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Mark Scheme (Results)

January 2018

Pearson Edexcel International GCSE

In Chemistry (4CH0) 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	Notes	Marks
1 (a)	Si		1
(b)	N		1
(c)	0	**ACCEPT** 8	1
(d)	A (1)		1
(e)	D (7)		1

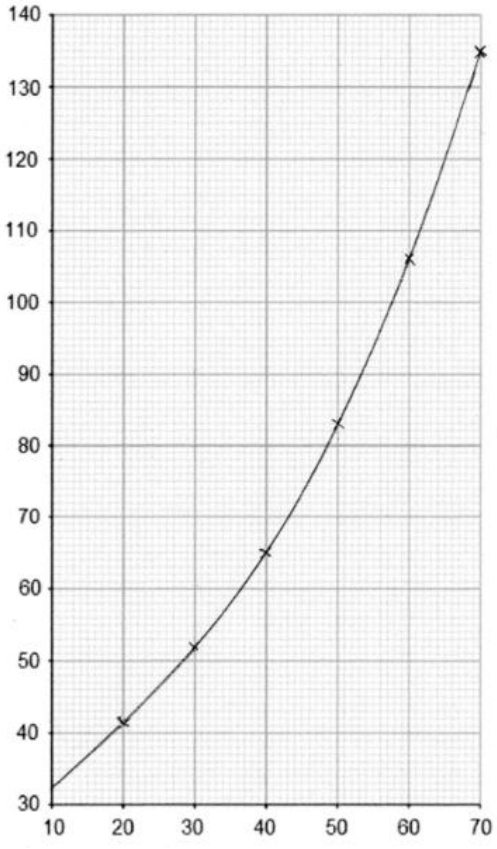
Total 5 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a)</td><td>
<table>
<tr><th>Change</th><th>Starting state</th><th>Finishing state</th></tr>
<tr><td>ice to water</td><td></td><td></td></tr>
<tr><td>solid iodine to iodine vapour</td><td>Z</td><td>X</td></tr>
<tr><td>molten iron to solid iron</td><td>Y</td><td>Z</td></tr>
<tr><td>ethene to (poly)ethene</td><td>X</td><td>Z</td></tr>
</table>
</td><td>1 mark for each correct row</td><td>3</td></tr>
<tr><td>(b)</td><td>D (sublimation)</td><td></td><td>1</td></tr>
</table>

Total 4 marks

Question number	Answer	Notes	Marks
3 (a)	**M1** (crystals) – get smaller	ACCEPT disappear IGNORE dissolve IGNORE reference to (incorrect) colours/loses colour IGNORE mass decreases	2
	M2 (water) – turns (from colourless to) purple	ALLOW pink IGNORE goes cloudy ALLOW (water) turns to colour of crystals REJECT other incorrect observations, e.g. fizzing, crystals change colour, only once in (a)	
(b)	**C** diffusion		1
(c)(i)	(water would change colour/go purple) more quickly	ALLOW change (in appearance) /it happens more quickly ALLOW (dissolves) more quickly IGNORE cloudy/incorrect colour ALLOW references to darker purple/colour with hot water ALLOW references to faster reaction IGNORE references to collisions	1
(c)(ii)	**M1** particles/molecules/ions/they have more (kinetic) energy/are moving faster (in hot water)	ALLOW reverse argument in cold water If change is slower in (i) then ALLOW particles/molecules/ions have less (kinetic) energy/are moving slower	2
	M2 particles/molecules/ions/they diffuse/spread more quickly	ALLOW particles/molecules/ions/they dissolve more quickly ALLOW more particles dissolve ALLOW references to more frequent collisions between water molecules and crystals	

Total 6 marks

Question number	Answer	Notes	Marks
4 (a)		**M1** and **M2** all points plotted correctly to nearest gridline Penalise 1 mark for each point plotted incorrectly **M3** suitable curve of best fit drawn for points plotted Do not consider any extrapolation of curve for M3	3
(b)	**M1** curve correctly extrapolated to cut y axis (at 10 °C) **M2** correct reading to nearest gridline from curve drawn	typical answer in range 32-33	2
(c)	**M1** correct reading to nearest gridline at 35 °C from curve drawn **M2** value from **M1** divided by 2 and correctly evaluated	typical answer = 58	2

