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Mark Scheme (Results)

Summer 2015

GCE Chemistry (6CH04/01)

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Summer 2015
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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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Section A (multiple choice)

Question Number	Correct Answer	Reject	Mark
1	D		1

Question Number	Correct Answer	Reject	Mark
2	B		1

Question Number	Correct Answer	Reject	Mark
3	C		1

Question Number	Correct Answer	Reject	Mark
4	C		1

Question Number	Correct Answer	Reject	Mark
5	C		1

Question Number	Correct Answer	Reject	Mark
6 (a)	D		1

Question Number	Correct Answer	Reject	Mark
6 (b)	A		1

Question Number	Correct Answer	Reject	Mark
7	D		1

Question Number	Correct Answer	Reject	Mark
8(a)	D		1

Question Number	Correct Answer	Reject	Mark
8(b)	A		1

Question Number	Correct Answer	Reject	Mark
9	C		1

Question Number	Correct Answer	Reject	Mark
10(a)	D		1

Question Number	Correct Answer	Reject	Mark
10(b)	B		1

Question Number	Correct Answer	Reject	Mark
10(c)	C		1

Question Number	Correct Answer	Reject	Mark
11(a)	D		1

Question Number	Correct Answer	Reject	Mark
11(b)	A		1

Question Number	Correct Answer	Reject	Mark
11(c)	C		1

Question Number	Correct Answer	Reject	Mark
12(a)	B		1

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

Question Number	Correct Answer	Reject	Mark
12(c)	B		1

Total for Section A = 20 marks

Section B

Q13 (a) PENALISE USE OF CH_3COOH / 'ethanoic acid' [instead of propanoic acid] once only. ALLOW 'NaOH' for 'KOH', however.

Question Number	Correct Answer	Reject	Mark
13 (a)(i)	**Q13 (a) PENALISE USE OF CH_3COOH / 'ethanoic acid' [instead of propanoic acid] once only.** **ALLOW 'NaOH' for 'KOH', however.** **1st mark: Identification of buffer** **Any** mention of **buffer** / **buffering** (region) **(1)** IGNORE references to shape / gradient of graph **2nd mark: Identification of species present responsible for buffering action** (Both) propanoic acid **and** propanoate (ions) present OR (Both) propanoic acid **and** potassium propanoate present OR (Both) a **weak** acid and its salt/conjugate base are present OR (Both) CH_3CH_2COOH **and** $CH_3CH_2COO^-$ present OR (Both) HA and A^- are present **Can be awarded from an equation** **(1)**		**3**

	3rd mark: Two routes for this mark: **1st route:** **For how these species were formed** **OR** **alternatively** **2nd route:** **For mention of how this buffer works, on small additions of OH^-** **1st ROUTE to 3rd mark** $CH_3CH_2COOH + OH^- \rightarrow H_2O + CH_3CH_2COO^-$ OR In words, **excess** CH_3CH_2COOH is left / some CH_3CH_2COOH has reacted with potassium hydroxide / KOH / OH^- (forming propanoate ions) **2nd ROUTE – buffering action** On addition of OH^- (in small quantities) H^+ ions react with (the added) OH^- **and** (the equilibrium) $CH_3CH_2COOH \rightleftharpoons CH_3CH_2COO^- + H^+$ shifts to the **right** OR (the reservoir of undissociated) CH_3CH_2COOH molecules react with (the added) OH^- **NOTE:** For the 2nd route "OR" mark here, this statement/equation must be in the context of buffering action **IGNORE** References to buffering action on addition of H^+ ions (not relevant here) **(1)**		

Question Number	Correct Answer	Reject	Mark
13 (a) (ii)	**1st scoring point:** Propanoate ions present (at equivalence point) OR Potassium propanoate present (at equivalence point) **(1)** **2nd scoring point:** Propanoate (ions) react with water / propanoate (ions) are hydrolysed by water / $CH_3CH_2COO^-$ ions react with water ALLOW propanoate ions react with H^+ (from water) / the salt reacts with water (molecules) **(1)** **3rd scoring point – consequential on 2nd scoring point being awarded:** Forming hydroxide ions/ leaves excess of hydroxide ions / produces OH^- / forming OH^- / forming KOH / $[OH^-] > [H^+]$ **(1)** **NOTE – the equation:** $CH_3CH_2COO^- + H_2O \rightarrow OH^- + CH_3CH_2COOH$ **OR** $CH_3CH_2COOK + H_2O \rightarrow KOH + CH_3CH_2COOH$ scores **ALL THREE MARKS** **NOTE** **Just** 'weak acid – strong base titration' scores **(1) only**		**3**

