Mark Scheme (Results)

January 2023

Pearson Edexcel International GCSE in Chemistry (4CH1)
Paper 1CR

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk
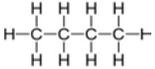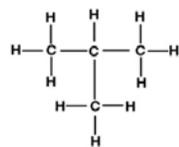
General Marking Guidance

- 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)	X evaporating Y condensing Z freezing	ALLOW evaporation ALLOW condensation	3
(b)	**M1** solid particles vibrate about a fixed position **M2** gas particles move randomly	REJECT do not move **ALLOW** gas particles move rapidly/quickly/freely	2
			Total 5

Question number			Answer	Notes	Marks
2	(a)	(i)	nitrogen	**ALLOW** N_2 **IGNORE** N	1
		(ii)	argon	**ALLOW** Ar	1
		(iii)	carbon dioxide	**ALLOW** CO_2/H_2O(g)/water vapour/CH_4/methane	1
	(b)	(i)	brown/red-brown/orange-brown	**ALLOW** orange **IGNORE** red **ALLOW** rusty/rust coloured (looks like)rust/rusted	1
		(ii)	**M1** (change in length of column =) 84 − 69 **OR** 15 (mm) **M2** $\frac{15 \times 100}{84}$ = 17.86/17.9 (=18)	**M2** subsumes **M1** Working must be shown to score **M2** **Ecf for M2 eg 18/84 x100 =21.4** **REJECT** 17.85/17.8 as wrongly rounded	2
		(iii)	not all the oxygen in the sample of air had reacted with the iron wool OWTTE /not enough iron wool	**ALLOW** there is water vapour in the column of air/changes in temperature / pressure / location ALLOW Reaction incomplete/reaction too slow	1
					Total 7

Question number		Answer	Notes	Marks
3	(a)	structural formula $CH_3CH_2CH_2CH_3$ name butane molecular formula C_4H_{10} empirical formula C_2H_5 general formula C_nH_{2n+2} 1 mark for each correct answer		4
	(b) (i)	**M1** (compounds with the) same molecular formula **M2** (but with) different structural/displayed formulae	**ALLOW same numbers of each atom** **ALLOW** different arrangement of atoms	2
	(ii)	**M1** displayed formula of butane **M2** displayed formula of methylpropane 		2
	(c) (i)	HBr	REJECT incorrect case letters Ignore name	1
	(ii)	**D** substitution A is incorrect as it is not an addition reaction B is incorrect as it is not a decomposition reaction C is incorrect as it is not a neutralisation reaction		1
	(iii)	ultraviolet (radiation)	**ACCEPT** UV (radiation) **ALLOW** ultraviolet/UV light/sunlight	1
	(d) (i)	$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ **M1** all formulae correct **M2** balancing of correct formulae	**ALLOW** multiples and fractions **M2** dep **on M1**	2
	(ii)	An explanation that links the following points **M1** carbon monoxide/CO (is the gas produced) **M2** (carbon monoxide) limits the capacity of the blood/haemoglobin to carry oxygen OWTTE	 **M2** dep **on M1**	2
				Total 15

Question number			Answer	Notes	Marks
4	(a)		Any two from **M1** concentration of solution A **M2** concentration of solution B **M3** volume of solution B	ALLOW amount of solution B Ignore apparatus	2
	(b)	(i)	all points plotted correctly to the nearest grid line		1
		(ii)	anomalous point at 25°C circled	**ALLOW** ecf from incorrect plotting	1
		(iii)	smooth curve of best fit ignoring the anomalous point	ALLOW Ecf if 35,130 circled	1
		(iv)	Any one from **M1** temperature was higher than 25°C **M2** started the timer too late /stopped the timer too early/took reading too early	**ALLOW** ecf from incorrect anomalous result circled so 35,130 gives slower as temp<35/timer stopped too late	1
		(v)	**M1** vertical line on graph drawn to curve from 55°C **M2** value obtained from candidate's graph	ALLOW extra point at 55°C on curve expected value 115 to 117 s	2
	(c)		**M1** $\frac{1}{156}$ **OR** 0.00641 **M2** 6.41×10^{-3}	**ALLOW** use of value from graph ALLOW 6.4×10^{-3}	2
	(d)		An explanation that links the following three points **M1** rate (of reaction) increases **M2** (mean) kinetic energy of particles increases **M3** more successful collisions per second/unit time/ more frequent successful collisions	**ALLOW** reaction is faster/ speeds up **ALLOW** particles move faster **IGNORE** vibrate more /faster **ALLOW** more frequent collisions having energy $\geq$ activation energy	3
					Total 13

