Pearson

Mark Scheme (Results)

January 2018

Pearson Edexcel International Advanced Level In Chemistry (WCH02) Paper 01 Applications Of 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.

Section A (multiple choice)

Question Number	Correct Answer	Mark
1	**The only correct answer is D** ***A*** *is not correct because this is linear* ***B*** *is not correct because this is trigonal planar* ***C*** *is not correct because this is tetrahedral*	**(1)**

Question Number	Correct Answer	Mark
2	**The only correct answer is B** ***A*** *is not correct because 90º is not in methanol* ***C*** *is not correct because 180 º is not in methanol* ***D*** *is not correct because Neither bond angle in methanol*	**(1)**

Question Number	Correct Answer	Mark
3(a)	**The only correct answer is C** ***A*** *is not correct because all have boiling temperature below water* ***B*** *is not correct because all have boiling temperature below water* ***D*** *is not correct because all have boiling temperature below water*	**(1)**

Question Number	Correct Answer	Mark
3(b)	**The only correct answer is D** ***A*** *is not correct because all have weaker hydrogen bonds than hydrogen fluoride* ***B*** *is not correct because all have weaker hydrogen bonds than hydrogen fluoride* ***C*** *is not correct because all have weaker hydrogen bonds than hydrogen fluoride*	**(1)**

Question Number	Correct Answer	Mark
4	**The only correct answer is D** ***A*** *is not correct because both decrease* ***B*** *is not correct because ionization energy decreases* ***C*** *is not correct because solubility decreases*	**(1)**

Question Number	Correct Answer	Mark
5	**The only correct answer is D** ***A*** *is not correct because only Mg has correct colour* ***B*** *is not correct because no correct colours* ***C*** *is not correct because Mg and Ba have incorrect colour*	**(1)**

Question Number	Correct Answer	Mark
6	**The only correct answer is B** ***A*** *is not correct because are incorrect because all give nitrogen dioxide* ***C*** *is not correct because incorrect because all give nitrogen dioxide* ***D*** *is not correct because incorrect because all give nitrogen dioxide*	**(1)**

Question Number	Correct Answer	Mark
7	**The only correct answer is B** ***A*** *is not correct because chlorine does not give a brown solution in hexane* ***C*** *is not correct because iodine is a grey/silver solid* ***D*** *is not correct because it does not give a brown solution in hexane*	**(1)**

Question Number	Correct Answer	Mark
8	**The only correct answer is C** ***A*** *is not correct because give other products* ***B*** *is not correct because give other products* ***D*** *is not correct because give other products*	**(1)**

Question Number	Correct Answer	Mark
9	**The only correct answer is C** ***A*** *is not correct because hydrogen sulfide is not formed* ***B*** *is not correct because sulfur is not formed* ***D*** *is not correct because this is not an reduction*	**(1)**

Question Number	Correct Answer	Mark
10	**The only correct answer is D** ***A*** *is not correct because all have lower mean concentrations* ***B*** *is not correct because all have lower mean concentrations* ***C*** *is not correct because all have lower mean concentrations*	**(1)**

Question Number	Correct Answer	Mark
11	**The only correct answer is A** ***B*** *is not correct because ion-ion does not make a solution* ***C*** *is not correct because there is only a dipole in water* ***D*** *is not correct because there is only hydrogen bonding in water*	**(1)**

Question Number	Correct Answer	Mark
12	**The only correct answer is A** ***B*** *is not correct because stream is diverted* ***C*** *is not correct because it is insoluble* ***D*** *is is not correct because both statements are incorrect*	**(1)**

Question Number	Correct Answer	Mark
13	**13. The only correct answer is C** ***A*** *is not correct because they are too few products* ***B*** *is not correct because they are too few products* ***D*** *is not correct because this is too many products*	**(1)**

