Mark Scheme (Results)

Summer 2017

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 1C
Science (Double Award) (4SC0) Paper 1C

Pearson Edexcel Level 1/Level 2 Certificate
Biology (KCH0) Paper 1C
Science (Double Award) (KSC0) Paper 1C

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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	Marks
1		5

atomic number of the atom	3
number of shells shown	2
mass number of the atom	7
number of protons in an isotope of this element	3
group where element is found in the Periodic Table	1

(Total for Question 1 = 5 marks)

Question number	Answer	Notes	Marks
2 (a)	**B (H_2)** **The only correct answer is B** A is not correct because H is the symbol of an atom of hydrogen not a molecule of hydrogen C is not correct because H_2O is the formula of water which is a compound D is not correct because H_2O_2 is the formula of hydrogen peroxide which is a compound		1
(b)	**D (sodium chloride solution)** **The only correct answer is D** A is not correct because sodium is an element not a mixture B is not correct because chlorine is an element not a mixture C is not correct because sodium chloride is a pure compound not a mixture		1

Question number	Answer	Notes	Marks
(c)	**A (chromatography)** **The only correct answer is A** B is not correct because crystallisation would not separate the dyes in food colouring C is not correct because evaporation would not separate the dyes in food colouring D is not correct because filtration would not separate the dyes in food colouring		1
(d) (i)	M1 add (dilute) nitric acid M2 add silver nitrate (solution) M3 white precipitate	Accept HNO_3 If no acid then M2 M3 can be scored If incorrect acid then M2 M3 can be scored Ignore references to testing for chlorine/electrolysis Accept $AgNO_3$ Do not award mark if additional reagent added Ignore litmus Accept usual alternatives to precipitate Ignore cloudy/milky Ignore qualifiers such as pale Reject all other colours Reject other observations e.g. fizzing M3 DEP on mention of silver nitrate/$AgNO_3$	3

Question number	Answer	Notes	Marks
(d) (ii)	diffusion	Ignore identity of precipitate	1
(e) (i)	M1 flask M2 column M3 condenser		3
(ii)	**C (g) → (l)** **The only correct answer is C** A is not correct because change of state from solid to aqueous does not occur in fractional distillation B is not correct because change of state from liquid to solid does not occur in fractional distillation D is not correct because change of state from aqueous to solid does not occur in fractional distillation		1

(Total for Question 2 = 11 marks)

Question number	Answer	Notes	Marks
3 (a)	galvanising/galvanisation	Ignore sacrificial protection	1
(b) (i)	rust		1
(ii)	M1 oxygen	Accept air / O_2 Ignore O	2
	M2 water	Accept H_2O Allow moisture Ignore vapour	
		Accept answers in either order If name and formulae given both must be correct	

Question number	Answer	Notes	Marks
(iii)	M1 Zn/zinc is more reactive than Fe/iron	Accept Zn higher in reactivity series Accept zinc reacts in preference to/instead of iron Allow zinc is oxidised in preference to iron Ignore references to sacrificial protection Reject zinc rusts Reject use of Zn^{2+} and Fe^{2+} in place of Zn / Fe Accept reverse argument for iron	3
	M2 Zn loses (two) electrons / Zn forms Zn^{2+}	Accept Zn → Zn^{2+} (+ $2e^-$) Reject Fe loses (two) electrons/Fe forms Fe^{2+}	
	M3 prevents Fe from losing electrons / prevents Fe forming Fe^{2+}	Accept (so) Fe → Fe^{2+} (+ $2e^-$) does not take place Accept (so) Fe^{2+} (+ $2e^-$) → Fe (does take place) IF mentioned in correct context of reaction with zinc/displacement Accept Fe^{2+} (ions) gain (two) electrons and converted into Fe (atoms) IF mentioned in context of reaction with zinc/displacement	

(Total for Question 3 = 7 marks)

Question number	Answer	Notes	Marks
4 (a)	M1 (top row) $CuCl_2$ M2 (middle row) $(NH_4)_2SO_4$ M3 (bottom row) $Fe_2(CO_3)_3$		3
(b)	**C (copper(II) sulfate)** **The only correct answer is C** A is not correct because the name of CuSO4 is not copper(I) sulfate B is not correct because the name of CuSO4 is not copper(I) sulfite D is not correct because the name of CuSO4 is not copper(II) sulphite		1
(c)	**C (white AND colourless)** **The only correct answer is C** A is not correct because NH4Cl(s) is not colourless B is not correct because NH4Cl(s) is not colourless D is not correct because NH4Cl(aq) is not white		1

