

# Mark Scheme (Results) January 2011

GCE

GCE Chemistry (6CH02/01)

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### Section A (multiple choice)

Question Number	Correct Answer	Mark
1	D	1

Question Number	Correct Answer	Mark
2	C	1

Question Number	Correct Answer	Mark
3	A	1

Question Number	Correct Answer	Mark
4	B	1

Question Number	Correct Answer	Mark
5	D	1

Question Number	Correct Answer	Mark
6 (a)	B	1

Question Number	Correct Answer	Mark
6 (b)	A	1

Question Number	Correct Answer	Mark
7 (a)	C	1

Question Number	Correct Answer	Mark
7 (b)	B	1

Question Number	Correct Answer	Mark
7 (c)	C	1

Question Number	Correct Answer	Mark
7 (d)	B	1

Question Number	Correct Answer	Mark
8	D	1

Question Number	Correct Answer	Mark
9	D	1

Question Number	Correct Answer	Mark
10 (a)	C	1

Question Number	Correct Answer	Mark
10 (b)	D	1

Question Number	Correct Answer	Mark
11 (a)	D	1

Question Number	Correct Answer	Mark
11 (b)	C	1

Question Number	Correct Answer	Mark
11 (c)	D	1

Question Number	Correct Answer	Mark
11 (d)	B	1

Question Number	Correct Answer	Mark
12	A	1

TOTAL FOR SECTION A = 20 MARKS

## Section B

Question Number	Acceptable Answers	Reject	Mark
13 (a) (i)	<p>Each mark is independent</p> <p>Diagram of separating funnel with tap. Sides can be straight or bulbous. Top can be stoppered or unstoppered, but not sealed (eg inverted test-tube with tap at bottom). (1)</p> <p>Allow straight sides with an open top</p> <p>Two layers. Upper layer is hydrocarbon layer (1)</p> <p>Colour - pink/purple/mauve. Allow violet (1)</p>	<p>Filter funnel with tap</p> <p>Three layers</p> <p>Mention of any other colours on their own (e.g. grey, brown, red) or in combination with those accepted.</p>	3

Question Number	Acceptable Answers	Reject	Mark
13 (a) (ii)	<p><math>2\text{Fe}^{3+} + 2\text{I}^{-} \rightarrow 2\text{Fe}^{2+} + \text{I}_2</math></p> <p>Ignore state symbols</p> <p>Allow multiples/half amounts shown</p> <p>Accept answers involving <math>\text{I}_3^{-}</math></p>	Formation of $\text{Fe}^{+}$	1

Question Number	Acceptable Answers	Reject	Mark
13 (b)(i)	<p>Answers must refer to oxidation/reduction</p> <p>Sulfuric acid oxidizes (hydrogen/potassium) iodide (to iodine)</p> <p>OR</p> <p>(hydrogen) iodide reduces sulfuric acid</p> <p>OR</p> <p>Phosphoric(V) acid does not oxidize (hydrogen) iodide (to iodine) (as well as sulfuric acid does)</p> <p>Allow sulfuric acid is a strong(er)/good oxidizing agent/phosphoric(V) acid is a weaker oxidizing agent</p>	<p>Sulfuric acid oxidizes iodine/oxidizes iodide to iodide</p> <p>Phosphoric acid is a better reducing agent</p> <p>Comments about hazards or strength of sulfuric acid alone</p> <p>Stability of phosphoric(V) acid alone</p>	1

Question Number	Acceptable Answers	Reject	Mark
13 (b) (ii)	Water rises in the test tube  Allow the gas /HI is soluble / dissolves	Steamy fumes  Any coloured solutions forming even if with the acceptable/allowed answer  Water would displace the gas	1

Question Number	Acceptable Answers	Reject	Mark
13 (b) (iii)	$\text{NH}_3(\text{g})/\text{(aq)} + \text{HI}(\text{g}) \rightarrow \text{NH}_4\text{I}(\text{s})$ Species and balanced equation (1)  Allow $\text{NH}_4^+ + \text{I}^-$ for product  All state symbols present (dependent on the entities above) (1)	$\text{NH}_3\text{I}$ $\text{NH}_3\text{HI}$ $\text{NIH}_4$	2

Question Number	Acceptable Answers	Reject	Mark
13 (c) (i)	$\text{PI}_3 + 3\text{C}_4\text{H}_9\text{OH} \rightarrow 3\text{C}_4\text{H}_9\text{I} + \text{H}_3\text{PO}_3$ Accept multiples  Allow $\text{P}(\text{OH})_3$ , $\text{PH}_3\text{O}_3$ , $\text{H}_2\text{O} + \text{HPO}_2$ , as product/s		1

