Mark Scheme (Results)

January 2017

International GCSE
Chemistry (4CH0) Paper 2C

Pearson Edexcel Certificate in
Chemistry (KCH0) Paper 2C

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General Marking Guidance

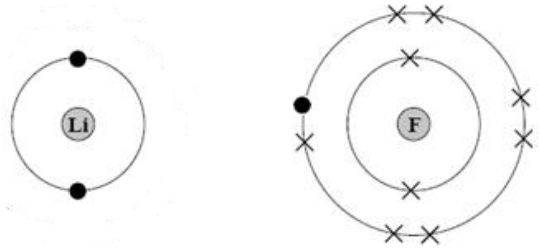
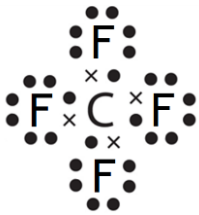
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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.

Question number	Answer	Notes	Marks
1 (a)	air		1
(b)	hydrogen	**ACCEPT** H_2 **IGNORE** H	
(c)	chlorine	**ACCEPT** Cl_2 **IGNORE** Cl	1
(d)	chlorine	**ACCEPT** Cl_2 **IGNORE** Cl	1
(e)	iron	**ACCEPT** Fe	1
		Total	**5**

Question number	Answer	Notes	Marks
2 (a) (i)	(both are) solids **AND** (both) form alkaline solutions (in water)	**ALLOW** (both are) <u>slightly</u> soluble	1
(ii)	(both are) gases **AND** (both) form acidic solutions (in water)		1
(b) (i)	the oxide is solid		1
(ii)	the oxide forms an acidic solution (in water)		1
(c)	**M1** the lamp does not light up **M2** (so this shows that) phosphorus/it does not conduct electricity	**ACCEPT** reverse arguments	2
		Total	**6**

Question number	Answer	Notes	Marks
3 (a)	**M1** calcium is the most reactive; titanium is the second most reactive; tin is the least reactive OR calcium most reactive **AND** tin least reactive **M2** (because) titanium displaces tin **M3** (and because) titanium does not displace calcium	**ACCEPT** Ca > Ti > Sn **ACCEPT** replaces **ACCEPT** replaces	3
(b) (i)	$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$	**ACCEPT** multiples and halves	1
(ii)	**M1** aluminium **M2** because it has gained oxygen OR because it has lost electrons OR because its oxidation number has increased OR because its oxidation number has changed from 0 to +3	**M2** DEP on **M1**	2
(iii)	**M1** (powders have) larger surface area **M2** (therefore) faster reaction	**ACCEPT** reverse arguments **IGNORE** references to collisions between particles	2
		Total	**8**

Question number	Answer	Notes	Marks
4 (a)	**D** (NH_4^+)		1
(b)	**D** (I^-)		1
(c)	**A** (carbonate)		1
(d)	**C** (blue, green, brown)		1
(e)	**A** (carbonate)		1
		Total	**5**

Question number	Answer	Notes	Marks
5 (a)		1 mark for each correct ion **IGNORE** charges on ion **ALLOW** any combination of dots and crosses Diagram showing sharing of electrons scores 0	2
(b)		**M1** all four bonding pairs correct, and only 8 electrons shown in outer shell of carbon **M2** all non-bonding pairs correct **IGNORE** inner shells even if incorrect If rings are drawn then both bonding electrons must be in the overlapping area **M2** DEP on **M1**	2

Question number	Answer	Notes	Marks
(c)	**M1** (high melting point of LiF) strong forces (of attraction) between (oppositely charged) ions / strong forces (of attraction) between Li^+ and F^-	**ACCEPT** strong (ionic) bonding / strong (ionic) bonds **ACCEPT** large amount of energy required to overcome the forces between the ions/break (ionic) bonds **REJECT** any reference to molecules or intermolecular forces **REJECT** reference to atoms	4
	M2 (good conductivity of LiF) ions are mobile	**ACCEPT** ions can move **REJECT** any reference to electrons are mobile/delocalised electrons	
	M3 (low melting point of CF_4) weak forces (of attraction) between molecules / weak intermolecular forces (of attraction)	**ACCEPT** weak van der Waals forces / weak London forces / weak dispersion forces **ACCEPT** very little energy required to overcome the intermolecular forces. **ALLOW** weak intermolecular bonds **REJECT** any references to covalent bonds broken	
	M4 (poor conductivity of CF_4) molecules are not charged / molecules are neutral / no charged particles	**IGNORE** no free electrons/all electrons used in bonding **IGNORE** there are no ions **ALLOW** no delocalised / no mobile electrons	
		Total	**8**