Question number	Answer	Notes	Marks
(d) (i)	**A (brown precipitate)** **The only correct answer is A** B is not correct because the product of the test, iron(III) hydroxide is not a brown solution C is not correct because the product of the test, iron(III) hydroxide is not a green precipitate D is not correct because the product of the test, iron(III) hydroxide is not a green solution		1
(ii)	M1 iron(III) hydroxide M2 sodium sulfate	Ignore iron hydroxide Accept ferric hydroxide Ignore formulae whether correct or incorrect Accept sulphate Accept answers in either order	2
(iii)	to prevent the formation of other precipitates OR to react with/remove carbonate (ions)	Ignore references to impurities Accept so only sulfate (ions) react with barium chloride/barium ions Accept to remove sulfite ions Reject if to remove an incorrect ion	1

Question number	Answer	Notes	Marks
(d) (iv)	white precipitate	Reject other colours Accept usual alternatives for precipitate Reject incorrect extra observations	1
(e)	M1 add (dilute) acid /H^+ OR heat M2 bubble/pass gas/carbon dioxide into limewater/OWTTE M3 (limewater) turns milky	Accept any named acid Accept correct formulae Reject if limewater added to $CuCO_3$ Accept cloudy / white precipitate M3 indep	3

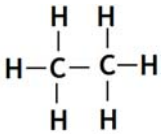
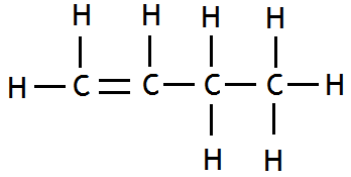
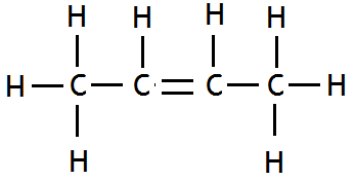
(Total for Question 4 = 13 marks)

Question number	Answer	Notes	Marks
5 (a) (i)	to (produce) heat (energy)	Ignore exothermic reaction Accept to reach/maintain a high temperature Allow to make the furnace/it hot Ignore to increase the temperature Ignore for energy alone Ignore to make carbon dioxide	1
(ii)	to produce the reducing agent	Accept to produce substance needed to reduce iron ore/iron oxide/haematite Ignore to make carbon monoxide Allow to make carbon monoxide/CO/substance which reacts with iron ore to produce iron	1
(b)	M1 $CaCO_3 \rightarrow CaO + CO_2$ M2 $CaO + SiO_2 \rightarrow CaSiO_3$	Award 1 mark for two correct equations in wrong order Ignore state symbols	2

Question number	Answer	Notes	Marks
(c)	M1 iron/iron oxide is reduced AND carbon is oxidised M2 (because) iron/iron oxide loses oxygen AND carbon gains oxygen	In M1 and M2 Accept Fe/Fe_2O_3/Fe^{3+} and C Allow use of O Ignore references to electrons Allow reference to oxidation number of iron has decreased and oxidation number of carbon has increased (if oxidation numbers stated must be correct)	2

(Total for Question 5 = 6 marks)

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>6 (a)</td><td>M1 vaporisation
M2 temperature
M3 condensation
M4 boiling point</td><td></td><td>4</td></tr>
<tr><td>(b)</td><td><table>
<tr><td>the molecules that are cracked are hydrocarbons</td><td>✓</td></tr>
<tr><td>catalytic cracking uses iron as the catalyst</td><td></td></tr>
<tr><td>cracking is used because of different requirements for hydrocarbons</td><td>✓</td></tr>
<tr><td>cracking reactions are examples of addition reactions</td><td></td></tr>
<tr><td>cracking produces molecules with shorter chains</td><td>✓</td></tr>
<tr><td>$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ is an equation for a cracking reaction</td><td></td></tr>
</table></td><td>Award 1 mark for each correct tick
If more than 3 ticks then subtract 1 mark for each extra tick</td><td>3</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

Question number	Answer	Notes	Marks
6 (c) (i)	C_nH_{2n}	Accept other letters, such as x, in place of n	1
(ii)	M1 propene	Accept propylene	2
	M2 methane	Accept answers in either order	
(iii)		Must show all atoms and all bonds	1
(iv)	 	Award 1 mark for each structure Accept answers in either order Must show all atoms and all bonds Allow cis/trans isomers Allow cyclobutane	2

