Mark Scheme (Results)

January 2015

Pearson Edexcel International Advanced Subsidiary in Chemistry (WCH02) Paper 01

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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

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) 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.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
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.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

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.

Section A (multiple choice)

Question Number	Correct Answer	Reject	Mark
1	C		1

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

Question Number	Correct Answer	Reject	Mark
2(b)	A		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	D		1

Question Number	Correct Answer	Reject	Mark
6	A		1

Question Number	Correct Answer	Reject	Mark
7	D		1

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

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

Question Number	Correct Answer	Reject	Mark
9	B		1

Question Number	Correct Answer	Reject	Mark
10	A		1

Question Number	Correct Answer	Reject	Mark
11	D		1

Question	Correct Answer	Reject	Mark

Number			
12	D		1

Question Number	Correct Answer	Reject	Mark
13	C		1

Question Number	Correct Answer	Reject	Mark
14	B		1

Question Number	Correct Answer	Reject	Mark
15	A		1

Question Number	Correct Answer	Reject	Mark
16	C		1

Question Number	Correct Answer	Reject	Mark
17	B		1

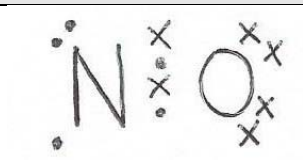
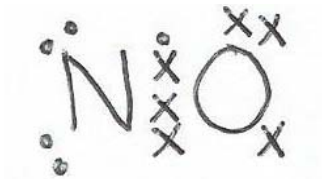
Question Number	Correct Answer	Reject	Mark
18	D		1

(TOTAL FOR SECTION A = 20 MARKS)

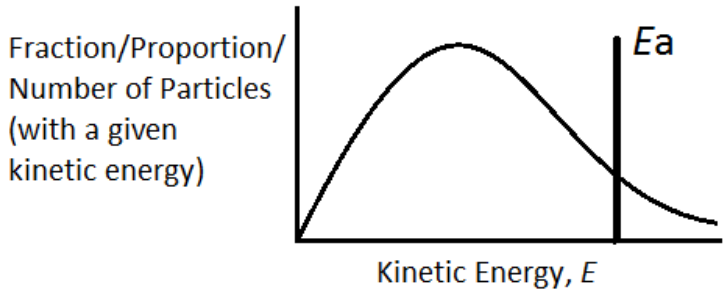
Section B

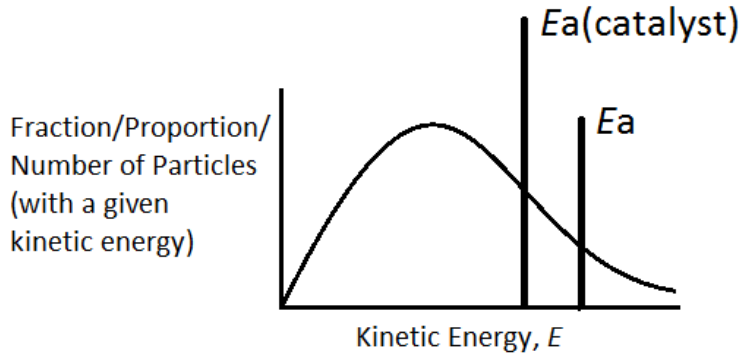
Question Number	Acceptable Answers	Reject	Mark
19(a)	(in NH_3 =) -3/3-/-III (1) (in NO =) +2/2+/+II (1)	Just '2'	2

Question Number	Acceptable Answers	Reject	Mark
19(b)(i)	It has an unpaired electron ALLOW non-paired Ignore references to reactivity/stability/orbital/charge/location of unpaired electron	Just 'single electron' 'lone electron' Electron**s** Free electron	1

Question Number	Acceptable Answers	Reject	Mark
19(b)(ii)	 ALLOW  Double bond as shown in either of above diagrams **(1)** 2 lone pairs on one atom and 1 lone pair + 1 unpaired electron on the other atom **(1)** Second mark dependent on the first		2

Question Number	Acceptable Answers	Reject	Mark
19(c)	To score 2 marks look for one of the following **pairs** of answers: Carry out in a fume cupboard IGNORE (face) masks **and** NH_3/ NO **toxic / poisonous** ALLOW Cr_2O_3 is **toxic / poisonous** **(2)** OR Wear gloves **and** (Concentrated) ammonia is corrosive /causes burns (2) OR Safety screens / **students** wearing safety goggles **and** Risk of explosion / very exothermic **(2)** If the linked points are not made for 2 marks, then any of the above precautions or hazards scores 1 mark max Ignore correct but irrelevant chemistry and penalise incorrect statements, e.g. environmental damage by NO can be ignored but flammability of chromium(III) oxide is incorrect	Harmful/ Dangerous 'Fireflies' flashes	2

