **(1)** $Cu \rightarrow Cu^{2+} + 2e^-$ OR $Cu \rightleftarrows Cu^{2+} + 2e^-$ OR $Cu - 2e^- \rightarrow Cu^{2+}$ OR $Cu - 2e^- \rightleftarrows Cu^{2+}$ **(1)** [not cq on (iv)]	e for electron		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(a)(vi)	$Cu + 2Fe^{3+} \rightarrow 2Fe^{2+} + Cu^{2+}$ **(1)**	$2Fe^{2+} + Cu^{2+} \rightarrow Cu + 2Fe^{3+}$ if both half equations in opposite direction in (v)		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(b)	½ O_2 +2e^- +H_2O ⇄/→ 2OH^- species **(1)** balance **(1)** ignore state symbols	multiples		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5.(c)	Moles $S_2O_3^{2-}$ = ($\frac{16.5}{1000}$)x0.1 = 1.65x10^{-3} **(1)** (Moles I_2 = $\frac{1.65x10^{-3}}{2}$ = 8.25x10^{-4}) Moles Cu^{2+} = 1.65x10^{-3} **(1)** Conc $CuSO_4$ = 1.65x10^{-3} x($\frac{1000}{25}$) = 0.066(mol dm^{-3}) **(1)** Penalise incorrect unit			3