edexcel
advancing learning, changing lives

Mark Scheme (Results)
January 2011

GCE

GCE Chemistry (6CH05/01)

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

A PEARSON COMPANY

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information, please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our website at www.edexcel.com.

If you have any subject specific questions about the content of this Mark Scheme that require the help of a subject specialist, you may find our Ask The Expert email service helpful.

Ask The Expert can be accessed online at the following link:
http://www.edexcel.com/Aboutus/contact-us/

Alternatively, you can speak directly to a subject specialist at Edexcel on our dedicated Science telephone line: 0844 576 0037

January 2011

Publications Code UA026203

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	B	**1**

Question Number	Correct Answer	Mark
4	C	**1**

Question Number	Correct Answer	Mark
5	B	**1**

Question Number	Correct Answer	Mark
6	A	**1**

Question Number	Correct Answer	Mark
7	D	**1**

Question Number	Correct Answer	Mark
8 (a)	A	**1**

Question Number	Correct Answer	Mark
8 (b)	D	**1**

Question Number	Correct Answer	Mark
8 (c)	C	**1**

Question Number	Correct Answer	Mark
8 (d)	A	**1**

Question Number	Correct Answer	Mark
9 (a)	C	**1**

Question Number	Correct Answer	Mark
9 (b)	A	**1**

Question Number	Correct Answer	Mark
9 (c)	D	**1**

Question Number	Correct Answer	Mark
10	C	**1**

Question Number	Correct Answer	Mark
11	A	**1**

Question Number	Correct Answer	Mark
12 (a)	D	**1**

Question Number	Correct Answer	Mark
12 (b)	A	**1**

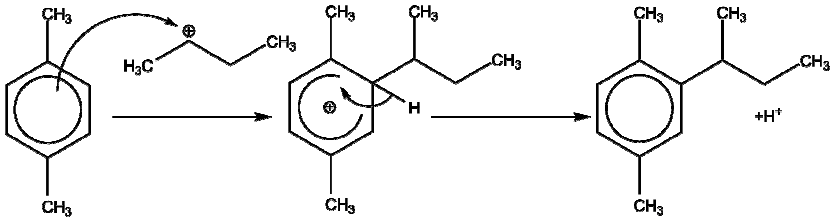
Question Number	Correct Answer	Mark
13	B	**1**

Question Number	Correct Answer	Mark
14	D	**1**

TOTAL FOR SECTION A = 20 MARKS

Section B

Question Number	Acceptable Answers	Reject	Mark
15 (a) (i)	Electrophilic substitution (any order)		**1**

Question Number	Acceptable Answers	Reject	Mark
15 (a) (ii)	$AlCl_3 + CH_3CH(Br)CH_2CH_3 \rightarrow AlCl_3Br^- + CH_3C^+HCH_2CH_3$ ALLOW $CH_3CH(Br)CH_2CH_3 \rightarrow Br^- + CH_3C^+HCH_2CH_3$ Ignore position of the + for this mark Ignore curly arrows in this equation **(1)**  Electron pair (curly arrow) from ring to positively charged **second** carbon of carbocation **(1)** Structure of intermediate must include positive sign **(1)** Electron pair from C-H bond reforms delocalized ring **(1)**	$AlCl_4^-$	**4**

Question Number	Acceptable Answers	Reject	Mark
15 (b)	**Advantage** Graphite catalyst easier to remove / separate / can be filtered off (from reaction mixture) / graphite can be re-used **(1)** **Justification** $AlCl_3$ is soluble or graphite is insoluble /different state / different phase **OR** Graphite can be re-used **(1)** **Mark independently**	Just graphite is a heterogeneous catalyst	**2**

Question Number	Acceptable Answers	Reject	Mark
15 (c) (i)	(Conc) nitric acid **(1)** (Conc) sulfuric acid **(1)** penalise dilute once only		**2**

Question Number	Acceptable Answers	Reject	Mark
15 (c) (ii)	Greater electron density **in ring** / ring is activated / more susceptible to electrophilic attack **(1)** Due to electron releasing / donating methyl groups **(1)**	Just more susceptible to attack	**2**

Question Number	Acceptable Answers	Reject	Mark
15 (c) (iii)	Reduction ALLOW redox	Hydrogenation	**1**

