Mark Scheme (Results)

Summer 2018

Pearson Edexcel International Advanced Level in Chemistry (WCH01) Paper 01 The Core Principles of Chemistry

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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

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	Answer	Mark
1	**The only correct answer is D** ***A*** *is not correct because it shows the simplest ratio of atoms present* ***B*** *is not correct because it shows the actual numbers of atoms present in a molecule* ***C*** *is not correct because it shows the structural arrangement but not all the bonds*	**(1)**

Question Number	Answer	Mark
2	**The only correct answer is B** ***A*** *is not correct because it is the mass of potassium ions in 1 dm^3, not 5 dm^3* ***C*** *is not correct because it is the maximum mass of potassium in 5 dm^3* ***D*** *is not correct because it is the mass of potassium ions multiplied by 1000.*	**(1)**

Question Number	Answer	Mark
3	**The only correct answer is C** ***A*** *is not correct because it is a factor of ten out* ***B*** *is not correct because it is just the number of molecules present* ***D*** *is not correct because it is failing to find the number of moles and failing to multiply by 3*	**(1)**

Question Number	Answer	Mark
4	**The only correct answer is C** ***A*** *is not correct because it is dividing by* 10^6 ***B*** *is not correct because it is dividing by* 10^4 ***D*** *is not correct because it is multiplying by* 10^6	**(1)**

Question Number	Answer	Mark
5	**The only correct answer is C** ***A*** *is not correct because cold packs have a positive value* ***B*** *is not correct because cold packs have a positive value and hot packs a negative value* ***D*** *is not correct because hot packs have a negative value*	**(1)**

Question Number	Answer	Mark
6	**The only correct answer is D** ***A*** *is not correct because atomisation produces gaseous atoms* ***B*** *is not correct because combustion is reaction with oxygen* ***C*** *is not correct because formation is the formation of a compound from its elements*	**(1)**

Question Number	Answer	Mark
7	**The only correct answer is B** ***A*** *is not correct because it should not include the mass of zinc* ***C*** *is not correct because the specific heat capacity of water is usually used* ***D*** *is not correct because the specific heat capacity of water is usually used*	**(1)**

Question Number	Answer	Mark
8	**The only correct answer is B** ***A*** *is not correct because though twice as much heat released it heats 1.33 x volume of solution* ***C*** *is not correct because twice amount of heat released as twice as much reactant* ***D*** *is not correct because twice amount of heat released as twice as much reactant*	**(1)**

Question Number	Answer	Mark
9	**The only correct answer is D** ***A*** *is not correct because it is enthalpy of atomisation plus first and second ionisation energies* ***B*** *is not correct because it is first and second ionisation energies* ***C*** *is not correct because it is addition of electrons*	**(1)**

Question Number	Answer	Mark
10(a)	**The only correct answer is A** ***B*** *is not correct because the log of the of first value is unnecessary* ***C*** *is not correct because the values on Graph 2 have too big a range* ***D*** *is not correct because the values on Graph 2 have too big a range*	**(1)**

Question Number	Answer	Mark
10(b)	**The only correct answer is B** ***A*** *is not correct because it confuses quantum shell and types of sub-shell* ***C*** *is not correct because it counts all four sub-shells* ***D*** *is not correct because it counts all orbitals*	**(1)**

Question Number	Answer	Mark
11	**The only correct answer is D** ***A*** *is not correct because it is the largest and not isoelectronic* ***B*** *is not correct because it is the second largest* ***C*** *is not correct because it is larger than* F^-	**(1)**

Question Number	Answer	Mark
12	**The only correct answer is A** ***B*** *is not correct because it is not metal ions* ***C*** *is not correct because it is not metal ions* ***D*** *is not correct because it is not metal ions*	**(1)**

Question Number	Answer	Mark
13	**The only correct answer is B** ***A*** *is not correct because copper(II) ions move towards the negative electrode* ***C*** *is not correct because manganate(VII) ions move towards the positive electrode and copper(II) ions move towards the negative electrode* ***D*** *is not correct because manganate(VII) ions move towards the positive electrode*	**(1)**