Question Number	Acceptable Answers	Reject	Mark
19(d)(i)	 Labelled y axis: fraction / proportion / number of molecules (with a given kinetic energy) **and** activation energy labelled with a vertical line to the right of the curve peak ALLOW Particles for molecules **(1)** Shape of curve **(1)** The curve **must** clearly start from the origin, rise to a peak and then decrease, approaching the x axis **without** crossing/touching it. If the curve is concave at the start or rises at the end then this mark is lost.	Atoms	2

Question Number	Acceptable Answers	Reject	Mark
19*(d)(ii)	Can be shown on diagram (as below): (A catalyst) provides (an alternative reaction pathway with) a lower activation energy (1) Greater Proportion/More particles (as shown in the diagram) have or exceed the (lower) activation energy (so greater proportion of successful collisions) (1)  Ignore references to temperature change Graphs with two curves scores max 1	Ea catalyst to the RHS =0	2

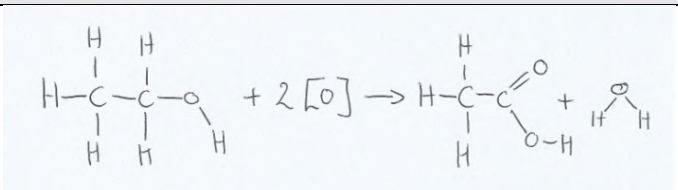
Question Number	Acceptable Answers	Reject	Mark
19(e)	**Marking point 1** Catalysts weaken/break the bonds of the reactants OR Increase the collision rate/number of collisions **(1)** **Marking point 2** Any one of: Reaction takes place on the (catalyst) surface /active sites **(1)** The gaseous reactant molecules **adsorb** on the catalyst (and then react) **(1)** The product molecules desorb from the surface **(1)** Marks are stand alone Ignore general definitions of a catalyst	Absorb	2

Question Number	Acceptable Answers	Reject	Mark
19(f)(i)	$(NH_4)_2Cr_2O_7$ OR Formula with **balanced** charges		1

Question Number	Acceptable Answers	Reject	Mark
19(f)(ii)	Fill the flask with nitrogen / noble gas / argon / helium (and the reaction still takes place) ALLOW Carry out in a vacuum/remove the air		1

Question Number	Acceptable Answers	Reject	Mark
19(f)(iii)	Orange to green Ignore such descriptors as 'bright' or 'dark' etc	Any other colours in combination e.g. orange-yellow	1

TOTAL FOR QUESTION 19 = 16 MARKS

Question Number	Acceptable Answers	Reject	Mark
20(a)	 Displayed formula for ethanol **(1)** Displayed formula for ethanoic acid **(1)** Balancing correct equation **(1)** Penalise OH and/or CH_3 and/or omission of square bracket around the O for the oxidizing agent **once** only Ignore absence of displayed formula for water Ignore state symbols even if incorrect ALLOW full marks for one equation for the oxidation of ethanol to ethanal and then a second equation for the oxidation of ethanal to ethanoic acid as long as displayed formulae are given	O_2	3

Question Number	Acceptable Answers	Reject	Mark
20(b)(i)	Primary/ 1°	Secondary Tertiary	1

Question Number	Acceptable Answers	Reject	Mark
20(b)(ii)	**Marking point 1** Ethanal... volatile/has low boiling temperature (compared to ethanol) ALLOW evaporates easily/readily **(1)** **Marking point 2** Ethanal... Distils OR Boils out of the mixture/boils off OR Condenses in the right-hand flask ALLOW Passes through the condenser **(1)** Ignore 'fractional' **Marking point 3** Ethanal... Separates before being oxidized further/completely OR Away from the oxidizing agent ALLOW Reflux is needed for complete oxidation OR Reflux is needed for oxidation (of ethanol) to ethanoic acid OR Reflux is needed otherwise only partial oxidation occurs **(1)**	ethanoic acid	3

Question Number	Acceptable Answers	Reject	Mark
20(b)(iii)	Prevents pressure building up (by allowing gases to escape) ALLOW: prevent explosion Ignore the identification of any gases produced even if incorrect		1