Question number			Answer	Notes	Marks
5	(a)	(i)	5/five		1
		(ii)	46		1
		(iii)	**M1** hydrocarbons contain only carbon and hydrogen (atoms)	REJECT molecules	2
			M2 methanoic acid/it contains oxygen (as well as hydrogen and carbon)		
	(b)	(i)	**M1** (electrostatic) attraction between nuclei	Must be plural	2
			M2 (and the) shared pair of electrons		
			OR		
			M1 (electrostatic) attraction between shared pair(s) of electrons		
			M2 and nuclei	Must be plural	
		(ii)	**M1** 3 pairs of electrons for 3 single bonds	**ALLOW** any combination of dots and crosses	3
			M2 2 shared pairs for one C=O double bond		
			M3 rest of molecule fully correct (lone pairs on oxygen atoms must be shown)	**M3** dep on **M1** and **M2** correct	
	(c)		• divide percentages by relative atomic masses • divide results by smallest value to obtain ratio • write empirical formula	0 marks if division by atomic numbers or upside-down calculation	3
			Example calculation		
			M1 C H O $\frac{52.2}{12}$ $\frac{13.0}{1}$ $\frac{34.8}{16}$		
			M2 $\frac{4.35}{2.175}$ $\frac{13.0}{2.175}$ $\frac{2.175}{2.175}$		
			OR 2 6 1		
			M3 C_2H_6O	**ACCEPT** symbols in any order	
					Total 12

Question number			Answer	Notes	Marks
6	(a)	(i)	**B** bromine A is incorrect as astatine is a solid at room temperature C is incorrect as chlorine is a gas at room temperature D is incorrect as fluorine is a gas at room temperature		1
		(ii)	**C** dark grey A is incorrect as solid iodine is not black B is incorrect as solid iodine is not dark brown D is incorrect as solid iodine is not purple		1
		(iii)	**M1** test with (damp blue) litmus paper **M2** bleaches/turns white	ALLOW Universal indicator paper/ pH paper **ACCEPT** turns red and then bleaches	2
	(b)		**M1** 71.2 x 35 + 28.8 x 37 **OR** 3557.6 **M2** $\dfrac{71.2 \times 35 + 28.8 \times 37}{100}$ **OR** $\dfrac{3557.6}{100}$ **OR** 35.576 **M3** 35.6	Correct answer without working scores 3 **M2** subsumes **M1** 35.5 without working scores 0	3
	(c)		An explanation that links the following four points **M1** add chlorine (solution) to sodium iodide (solution) **M2** solution turns brown **M3** iodine/I_2 is displaced **M4** (so) chlorine is more reactive (than iodine) ORA	**ALLOW** mix the two solutions **ALLOW** iodine/I_2 is formed **REJECT** incorrect use of iodide or chloride once only	4
					Total 11

Question number			Answer	Notes	Marks
7	(a)		**M1** (bright) white flame/light		2
			M2 white powder/solid (formed)	**ALLOW** white smoke/ash	
				ALLOW grey powder	
				REJECT white precipitate	
	(b)	(i)	gives out/releases heat (energy)/thermal energy	**IGNORE** energy alone	1
		(ii)	$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$	**ALLOW** multiples and fractions	1
		(iii)	An explanation that links two of the following pairs of points		2
			M1 aluminium/Al gains oxygen so is oxidised	**ACCEPT** aluminium loses electrons so is oxidised	
			M2 iron oxide/Fe_2O_3 loses oxygen so is reduced	**ACCEPT** iron ions/Fe^{3+} ions gain electrons so are reduced	
			OR		
			M1 aluminium/Al is oxidised and iron oxide/Fe_2O_3 is reduced	**ACCEPT** aluminium loses electrons and iron ions/Fe^{3+} ions gain electrons	
			M2 as aluminium/Al gains oxygen and iron oxide /Fe_2O_3 loses oxygen	**ALLOW** answers in terms of change in oxidation number	
	(c)	(i)	An explanation that links the following two points		2
			M1 to allow air/oxygen to enter the crucible OWTTE		
			M2 so that oxygen can react with the magnesium		
		(ii)	A description that refers to the following points		2
			M1 heat the crucible again and reweigh		
			M2 repeat until constant mass	Heat and reweigh to constant mass scores 2	
					Total 10