Question Number	Acceptable Answers	Reject	Mark
15 (c) (iv)	$NaNO_2$ / sodium nitrite / sodium nitrate(III) & HCl (any strong acid) **(1)** Temp 0-10˚C / less than 10˚C / any quoted temperature between 0 -10˚C / in ice bath **(1)** $C_6H_3(CH_3)_2NH_2 + HNO_2 + HCl \rightarrow C_6H_3(CH_3)_2N_2^+Cl^- + 2H_2O$ **(1)** Add phenol dissolved in alkali **(1)** $(C_6H_3(CH_3)_2N_2^+Cl^- + C_6H_5OH) \rightarrow C_6H_3(CH_3)_2N_2C_6H_4OH + (HCl)$ **(1)** Mark given for correct organic product Allow correct organic product shown as $-O^-$ instead of -OH **Mark independently**	HNO_3	**5**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (i)	$(COOH)_2 \rightarrow 2CO_2 + 2H^+ + 2e^-$ **(1)** $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (ii)	$5(COOH)_2 + 2MnO_4^- + 6H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$ ALLOW multiples ALLOW $5(COOH)_2 + 2MnO_4^- + 16H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O + 10H^+$ Ignore state symbols even if incorrect	Equation with electrons left in	**1**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (iii)	Moles of MnO_4^- = 11.30/1000 x 0.010 = 1.13×10^{-4} (mol) **(1)** Moles of $(COOH)_2$ in 10 cm^3 = 1.13×10^{-4} x 5/2 = 2.825×10^{-4} (mol) **(1)** Moles of $(COOH)_2$ in whole sample = 2.825×10^{-4} x 50 = 0.01412(5) (mol) **(1)** Mass of acid = 0.01412(5)x 90 = 1.27 g **(1)** % in leaves = 1.27/250 x 100 = 0.51 (%) **(1)** If ratio 5 : 2 is not used, maximum **(4)** e.g. if ratio 2:5 is used then percentage in leaves = 0.08%	TE for 5th mark if % is greater than 100% Rounding errors once in first 4 marks Final answers not quoted to 2 dp	**5**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (iv)	± 0.05 cm^3 **(1)** [(0.05 x 2) / 11.3] x 100 = 0.88% **(1)** ALLOW ±0.025 cm^3 **(1)** [(0.025 x 2) / 11.3] x 100 = 0.44% **(1)** ALLOW TE for second mark		**2**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (v)	Any two from: Only one titration carried out **(1)** Leaves may contain other substances that MnO_4^- could oxidize/ react with **(1)** Not all ethanedioic acid extracted from leaves **(1)** ALLOW temperature too low / below 60˚C **(1)** Different amounts of acid from different leaves **(1)**	Errors in technique e.g. transfer errors	**2**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (vi)	(Wearing gloves suggested as) ethanedioic acid is toxic / harmful OR rhubarb **leaves** are toxic /harmful **(1)** (Unnecessary because) it is (very) dilute / present in small amounts **(1)** ALLOW because is not absorbed through the skin **Second mark is independent of the first**	References to weak acid Rhubarb is toxic	**2**

Question Number	Acceptable Answers	Reject	Mark
16 (a) (vii)	(Cloudiness due to) **MnO_2** (solid /precipitate) **(1)** Ignore colour of precipitate EITHER Suitable use of E^θ (+0.34V) **OR** MnO_4^- ions are a strong enough oxidizing agent to oxidize Cl^- ions **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
16 (b) (i)	$(1s^2)2s^22p^63s^23p^63d^5$ $(4s^0)$	$4s^2$ $3d^3$	**1**

Question Number	Acceptable Answers	Reject	Mark
16 (b) (ii)	Octahedral		**1**

Question Number	Acceptable Answers	Reject	Mark
17 (a) (i)	(Ligands cause) d orbitals / sub-shell / sub level to split **(1)** **Some** frequencies of light (energy) are absorbed **(1)** To promote electrons (within d level / d → d transitions) **(1)** ALLOW as alternative for second mark Remaining light is transmitted / reflected (resulting in the colour seen) **Mark independently**	Description of flame test	**3**

Question Number	Acceptable Answers	Reject	Mark
17 (a) (ii)	Concentrated HCl / HCl / HCl (aq) **(1)** **Ligand** exchange / replacement / substitution **(1)** **Mark independently**	Dilute HCl	**2**