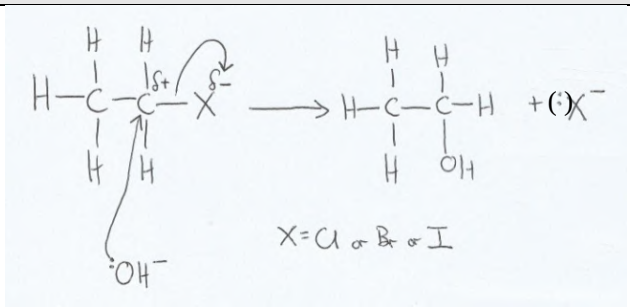
Question Number	Acceptable Answers	Reject	Mark
20(c)(i)	**An incorrect test scores zero** Either of the following approaches: (Reagent) PCl_5 / phosphorus(V) chloride / phosphorus pentachloride OR $SOCl_2$ / thionyl chloride **(1)** (Observation) Misty fumes/steamy fumes / white fumes **(1)** OR (Reagent) Na/Sodium **(1)** (Observation) Effervescence / bubbles **(1)** Observation consequential on reagent or a 'near miss' such as PCl_3 / PCl_5(l) PCl scores 0/2	White smoke Just 'gas' Any incorrect gas	2

Question Number	Acceptable Answers	Reject	Mark
20(c)(ii)	**Allow the atoms in any order** (Mass Spectrum fragment) $CH_3CO^+/C_2H_3O^+$ ALLOW HCO^+ **(1)** (Infrared spectrum difference) Any from (Presence of) C=O absorption/peak/stretch OR (Presence of) C-H in CHO absorption/peak/stretch ALLOW Lack of O-H absorption/peak/stretch OR Lack of C-O absorption/peak/stretch **(1)** Ignore any wave numbers quoted	Absence of $^+$ sign CH_3CHO^+	2

Question Number	Acceptable Answers	Reject	Mark
20(d)(i)	$C_3H_8O_3 + 3½O_2 \rightarrow 3CO_2 + 4H_2O$ OR multiples Ignore state symbols even if incorrect		1

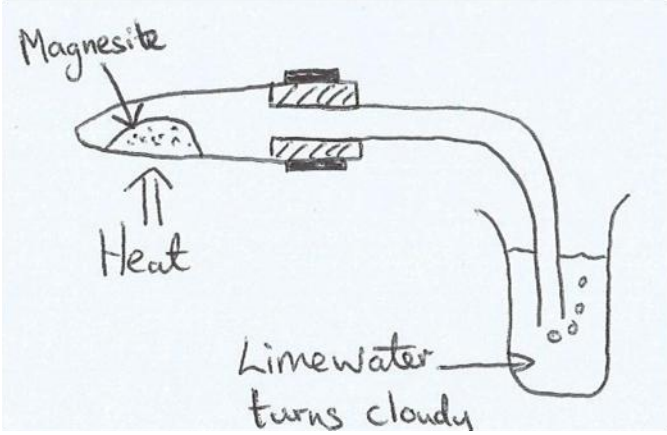
Question Number	Acceptable Answers	Reject	Mark
20(d)(ii)	Many possibilities but the most likely are $C_3H_8O_3 + ½O_2 \rightarrow 3C + 4H_2O$ OR $C_3H_8O_3 + 2O_2 \rightarrow 3CO + 4H_2O$ One mark for species **(1)** One mark for balancing **(1)** ALLOW any suitable combination of above e.g. $C_3H_8O_3 + 1½O_2 \rightarrow 2CO + C + 4H_2O$ $C_3H_8O_3 + 2O_2 \rightarrow CO_2 + CO + C + 4H_2O$ Ignore state symbols even if incorrect (Observation – standalone mark) black smoke/black fumes / sooty / yellow flame ALLOW Black solid/black deposit/soot **(1)**	H_2 as product scores 0/2 Equation for complete combustion scores 0/2 Just 'smoke' Just 'carbon' Just 'blue flame' Grey	3

Question Number	Acceptable Answers	Reject	Mark
20(e)(i)	Nucleophilic **(1)** Substitution **(1)** ALLOW phonetic/alternative spellings of nucleophilic ALLOW for one mark: S_N2/ S_N1 alone ALLOW in any order	Elimination Addition	2

Question Number	Acceptable Answers	Reject	Mark
20(e)(ii)	 Dipole on halogenoalkane **and** lone pair on the oxygen of the hydroxide ion **and** negative charge on the hydroxide ion **(1)** curly arrows (ALLOW from any part of the OH^- including the charge) **(1)** Both correct products **(1)** S_N1 mechanism scores first and third marks only If ethanol is not the alcohol formed max 2	X = F	3