Question Number	Correct Answer	Reject	Mark
13 (a) (iii)	**[FIRST, CHECK THE FINAL ANSWER IF ANSWER pH = 12(.02), award 5 marks]** Moles of acid used = 25/1000 x 0.024 OR moles of acid used = 6×10^{-4} (mol) **and** Moles of alkali added = 40/1000 x 0.032 OR Moles of alkali added = 1.28×10^{-3} (mol) **(1)** Moles of excess alkali = $1.28 \times 10^{-3} - 6 \times 10^{-4}$ OR Moles of excess alkali = 6.8×10^{-4} (mol) **(1)** $[OH^-] = 6.8 \times 10^{-4} / (65/1000)$ $= 0.01046$ (mol dm^{-3}) **(1)** Allow TE from incorrect moles of acid or alkali, **provided the alkali moles are in excess** $[H^+] = 1 \times 10^{-14} / 0.01046$ $= 9.56 \times 10^{-13}$ (mol dm^{-3}) **(1)** Allow TE from incorrect moles of excess alkali or the candidate's value of $[OH^-]$. Must use K_w value here to get $[H^+]$ pH = $-\log 9.56 \times 10^{-13}$ = 12(.02) **(1)** Can get M4 and M5 using pH + pOH = 14 Allow TE from incorrect $[H^+]$ for M5, but their CQ pH must **>** 7 IGNORE S.F. EXCEPT 1 SF		**5**

	NOTE If fail to **÷ by 0.065 dm^3**, then pH = 10.8 scores 4 marks. Other answers to look for if M1 and M2 have been awarded, but division by an incorrect value for the total volume of the mixture, then each of the following would score 4 overall as shown. **If ÷ by 0.025 dm^3, no M3** pH = 12(.43) scores 4 marks. **If ÷ by 0.040 dm^3, no M3** pH = 12(.23) scores 4 marks. **If ÷ by 0.015 dm^3, no M3** pH = 12(.66) scores 4 marks.		

Question Number	Correct Answer	Reject	Mark
13 (b)	No, as T increases eqm moves to RHS / K_w increases / 'favours RHS' / ΔS_{total} increases **(1)** So $[H^+]$ ions increases / more H^+ ions $[H^+] > 1 \times 10^{-7}$ **(1)** Hence pH < 7 / pH decreases **(1)** **OR** reverse argument for a decrease in temperature **NOTE** If answer given is 'Yes' (i.e. candidate thinks that the pH of pure water **is** always 7.0), then max **(1)** for stating that equilibrium shifts to the right when temperature increases (since reaction is endothermic in the forward direction) **NOTE** If says K_w **decreases** as T increases, then max **(1)** for a completely logical CQ argument mentioning the effect on $[H^+]$ (decreasing) **and** pH (increasing)		**3**

(TOTAL FOR QUESTION 13 = 14 marks)

Question Number	Correct Answer	Reject	Mark
14 (a)	**1st mark:** Take **samples** (of reaction mixture) at various times OR Using of different mixtures (e.g. in separate conical flasks) **(1)** THEN: **EITHER** Quench (with ice) / remove the catalyst **(1)** **Titrate** with **acid of known concentration/standard** (using a suitable indicator) **(1)** **OR** Quench with acid **(1)** **Titrate** with **alkali of known concentration** (using a suitable indicator) **(1)** If no quenching, M3 can only be awarded if titrate with acid of known concentration	$NaHCO_3$ $NaHCO_3$	**3**

Question Number	Correct Answer	Reject	Mark
14 (b) (i)	(As) rate is (directly) proportional to concentration / as [A] doubles so does rate / rate ∞ concentration / rate ∞ [A] ALLOW Just 'straight line through origin/(0,0)' IGNORE References just to a 'constant gradient' References to **just** 'it is a straight line' References to positive correlation		**1**