Question Number	Answer	Mark
14	**The only correct answer is B** ***A*** *is not correct because both do not contain ions* ***C*** *is not correct because both contain negative particles as well* ***D*** *is not correct because ionic compounds do not contain atoms – they contain positive ions and negative ions*	**(1)**

Question Number	Answer	Mark
15	**The only correct answer is A** ***B*** *is not correct because sodium chloride only conducts in the liquid state* ***C*** *is not correct because sodium conducts as a liquid* ***D*** *is not correct because sodium chloride only conducts in the liquid state*	**(1)**

Question Number	Answer	Mark
16	**The only correct answer is B** ***A*** *is not correct because the oxygen atoms are missing their non-bonding pairs of electrons* ***C*** *is not correct because Y is correct* ***D*** *is not correct because W and Y are correct, the oxygen atoms are missing their non-bonding pairs of electrons*	**(1)**

Question Number	Answer	Mark
17	**The only correct answer is A** ***B*** *is not correct because it contains 1 π bond* ***C*** *is not correct because it contains no π bonds* ***D*** *is not correct because it contains 1 or no π bonds*	**(1)**

Question Number	Answer	Mark
18	**The only correct answer is B** ***A*** *is not correct because it shows a 1s orbital* ***C*** *is not correct because it shows a 3s orbital* ***D*** *is not correct because it shows a 2p orbital*	**(1)**

Question Number	Answer	Mark
19	**The only correct answer is C** ***A*** *is not correct because it is too few* ***B*** *is not correct because it is too few* ***D*** *is not correct because it is too many*	**(1)**

(TOTAL FOR SECTION A = 20 MARKS)

Section B

Question Number	Acceptable Answers	Reject	Mark
20(a)(i)	**M1** P is the electric field OR Electric / charged plate(s) (1) IGNORE -ve / +ve charges on the plates **M2** To accelerate the **ions** OR To get **ions** travelling in a straight line OR To get **ions** moving with the same velocity/speed (1)	Magnetic field Magnets To ionise	**(2)**

Question Number	Acceptable Answers	Reject	Mark
20(a)(ii)	Electromagnet ALLOW (variable) Magnetic (field) / electromagnetic (field) / Magnet IGNORE Deflector Or Anything else		**(1)**

Question Number	Acceptable Answers	Reject	Mark
20(a)(iii)	**Any two from** **M1** Ions have low(er) mass/light(er) 0020 (1) **M2** Doubly charged ALLOW High(er) charge / more ionised / lost more than 1 electron (1) **M3** Low(er) mass to charge ratio (1) Ignore references to charge density / size of ions If no other mark is awarded, different mass **and** different charge scores 1 max		**(2)**

<table>
<tr><th>Question Number</th><th>Acceptable Answers</th><th>Reject</th><th>Mark</th></tr>
<tr><td>20(b)(i)</td><td>
<table>
<tr><th>Isotope mass number</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr>
<tr><td>24</td><td>12</td><td>12</td><td>12</td></tr>
<tr><td>25</td><td>12</td><td>13</td><td>12</td></tr>
<tr><td>26</td><td>12</td><td>14</td><td>12</td></tr>
</table>
All three columns correct (2)

Any two columns / rows correct (1)
</td><td></td><td>(2)</td></tr>
</table>

Question Number	Acceptable Answers	Reject	Mark
20(b)(ii)	(Isotopes / atoms / they / species that have the) same numbers of protons (and electrons) but different numbers of neutrons (1) Magnesium has 12 protons **and** at least 2 out of 12, 13 or 14 neutrons ALLOW Magnesium has 12 protons **and** number of neutrons increases by 1 as (isotopic) mass increases by 1 (1) If MP1 or MP2 not scored then allow 1 mark for Same atomic number, different mass / nucleon number		**(2)**

Question Number	Acceptable Answers	Reject	Mark
20(b)(iii)	$\frac{0.786 \times 24 + 0.101 \times 25 + 0.113 \times 26}{1.000} = 24.327$ = 24.33 Numerator (1) Answer to **2** DP (1) ALLOW internal TE's Correct answer with no working scores 2 IGNORE units even if incorrect	24.32	**(2)**