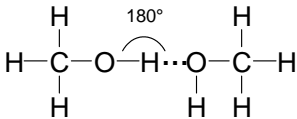
Question Number	Acceptable Answers	Reject	Mark
13 (c) (ii)	<b>Both points required</b>  Van der Waals' / London / dispersion / induced dipole / temporary dipole (forces) in 1-iodobutane  Allow recognisable spelling of van der Waals'  <b>and</b>  (permanent) dipole dipole/permanent dipole (forces)  Allow dipolar-dipolar	Any mention of hydrogen bonding (0)	1

Question Number	Acceptable Answers	Reject	Mark
13 (c) (iii)	<p>Yellow precipitate /ppt /ppte / solid</p> <p>The answer may appear with additional words and phrases: e.g. two clear colourless solutions form a yellow precipitate which is insoluble in concentrated ammonia solution</p> <p>Allow bright yellow, sunshine yellow</p> <p>Allow recognisable spelling eg yello percipitate</p>	<p>Off-white Cream</p> <p>Any other colours and combinations of yellow with any other colours</p> <p>Any other qualifications of yellow eg pale/light</p> <p>Any answers which include bubbles, fizzing, effervescence</p>	1

Question Number	Acceptable Answers	Reject	Mark
13 (c) (iv)	<p>CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub> /CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>NH<sub>2</sub> /CH<sub>2</sub>(NH<sub>2</sub>)CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> / NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> / H<sub>2</sub>NCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> /(CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>)<sub>2</sub>NH /(CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>)<sub>3</sub>N</p> <p>Allow displayed and skeletal formulae, C<sub>4</sub>H<sub>9</sub>NH<sub>2</sub></p> <p>Salts of amines which must include a positively charged ion and I<sup>-</sup></p>	<p>NH<sub>4</sub>I NH<sub>3</sub> instead of NH<sub>2</sub></p> <p>Three carbon chains Missing hydrogens</p> <p>C<sub>4</sub>H<sub>11</sub>N</p>	1

Question Number	Acceptable Answers	Reject	Mark
14 (a) (i)	<p style="text-align: center;">H            .x xx            H.x C.x O .xH            .x xx            H</p> <p>Allow all dots / crosses, combinations of dots, crosses and other symbols like triangles</p> <p>Allow extra inner electrons around carbon and /or oxygen</p>	<p>Missing symbols</p> <p>Missing non-bonding electrons</p>	1

Question Number	Acceptable Answers	Reject	Mark
14 (a) (ii)	<p>Each mark is independent of the next unless the bond angle is greater than <math>119^\circ</math></p> <p><math>109^\circ / 109.5^\circ</math> (1)</p> <p><b>Minimum repulsion / maximum separation</b>            (between four bond pairs of electrons / bonds)            (1)</p> <p><math>104^\circ - 105^\circ</math> (1)</p> <p>(Two) lone pairs / non-bonding pairs (of electrons) repel more (than bonding pairs)/repel a lot (1)</p>	<p>Four bond pairs give tetrahedral shape</p>	4

Question Number	Acceptable Answers	Reject	Mark
14 (a) (iii)	 <p>Correct atoms in the hydrogen bond (O–H···O) (1)            Allow CH<sub>3</sub> groups not displayed, correct ethanol formulae.</p> <p>Hydrogen bond can be shown as dots horizontal or vertical dashes. If it is a bond-like line it must be labelled.</p> <p>Second mark dependent on correct atoms involved.</p> <p>O–H...O in straight line (within small tolerance) and <math>180^\circ</math> bond angle given in the correct place (1)</p>	<p>Hydrogen bond between methanol and water does not score</p>	2



Question Number	Acceptable Answers	Reject	Mark
14 (b) (i)	Any two from:  Bubbles/ fizzing / effervescence (of gas) forming (1)  Sodium /solid disappearing /dissolving (to form a clear colourless solution) (1)  White solid /precipitate forming (1)	Vigorous reaction  White solution/fumes form  Clear colourless solution forms alone	2

Question Number	Acceptable Answers	Reject	Mark
14 (b) (ii)	$\text{CH}_3\text{OH} + \text{Na} \rightarrow \text{CH}_3\text{O}^{(-)}\text{Na}^{(+)} + \frac{1}{2}\text{H}_2$  Allow multiples, NaOCH <sub>3</sub> as product, ethanol as CH <sub>3</sub> CH <sub>2</sub> OH/C <sub>2</sub> H <sub>5</sub> OH with sodium ethoxide as product,  Ignore state symbols and charges	Na <sup>+</sup> as reactant CH <sub>3</sub> O–Na  CH <sub>3</sub> NaO or NaCH <sub>3</sub> O	1