Question Number	Correct Answer	Mark
14	**The only correct answer is A** ***B*** *is not correct because 2-methylpropan-2-ol does not give this peak* ***C*** *is not correct because 2-methylpropan-2-ol does not give this peak* ***D*** *is not correct because neither give this peak*	**(1)**

Question Number	Correct Answer	Mark
15	**The only correct answer is C** **A** *is not correct because* there is no OH absorption **B** *is not correct because* there is no OH absorption **D** *is not correct because* there is no C=O absorption	**(1)**

Question Number	Correct Answer	Mark
16	**The only correct answer is B** ***A*** *is not correct because secondary alcohols oxidize to ketones* ***C*** *is not correct because secondary alcohols oxidize to ketones* ***D*** *is not correct because secondary alcohols oxidize to ketones*	**(1)**

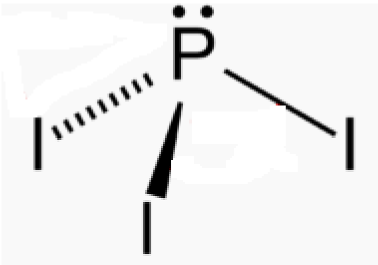
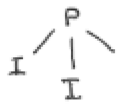
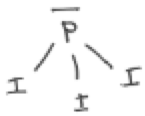
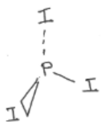
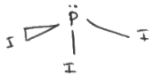
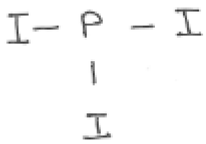
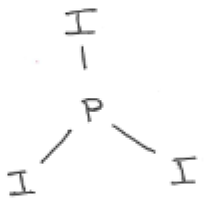
Question Number	Correct Answer	Mark
17	**The only correct answer is C** ***A*** *is not correct because both are oxidized* ***B*** *is not correct because both are oxidized* ***D*** *is not correct because ketones do not react with sodium*	**(1)**

Question Number	Correct Answer	Mark
18	**The only correct answer is D** ***A*** *is not correct because it has carbon footprints in production or delivery* ***B*** *is not correct because it has carbon footprints in production or delivery* ***C*** *is not correct because it has carbon footprints in production or delivery*	**(1)**

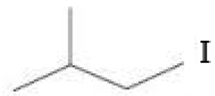
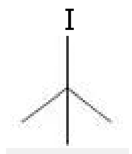
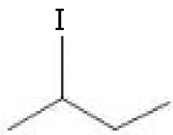
Question Number	Correct Answer	Mark
19	**The only correct answer is A** ***B*** *is not correct because it then goes paler* ***C*** *is not correct because it initially goes darker* ***D*** *is not correct because it is the wrong way round*	**(1)**

(Total for Section A = 20 marks)

Section B

Question Number	Acceptable Answers	Reject	Mark
***20(a)(i)**	**M1** These are all OK:      These are not OK, but they can score If (trigonal) pyramidal or tetrahedral is mentioned in text:   ALLOW A diagram without lone pair (1) **M2** Bond angle in the range 106 – 108^{o} ALLOW (Actual value is) 102^{o} (1) **M3** Minimum repulsion between **electron** pairs (and lone pair of electrons) ALLOW maximum separation between **electron** pairs (1) **M4** Non-bonding/lone pairs (of electrons) repel **more** than bonding pairs (1)	Use of Cl or Br loses M1 only	**(4)**

Question Number	Acceptable Answers	Reject	Mark
20(a)(ii)	$3C_4H_9OH + PI_3 \rightarrow 3C_4H_9I + H_3PO_3$ ALLOW $P(OH)_3$ for H_3PO_3 IGNORE state symbols, even if incorrect		**(1)**

Question Number	Correct Answer	Reject	Mark
20(a)(iii)	**COMMENT** First check for four bonds. Many will give two 2-iodobutane structures     ALLOW bonds of different lengths and strange bond angles 2/3 correct (1) All 4 correct (2) All four fully correct displayed/structural formulae (1)		**(2)**