Question number	Answer	Notes	Marks
(d)	M1 product has longer (carbon) chain M2 only product has (all) single (C—C) bonds M3 only the product is a solid / only the reactant is a gas	Must have a comparative statement / a statement about both reactant and product Accept reactant has shorter (carbon) chain Ignore reactant is a monomer and product is a polymer Accept only the reactant has a double bond Allow only the reactant is unsaturated Allow only the product is saturated Ignore references to alkanes/alkene Reject if an incorrect state also given	3

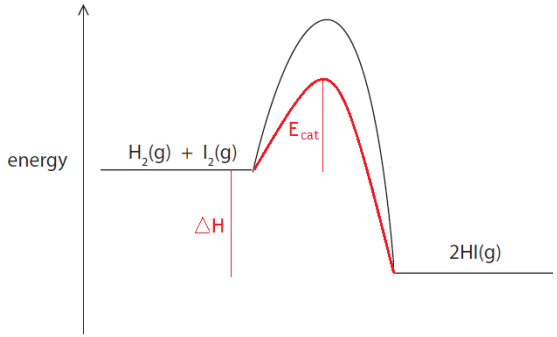
(Total for Question 6 = 16 marks)

Question number	Answer	Notes	Marks
7 (a)	reaction faster / takes less time	Ignore references to larger surface area Reject references to dissolving	1
(b)	reaction very slow/too slow without water	Accept rusting needs water/moisture Allow so that iron can rust Accept reference to increasing rate of reaction/rusting	1
(c)	M1 (at start) 71 M2 (at end) 16 M3 (change) (-)55	Ignore trailing .0(0) in all answers Ignore units M3 CQ M1 -M2	3

Question number	Answer	Marks
(d)	**D (he uses a smaller mass of iron filings)** **The only correct answer is D** A is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – increasing the volume of water would not produce a smaller volume B is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – leaving the apparatus for longer would not produce a smaller change in volume C is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – having the apparatus in a warmer place would change the rate of reaction – and would not affect the change in volume	1

Question number	Answer		Marks
(e) (i)	identifies the error e.g. has divided by the syringe reading at the start OR corrects the error e.g. should divide by the total volume	Accept has divided by 90 / has divided by the wrong number/has not included the volume of air in the flask and glass tube/has not included the 250 Accept should divide by 340 / should include the volume of air in the flask and glass tube	1
(ii)	M1 $\frac{70 \times 100}{340}$ (= 20.5882…..) M2 21	 Allow any number of sig. fig. but reject 20	2
		Allow $\frac{70 \times 100}{250}$ = 28 for (1) Correct final answer with or without working scores 2 marks	

(Total for Question 7 = 9 marks)

Question number	Answer	Notes	Marks
8 (a) (i)		curve from reactant level to product level with peak below that of original (1)	1
(ii)		M1 for approximately vertical line/arrow between reactant level and product level labelled Δ*H*/enthalpy change/-9 kJ/mol M2 for approximately vertical line/arrow between reactant level and peak of candidate curve labelled E_{cat} /activation energy M1 and M2 CQ candidate curve	2
(b) (i)	rate decreases / OWTTE	Allow (reaction is) slower Allow reaction takes longer Ignore references to yield / position of equilibrium	1
(ii)	M1 (at lower temperature equilibrium position shifts to right so yield of hydrogen iodide) increases M2 because (forward) reaction is exothermic	 Ignore Δ*H* is negative Accept backward reaction is endothermic Ignore because reaction moves in exothermic direction Ignore references to Le Chatelier's principle e.g. decrease in temperature favours exothermic reaction M2 DEP M1	2

Question number	Answer	Notes	Marks
(c) (i)	(rate) decreases / OWTTE	Allow (reaction is) slower Allow reaction takes longer (to reach equilibrium) Ignore references to yield / position of equilibrium	1
(ii)	M1 (decrease in pressure has) no effect (on yield of hydrogen iodide)	Allow no change Ignore has no effect on other factors e.g. equilibrium (position) Ignore references to rate	2
	M2 because equal numbers of (gas) moles/molecules on both sides	Allow (gas) particles for moles/molecules M2 DEP M1	

(Total for Question 8 = 9 marks)

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>9 (a)</td><td>
<table>
<tr><td>the elements can be obtained by electrolysing molten metal halides</td><td>✓</td></tr>
<tr><td>the elements with paler colours are lower down the group</td><td></td></tr>
<tr><td>the boiling points decrease down the group</td><td></td></tr>
<tr><td>the elements form covalent compounds with other non-metals</td><td>✓</td></tr>
<tr><td>their molecules contain two atoms</td><td>✓</td></tr>
<tr><td>all are gases at room temperature</td><td></td></tr>
</table>
</td><td>Award 1 mark for each correct tick