Question Number	Acceptable Answers	Reject	Mark
14 (c) (i)	Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> / K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> / Sodium / potassium dichromate((VI)) (1)  Allow recognisable spelling of potassium and dichromate  If name and formula given, both must be correct.  H <sub>2</sub> SO <sub>4</sub> / (Dilute / concentrated) sulfuric acid (1)  Second mark dependent on recognisably correct oxidizing agent  Allow acidified / H <sup>+</sup> and dichromate((VI)) / Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> for 1 mark  Allow potassium manganate((VII)) and dilute sulfuric acid for 1 mark	Other oxidation numbers Potassium/sodium dichromate(VI) ions  Other acids e.g. hydrochloric, nitric, phosphoric  Other oxidation numbers	2

Question Number	Acceptable Answers	Reject	Mark
14 (c) (ii)	<p>Round-bottomed/pear shaped flask with heat Still head (1)</p> <p>Delivery tube and exit above/in (cooled) collection vessel (1)</p> <p>A condenser may be included Sealed apparatus (max. 1)</p>	<p>Reflux apparatus or reflux followed by distillation scores 0</p> <p>Conical flask Open still head</p>	2

Question Number	Acceptable Answers	Reject	Mark
14 (c) (iii)	<p><b>Mark independently</b></p> <p>(Permanent) dipole dipole/permanent dipole (forces) in ethanal (1)</p> <p><b>Ethanal higher</b> because</p> <p>both compounds have (similar) London /van der Waals' /etc forces</p> <p>OR</p> <p>no (permanent) dipole dipole /permanent dipole (forces) in propane</p> <p>OR</p> <p>propane (only) has London /van der Waals' /etc forces (1)</p>	<p>Ethanal has hydrogen bonds loses <b>first mark only</b></p>	2

Question Number	Acceptable Answers	Reject	Mark
15 (a) (i)	Pestle (and mortar) / mortar and pestle Allow any recognisable spelling eg pessl, morta	Anything else, including hammer, mallet, heavy metal object, spatula, glass rod, crusher, grinder	1

Question Number	Acceptable Answers	Reject	Mark
15 (a) (ii)	Methyl /methly orange (1) Red to orange / peach (allow yellow) (1) Accept other acid-base indicators eg phenolphthalein (1) Accept recognisable spelling for all acid-base indicators Correct colour change, the correct way round, to end point or beyond (1)	Litmus, Universal Indicator score 0/2	2

Question Number	Acceptable Answers	Reject	Mark
15 (b) (i)	(11.20 and 11.40 give) 11.3(0) (cm <sup>3</sup> )		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (ii)	$\frac{11.3 \times 0.300}{1000} = 3.39 \times 10^{-3} / 0.00339$ (mol) If mean titre value is 11.47 then $3.44 \times 10^{-3}$	Ignore SF unless only one, in which case penalise this only once.	1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (iii)	$3.39 \times 10^{-3}$ (mol) Or answer to (ii)		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (iv)	$3.39 \times 10^{-2}$ (mol) answer (iii) x 10		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (v)	$0.05 - 0.0339 = 0.0161$ (mol) Or $0.05 -$ (answer to (iv)) If mean titre value is 11.47 then 0.0156		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (vi)	0.00805 (mol) Or answer to (v) divided by 2 If mean titre value is 11.47 then 0.0078		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (vii)	$0.00805 \times 100$ $= 0.805 \text{ (g) / } 805 \text{ mg}$ Or answer to (vi) $\times 100$ If mean titre value is 11.47 then 0.780		1

Question Number	Acceptable Answers	Reject	Mark
15 (b) (viii)	Reason - there must be some other ant acid present / substance/chemical which reacts with acid	Experimental / calculation error	1