Question Number	Correct Answer	Reject	Mark
20(b)(i)	(Attacking reagent) water/H_2O (1) IGNORE Hydroxide/OH^- (Type and mechanism) Nucleophilic substitution ALLOW these words in any order and anywhere (1) IGNORE SN1 and SN2		**(2)**

Question Number	Correct Answer	Reject	Mark
20(b)(ii)	$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$ ALLOW "alc" or "ethanol" for "aq" IGNORE Charges on ions in product.	Any other additional ions	**(1)**

Question Number	Correct Answer	Reject	Mark
20(c)	(1-)aminobutane/(1-)butylamine/$C_4H_9NH_2$ ALLOW 1- anywhere OR Butan(e)(-1-)amine OR Multisubstituted amines, e.g. $(C_4H_9)_2NH$ (1) Ammonium iodide/NH_4I (1) IGNORE Hydrogen iodide/HI If both names and formulae are given, both must be correct.		**(2)**

(Total for Question 20 = 12 marks)

Question Number	Correct Answer	Reject	Mark
21(a)	**M1** Correct directions The equilibrium will move to/favours the right/forward when the temperature is increased **and** will be unchanged when the pressure is increased (1) **M2** Temperature: because the reaction is **endothermic** OR *ΔH* is positive OR Reverse reaction is exothermic /*ΔH* is negative (1) **M3** Pressure: there are the same number of (gaseous) molecules/moles/particles on each side of the equation (1) Mark independently	…volumes …alone	**(3)**

Question Number	Correct Answer	Reject	Mark
21(b)(i)	Nitrogen from −3 to +2 (1) Oxygen from 0 to −2 (1) Elements can be named in either order but numbers must be correct for the element ALLOW signs on the right side		**(2)**

Question Number	Correct Answer	Reject	Mark
21(b)(ii)	Increasing temperature increases the proportion/number of molecules/particles (colliding) with energy greater than the **activation energy/E_a**. OR Area under the Maxwell Boltzmann graph to the right of **activation energy/E_a** increases IGNORE High temperature results in more (effective) collisions		**(1)**

Question Number	Correct Answer	Reject	Mark
21(b)(iii)	A catalyst reduces the activation energy (so a greater proportion of molecules have sufficient energy to react.) ALLOW In the graph the activation energy moves to the left IGNORE More collisions between particles / frequency of collisions increases	Any reference to energy increasing	**(1)**

Question Number	Correct Answer	Reject	Mark
21(c)(i)	**M1** A nitrogen monoxide molecule changes its dipole moment as it vibrates / vibrating dipole ALLOW NO is polar/contains polar bonds (1) **Then any two of M2, M3 or M4** **M2** NO allows through higher energy/frequency OR longer wavelength, radiation (from the sun) (1) OR **M3** NO absorbs (reflected) (longer wavelength/higher frequency) **IR** (1) OR **M4** NO re-emits/reflects IR/heat/radiation back to earth OR traps IR/heat/radiation (1) IGNORE NO reacts with the ozone layer or any reference to the ozone layer	…IR from sun loses M3 only	**(3)**

Question Number	Correct Answer	Reject	Mark
21(c)(ii)	$NO\cdot + O_3 \rightarrow NO_2\cdot + O_2$ (1) $NO_2\cdot + O_3 \rightarrow NO\cdot + 2O_2$ (1) Omitting all dots 1 max of first two marks BUT ALLOW if one dot shown on both NO **and** NO_2 in either equation $2O_3 \rightarrow 3O_2$ (1) IGNORE state symbols, even if incorrect		**(3)**

(Total for Question 21 = 13 marks)

Question Number	Correct Answer	Reject	Mark
22(a)(i)	$3I_2 + 6KOH \rightarrow KIO_3 + 5KI + 3H_2O$ Balancing numbers as shown, 3 and 5 for iodine (1) Balancing for oxygen and hydrogen, 6KOH and $3H_2O$ (1) ALLOW multiples IGNORE state symbols, even if incorrect		**(2)**