Question Number	Acceptable Answers	Reject	Mark
17 (b) (i)	$[Cr(H_2O)_6]^{3+} + H_2O \rightleftharpoons [Cr(H_2O)_5(OH)]^{2+} + H_3O^+$ **(1) (1)** ALLOW $[Cr(H_2O)_6]^{3+} + H_2O \rightleftharpoons [Cr(H_2O)_5(OH)]^{2+} + H_2O + H^+$ **(1) (1)** ALLOW second mark for number of H_3O^+ ions related to incorrect complex e.g. $[Cr(H_2O)_4(OH)_2]^{2+} + 2H_3O^+$ scores second mark Ignore state symbols even if wrong		**2**

Question Number	Acceptable Answers	Reject	Mark
17 (b) (ii)	The concentration of oxonium / hydrogen ions is less in the $[Cu(H_2O)_6]^{2+}$ / fewer hydrogen ions produced or reverse argument based on Cr ion **(1)** ALLOW $[Cr(H_2O)_6]^{3+}$ / chromium ion deprotonates more easily if H_3O^+ shown in equation in (b) (i) Because copper ion is 2+ whilst the chromium ion is 3+ / charge on copper ion is less than charge on Cr ion / less charge density on 2+ ions / Cr (3+) draws more electron density from the O-H bond **(1)**	Just chromium complex more acidic The concentration of oxonium / hydrogen ions is greater in the $[Cu(H_2O)_6]^{2+}$ / more hydrogen ions produced Ligand exchange	**2**

Question Number	Acceptable Answers	Reject	Mark
17 (c)	$Cr(OH)_3$ / $Cr(H_2O)_3(OH)_3$		**1**

Question Number	Acceptable Answers	Reject	Mark
17 (d)	NaOH is a (strong) base / alkali **(1)** $Cr(H_2O)_3(OH)_3$ loses (three) protons / undergoes further deprotonation **OR** $Cr(OH)_3$ is amphoteric (so reacts with strong bases) **(1)** To reverse reaction 4 add (sulfuric) acid / H^+ / HCl **(1)**	Chromium is amphoteric	**3**

Question Number	Acceptable Answers	Reject	Mark
17 (e)	$[Cr(NH_3)_6]^{3+} + (edta)^{4-} \rightarrow [Cr(edta)]^- + 6NH_3$ **(1)** Ignore missing brackets Ignore state symbols even if wrong During the reaction number of particles increases (2 to 7) / more moles of product than reactants AND entropy (of system) increases **(1)**	Entropy increases because a gas is produced only Just more products than reactants	**2**

TOTAL FOR SECTION B = 50 MARKS

Section C

Question Number	Acceptable Answers	Reject	Mark
18 (a) (i)	Mass of C in CO_2 = 12/44 x 0.88 = 0.24 g Mass of H in H_2O = 2/18 x 0.216 = 0.024g **(1)** So mass of oxygen = 0.328 – (0.24 + 0.024) = 0.064 g **(1)** Moles of C = 0.24/12 = 0.02 Moles of H = 0.024/1 = 0.024 Moles of O = 0.064/16 = 0.004 **(1)** Ratio = simplest ratio = 5:6:1 so $C_{10}H_{12}O_2$ **(1)** **OR** Moles of CO_2 0.88/44 = 0.02 Moles of H_2O 0.216/18 = 0.012 **(1)** Moles of H = 0.024 therefore ratio of C:H is 5:6 **(1)** Can gain remaining two marks if they continue calculation as above **OR** $C_{10}H_{12}O_2$ = 164 **(1)** Percentage carbon is 120/164 = 73.2% Percentage hydrogen is 7.3% Percentage oxygen is 19.5% **(1)** Mass of carbon = 73.2 x 0.328/100 = 0.24 Mass of hydrogen = 7.3 x 0.328/100 = 0.024 Mass of oxygen = 19.5 x 0.328/100 = 0.064 **(1)** Mass of carbon in CO_2 is 12/44 x 0.88 = 0.24 Mass of hydrogen in H_2O is 1/9 x 0.216 = 0.024 **(1)** **OR** Mass of C in CO_2 = 12/44 x 0.88 = 0.24 g Mass of H in H_2O = 2/18 x 0.216 = 0.024g **(1)** So mass of oxygen = 0.328 – (0.24 + 0.024) = 0.064 g **(1)** Percentage of C = 0.24/0.328 = 73.2% Percentage of H = 0.024/0.328 = 7.3% Percentage of O = 0.064/0.328 =19.5% **(1)** $C_{10}H_{12}O_2$ = 164 Percentage carbon is 120/164 = 73.2% Percentage hydrogen is 12/164 = 7.3% Percentage oxygen is 32/164 = 19.5% **(1)**		**4**