TOTAL FOR SECTION B = 39 MARKS

## Section C

Question Number	Acceptable Answers	Reject	Mark
16 (a)	<p>1 Reaction 1: C goes from <math>-4</math> to <math>+2</math>, (1)</p> <p>2 H from <math>+1</math> to <math>0</math> (redox reaction) (1)</p> <p>3 Reaction 2: C goes from <math>+2</math> to <math>+4</math> (1)</p> <p>4 H from <math>+1</math> to <math>0</math> (redox reaction) (1) Allow from <math>2(+1)</math> to <math>0</math></p> <p>For each mark <b>both</b> correct oxidation states are needed</p> <p>Additional incorrect oxidation numbers of oxygen lose 1 mark per reaction</p> <p>Allow number followed by charge</p> <p>Penalise missing plus signs only once</p> <p>Penalise wrong use of the terms reduced and oxidized only once</p> <p>Penalise correct oxidation states and <b>not</b> a redox reaction only once</p> <p>5 Reaction 3 <b>no</b> (elements) <b>change</b> (oxidation number)/<b>details for carbon / hydrogen calculated</b></p> <p><b>AND</b> so this is <b>not</b> a redox reaction</p> <p><b>OR</b></p> <p>Redox mentioned in reactions 1 and 2 but 'not redox' omitted in reaction 3 (1)</p>	<p>H from <math>+2</math> to <math>0</math></p> <p>H from <math>+2</math> to <math>0</math></p>	5

Question Number	Acceptable Answers	Reject	Mark
*16 (b) (i)	<p>Any seven from:</p> <p>1 A higher temperature would increase the yield /favour the forward reaction /produce more hydrogen... (1)</p> <p>2 ...(as) the reaction is endothermic (1)</p> <p>3 Increased temperature would increase the rate/speed of reaction /make the reaction go faster... (1)</p> <p>4 ...(as) a greater proportion of /more molecules have sufficient /higher/activation energy (to react) (1)</p> <p>5 Decreased pressure increases the yield /favour the forward reaction /produce more hydrogen... (1)</p> <p>6...(as) the forward reaction is favoured with more (gaseous) molecules /mole (1)</p> <p>7 Decreased pressure would decrease the rate of reaction... (1)</p> <p>8 ...(as) collision frequency decreases/less collisions (1)</p> <p>Points may muddle into one another</p> <p><b>Reverse statements allowed</b> e.g. 'lower temperature decreases yield because reaction is endothermic'.</p> <p><b>Contradictory statements</b> in each pair lose both marks e.g. 'lower temperature increases yield because reaction is endothermic'.</p>	'More (successful) collisions' alone	7

Question Number	Acceptable Answers	Reject	Mark
16 (b) (ii)	<p>An excess is used to drive the equilibrium to the right / to ensure all the methane reacts (as the reaction responds to remove steam by Le Chatelier's principle) (1)</p> <p>Methane is more expensive (so it is better to increase the amount of steam) / steam is cheaper / readily available / renewable</p> <p>OR</p> <p>Methane is not renewable (1)</p>	<p>...to get a better yield of hydrogen /to allow reaction to happen fully / so all the reactants react / to make the reaction go to completion</p> <p>Methane is a greenhouse gas / dangers associated with methane e.g. flammable</p>	2

Question Number	Acceptable Answers	Reject	Mark
16 (c)	<p>The catalyst provides an alternative route for the reaction (1)</p> <p>(with) a lower activation energy (1)</p> <p>Allow 'catalyst lowers activation energy' alone for one mark</p>		2

Question Number	Acceptable Answers	Reject	Mark
16 (d) (i)	<p>It regenerates /reforms potassium carbonate /reactant(s) (which reduces the cost of the process)</p> <p>OR</p> <p>potassium carbonate can be re-used</p> <p>Allow recycles potassium carbonate</p>	<p>Regenerates some of the other reactants. Chemicals are regenerated</p>	1

Question Number	Acceptable Answers	Reject	Mark
*16 (d) (ii)	<p>1 Carbon dioxide / CO<sub>2</sub> Allow both water and carbon dioxide (1)</p> <p>2 Traps longer wavelength radiation / traps radiation / IR emitted (from the earth)</p> <p>OR Absorbs/traps heat /IR OR Prevents loss of IR / heat (1)</p> <p>3,4 Any two from: Rising sea levels / flooding</p> <p>Polar ice / ice caps /glacier(s) / glacial / habitat ice melting</p> <p>Changing (sea /air) currents</p> <p>Changing weather patterns /more extreme weather / climate change (2)</p> <p>Other acceptable alternatives only if well justified e.g. more malaria because more breeding areas for mosquitoes</p> <p>But more malaria /desertification /forest fires alone is insufficient</p> <p>Three or more correct answers get 2 marks</p> <p>Three or more answers, where some are wrong, are marked 1 mark for each correct answer and -1 mark for each incorrect answer e.g. Two correct and one wrong award 1 mark Three correct and two wrong award 1 mark etc</p> <p>One on list and one wrong award 1. Ignore neutral statements</p>	<p>Water alone</p> <p>Mark is lost if any mention of UV / ozone layer depletion</p> <p>Absorbs IR / heat from the sun</p> <p>Increased UV Increased skin cancer/melanoma</p>	4

TOTAL FOR SECTION C = 21 MARKS



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