Question Number	Correct Answer	Reject	Mark
14 (b) (ii)	**1st mark:** Rate higher than expected / rate unusually high / higher rate (for the anomalous points on the graph) **(1)** **2nd mark:** Reaction is exothermic / (heat) energy is released during the reaction **(1)** **3rd mark:** **EITHER** (So) there are more particles/collisions with energy > E_a ALLOW Higher **proportion of** successful collisions / just more successful collisions **IGNORE** **Just** 'more collisions' / 'more frequent collisions' **OR** At higher concentrations of **A**, the effect of the reaction being exothermic is greater **(1)**		**3**

Question Number	Correct Answer	Reject	Mark
14 (c) (i)	Increases reliability / improves validity (of the data obtained) / confirms the initial results / to check for anomalous results IGNORE References to average / precision / accuracy **OR** To determine order w.r.t. B and X / to see the effect of B and X (on the rate) / enables order of other reagents to be determined / to determine order w.r.t. B / find overall order / determine rate equation / to calculate *k*		**1**

Question Number	Correct Answer	Reject	Mark
14 (c) (ii)	0 order w.r.t. B **(1)** 1st order w.r.t. X **(1)** Rate = k [A][X] OR Rate = k [A][X][B]^0 ALLOW TE for CQ correct rate equation on incorrect order(s) **(1)** **Correct** reasoning **using data from table** to deduce the **CORRECT** order w.r.t. B NOTE that there must be reference to **TWO** relevant concentrations changing Eg (Expt 1 & 3) [A] triples, so does rate **AND** [B] doubles so order w.r.t. B is 0 (Expt 2 & 3) [A] x 1.5, rate x 1.5 **AND** [B] doubles so order w.r.t. B is 0 This mark can only be awarded if the reasoning shows that order w.r.t B is zero. **(1)** Not enough **just** to say 'as [B] doubles, rate unchanged' **Correct** reasoning **using data from table** to		**5**

	deduce the **CORRECT** order w.r.t. X NOTE that there must be reference to **TWO** relevant concentrations changing E.g. (Expt 1 & 4) [A] x 4 (and [B] x 2) **AND** [X] ÷ 2 rate doubles so order w.r.t. X is 1 (Expt 2 & 4) [A] x 2 (and [B] x 2) **AND** [X] ÷ 2 rate stays the same so order w.r.t. X is 1 (Expt 3 & 4) [A] x 4/3 (and [B] stays the same) **AND** [X] ÷ 2 rate decreases by 2/3, so order w.r.t. X is 1 This mark can only be awarded if the reasoning shows that order w.r.t X is one. Not enough **just** to say 'as [X] doubles, rate doubles' **(1)** IGNORE Any justification not concluded from data in the table Working to confirm order w.r.t. A = 1 (already given in question) NOTE Correct rate equation **alone** scores M1, M2 and M3		

Question Number	Correct Answer	Reject	Mark
14 (c) (iii)	k = rate / [A][X] = $4.2 \times 10^{-3} \div (0.08 \times 0.25)$ = 0.21 **(1)** $dm^3\,mol^{-1}\,s^{-1}$ / $mol^{-1}\,dm^3\,s^{-1}$ ALLOW units in any order **(1)** Comment Unit mark is independent of the value **Allow use of data from experiments 1, 2 & 3** Allow TE from an incorrect rate equation given in answer to Q14(c)(ii) or a 'new' rate equation given at the start of answer to Q14(c)(iii), if of the form rate = k …		**2**

Question Number	Correct Answer	Reject	Mark
14 (d)	**Correct feature** **ANY <u>one</u> of:** First step does involve carbocation formation / carbocation is correct / two electrons taken by Br atom in C−Br bond / C−Br bond breaks (heterolytically) (Second step does involve) attack of hydroxide ion First order wrt the halogenoalkane / 1st order wrt 2-bromomethylpropane (S_N1) is a two-step process Curly arrow**<u>s</u>** are correct **(1)** **Incorrect features** **ANY <u>two</u> of:** • Should be S_N1 (not S_N2) • First step is slow • Second step is fast • (It is not) S_N2 • $C^{\delta+}-Br^{\delta-}$ not shown / dipole on C−Br bond not shown **(2)**		**3**

TOTAL FOR QUESTION 14 = 18 marks)