If more than 3 ticks then subtract 1 mark for each extra tick</td><td>3</td></tr>
<tr><td>(b)</td><td>$2K + I_2 \rightarrow 2KI$</td><td>Accept fractions/multiples
Ignore state symbols</td><td>1</td></tr>
<tr><td>(c)</td><td>(hydrogen chloride) g

(hydrochloric acid) aq</td><td></td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
(d)	M1 effervescence / bubbles / fizzing	Accept gas formed / evolved / given off Ignore hydrogen Reject extra incorrect observations	3
	M2 (in water hydrogen chloride forms) H^+ ions / forms (hydrochloric) acid	Ignore dissociates/ionises if no reference to H^+ / acid	
	M3 magnesium reacts to form hydrogen/H_2	Accept chemical/word equation M3 DEP M2	
	OR		
	M1 magnesium disappears/gets smaller	Allow dissolves Reject extra incorrect observations Ignore magnesium moving	
	M2 (in water hydrogen chloride forms) H^+ ions / forms (hydrochloric) acid	Ignore dissociates/ionises if no reference to H^+ / acid	
	M3 magnesium reacts to form magnesium chloride/$MgCl_2$/magnesium ions/Mg^{2+}	Accept chemical/word equation M3 DEP M2	
		Ignore references to solution with HCl dissolved in methylbenzene before water added	

Question number	Answer	Notes	Marks
9 (e) (i)	M1 test 2 M2 chlorine does not react with chloride (ions)	Allow description of test Accept chlorine does not displace itself Allow chlorine does not react with itself Accept reference to halogen/halide in place of chlorine/chloride Ignore chlorine does not displace chloride M2 DEP on correct M1 or missing M1	2
(ii)	**C (solution becomes darker)** **The only correct answer is C** A is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)– no effervescence is seen as no gas being formed B is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)– no iodine vapour produced so no purple fumes produced D is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)– no white precipitate formed		1

Question number	Answer	Notes	Marks
(f) (i)	$Cl_2 + 2At^- \rightarrow At_2 + 2Cl^-$	Accept fractions/multiples Ignore 2e on both sides of equation Reject other extra species	1
(ii)	M1 chlorine/Cl_2 is reduced AND astatide (ion)/At^- is oxidised M2 chlorine/Cl_2 gains electron(s) AND astatide (ion)/At^- loses electron(s)	Allow Cl Reject chloride (ions) reduced Allow Cl Ignore references to oxidation numbers Reject use of astatine in place of astatide ions once only in (ii)	2

(Total for Question 9 = 15 marks)

Question number	Answer	Notes	Marks
10 (a)	M1 replace — signs by + signs / OWTTE	Accept all ions should be cations/positive Reject if state/imply these particles are protons/nuclei	2
	M2 replace protons (label) by electrons	Allow electrons (not protons) are delocalised	
(b)	M1 (magnesium) ions in layers/rows/sheets/planes/OWTTE	Accept atoms/cations/particles for ions Reject molecules	4
	M2 slip / slide (over each other)	Allow OWTTE eg shift/roll/flow M2 DEP on mention of EITHER layers or equivalent OR mention of ions or equivalent Do not award M2 if molecules/protons/electrons/nuclei in place of ions etc. If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, M1 and M2 cannot be scored	
	M3 delocalised electrons	Accept sea of electrons Ignore free electrons	
	M4 can flow/move (through the magnesium/metal/structure) / are mobile (when voltage/p.d. is applied)	Ignore carry the charge M4 DEP on mention of electrons	