TOTAL FOR QUESTION 20 = 21 MARKS
(TOTAL FOR SECTION B = 37 MARKS)

Section C

Question Number	Acceptable Answers	Reject	Mark
21(a)	Diagram similar to:  **Marking point 1** Heat/Bunsen flame and Magnesite **(1)** **Marking point 2** Suitable container and delivery tube dipping into the liquid ALLOW the collection of gas over water/ syringe **(1)** **Marking point 3** Limewater turns cloudy/milky/white precipitate **(1)** ALLOW alternative correct diagrams e.g. use of teat pipette to collect carbon dioxide The limewater change can be stated on the diagram or on the lines provided. Clamp not required	System sealed	3

Question Number	Acceptable Answers	Reject	Mark
21(b)	$Mg(OH)_2(s) \rightarrow MgO(s) + H_2O(g)$ /(l) Equation **(1)** State symbols **(1)** OR multiples Symbol mark dependent on correct equation	 (aq)	2

Question Number	Acceptable Answers	Reject	Mark
21(c)	Any from: $Ca(OH)_2$/$Sr(OH)_2$/$Ba(OH)_2$ ALLOW $Ra(OH)_2$	 $Be(OH)_2$	1

Question Number	Acceptable Answers	Reject	Mark
21(d)	Mg_3N_2 **(1)** Energy from (burning) magnesium/the reaction... **and** breaks the N≡N triple bond ALLOW breaks down nitrogen molecules **(1)** Carry out in a mixture of an inert gas (argon) and oxygen (gas) ALLOW Carry out in (pure) oxygen (gas) OR Carry out in steam **(1)**	 Just 'remove nitrogen'	3

Question Number	Acceptable Answers	Reject	Mark
21(e)	Electrons are... promoted OR excited OR moved to a higher energy level **(1)** Electrons... return to lower energy level OR return to ground state OR fall back **(1)** Energy/Light/Radiation/Photon is emitted/released upon return **(1)** IGNORE colour is released (For magnesium compounds) this energy/ radiation/photon is not in the visible region ALLOW light is not in the visible region **(1)**	Proton	4

Question Number	Acceptable Answers	Reject	Mark
21(f)	$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$ OR multiples Ignore state symbols even if incorrect		1

Question Number	Acceptable Answers	Reject	Mark
21(g)	H_2SO_4 ALLOW As part of the following equation $MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$ Ignore sulfuric acid and references to concentration		1

Question Number	Acceptable Answers	Reject	Mark
21(h)(i)	If x = 6.41 (from M_r = 120/120.1) 6.42 (from M_r = 120.3) 6.43 (from M_r = 120.4) **and** there is some evidence of working, award all 3 marks If the masses of water and $MgSO_4$ are transposed, then x = 6.96 and scores 2 Answer must be to 3SF Answer alone scores (1) $n(MgSO_4) = 2.55 \div 120.4 = 0.021179$ (mol) **(1)** ($m(H_2O) = 5.00 - 2.55 = 2.45$) $n(H_2O) = 2.45 \div 18 = 0.136111$ (mol) **(1)** (Ratio 1:6.43) x = 6.43 TE on **calculated** values above **(1)** ALTERNATIVE METHOD $2.55 \div 5 = 120.4 \div (120.4 + 18x)$ **(1)** $0.51(120.4 + 18x) = 120.4$ **(1)** $61.404 + 9.18x = 120.4$ $X = 6.43$ **(1)** Penalise use of 1SF in intermediate values **OR** final answer not 3SF		3

Question Number	Acceptable Answers	Reject	Mark
21(h)(ii)	Heat to constant mass ALLOW Heat for a longer period of time **(1)** To ensure all the water is removed ALLOW To ensure all the water is evaporated **(1)** Second mark is dependent on first For max (1) Solid may 'spit' and lose mass **and** so heat gently OR Use a larger mass of Epsom salts to reduce percentage error (of weighing)	Just 'Heat more strongly'	2

Question Number	Acceptable Answers	Reject	Mark
21(i)	90(°) **(1)** Four bonded pairs of electrons (in a flat/planar ring) result in maximum separation/minimum repulsion **(1)** If a bond angle of 109.5° is given then the second mark can be awarded for four bonded electron pairs repelling to maximum separation/minimum repulsion		2

Question Number	Acceptable Answers	Reject	Mark
21(j)	Layer/barrier of magnesium oxide forms OR magnesium oxide forms on the surface (preventing further reaction)		1

TOTAL FOR SECTION C (QUESTION 21) = 23 MARKS

TOTAL FOR PAPER = 80 MARKS