Question Number	Correct Answer	Reject	Mark
15 (a)	**EITHER** (consideration of kinetics) Rate of reaction increases **(1)** As collisions are **more frequent** / **increases frequency** of collisions / more collisions **per second** IGNORE **Just** 'more collisions' or **just** 'more successful collisions' **(1)** **OR** (if assumes an equilibrium reaction) Yield increases / eq'm shifts to RHS **(1)** Since fewer moles **of gas** / no moles **of gas** / fewer molecules **of gas** (on RHS) **(1)** **MUST AWARD MARKS BY ONLY CONSIDERING ONE OF THE ROUTES – CANNOT score full marks via one mark from each route if 'MIX UP' KINETICS AND EQUILIBRIUM ARGUMENTS** Eg Rate increases, so yield of product increases scores **(1)**		**2**

Question Number	Correct Answer	Reject	Mark
15 (b)	**[FIRST, CHECK THE FINAL ANSWER IF ANSWER = 3.1 (tonnes), award 3 marks]** **EITHER** 1 tonne C_6H_5ONa : 180/116 tonnes $C_6H_4(OH)(CO_2H)$ **(1)** 2.5 tonnes C_6H_5ONa : (180/116) x 2.5 (tonnes) $C_6H_4(OH)(CO_2H)$ at 100% yield **(1)** (= 3.879 tonnes) So actual yield = (180/116) x 2.5 x 79/100 (3.06) = 3.1 (tonnes) **(1)** **OR** Moles C_6H_5ONa (= 2.5 x 10^6 ÷ 116) = 21 551.7 (mol) **(1)** Moles C_6H_5ONa (79% yield) (= 21 551.7 x 0.79) = 17025.8 (mol) **(1)** Mass C_6H_5ONa (= 17025.8 x 180 = 3064644 g = 3.06 tonnes) = 3.1 (tonnes) **to 2SF** **(1)** Correct answer **TO 2 SF**, no working **(3)** Can work in g (instead of tonnes) until final answer So final answer of 3.06 (tonnes) scores M1 and M2 only Award only **(1)** mark for 3.07 (tonnes) without working	**g**	**3**

Question Number	Correct Answer	Reject	Mark
15 (c)	Esterification / acylation / ethanoylation ALLOW 'acetylation' **OR** '(nucleophilic) addition-elimination' BOTH words (addition and elimination) are needed for this option IGNORE 'Condensation' **(1)** CH_3COCl / ethanoyl chloride **OR** $(CH_3CO)_2O$ / ethanoic anhydride **(1)** ALLOW CH_3COOH / ethanoic acid (in presence of H_2SO_4) Correct displayed / skeletal formulae **IGNORE** JUST 'acid anhydride' / 'acid chloride'		**2**

(TOTAL FOR QUESTION 15 = 7 marks)

Question Number	Correct Answer	Reject	Mark
16 (a) (i)	**1st mark:** Filter (off solid) / centrifuge **(1)** **2nd mark:** (Fractionally) distil / evaporate ALLOW Just 'heat' / steam distillation for 2nd mark **(1)** **IGNORE** Any other practical steps (e.g. separating funnel) Mark the two scoring points independently, but award **(1)** if 'filter' is first mentioned **after** 'distil' / 'evaporate' / 'heat' / 'steam distillation'	'recrystallise' for 2nd mark	**2**

Question Number	Correct Answer	Reject	Mark
16 (a) (ii)	$R'COOCH_3 + R''COOCH_3 + R'''COOCH_3 + CH_2OH\text{-}CHOH\text{-}CH_2OH$ First mark for all three esters **(1)** Second mark for structure of propane–1,2,3-triol IGNORE Formulae written such as $C_3H_5(OH)_3$ or $C_3H_8O_3$ **(1)** ALLOW CO_2 or OCO for COO for ester linkage H_3COOCR' / CH_3OOCR' Mark independently		**2**

Question Number	Correct Answer	Reject	Mark
16 (a) (iii)	Sodium hydroxide / potassium hydroxide / NaOH / KOH / OH^- **ALLOW** sulfuric acid / H_2SO_4 or any other named strong acids or strong alkalis / HCl / just 'acid' / just 'base' / just 'alkali' / just H^+	Ni / nickel 'weak'	**1**