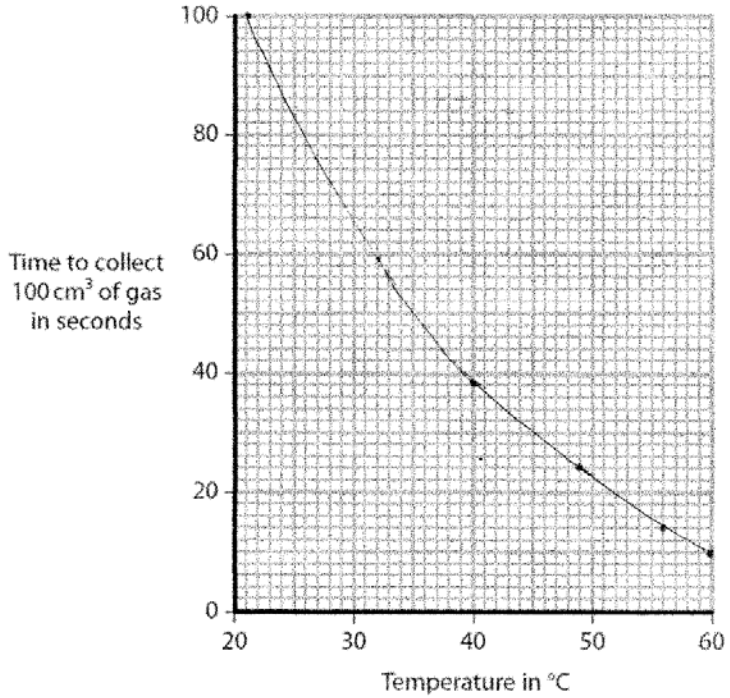
Question number	Answer	Notes	Marks
(c) (i)	M1 bright / white flame M2 white solid / powder / ash / smoke	Allow bright / white light Ignore sparks Ignore grey Reject precipitate	2
(ii)	**A (it makes a squeaky pop with a lighted splint)** **The only correct answer is A** B is not correct because hydrogen gas does not relight a glowing splint C is not correct because hydrogen gas does not turn damp blue litmus red D is not correct because hydrogen gas does not turn limewater milky		1

Question number	Answer	Notes	Marks
(d)	to evaporate/remove/boil off some of the water	Reject to remove (all) the water (stated or implied) Accept to increase the concentration (of the solution) Accept to produce a (hot) saturated solution Accept to reach crystallisation point Allow to reduce the volume (of the solution) Allow to evaporate/remove some of the solution Ignore references to rate of reaction Reject to evaporate acid	1
	M1 to see if/when crystals form	Allow solid for crystals	2
	M2 indicates the crystallisation point/when solution is saturated/OWTTE	Accept indicates when to stop heating/if need to continue heating	
	Any two from M1 $MgSO_4$ M2 H_2O M3 H_2SO_4	Ignore names even if incorrect	2

Question number	Answer	Notes	Marks
10 (e)	M1 calculation of mass of water	m(H_2O) = (17.2 – 8.3) = 8.9 (g)	4
	M2 calculation of amounts of $MgSO_4$ AND H_2O	*n*($MgSO_4$) = 8.3 ÷ 120 OR 0.069 (mol) Allow any sig. fig e.g. 0.07 AND *n*(H_2O) = 8.9 ÷ 18 OR 0.49 (mol) Allow any sig. fig e.g. 0.5	
	M3 calculation of $MgSO_4$: H_2O ratio	0.069 : 0.49 OR 1 : 7.101449275.. allow any sig. fig. OR 0.49/0.069 OR 7.101449275.. allow any sig. fig.	
	M4 x=7	accept $MgSO_4.7H_2O$ Correct final answer with or without working scores 4 marks Check for incorrect working e.g. 120 ÷ 18 = 6.66 = 7 Mark CQ throughout	

(Total for Question 10 = 18 marks)

Question number	Answer	Notes	Marks
11 (a) (i)	(moles route) M1 n(CaO) = 28000 ÷ 56 OR 500 (mol) M2 n(H_2O) = 500 (mol) M3 m(H_2O) = 500 × 18 = 9000 g / 9 kg OR (mass ratios route) M1 M_r (CaO) = 56 AND M_r (H_2O) = 18 M2 m(H_2O) = $\frac{28 \times 18}{56}$ M3 = 9 kg / 9000 g	Allow 0.5 if final answer given in kg For M2 need to use or state mol H_2O Units not needed for intermediate answers Do not award M3 if unit missing or incorrect Correct final answer with or without working scores 3 marks Mark M2 and M3 CQ on M1 Do not award M3 if unit missing or incorrect Correct final answer with or without working scores 3 marks Mark M2 and M3 CQ on M1	3
(ii)	M1 carbon dioxide is (an) acidic (oxide) M2 calcium hydroxide is a base / an alkali	Ignore contains hydroxide/OH^- ions	2

Question number	Answer	Notes	Marks
11 (b)		M1 + M2 all five points plotted to nearest gridline Deduct 1 mark for each error up to max 2 M3 curve of best fit Curve CQ on points plotted Penalise repeated straight line(s) joining points Penalise more than one curve visible	3
(c)	M1 particles have more energy M2 more collisions have energy equal to/greater than the activation energy M3 more successful collisions per second		3

(Total for Question 11 = 11 marks)

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