Total 7 marks

Question number	Answer	Notes	Marks
5 (a)	**M1** heated **M2** (until it is) vaporised	ALLOW boiled ALLOW raised to high temperature / temperature above 350 °C IGNORE distilled IGNORE references to pressure/catalyst ACCEPT made into a vapour/gas ALLOW evaporates If definite implication/use of cracking allow max 1	2
(b)	increases	ACCEPT decreases from bottom to top ALLOW gets hotter from top to bottom ALLOW hotter at bottom/cooler at top IGNORE references to boiling points IGNORE stated temperature values	1
(c)	**M1** (gasoline) fuel for cars / petrol **M2** (bitumen) (making) roads / (surfacing) roofs		2
(d)	bitumen		1
(e)	boiling point	IGNORE melting point IGNORE density IGNORE references to chain length/IMF	1

Total 7 marks

Question number	Answer	Notes	Marks
6 (a)	**M1** (X) – chlorine **M2** (Y) – potassium hydroxide **M3** (Z) – hydrochloric (acid)	ACCEPT Cl_2 IGNORE Cl ACCEPT KOH ACCEPT HCl In each case, if both name and formula given then mark name only	3
(b) (i)	$2Na + I_2 \rightarrow 2NaI$	ACCEPT multiples and halves IGNORE state symbols correct case/subscript required	1
(ii)	**M1** add (dilute) nitric acid **M2** add (aqueous) silver nitrate **M3** yellow precipitate (forms)	ACCEPT HNO_3 If no acid then M2 and M3 can be scored If incorrect acid or other incorrect reagent then M2 and M3 can be scored ACCEPT $AgNO_3$ If more than two reagents added penalise extra incorrect reagent(s) ACCEPT usual alternatives to precipitate IGNORE cloudy IGNORE qualifiers such as pale/light/dark REJECT other observations e.g. fizzing **M3** DEP on addition of silver nitrate/ $AgNO_3$ IGNORE identity of precipitate If use more reactive halogen (solution) ALLOW M1 add chlorine/bromine (solution) M3 turns (reddish) brown OR M1 add chlorine/bromine (solution) M2 (followed by) starch M3 turns blue/black IGNORE references to electrolysis	3

Total 7 marks

Question number	Answer	Notes	Marks
7 (a)	**M1** (Cu) $\frac{34.60}{63.5}$ (Fe) $\frac{30.52}{56}$ (S) $\frac{34.88}{32}$ **M2** 0.545 0.545 1.09 **M3** (divide by the smallest number) 1 1 2 **OR** **M1** Calculation of Mr of $CuFeS_2$ = 183.5/184 **M2** expression for percentage of <u>each</u> element e.g. Cu = 63.5 ÷ 183.5 x 100 **M3** evaluation to show these equal 34.60% Cu, 30.52% Fe and 34.88% S	Division by atomic numbers or other inappropriate numbers scores 0/3 Fractions upside down scores 0/3 ACCEPT use of 64 for Cu With 63.5 = (0.54488 0.545 1.09) With 64 = 0.5406 0.545 1.09 ALLOW any number of sig figs greater than one, rounded correctly ALLOW ECF from minor error in M1 ALLOW M3 to score from 0.5:0.5:1 or other incorrect rounding in M2	3

Question number	Answer	Notes	Marks
7 (b) (i)	(sulfur) gained oxygen	ALLOW combined with oxygen ALLOW had oxygen added ALLOW gained O/O_2 IGNORE formed sulfur dioxide/SO_2 IGNORE reacted/mixed with oxygen ACCEPT oxidation state/number increases ACCEPT oxidation state/number changes from -2 to (+)4 IGNORE references to electron loss	1
(ii)	$CuS + O_2 \rightarrow Cu + SO_2$	ACCEPT multiples and halves	1
7 (c) (i)	hydrogen (ion) / H^+	ACCEPT hydronium (ion) / H_3O^+ If both name and formula given, both must be correct	1
(ii)	(blue/purple/neutral litmus (paper)) turns/goes red		1
(iii)	**M1** effervescence/bubbles/fizzing	ACCEPT gas given off/formed/produced IGNORE name of gas IGNORE hydrogen/H_2	2
	M2 magnesium/solid/ribbon disappears	ACCEPT magnesium/solid/ribbon dissolves ACCEPT magnesium/ solid/ribbon gets smaller IGNORE mass decreases IGNORE reference to movement IGNORE references to temperature change/heat evolved/exothermic REJECT extra incorrect observations e.g. white flame	

