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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

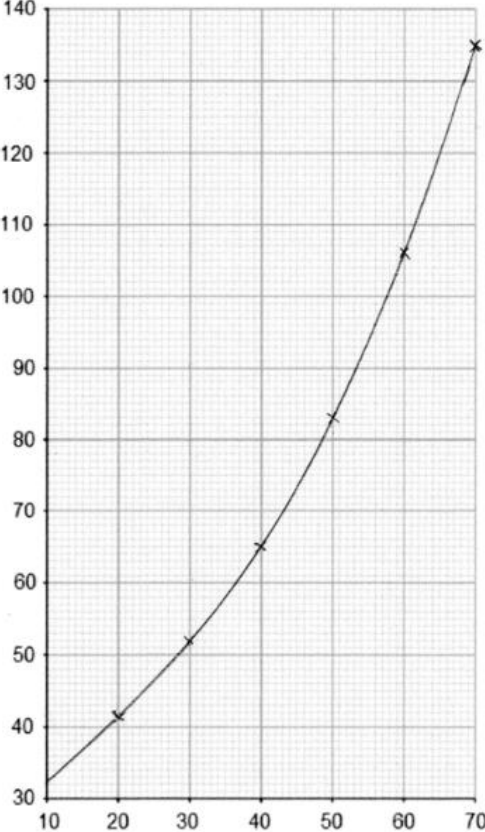
Total 5 marks

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

Total 4 marks

Question number	Answer	Notes	Marks
3 (a)	<b>M1</b> (crystals) - get smaller  <b>M2</b> (water) - turns (from colourless to) purple	ACCEPT disappear IGNORE dissolve IGNORE reference to (incorrect) colours/loses colour IGNORE mass decreases  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)	2
(b)	<b>C</b> 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)	<b>M1</b> particles/molecules/ions/they have more (kinetic) energy/are moving faster (in hot water)  <b>M2</b> particles/molecules/ions/they diffuse/spread more quickly	ALLOW reverse argument in cold water  If change is slower in (i) then ALLOW particles/molecules/ions have less (kinetic) energy/are moving slower  ALLOW particles/molecules/ions/they dissolve more quickly ALLOW more particles dissolve ALLOW references to more frequent collisions between water molecules and crystals	2

Total 6 marks

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

Total 7 marks

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

Total 7 marks

Question number	Answer	Notes	Marks
7 (a)	<p><b>M1</b> (Cu) (Fe) (S)  <math>\frac{34.60}{63.5}</math> <math>\frac{30.52}{56}</math> <math>\frac{34.88}{32}</math></p> <p><b>M2</b> 0.545 0.545 1.09</p> <p><b>M3</b> (divide by the smallest number)  1 1 2</p> <p><b>OR</b></p> <p><b>M1</b> Calculation of Mr of <math>\text{CuFeS}_2 = 183.5/184</math></p> <p><b>M2</b> expression for percentage of <u>each</u> element e.g. Cu = <math>63.5 \div 183.5 \times 100</math></p> <p><b>M3</b> evaluation to show these equal 34.60% Cu, 30.52% Fe and 34.88% S</p>	<p>Division by atomic numbers or other inappropriate numbers scores 0/3  Fractions upside down scores 0/3  ACCEPT use of 64 for Cu</p> <p>With 63.5 = (0.54488 0.545 1.09)  With 64 = 0.5406 0.545 1.09</p> <p>ALLOW any number of sig figs greater than one, rounded correctly</p> <p>ALLOW ECF from minor error in M1</p> <p>ALLOW M3 to score from 0.5:0.5:1 or other incorrect rounding in M2</p>	3

Question number	Answer	Notes	Marks
7 (b)	(i) (sulfur) gained oxygen	ALLOW combined with oxygen ALLOW had oxygen added ALLOW gained O/O <sub>2</sub> IGNORE formed sulfur dioxide/SO <sub>2</sub> 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) $\text{CuS} + \text{O}_2 \rightarrow \text{Cu} + \text{SO}_2$	ACCEPT multiples and halves	1
7 (c)	(i) hydrogen (ion) / H <sup>+</sup>	ACCEPT hydronium (ion) / H <sub>3</sub> O <sup>+</sup> If both name and formula given, both must be correct	1
	(ii) (blue/purple/neutral litmus (paper)) turns/goes red		1
	(iii) <b>M1</b> effervescence/bubbles/fizzing  <b>M2</b> magnesium/solid/ribbon disappears	ACCEPT gas given off/formed/produced IGNORE name of gas IGNORE hydrogen/H <sub>2</sub>  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	2