Question Number	Acceptable Answers	Reject	Mark
18 (a) (ii)	Add (small amount of) Br_2 / bromine **(1)** (Br_2 turns from orange / yellow / red-brown to) colourless / decolourised **(1)** **OR** Add (small amount of) **acidified** $KMnO_4(aq)$ **(1)** $KMnO_4(aq)$ turns from purple/pink to colourless / brown **(1)** **OR** Add (small amount of) **alkaline** $KMnO_4(aq)$ **(1)** $KMnO_4(aq)$ turns from purple/pink to green **(1)**	clear	**2**

Question Number	Acceptable Answers	Reject	Mark
18 (a) (iii)	(Heat under) reflux **OR** microwave (in sealed container)		**1**

Question Number	Acceptable Answers	Reject	Mark
18 (a) (iv)	CH_3COCl / $CH_3COO(COCH_3)$ / ethanoyl chloride / ethanoic anhydride ALLOW CH_3COOH / ethanoic acid **and** H_2SO_4 / sulfuric acid / HCl / hydrochloric acid	Correct answer plus $AlCl_3$ Acyl chloride	**1**

Question Number	Acceptable Answers	Reject	Mark
18 (b) (i)	steam source and r.b /pear-shaped flask (and clove buds) **OR** r.b /pear-shaped flask being heated and containing **water** (and clove buds) **(1)** Condenser with water jacket, in correct position and direction of water flow **(1)** Collection vessel **(1)** -1 if apparatus does not work e.g. sealed -1 for no joints or leaky joint	Conical flask if being heated with the clove buds in	**3**

Question Number	Acceptable Answers	Reject	Mark
18 (b) (ii)	Mix organic solvent and oil-water mixture in a separating funnel then separate **(1)** Distil / rotary evaporate (to separate clove oil from organic solvent) **(1)** Add (anhydrous)$CaCl_2$ /(anhydrous) $MgSO_4$ /(anhydrous) Na_2SO_4 /silica gel / calcium oxide to clove oil, (then filter / decant) **(1)** ALLOW name or formula of drying agent (Second and third marks in either order) **OR** Add (saturated solution) of NaCl / sodium salt **(1)** Separate in a separating funnel **(1)** Add named drying agent to clove oil, (then filter / decant) **(1)**	(Anhydrous) $CuSO_4$ NaOH, sodium carbonate, sodium hydrogencarbonate , calcium carbonate	**3**

Question Number	Acceptable Answers	Reject	Mark
18 (c)	Choice with justification **(1)** e.g. 'yes it's reasonable as clove oil may be in use at harmful /toxic levels so we need to identify what that **level** is' 'no as clove oil has been in use for many years in many ways so tests on animals not necessary to confirm it's safe to use at current levels' / no, as humans would have to consume large amounts	Yes because it's toxic No, because of objections to animal testing in general	**1**

Question Number	Acceptable Answers	Reject	Mark
18 (d)*	**4 clear justified comparisons – 1 mark each** **$ScCO_2$** oil obtained seems **purer** (as colour closely matches that of eugenol) requires no further purification, (others use solvent extraction) greater yield per hour yield 15.3g per 100g of buds no organic solvent (because it is chlorinated) **and** so environmental problems / harmful / damage ozone layer requires high pressure so likely to be expensive / requires specialist equipment **Steam distillation** steam distillation can be done using standard lab equipment /does not require high pressures yield only 6.1g / 6.2g per 100g of buds Steam gives the least yield per hour **Soxhlet** produces greater yield of oil but has a smaller percentage of eugenol /eugenol ethanoate yield 16.8g per 100g of buds (takes longer) but does not require high pressures uses organic solvent (because it is chlorinated) **and** so environmental problems / harmful / damage ozone layer Oil obtained seems least pure **(4)** **Synthetic route** has several steps, each with a low yield clove buds are renewable but materials in synthesis are not / materials in synthesis likely to be obtained from oil **(1)**	produces pale yellow oil Just no organic solvent Only two hours / shorter time than other methods Just higher percentage yield Just no organic solvent Higher yield than soxhlet Cost of chemicals Yield is 35 %	**5**

TOTAL FOR SECTION C = 20 MARKS

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481

Email publications@linneydirect.com

Order Code UA026203 January 2011

For more information on Edexcel qualifications, please visit www.edexcel.com/quals

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