Question Number	Correct Answer	Reject	Mark
22(a)(ii)	Disproportionation (reaction) IGNORE redox	Disproportion(al) alone	**(1)**

Question Number	Correct Answer	Reject	Mark
22(b)	The mixture turns (pale) yellow/brown	Fizzing Dark brown /red-brown/ grey/grey solid/ purple vapour/ precipitate/ any solid	**(1)**

Question Number	Correct Answer	Reject	Mark
22(c)	(Both salts are soluble in hot water.) Potassium iodate(V) is (much) less soluble (than potassium iodide in cold water). ALLOW Potassium iodate is not soluble (in cold water) OR Potassium iodide is (more) soluble OR Solubility difference between potassium iodate and potassium iodide		**(1)**

Question Number	Correct Answer	Reject	Mark
22(d)(i)	Second mark depends on the first mark (Freshly prepared) starch (solution) (1) Added when (solution is) **pale** yellow/straw coloured OR Added when solution is **pale** ALLOW Added **just before**/ **near** the end-point/ end of reaction/ titration/ experiment (1)	**At** the end-point etc	**(2)**

Question Number	Correct Answer	Reject	Mark
22(d)(ii)	blue/black to colourless	…to clear	**(1)**

ALLOW TE from d (iii) to (iv), to (v), to (vi)

Question Number	Correct Answer	Reject	Mark
22(d)(iii)	$\frac{27.45 \times 0.010}{1000} = 2.745 \times 10^{-4}$ (mol)		**(1)**

Question Number	Correct Answer	Reject	Mark
22(d)(iv)	$\frac{2.745 \times 10^{-4}}{6} = 4.575 \times 10^{-5}$ COMMENT Multiplying by 6 gives 1.647×10^{-3}		**(1)**

Question Number	Correct Answer	Reject	Mark
22(d)(v)	Correct answer (with or without working) (3) Molar mass KIO_3 = 214.0 g mol^{-1} (1) $4.575 \times 10^{-5} \times 10 \times 214$ = 0.0979(05) (g) / 97.9 mg (1) (1) IGNORE SF except 1SF TE from x 6 in (iv) gives 3.5246 (g) Internal TE if oxygen omitted from molar mass giving 166, gives 0.075945, scores 2 marks AND Failure to multiply by 10 gives 0.00979(05)		**(3)**

Question Number	Correct Answer	Reject	Mark
22(d)(vi)	$\frac{0.0979(05) \times 100}{0.10}$ = 97.905 = 98% Expression (1) 2 SF (1) **Example TE** 166 gives 76% Failure to multiply by 10 gives 9.8% If expression is reversed or incorrect in any other way, give 1 max for their correct answer to 2 SF. Comment Percentages greater than 100 are allowed for 2 marks		**(2)**

Question Number	Correct Answer	Reject	Mark
22(d)(vii)	Potassium iodate may contain potassium iodide/ water ALLOW Absorption of water / hydrated (crystals) Iodine IGNORE Impurities/transfer errors	Potassium hydroxide	**(1)**

(Total for Question 22 = 16 marks)
(Total for Section B = 41 marks)

Question Number	Correct Answer	Reject	Mark
*23(a)(i)	**Mark independently** **M1** London/dispersion/van der Waals forces OR Instantaneous/temporary dipole induced dipole forces (1) **M2** all atoms OR C and H atoms / C and C atoms / H and H atoms OR non-polar parts of the molecule (1) **M3** **Permanent** dipole (permanent) dipole forces (1) **M4** Between $C^{(\delta+)}$ and $O^{(\delta-)}$ / $H^{(\delta+)}$ and $O^{(\delta-)}$ (atoms) OR Between C-O bonds OR Between O-H bonds OR CO bond / C-O is polar OR OH bond / O-H is polar (1) **M5** Hydrogen **bonds** (1) **M6** Between hydrogen of OH / $H^{\delta+}$ and another oxygen OR Between OH groups OR Because hydrogen is bonded to very electronegative element / is bonded to oxygen (1) If confusion between intermolecular and intramolecular bonds award 5 max, so two points 1 mark, three points two marks etc.	Between bonds C-H is polar Between OH molecules/atoms	**(6)**