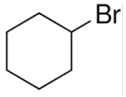
Question Number	Acceptable Answers	Reject	Mark
20(c)	Any two from: Radioactive dating / carbon dating / hydrogen dating (1) IGNORE Reference to specific isotopes even if incorrect e.g C-12 Space research (1) Testing for (anabolic) steroids / drugs (in sport) (1) Identifying compounds (e.g. for possible drugs in the pharmaceutical industry OR Determination of molecular structure/M_r (1) IGNORE Anything else unless a direct contradiction		**(2)**

(Total for Question 20 = 13 marks)

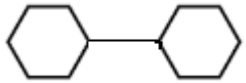
Question Number	Acceptable Answers	Reject	Mark
21(a)(i)	Notice that credit can be given for the idea of two layers in any part of (a), but mark must be awarded in (a)(i) **M1** Two layers would form (1) **M2** Lower layer yellow / orange / brown **and** Upper layer is colourless (1)	Red Red-brown	**(2)**

Question Number	Acceptable Answers	Reject	Mark
21(a)(ii)	The colour moves to the other layer IGNORE Any other information even if incorrect		**(1)**

Question Number	Acceptable Answers	Reject	Mark
21(a)(iii)	(The yellow/orange / brown colour) would turn colourless ALLOW decolourises IGNORE Description of layers		**(1)**

Question Number	Acceptable Answers	Reject	Mark
21(b)(i)	 **M1** ALLOW br (1) **M2** bromocyclohexane ALLOW 1- bromocyclohexane OR Correct name elements in any order Eg cyclobromohexane IGNORE punctuation **M2** depends on **M1**, but ALLOW M2 for correct name If C-Br bond is missing from formula OR If displayed or structural formula is drawn OR If incorrect halogen and consistent name used (1)	C-Br bond missing Any other number	**(2)**

Question Number	Acceptable Answers	Reject	Mark
21(b)(ii)	**M1** Br – Br → Br• + Br• OR Br_2 → 2Br• (1) **M2** Appropriate curly half-arrows (1) IGNORE UV and hv ALLOW M2 for curly arrows using incorrect halogen or Br—OH IGNORE Anything else	+ or — charges	**(2)**

Question Number	Acceptable Answers	Reject	Mark
21(b)(iii)	 IGNORE Bond angles	H atoms	**(1)**

Question Number	Acceptable Answers	Reject	Mark
21(c)	$C_6H_{12}(l) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ Left side (1) Right side (1) No / wrong state symbols 1 max Correct species and state symbols but no/incorrect balancing 1 max		**(2)**

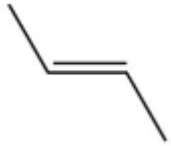
Question Number	Acceptable Answers	Reject	Mark
21(d)	To prevent pre-ignition / knocking / pinking/compression ignition OR (Promotes) smooth / efficient **burning** OR (Promotes) smooth / efficient **combustion** ALLOW High(er) octane number OR Cyclic compound IGNORE More branched	Lower octane number Less branched	**(1)**

Question Number	Acceptable Answers	Reject	Mark
21(e)(i)	$C_6H_{12}(g) \rightarrow 6C(g) + 12H(g)$	Multiples	**(1)**

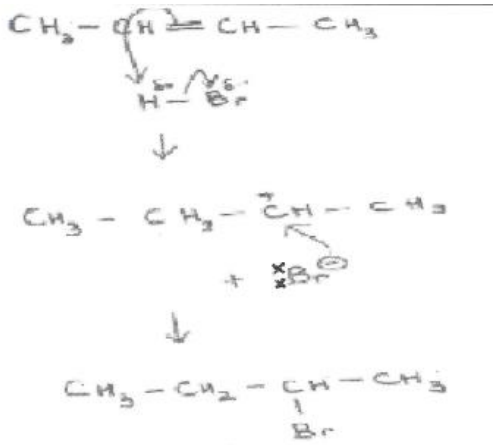
Question Number	Acceptable Answers	Reject	Mark
21(e)(ii)	6 x 347 + 12 x 415 = (+)7062 (kJ mol^{-1}) (1) (1) Correct answer with no working scores (2) ALLOW For 1 mark (+)6715 OR –7062 IGNORE Units	(+)7892	**(2)**