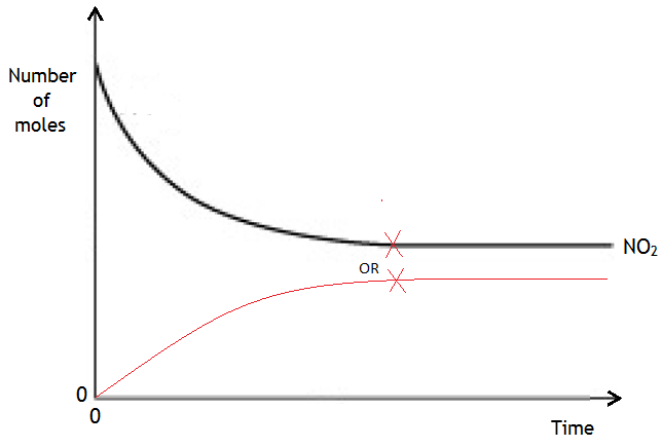
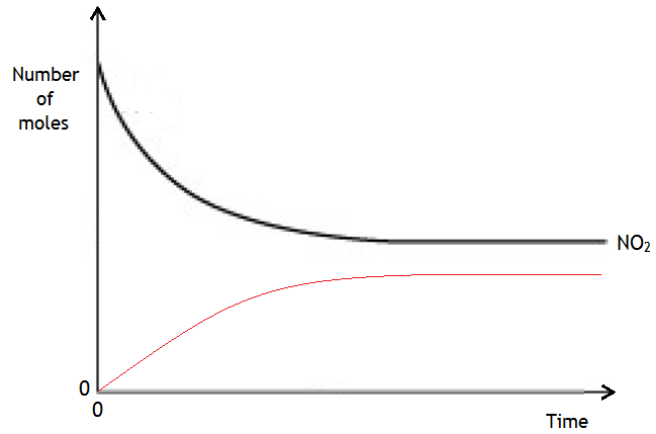
Question number	Answer	Notes	Marks
6 (a) (i)	(to provide the) zymase/enzyme (that acts as a catalyst)	**ALLOW** (to act as a) catalyst **ALLOW** to increase the rate of reaction **IGNORE** to lower the activation energy **IGNORE** to start the reaction **REJECT** to provide (activation) energy	1
(ii)	(turns) milky / cloudy / turbid (then clear) OR <u>white</u> precipitate / <u>white</u> suspension / <u>white</u> solid (forms then disappears)		1
(iii)	30 ºC	**ACCEPT** any temperature, or range of temperatures, between 25 and 40 ºC	1

Question number	Answer	Notes	Marks
(b)	**Route 1:** **M1** Σ(bonds broken) = 348 + (5 x 412) + 360 + 463 + (3 x 496) OR 4719 (kJ/mol) **M2** Σ(bonds made) = (4 x 743) + (6 x 463) OR 5750 (kJ/mol) **Route 2:** **M1** Σ(bonds broken) = 348 + (5 x 412) + 360 + (3 x 496) OR 4256 (kJ/mol) **M2** Σ(bonds made) = (4 x 743) + (5 x 463) OR 5287 (kJ/mol) **M3** 4719 – 5750 (kJ/mol) / **M1** – **M2** **M4** – 1031 (kJ/mol) OR correct evaluation of **M3**	**IGNORE** negative sign **IGNORE** negative sign Sign required **ACCEPT** answers given to three significant figures Correct answer with no working scores 4 + 1031 (kJ/mol) scores 3	4

Question number	Answer	Notes	Marks
6 (c) (i)	**M1** 32 **M2** (32 × 15.6) = 500 (kJ) OR **M1** × 15.6 correctly evaluated	 **ACCEPT** 499 / 499.2 Correct answer with no working scores 2	2
(ii)	**M1** & **M2** Any two from: • mass of water / volume of water / amount of water • distance of flame from the can • length of wick	 **IGNORE** temperature of water (at start) **ALLOW** distance of burner from can	2
(iii)	Any two from: **M1** heat (energy)/thermal energy is lost (to /surroundings) **M2** incomplete combustion (of the fuel) **M3** evaporation of water/fuel	 **IGNORE** just energy lost **IGNORE** not all of the ethanol is burned	2
		Total	**13**

Question number	Answer	Notes	Marks
7 (a) (i)	**M1** 0.080 mol of HCl react with 0.040 mol of $MgCO_3$ **M2** 0.050 > 0.040	**ACCEPT** any method involving correct ratios of moles, eg HCl to $MgCO_3$ is 2:1 0.08 to 0.05 is 2:1.25 **ACCEPT** correct calculations involving masses	2
(ii)	**M1** $n(CO_2)$ = ½ x 0.08(0) OR 0.04(0) **M2** $vol(CO_2)$ = (0.04(0) x 24 000) = 960 (cm^3) OR **M1** × 24 000 correctly evaluated	Correct answer with no working scores 2 1920 (cm^3) scores 1 mark	2
(b) (i)	**M1** $M_r(MgCl_2.6H_2O)$ = 203 **M2** % yield = ((5.5 ÷ (203 x 0.050)) x 100 = 54	**M2** CSQ on **M1** **ACCEPT** any number of significant figures except one (eg reject 50) Calculator value is 54.1871921182 **REJECT** answers > 100	2
(ii)	Any one of: • some of the crystals remained in the filtrate (after cooling and filtration) • the solution was not allowed to cool for long enough (for complete crystallisation) • magnesium carbonate is impure	**IGNORE** references to side reactions **REJECT** not all of the magnesium carbonate reacted	1
		Total	**7**

Question number	Answer	Notes	Marks
8 (a)	**M1** rate of forward reaction = rate of backward reaction	**IGNORE** forward reaction = backward reaction	2
	M2 concentrations of reactants/products remain/stay constant	**ACCEPT** amounts/masses for concentrations **ACCEPT** do not change for remain constant **ALLOW** colour remains constant **ALLOW** pressure remains constant **IGNORE** concentrations/amounts of reactants and products are the same/are equal	

Question number	Answer	Notes	Marks
8 (b) (i)	 cross drawn on either curve just where it becomes horizontal		1
(ii)	 **M1** curve starts at 0,0 and has the general shape shown **M2** curve becomes horizontal at approximately the same time as the original curve **M3** curve finishes below original curve	**M2** and **M3** DEP on **M1** or near miss (eg curve does not start at exactly 0,0)	3

Question number	Answer	Notes	Marks
8 (c)	**M1** equilibrium has shifted to the left / equilibrium has shifted to the NO_2 side / equilibrium has shifted to the reactants side OR more NO_2 has been produced / more reactants have been produced **M2** (therefore) backward reaction is endothermic	**IGNORE** references to Le Chatelier's principle eg an increase in temperature favours the reaction that reduces the temperature **ACCEPT** (forward) reaction is exothermic	2
		Total	**8**