Question Number	Correct Answer	Reject	Mark
23(a)(ii)	**Any two of the following** **M1** Glucose/it forms hydrogen bonds **with water** (molecules) (1) **M2** The **large number** of O-H groups / hydroxy(l) groups OR large number of hydrogen bonds (with water) ALLOW several/five/any number greater than five /many for 'large' number (1) **M3** Energy arguments like: Energy released by forming new hydrogen bonds makes up for energy used in breaking hydrogen bonds in water and/or glucose (1) IGNORE glucose forms London forces with water	…hydrox**ide** Glucose is non-polar	**(2)**

Question Number	Correct Answer	Reject	Mark
23(b)	($C_6H_{12}O_6$ →) $2C_2H_5OH$ + $2CO_2$ ALLOW Multiples OR C_2H_6O for ethanol IGNORE state symbols, even if incorrect		**(1)**

Question Number	Correct Answer	Reject	Mark
23(c)	**Any two from:** Taxation of alcohol is acceptable to the public (as they can choose whether or not to drink alcohol) (1) (Expense may) reduce alcohol abuse (1) (Expense may) reduce alcohol use/consumption (1) Raises money for the government (1) Tax can be used to pay for treatment for alcohol related diseases (1) Alcohol is harmful/causes disease/disorders (1) Reduces road accidents (1) Detailed argument leading to less global warming (1)		**(2)**

Question Number	Correct Answer	Reject	Mark
23(d)(i)	$\frac{100 \times 100}{57.15} = 174.9781 = 175^{(o)}$ Ignore SF except 1 or 2		**(1)**

Question Number	Correct Answer	Reject	Mark
23(d)(ii)	**Correct answer with or without working** 9.8(02) Ignore SF unless 1SF, Ignore units unless incorrect **3** marks Otherwise any **two** in any order from: **M1** Mass of ethanol = 57.15 x 0.789 (= 45.09)(g) (1) **M2** Number of moles of ethanol = $\frac{57.15 \times 0.789}{46}$ = (0.98025) ALLOW any number divided by 46 (1) **M3** Concentration of ethanol = $\frac{57.15 \times 0.789 \times 1000}{46 \times 100}$ = 9.8(025) (mol dm^{-3}) ALLOW Multiplication of any number by 10 (1)		**(3)**

Question Number	Correct Answer	Reject	Mark
23(e)	Potassium nitrate is (very) soluble in water/dissolves in water. OR The potassium nitrate does not dissolve if there is a low enough concentration of water that the powder still ignites. OR The alcohol burns giving out sufficient heat to drive of a limited amount of water. ALLOW Any reference to the need to keep gunpowder dry		**(1)**

Question Number	Correct Answer	Reject	Mark
23(f)	$2KNO_3(s) + S(s) + 3C(s) \rightarrow K_2S + N_2(g) + 3CO_2(g)$ ALLOW Multiples		**(1)**

Question Number	Correct Answer	Reject	Mark
23(g)	$C_2H_4(g) + H_2O(g) \rightarrow C_2H_5OH(aq)$ ALLOW No states, or **any** states except solid (1) Conditions (which may be over the arrow in the equation) – any **one** from: High temperature / any specified temperature above 25°C / heat High pressure / pressure greater than 1 atmosphere Catalyst / a specified catalytic substance eg Pt / Ni / sulfuric acid (phosphoric acid is used normally) (1) Mark independently	Reflux	**(2)**

(Total for Section C = 19 marks)
(Total for Paper = 80 marks)