Question number			Answer	Notes	Marks
8	(a)	(i)	(thermal) decomposition		1
		(ii)	**M1** amount of $PbCO_3$ = $\dfrac{5.34}{267}$ = 0.02(00) (mol) **M2** mass of PbO = 0.02(00) x 223 = 4.46 (g)	Correct answer without working scores 2 **ACCEPT** alternative methods	2
	(b)	(i)	**M1** diagram showing delivery tube going into test tube containing liquid **M2** limewater labelled	REJECT if sealed with a bung **ALLOW** white precipitate (ii) dep on mention of limewater in either (i) or (ii)	2
		(ii)	(limewater) turns cloudy/milky		1
	(c)		An explanation that links six of the following points **M1** silicon dioxide has a giant (covalent) structure **M2** covalent bonds are (very) strong **M3** (in silicon dioxide) many covalent bonds need to be broken **M4** a large amount of energy/more energy is required to break the bonds in silicon dioxide **M5** carbon dioxide has a simple molecular structure/is a simple molecule **M6** the forces between the molecules/intermolecular forces (in carbon dioxide) are weak **M7** very little energy/less energy is needed to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)	No **M3 or M4** if reference to intermolecular forces in silicon dioxide No **M6 or M7** if any reference to weak covalent bonds or breaking of covalent bonds in carbon dioxide Accept bonds between molecules weak A statement such as 'more energy is needed to break the bonds in silicon dioxide than to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)' scores **M4** and **M7**	6
					Total 12

Question number			Answer	Notes	Marks
9	(a)	(i)	$Zn (s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$	**ACCEPT** upper case letters	1
		(ii)	effervescence/bubbles/fizzing	**IGNORE** gas produced /given off **IGNORE** hydrogen produced / given off **ALLOW** colourless solution formed/gets hot/exothermic reaction/zinc dissolves IGNORE crystals form	1
	(b)	(i)	so all the nitric acid reacts/is neutralised		1
		(ii)	A description which refers to the following five points M1 filter off the excess zinc M2 heat the solution until crystals form M3 leave the solution to cool (and crystallise) M4 pour/filter off excess liquid (to obtain crystals) M5 leave (crystals) to dry	ALLOW heat until the solution is saturated/ heat until crystals form on the end of a glass rod/heat to evaporate some of the water IGNORE washing ALLOW any method of drying that avoids excess heat e.g. filter paper, a desiccator, a warm oven If heated to dryness only M1 can be scored If solution is not heated only M1, M4 and M5 can be scored	5
	(c)		$2Zn(NO_3)_2.6H_2O \rightarrow 2ZnO + 4NO_2 + O_2 + 12H_2O$ **M1** all formulae correct **M2** balancing of correct formulae	**M2** dep on **M1**	2
					Total 10

Question number		Answer	Notes	Marks
10	(a)	**M1** so that the solid/ammonium nitrate dissolves more quickly **M2** so that the temperature is even throughout the solution OWTTE	IGNORE speed up reaction ALLOW heat transfers evenly (throughout the solution)	2
	(b)	<table><tr><td>initial temperature of distilled water in ºC</td><td>23.4</td></tr><tr><td>minimum temperature of solution in ºC</td><td>19.4</td></tr><tr><td>temperature change in ºC</td><td>4.0</td></tr></table>	must be to 1 dp **ALLOW** ecf on incorrect mimimum temperature	2
	(c) (i)	**M1** (Q =) 50 x 4.2 x 3.9 (J) **M2** (Q =) 819/820 (J)	answer of 819 or 820 without working scores 2 **ALLOW** use of 4.0 giving an answer of 840	2
	(ii)	• find moles of NH_4NO_3 • division of Q by moles • conversion to kJ/mol • answer with correct sign **M1** (amount of NH_4NO_3 =) 2.8 ÷ 80 **OR** 0.035 (mol) **M2** 819 ÷ 0.035 **OR** 23 400 (J/mol) **M3** 23 400 ÷ 1000 **OR** 23.4 (kJ/mol) **M4** (ΔH =) +23.4/+23 (kJ/mol)	correct answer without working scores 4 use of 820 gives 23 429 use of 800 gives 22 857 use of 840 gives 24 000 use of 820 gives 23.4 use of 800 gives 22.9 use of 840 gives 24.0	4
	(d)	A description that refers to the following points **M1** add sodium hydroxide (solution to the ammonium nitrate and warm) **M2** test the gas/ammonia evolved with (damp) red litmus paper/(damp) universal indicator paper **M3** (red litmus) turns blue/ (universal indicator) turns blue/purple	 **M2** and **M3** dep on **M1** No **M2** or **M3** if solution tested with litmus/ universal indicator paper	3

(e)	An explanation that links the following points		2
	M1 the temperature increases/rises		
	M2 so the reaction is exothermic		**Total 15**