Total 9 marks

Question number	Answer	Notes	Marks						
8 (a)	<table border="1"> <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>	Temperature after in °C	32.5	Temperature before in °C	(27.0)	Change in temperature in °C	(+) 5.5	<p><b>M1</b> 32.5</p> <p><b>M2</b> 5.5</p> <p>ALLOW <b>M2</b> ECF from <b>M1</b></p>	2
Temperature after in °C	32.5								
Temperature before in °C	(27.0)								
Change in temperature in °C	(+) 5.5								
(b) (i)	<p><b>M1</b> EITHER</p> <p>size/surface area (of metal)</p> <p><b>OR</b></p> <p>amount / number of moles (of metal)</p> <p><b>AND</b> Any TWO from</p> <p><b>M2</b> concentration of acid</p> <p><b>M3</b> volume of acid</p> <p><b>M4</b> rate/time of stirring</p>	<p>IGNORE volume of metal</p> <p>IGNORE mass of metal</p> <p>ALLOW amount of acid</p> <p>ALLOW starting temperature</p>	3						
(ii)	<p><b>M5</b> external/room temperature the more reactive the metal the greater the temperature rise</p>	<p>ACCEPT reverse argument</p> <p>IGNORE reactivity is proportional to temperature rise</p>	1						
(iii)	<p>no reaction (takes place)/ gold does not react (with hydrochloric acid)</p>	<p>IGNORE gold is (too) unreactive/not reactive enough</p>	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)	<b>M1</b> add magnesium chloride (solution)  <b>M2</b> carbonate ions give a (white) precipitate  <b>M3</b> 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)	<b>ANY TWO</b> from <b>M1</b> did not stir the mixture <b>M2</b> added less than 5 cm <sup>3</sup> (extra) of acid <b>M3</b> did not wait until highest temperature reached	ALLOW less/slower stirring  ALLOW added less than 20cm <sup>3</sup> (total) acid ALLOW not enough acid added  ALLOW read thermometer too soon	1  1
(ii)	Any value between 32 and 34 (°C) inclusive	ALLOW range between 32 and 34 IGNORE units	1
(c)	<b>M1</b> $\Delta T = 19.0$ (°C) <b>M2</b> $m = 50.0$ (g) <b>M3</b> $Q = 3970$ (J)	ALLOW {35.0 – 16.0} if not evaluated  ALLOW {25.0 + 25.0(0)} if not evaluated  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  1  1

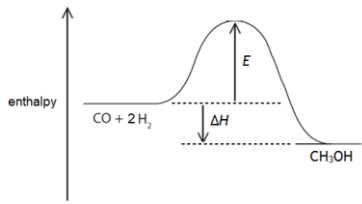
Total 7 marks

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)	<b>M1</b> the layers of (cat)ions  <b>M2</b> can slide/slip over one another	ALLOW rows/sheets/OWTTE for layers ALLOW atoms for ions  REJECT molecules/protons/electrons/nuclei IGNORE particles  ALLOW OWTTE e.g. roll/flow  <b>M2</b> DEP on mention of layers or equivalent <b>OR</b> 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	2
(b)	<b>TiCl<sub>4</sub></b> <b>M1</b> simple molecular (structure) <b>M2</b> weak intermolecular forces (of attraction)/weak forces (of attraction) between molecules  <b>TiO<sub>2</sub></b> <b>M3</b> giant (covalent structure) <b>M4</b> strong (covalent) bonds  <b>M5</b> Little/less energy required to overcome the forces (in TiCl <sub>4</sub> )  <b>AND</b>  large amount of/more energy required to break the (covalent) bonds (in TiO <sub>2</sub> )	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 <sub>4</sub> 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)	$\text{TiO}_2 + \text{C} + 2\text{Cl}_2 \rightarrow \text{TiCl}_4 + \text{CO}_2$ M1 all formulae correct M2 balanced correctly	ACCEPT halves and multiples  M2 DEP on M1	2
(ii)	$\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$	ACCEPT halves and multiples	1