Question Number	Acceptable Answers	Reject	Mark
21(e)(iii)	(The standard enthalpy change) would be more (positive / endothermic) / higher / greater **and** (because) energy / heat would be needed to form gas OR energy / heat would be needed to break intermolecular forces OR Intermolecular forces are stronger in liquid ALLOW reverse argument	break bonds	**(1)**

(Total for Question 21 = 16 marks)

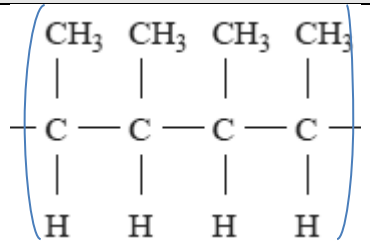
Question Number	Acceptable Answers	Reject	Mark
22(a)(i)	 *Cis*-but-2-ene / *Z*-but-2-ene  *Trans*-but-2-ene / *E*-but-2-ene **M1** Formulae correct ALLOW displayed/part displayed/structural formulae (1) IGNORE Incorrect connectivity of methyl groups **M2** Names correct linked to correct orientation (1) IGNORE punctuation One correct formula with correct name scores 1 mark IGNORE Any additional incorrect structural / displayed / skeletal formulae		**(2)**

Question Number	Acceptable Answers	Reject	Mark
***22(a)(ii)**	(There are two geometric isomers of but-2-ene because) there is no / restricted rotation (about the double / π bond) OR the double / π bond is formed by overlap of adjacent p-orbitals (1) there are (two) different groups attached to each of the double bond carbon atoms OR there is a methyl / alkyl group (and a hydrogen) on each double bond carbon (1)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
22(b)(i)	 **Penalise** M3 for incorrect alkene used even if correct carbocation is given **M1** Arrow from double bond to H (1) **M2** Polarity of HBr bond **and** arrow from H of H-Br bond to Br or just beyond (1) **M3** Carbocation (1) **M4** lone pair on Br^- **and** arrow from lone pair/negative charge on Br^- to C^+ **and** product consistent with carbocation (1) IGNORE dipole on product unless incorrect	Spare bond on C^+ $Br^{\delta-}$	**(4)**

Question Number	Acceptable Answers	Reject	Mark
***22(b)(ii)**	**M1** Atom economy with but-2-ene is 100% OR only 2-bromobutane/only one product forms from but-2-ene (1) **M2** With but-1-ene some **1-bromobutane** forms (so it is less than 100%) (1) If no other mark allow but-1-ene forms more than one product for 1 max		**(2)**

Question Number	Acceptable Answers	Reject	Mark
22(c)	Butan-2,3-diol OR Butane-2,3-diol OR 2,3-dihydroxybutane OR 2,3-butandiol OR 2,3-butanediol IGNORE formula IGNORE punctuation	But-2,3-diol	**(1)**

Question Number	Acceptable Answers	Reject	Mark
22(d)(i)	 Structure of two units (1) Extension bonds (1) ALLOW Extension bonds for one or more than two units 1 max IGNORE Missing brackets Any use of letter n Orientations		**(2)**

Question Number	Acceptable Answers	Reject	Mark
22(d)(ii)	They are not **biodegradable** ALLOW Recognisable spellings of biodegradable Toxic fumes released when **burnt** (Filling up) landfill Harmful/toxic to **wildlife** IGNORE non renewable		**(1)**

Question Number	Acceptable Answers	Reject	Mark
22(d)(iii)	Recycling OR Reusing OR Using renewable (energy) sources (in their production) OR Using chemicals from plants / bio-sources OR Making polylactic acid (PLA) ALLOW Using biopolymers as alternatives OR Manufacture from recycled materials OR Using polymers as a feedstock OR Using catalysts in production		**(1)**

(Total for Question 22 = 15 Marks)

