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# Mark Scheme (Results)

## January 2022

### Pearson Edexcel International GCSE

### In Chemistry (4CH1) Paper 2CR

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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.

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 1 (a) | **M1** oxygen | **ALLOW** air | 2 |
| | **M2** water / water vapour | **ALLOW** moisture<br><br>**ALLOW** answers in either order | |
| (b) (i) | iodine | | 1 |
| (ii) | methane | | 1 |
| (iii) | gold | | 1 |
| | | | **Total 5** |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (a) | **M1** heated | **ALLOW** boiled<br>**IGNORE** vapourised/evaporated | 3 |
| | **M2** fractionating | **ACCEPT** fractional distillation | |
| | **M3** boiling point(s) | **ACCEPT** boiling temperature(s)<br>**IGNORE** melting point(s)/low density | |
| (b) | road surfacing / roofing | **ALLOW** roads | 1 |
| (c) (i) | pentane | | 1 |
| (ii) | ($M_r$ = 5 x 12 + 12 x 1 =) 72 | | 1 |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (d) | **M1** alumina / silica<br><br>**M2** any temperature in the range 600 – 700 °C inclusive | **ACCEPT** aluminium oxide / silicon dioxide / $Al_2O_3$ / $SiO_2$ / zeolite(s) / aluminosilicate(s) | 2 |
| (e) | ($C_{10}H_{22}$ → $C_4H_{10}$) + $C_2H_4$ + $C_4H_8$<br><br>**M1** $C_2H_4$<br><br>**M2** $C_4H_8$ | alkenes can be in either order<br><br>**ALLOW** 1 mark for $C_6H_{12}$ / $2C_3H_6$ / $C_3H_6 + C_3H_6$<br><br>**ALLOW** correct displayed formulae | 2 |
| | | | **Total 10** |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (a) | A description that includes six of the following points<br><br>**M1** use the pipette to add (25 $cm^3$ of) potassium hydroxide (solution) to the (conical) flask<br><br>**M2** add a few drops of methyl orange (to the flask)<br><br>**M3** add sulfuric acid to the burette and record the initial burette reading<br><br>**M4** add sulfuric acid (from the burette) to the flask, swirling (continuously)<br><br>**M5** until the (methyl orange) indicator turns red/orange<br><br>**M6** take the final burette reading and find volume of acid added (by finding difference between initial and final burette readings)<br><br>**M7** repeat (the titration) adding the acid dropwise near the end-point / repeat (the titration) to obtain concordant results | <br><br><br><br>ALLOW fill burette with sulfuric acid to "0" mark<br><br>ALLOW shaking (gently) / stirring<br><br><br><br>**ALLOW** take final burette reading only if previously filled burette to "0" mark<br><br>**ACCEPT** repeat (the titration) to obtain results within 0.2 $cm^3$ of each other | 6 |
| (b) (i) | **M1** 0.0250 x 0.240 **OR** $\frac{25.0 \times 0.240}{1000}$<br><br>**M2** 0.006(00) | correct answer without working scores 2<br><br>If no division by 1000 giving an answer of 6 award 1 mark | 2 |
| (ii) | (0.006 ÷ 2 =) 0.003 | **ALLOW** ECF from (i) | 1 |
| (iii) | **M1** $\frac{0.003(00) \times 1000}{15.00}$<br><br>**M2** 0.2(00) | <br><br>**ALLOW** ECF from (ii)<br><br>correct answer without working scores 2<br><br>answer to (ii) ÷ 15.00 scores 1<br><br>do not penalise not multiplying by 1000 in (iii) if they have not divided by 1000 in (i) | 2 |
| | | | **Total 11** |