Total 9 marks

Question number	Answer	Notes	Marks
8 (a)	<table><tr><td>**Temperature after in °C**</td><td>32.5</td></tr><tr><td>**Temperature before in °C**</td><td>(27.0)</td></tr><tr><td>**Change in temperature in °C**</td><td>(+) 5.5</td></tr></table>	**M1** 32.5 **M2** 5.5 ALLOW **M2** ECF from **M1**	2
(b) (i)	**M1** EITHER size/surface area (of metal) **OR** amount / number of moles (of metal) **AND** Any TWO from **M2** concentration of acid **M3** volume of acid **M4** rate/time of stirring **M5** external/room temperature	IGNORE volume of metal IGNORE mass of metal ALLOW amount of acid ALLOW starting temperature	3
(ii)	the more reactive the metal the greater the temperature rise	ACCEPT reverse argument IGNORE reactivity is proportional to temperature rise	1
(iii)	no reaction (takes place)/ gold does not react (with hydrochloric acid)	IGNORE gold is (too) unreactive/not reactive enough	1

Total 7 marks

Question number	Answer	Notes	Marks
9 (a)	**M1** strontium carbonate **M2** strontium hydrogencarbonate	ACCEPT correct formulae	2
(b) (i)	Any TWO from: **M1** (could be) caesium (compound) as also gives a blue flame **M2** (could be) a carbonate as also turns yellow with methyl orange **M3** (could be) hydrogencarbonate as also turns yellow with methyl orange	In M1 M2 M3 REJECT if incorrect reason given ALLOW 1 mark if two correct ions identified without reasons e.g. could be caesium and could be a carbonate ALLOW 1 mark if two different correct observations given without naming the ions e.g. other (substances/ions) give blue flame and turn yellow with methyl orange	2
(ii)	add hydrochloric acid	ALLOW HCl REJECT extra tests/reagents	1

Question number	Answer	Notes	Marks
9 (c)	**M1** add magnesium chloride (solution) **M2** carbonate ions give a (white) precipitate **M3** no change with hydrogencarbonate ions	REJECT extra reagents e.g. HCl ALLOW no (white) precipitate forms M2 and M3 DEP on mention of magnesium chloride in M1	3

Total 8 marks

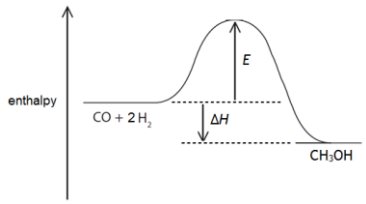
Question number	Answer	Notes	Marks
10 (a)	pipette / burette		1
(b) (i)	**ANY TWO from**		1
	M1 did not stir the mixture	ALLOW less/slower stirring	1
	M2 added less than 5 cm^3 (extra) of acid	ALLOW added less than 20cm^3 (total) acid ALLOW not enough acid added	
	M3 did not wait until highest temperature reached	ALLOW read thermometer too soon	
(ii)	Any value between 32 and 34 (°C) inclusive	ALLOW range between 32 and 34 IGNORE units	1
(c)	**M1** ΔT = 19.0 (°C)	ALLOW {35.0 − 16.0} if not evaluated	1
	M2 m = 50.0 (g)	ALLOW {25.0 + 25.0(0)} if not evaluated	1
	M3 Q = 3970 (J)	ACCEPT 3971 ACCEPT 4000 IGNORE any sign M3 ECF from M1 and for use of m = 25 ALLOW 3.971/3.97/4.(0)kJ Correct answer with no working scores 3 marks	1