Question Number	Correct Answer	Reject	Mark
16 (b)	**Advantage of coffee grounds:** **1st mark: For any mention of re-use of a resource or other listed advantages** EXAMPLES TO LOOK FOR: Reuse of a waste material / less waste / no need to set up (new) coffee plantations / recycling Prevents using up landfill Coffee (plants / beans are) renewable (resource) / can be re-grown NOTE 'renewable' can score M3 as well if palm oil also described as renewable Coffee is widely-used (so grounds available) IGNORE Just coffee easier to grow / JUST 'doesn't require tropical conditions' / doesn't require (extra) land **(1)** **Disadvantage of coffee grounds:** **2nd mark: For any mention that coffee grounds made on a small-scale (so uneconomical) or other features listed below** EXAMPLES TO LOOK FOR: Uses solvents / uses methanol / not carbon-neutral (from non-renewable resources such as crude oil) Only 10 – 15% by mass of oil / has a low(er) yield of oil (than palm oil)) **if not awarded for M3** (Only made on a) small-scale so will not meet demand for biodiesel Coffee grounds distributed in small amounts (so will need collecting and transporting) ALLOW Costs of the use of solvents or energy required for extraction / energy required for distillation / energy required for purification or transport costs **if not awarded for M4** **(1)**		**4**

	Advantage of palm oil: **3rd mark: For any mention of palm oil being a plant-based / renewable / sustainable (resource)** EXAMPLES TO LOOK FOR: Palm oil (made from plants that) can be re-grown / palm oil made from natural resources Palm oil (made from plants that are) renewable resources / palm oil made from 'sustainable' resource NOTE 'renewable' can score M1 as well if coffee also described as renewable Palm oil (made from plants that are) carbon-neutral / better carbon foot print / absorb CO_2 IGNORE **Just** 'greener' (already mentioned in question) **ALLOW** economic argument such as: Higher yield of oil (than in coffee grounds) **if not already awarded for M2** Large scale production so economies of scale / more able to meet demand Fewer stages in its production (so more economical) **(1)** **Disadvantage of palm oil:** **4th mark: For any mention of a disadvantage of a plant-based resource** EXAMPLES TO LOOK FOR: Large scale plantations could lead to habitat loss Deforestation Loss of land (which should be used for food production) Only grows in hot/tropical climates High cost of transporting palm oil (from the tropical countries) **if not already awarded for M2** Palm plants take a long time to grow **(1)**		

TOTAL FOR QUESTION 16 = 9 marks)

Section C

Question Number	Correct Answer	Reject	Mark
17 (a)(i)			**2**

	$CH_2CHCHCH_2$	CO	H_2O	$HOOC(CH_2)_4COOH$
ΔH_f / kJ mol^{-1}	+109.9	**−110.5**	**−285.8**	−994.3
S / J mol^{-1} K^{-1}	278.7	**197.6**	**69.9**	250.0

4 values correct **(2)** marks

3 / 2 values correct **(1)** mark

0 / 1 values correct **(0)** marks

Question Number	Correct Answer	Reject	Mark
17 (a)(ii)	−994.3 − [+109.9 + (2 x −110.5) + (2 x −285.8)] **(1)** = − 311.6 (kJ mol^{-1}) **(1)** Allow TE from (a) **NOTE** If both −110.5 and −285.8 are not doubled, answer CQ = −707.9 (kJ mol^{-1}) for **1** mark Ignore SF except 1 SF		**2**

Question Number	Correct Answer	Reject	Mark
17 (a)(iii)	250(.0) − [278.7 + (2 x 197.6) + (2 x 69.9)] **(1)** = −563.7 (J mol^{-1} K^{-1}) **(1)** Allow TE from (a) **NOTE** If both 197.6 and 69.9 are not doubled, answer CQ = −296.2 (J mol^{-1} K^{-1}) for **1** mark Ignore SF except 1 SF		**2**

Question Number	Correct Answer	Reject	Mark
17 (a)(iv)	ΔS_{surr} at 298 K = −ΔH/T **(1)** = − (−311.6 x 1000) / 298 = (+) **1045.6** (J mol^{-1} K^{-1}) Allow TE from (a)(ii) e.g. ΔS_{surr} = (+)2375.5(0) (J mol^{-1} K^{-1}) scores (2) if no doubling in (a)(ii) **(1)** $\Delta S_{tot} = \Delta S_{surr} + \Delta S_{sys}$ / ΔS_{tot} = 1045.6 −563.7 / ΔS_{tot} = (+) **481.9** (J mol^{-1} K^{-1}) Allow TE from (a)(ii) and (a)(iii) **(1)** Allow correct answers given in **kJ mol^{-1} K^{-1}** e.g. 0.4819 **kJ mol^{-1} K^{-1}** Ignore SF except 1 SF If candidates forget to convert ΔH into J mol^{-1}, then ΔS_{tot} = −562.7 (J mol^{-1} K^{-1}) would score (2) if correct working is included		**3**