Total 11 marks

Question number	Answer	Notes	Marks
12 (a) (i)	low <b>AND</b> because (forward) reaction is exothermic / (forward) reaction releases heat (energy)	ACCEPT (equilibrium) shifts in the exothermic direction IGNORE $\Delta H$ 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 <b>AND</b> 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)	<b>M1</b> profile curve completed with CH <sub>3</sub> OH/products below reactants  <b>M2</b> vertical line with arrow pointing downwards labelled $\Delta H$ / 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)	<b>M1</b> $n(\text{CaCO}_3) = 2.0 \times 10^5$ OR 200 000 (mol)	ACCEPT calculations in mega moles	1	
	<b>M2</b> $m(\text{CaO}) = 11.2$	<b>M2</b> ECF from <b>M1</b>	1	
	<b>M3</b> tonnes	ACCEPT $1.12 \times 10^7$ g ACCEPT $1.12 \times 10^4$ kg	1	
	OR			
	<b>M1</b> 100 → 56			
	<b>M2</b> 20 → 11.2	<b>M2</b> ECF from <b>M1</b>		
	<b>M3</b> tonnes	ACCEPT $1.12 \times 10^7$ g ACCEPT $1.12 \times 10^4$ kg  M3 DEP M2 being awarded  Correct answer including units with no working scores 3 marks		
(b)	calcium hydroxide		1	
(c) (i)	<b>M1</b> $0.025(0) \times 0.5(00)$		1	
	<b>M2</b> 0.0125 (mol)	ACCEPT 12.5 for 1 mark	1	
	(ii)	<b>M1</b> $n[\text{Ca}(\text{OH})_2] = 0.0125 \div 2$ OR 0.00625 (mol)		1
		<b>M2</b> mass of $\text{Ca}(\text{OH})_2 = 0.463$ (g)	ACCEPT 0.4625 and 0.46	1
		OR		
		<b>M1</b> answer to <b>M2</b> from (i) divided by 2		
	<b>M2</b> $\text{M1} \times 74$ evaluated correctly	ALLOW 1 mark for 0.925 ALLOW 1 mark for 1.85		
(d)	<b>M1</b> $\text{Ca}(\text{OH})_2$ / slaked lime / limewater / the solution reacts with $\text{CO}_2$	ACCEPT correct chemical or word equation REJECT any other gas	1	
	<b>M2</b> to form solid calcium carbonate/ $\text{CaCO}_3$	ACCEPT to form insoluble calcium carbonate/ $\text{CaCO}_3$  ALLOW to form the (white) precipitate calcium carbonate/ $\text{CaCO}_3$ ACCEPT any indication in an equation that the $\text{CaCO}_3$ 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)	$  \begin{array}{cccc}  \text{H} & \text{H} & \text{H} & \text{H} \\    &   &   &   \\  \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{Br} \\    &   &   &   \\  \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	ACCEPT Br in any position ACCEPT multiple substitutions	1

Total 6 marks

Question number	Answer	Notes	Marks
15 (a)	Haber (process)		1
(b)	<b>M1</b> (gas A) - nitrogen/N <sub>2</sub> <b>M2</b> (gas B) - hydrogen/H <sub>2</sub>	If name and formula given both must be correct  If both answers correct but in wrong order award 1 mark	1  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:  <b>M1</b> saves raw materials/resources  <b>M2</b> uses less energy  <b>M3</b> to produce more ammonia / to improve yield (of ammonia)	ALLOW stops raw materials/resources being wasted  ACCEPT saves energy  ALLOW so recycled gases/nitrogen and hydrogen/they can be reacted again  IGNORE references to saves money	2
(f) (i)	<b>M1</b> 350 (°C) <b>M2</b> 400 (atm)	ACCEPT low temperature  ACCEPT high pressure  If numerical answers given units or indication of which is temp/pressure required	1  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)	<b>M1</b> $n(\text{FeSO}_4) = 0.025$ (mol)		1
	<b>M2</b> $n(\text{H}_2\text{O}) = 0.10$		1
	<b>M3</b> $x = 4$	ALLOW ECF from <b>M1</b> and <b>M2</b> Answer must be given to nearest whole number	1
	<b>OR</b>		
	<b>M1</b> $(18x \div 152) = (1.80 \div 3.80)$		
	<b>M2</b> $x = (152 \times 1.80) \div (18 \times 3.80)$		
	<b>M3</b> $x = 4$		
		(iii) marked ECF from (b)(i) and (b)(ii) correct answer with no working scores 3 marks	
(c)	<b>M1</b> (reaction) is exothermic/gives out heat (energy)	ACCEPT gives out thermal energy	1
	<b>M2</b> hydrated copper(II) sulfate formed	ACCEPT $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ALLOW now contains water of crystallisation  IGNORE copper(II) sulfate crystals are formed	1

Total 8 marks