Total 7 marks

Question number	Answer	Notes	Marks
11 (a) (i)	delocalised electrons can flow (through structure when voltage/pd is applied)	ALLOW sea of electrons IGNORE free electrons ACCEPT can move ACCEPT are mobile IGNORE carry charge REJECT any reference to ions moving	1
(ii)	**M1** the layers of (cat)ions	ALLOW rows/sheets/OWTTE for layers ALLOW atoms for ions REJECT molecules/protons/electrons/nuclei IGNORE particles	2
	M2 can slide/slip over one another	ALLOW OWTTE e.g. roll/flow **M2** DEP on mention of layers or equivalent **OR** mention of (cat)ions/atom Do not award M2 if molecules/protons/electrons/nuclei in place of (cat)ions/atoms If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, M1 and M2 cannot be scored	
(b)	**$TiCl_4$** **M1** simple molecular (structure) **M2** weak intermolecular forces (of attraction)/weak forces (of attraction) between molecules **TiO_2** **M3** giant (covalent structure) **M4** strong (covalent) bonds **M5** Little/less energy required to overcome the forces (in $TiCl_4$) **AND** large amount of/more energy required to break the (covalent) bonds (in TiO_2)	 ALLOW simple covalent ACCEPT weak dispersion forces/van der Waals forces/temporary dipole-induced dipole forces ALLOW bonds for forces REJECT if mention of IMF/ions REJECT any reference to covalent bonds broken in $TiCl_4$ ALLOW intermolecular bonds /bonds between molecules IGNORE molecules more easily separated / easier to break forces REJECT any reference to IMF broken	5

Question number	Answer	Notes	Marks
11 (c) (i)	$TiO_2 + C + 2Cl_2 \rightarrow TiCl_4 + CO_2$ **M1** all formulae correct **M2** balanced correctly	ACCEPT halves and multiples **M2** DEP on **M1**	2
(ii)	$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$	ACCEPT halves and multiples	1

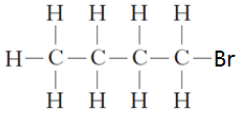
Total 11 marks

Question number	Answer	Notes	Marks
12 (a) (i)	low **AND** because (forward) reaction is exothermic / (forward) reaction releases heat (energy)	ACCEPT (equilibrium) shifts in the exothermic direction IGNORE ΔH is negative / = -91 ALLOW backwards/reverse reaction is endothermic IGNORE references to Le Chatelier's principle e.g. a decrease in temperature favours the reaction that produces heat/tries to decrease the temperature IGNORE references to rate of reaction	1
(ii)	high **AND** because there are fewer moles/molecules (of gas) on the RHS/products side/methanol side	ACCEPT (equilibrium) shifts to side with fewer moles/molecules (of gas) ACCEPT there are 4 moles/molecules (of gas) on the LHS but only 2 mole/molecule (of gas) on the RHS ALLOW there are more moles/molecules (of gas) on the LHS IGNORE references to Le Chatelier's principle e.g. an increase in pressure favours the reaction that tries to decrease in pressure	1
(b)	(the catalyst/it) increases both rates equally		1
(c)			
(i)	**M1** profile curve completed with CH_3OH/products below reactants **M2** vertical line with arrow pointing downwards labelled Δ*H* / enthalpy change / −91(kJ/mol)	 ALLOW double headed arrow line ALLOW vertical line with no arrowhead REJECT single arrow head pointing up	2
(ii)	vertical arrow line drawn from level of reactants to top of curve and labelled *E*	ACCEPT double headed arrow line REJECT arrow pointing downwards	1
(iii)	no effect		1