Question Number	Acceptable Answers	Reject	Mark
23(a)(i)	$H_2SO_4 + NaNO_3 \rightarrow HNO_3 + NaHSO_4$ ALLOW multiples IGNORE state symbols even if incorrect		**(1)**

Question Number	Acceptable Answers	Reject	Mark
23(a)(ii)	To prevent it decomposing/reacting in **sunlight/UV** ALLOW To prevent it reacting with/decomposing in light OR To shield it from (sun)light IGNORE Just 'to prevent it oxidising/reacting/decomposing/corroding'		**(1)**

Question Number	Acceptable Answers	Reject	Mark
23(a)(iii)	**Meaning 1** Corrosive IGNORE burning/acidic **Meaning 2** Oxidising ALLOW oxidant/oxidising agent **Meaning 3** Toxic/poisonous ALLOW recognisable spelling eg posiones All three correct (2) Any two correct (1)	 Irritant Flammable Harmful	**(2)**

Question Number	Acceptable Answers	Reject	Mark
***23(a)(iv)**	**Comment** • Scroll right down • Read the whole answer before marking • Use the highlighter to show by underlining where marks awarded **M1** Dissolve in **excess** (concentrated) nitric acid OR nitric acid added until no more alloy dissolves (1) **M2** Filter, (wash) and dry (1) **M3** Weigh the alloy at the start and weigh the gold at the end (1)		**(3)**

Question Number	Acceptable Answers	Reject	Mark
23(a)(v)	$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$ Left side (1) Right side (1) Fully correct but with no/wrong state symbols 1max ALLOW fully correct ionic equation with $NO_3^-(aq)$ on both sides for 1 max ALLOW fully correct overall equation with state symbols for 1 max ALLOW fully correct state symbols and ionic equation for formation of Mg^+ for 1 max $2Mg(s) + 2H^+(aq) \rightarrow 2Mg^+(aq) + H_2(g)$ OR fully correct state symbols and ionic equation as below for 1 max $Mg(s) + H^+(aq) \rightarrow Mg^{2+}(aq) + ½H_2(g)$ ALLOW multiples		**(2)**

Question Number	Acceptable Answers	Reject	Mark
***23(b)(i)**	$\triangle H_f[NO_3^-(g)]$ = -124 –(-832) -285 -731 (1) = -308 (kJ mol^{-1}) (1) Correct answer no working (2) ALLOW for 1 mark (+)308 Lose 1 mark per error if working clear. Ignore units		**(2)**

Question Number	Acceptable Answers	Reject	Mark
***23(b)(ii)**	**Route A** **M1** Silver nitrate is (almost completely) ionic (1) **M2** Because there is reasonable agreement (1) OR **Route B** **M1** Nitrate ions are slightly polarized OR silver nitrate has (slight) covalent character/slight covalent bonding (1) **M2** Because the Born Haber lattice energy is (slightly) more **negative**/**exothermic** than the theoretical lattice energy. (1)	Silver ion is (slightly) Polarized Covalent **bonds**	**(2)**

Question Number	Acceptable Answers	Reject	Mark
23(c)(i)	So silver nitrate/ions will dissolve (onto the skin) ALLOW Nitrate is soluble / nitrates are soluble OR Silver (ions) dissolve / soluble OR It is soluble / dissolves OR (Water) acts as a solvent / to form a solution / ions in aqueous state IGNORE To dilute the silver nitrate only Any additional information even if dubious/incorrect unless a clear contradiction For example: Water is needed to react OR Water absorbs the heat of the reaction OR It makes it easier to rub (the skin)		**(1)**

Question Number		Reject	Mark
23(c)(ii)	$\frac{20 \times 0.95}{169.9}$ = 0.112/0.11/0.111830488 (mol) (1) (1) Correct answer, no working (2) IGNORE SF except 1SF Penalise second mark for: incorrect rounding eg 0.111, 0.12 etc OR incorrect unit e.g. g incorrect scaling can still score TE for division of their mass by 169.9. Example values are 0.1239 and 0.1177		**(2)**

(Total for question 23 = 16 marks)

TOTAL FOR PAPER = 80 MARKS

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