Question Number	Correct Answer	Reject	Mark
17 (a)(v)	(Decrease in T) **1st mark: consideration of ΔS_{system}** ΔS_{system} is not (significantly) changed / is unchanged / remains (approximately) constant **(1)** **2nd mark: consideration of ΔS_{surr}** ΔS_{surr} or $-\Delta H/T$ is more positive / larger / greater COMMENT ALLOW 'less negative' **(1)** **3rd mark: consideration of ΔS_{total}** (So) increases ΔS_{tot} / makes ΔS_{tot} more positive / makes ΔS_{tot} greater **(1)** **NOTE** IF no reference / an incorrect reference made to ΔS_{system}, then only the 2nd and 3rd marks can be awarded **NOTE** If candidate states that ΔS_{surr} becomes **less +ve**, no M2 But if **then** states CQ that ΔS_{tot} decreases award M3 as a TE		**3**

Question Number	Correct Answer	Reject	Mark
17 (b)	**DIMINISHING:** (Peak between) **1669 – 1645** (cm^{-1}) (due to C=C) **OR** (Peak between) **3095 – 3010** (cm^{-1}) (due to alkene C-H) **(1)** **INCREASING:** (Peak between) **1725 – 1700** (cm^{-1}) (due to C=O in carboxylic acid) **OR** (Peaks due to alkane C–H bonds at) EITHER **2962 – 2853** (cm^{-1}) OR **1485** – **1365** (cm^{-1}) **ALLOW** (Peak between) **3300 – 2500** (cm^{-1}) (due to O–H in carboxylic acid) **(1)**	**1740 – 1720** **3750 – 3200**	**2**

Question Number	Correct Answer	Reject	Mark
17 (c)	(Makes it taste) sour / sharp / tart IGNORE 'acidic' / 'bitter' NOTE Contradictory answers (e.g. 'sharp and sweeter') score **(0)**	fruity sweet(er) none	**1**

Question Number	Correct Answer	Reject	Mark
17 (d) (i)	**1st mark:** (% of oxygen =) **43.9** (%) **(1)** **2nd mark:** Amount of C = 49.3/12 = 4.1 (mol) Amount of H = 6.8/1 = 6.8 (mol) Amount of O = 43.9/16 = 2.7 (mol) **(1)** **3rd mark:** Ratio **1.5 C : 2.5 H : 1 O** (≡3 C : 5 H : 2 O) ALLOW for 3rd mark:- Decimal values that round up to these values (e.g. **1.497 C : 2.478 H : 1 O** scores the 3rd mark) **(1)** **ALLOW** M_r of $C_3H_5O_2$ = 73 (g mol^{-1}) **(1)** %C = $\frac{36}{73}$ x 100 = 49.3% **and** %H = $\frac{5}{73}$ x 100 = 6.8% **(1)** %O = 43.9% ALLOW 43.8% **(1)**		**3**

<table>
<tr><th>Question Number</th><th>Correct Answer</th><th>Reject</th><th>Mark</th></tr>
<tr><td>17 (d) (ii)</td><td>For ‘Chemical shift’ column, allow any range or any single value within range
<table>
<tr><th>Feature of compound Q</th><th>Chemical shift / ppm</th><th>Splitting pattern</th></tr>
<tr><td>CH_3</td><td>0.1 – 1.9</td><td>Triplet (1)
Allow (splits into) three</td></tr>
<tr><td>CH_2</td><td>1.7 – 3(.0) (1)</td><td>Quartet (1)
Allow quadruplet / (splits into) four</td></tr>
<tr><td>OH</td><td>10(.0) – 12(.0) (1)</td><td>singlet</td></tr>
</table></td><td></td><td>4</td></tr>
</table>

(TOTAL FOR QUESTION 17 = 22 marks)

Total for paper = 90 marks

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