Total 7 marks

Question number	Answer	Notes	Marks
13 (a)	**M1** $n(CaCO_3) = 2.0 \times 10^5$ OR 200 000 (mol)	ACCEPT calculations in mega moles	1
	M2 $m(CaO) = 11.2$	**M2** ECF from **M1**	1
	M3 tonnes	ACCEPT 1.12×10^7 g ACCEPT 1.12×10^4 kg	1
	OR		
	M1 100 → 56		
	M2 20 → 11.2	**M2** ECF from **M1**	
	M3 tonnes	ACCEPT 1.12×10^7 g ACCEPT 1.12×10^4 kg M3 DEP M2 being awarded Correct answer including units with no working scores 3 marks	
(b)	calcium hydroxide		1
(c) (i)	**M1** 0.025(0) × 0.5(00)		1
	M2 0.0125 (mol)	ACCEPT 12.5 for 1 mark	1
(ii)	**M1** $n[Ca(OH)_2]$ = 0.0125 ÷ 2 OR 0.00625 (mol)		1
	M2 mass of $Ca(OH)_2$ = 0.463 (g)	ACCEPT 0.4625 and 0.46	1
	OR		
	M1 answer to **M2** from (i) divided by 2		
	M2 **M1** × 74 evaluated correctly	ALLOW 1 mark for 0.925 ALLOW 1 mark for 1.85	
(d)	**M1** $Ca(OH)_2$ / slaked lime / limewater /the solution reacts with CO_2	ACCEPT correct chemical or word equation REJECT any other gas	1
	M2 to form solid calcium carbonate/$CaCO_3$	ACCEPT to form insoluble calcium carbonate/$CaCO_3$ ALLOW to form the (white) precipitate calcium carbonate/$CaCO_3$ ACCEPT any indication in an equation that the $CaCO_3$ is formed as a solid e.g. state symbol	1

Total 10 marks

Question number	Answer	Notes	Marks
14 (a)	**B** (Q and U)		1
(b)	**C** (S and T)		1
(c)	**D** (V)		1
(d)	**A** (R and V)		1
(e) (i)	UV (light/radiation)	IGNORE any reference to high temperature IGNORE any reference to a catalyst	1
(ii)		ACCEPT Br in any position ACCEPT multiple substitutions	1

Total 6 marks

Question number	Answer	Notes	Marks
15 (a)	Haber (process)		1
(b)	**M1** (gas A) – nitrogen/N_2	If name and formula given both must be correct	1
	M2 (gas B) – hydrogen/H_2	If both answers correct but in wrong order award 1 mark	1
(c)	to liquefy the ammonia	IGNORE to condense the ammonia ALLOW to separate the ammonia from the unreacted gases/nitrogen and hydrogen	1
(d)	iron		1
(e)	Any two from:		2
	M1 saves raw materials/resources	ALLOW stops raw materials/resources being wasted	
	M2 uses less energy	ACCEPT saves energy	
	M3 to produce more ammonia / to improve yield (of ammonia)	ALLOW so recycled gases/nitrogen and hydrogen/they can be reacted again IGNORE references to saves money	
(f) (i)	**M1** 350 (°C)	ACCEPT low temperature	1
	M2 400 (atm)	ACCEPT high pressure If numerical answers given units or indication of which is temp/pressure required	1
(ii)	40 (%)	ACCEPT range 40-41 (%)	1
(iii)	the reaction does not reach equilibrium		1

Total 11 marks

Question number	Answer	Notes	Marks
16 (a)	to make sure that all the water has been removed (from the crystals)		1
(b)(i)	3.80 (g)	ACCEPT 3.8	1
(ii)	1.80 (g)	ACCEPT 1.8	1
(iii)	**M1** $n(FeSO_4)$ = 0.025 (mol)		1
	M2 $n(H_2O)$ = 0.10		1
	M3 x = 4	ALLOW ECF from **M1** and **M2** Answer must be given to nearest whole number	1
	OR		
	M1 (18 x ÷ 152) = (1.80 ÷ 3.80)		
	M2 x = (152 × 1.80) ÷ (18 × 3.80)		
	M3 x = 4		
		(iii) marked ECF from (b)(i) and (b)(ii) correct answer with no working scores 3 marks	
(c)	**M1** (reaction) is exothermic/gives out heat (energy)	ACCEPT gives out thermal energy	1
	M2 hydrated copper(II) sulfate formed	ACCEPT $CuSO_4.5H_2O$ ALLOW now contains water of crystallisation IGNORE copper(II) sulfate crystals are formed	1

Total 8 marks

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