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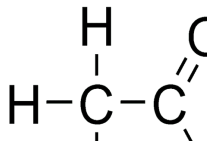
| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) | | | 3 |
| | structural formula: $CH_3COOH$ | 1 mark for each correct answer | |
| | name: ethanoic acid | **ALLOW** acetic acid | |
| | empirical formula: $CH_2O$ | | |
| | displayed formula:  | Must show O-H bond | |
| (b) (i) | **M1** potassium dichromate(VI) | VI not essential for the mark<br>**ACCEPT** sodium dichromate(VI)<br>**ALLOW** $K_2Cr_2O_7$ | 2 |
| | **M2** (dilute) sulfuric acid | **ALLOW** concentrated sulfuric acid<br>**ALLOW** $H_2SO_4$<br>**ACCEPT** reagents in either order | |
| (ii) | **B** orange to green<br>A is incorrect as the colour does not change from green to orange<br>C is incorrect as the colour does not change from red to yellow<br>D is incorrect as the colour does not change from yellow to red | | 1 |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (c) (i) | alcohols are flammable/might catch fire/might ignite | **ACCEPT** esters/mixture are/is flammable/might catch fire/might ignite<br><br>**ALLOW** alcohol/ester/ carboxylic acid might evaporate | 1 |
| (ii) | **C** methyl propanoate<br><br>A ethyl methanoate is not the correct name of the compound<br>B methyl ethanoate is not the correct name of the compound<br>D propyl methanoate is not the correct name of the compound | | 1 |
| | | | **Total 8** |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) (i) | (produces) acid rain | **ALLOW** any detrimental effect of acid rain e.g. kills fish, damages limestone buildings | 1 |
| (ii) | • M1 find moles of sulfur<br>• M2 multiply moles by 24<br>• M3 answer in standard form<br><br>Example calculation<br><br>**M1** $6.4 \times 10^6 \div 32$ **OR** $2.0 \times 10^5 / 200\,000$<br><br>**M2** $2.0 \times 10^5 \times 24 / 200\,000 \times 24 / 4\,800\,000$<br><br>**M3** $4.8 \times 10^6$ | **ALLOW** ECF as long as an attempt has been made to calculate moles<br><br>Correct answer without working scores 3<br><br>4 800 000 ($dm^3$) without working scores 2 | 3 |
| (b) (i) | An explanation that links the following two points<br><br>**M1** provides an alternative (reaction) pathway/route<br><br>**M2** with a lower activation energy OWTTE | **ACCEPT so** more particles/collisions have energy greater than the activation energy<br><br>**ALLOW** lowers the energy needed to start the reaction | 2 |
| (ii) | fewer moles (of gas) on RHS (than on (LHS) | **ALLOW** 3 moles (of gas) on LHS and 2 moles (of) gas on RHS<br>**ALLOW** fewer moles of product/$SO_3$ (gas) (than of reactants/$SO_2$ and $O_2$ (gas))<br><br>**ALLOW** molecules in place of moles<br>**IGNORE** references to rate | 1 |
| (iii) | as yield is approximately 98% /very high (it is not necessary to increase the pressure ) OWTTE | **ALLOW** reference to reaction rate (already high enough) as catalyst used OWTTE | 1 |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (c) | **M1** $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$<br><br>**M2** $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ | **ALLOW** multiples | 2 |
| (d) | **M1** (2 x 14 ÷ 132) x 100<br><br>**M2** 21.21 (%) | **ALLOW** any number of sig figs except 1<br><br>**ALLOW** ECF from **M1** as long as 132 used correctly<br><br>Correct answer without working scores 2 | 2 |
| | | | **Total 12** |

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| Question number | $_3$Answer | Notes | Marks |
|---|---|---|---|
| 6 (a) | A description that refers to the following three points<br><br>**M1** filter<br><br>**M2** wash the precipitate/solid/lead(II) bromide /residue (with distilled water)<br><br>**M3** dry with filter paper/in a (warm) oven | <br><br><br><br><br><br>**ALLOW** leave to dry or any other suitable method<br><br>**REJECT** direct heating e.g. with a Bunsen burner<br><br>If description relates to preparation of a soluble salt allow 1 mark only for **M3** for a suitable method of drying the solid | 3 |
| (b) | **M1** solid lead(II) bromide does not conduct electricity<br><br>**M2** because ions cannot move/are in fixed positions | **ALLOW** lead(II) bromide only conducts when molten<br>**ALLOW** when lead(II) bromide is solid no electricity/current flow(s) through the circuit/lamp<br><br>**REJECT** reference to (delocalised) electrons /atoms cannot move in solid | 2 |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (c) (i) | brown vapour/gas/fumes (of bromine) | **ALLOW** orange/orange-brown | 1 |
| (ii) | An explanation that links the following four points | Penalise incorrect use of ide/ine once only | 4 |
| | **M1** bromide ions are negatively charged / $Br^-$ | **ALLOW** bromide ions are anions | |
| | **M2** (so bromide ions/they) are attracted to the positive electrode | **ALLOW** anode | |
| | **M3** (at the positive electrode) bromide ions/they lose/give up electron(s) (to form bromine atoms) | **ALLOW** bromide ions are oxidised<br>**ALLOW** $Br^- \rightarrow Br + e^{(-)}$ | |
| | **M4** (bromine atoms) join in pairs to form bromine molecules/$Br_2$ OWTTE | **ALLOW** $Br + Br \rightarrow Br_2$<br>$2Br^- \rightarrow Br_2 + 2e^{(-)}$ scores **M1 M3** and **M4** | |
| (d) | $Pb^{2+}(l) + 2e^{(-)} \rightarrow Pb(s)$ | **ALLOW** Pb(l) | 2 |
| | **M1** formulae and balancing correct | **ALLOW** multiples and fractions | |
| | **M2** both state symbols correct | **ALLOW M2** ECF if charge on lead ion and/or balancing are incorrect | |
| | | | **Total 12** |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 7 (a) | gives out thermal energy/heat (energy) | | 1 |
| (b) | • M1 expression for ∑ bond energies of reactants/bonds broken<br>• M2 expression for ∑ bond energies of products/bonds made or evaluation<br>• M3 correct equation linking M1, M2 and value of ΔH<br>• M4 evaluation of Cl-Cl bond energy | | 4 |
| | Example calculation | Correct answer without working scores 4 | |
| | **M1** (∑ bond energies of reactants =) 436 + X | **ACCEPT** E(Cl– Cl) or any suitable symbol or expression for X | |
| | **M2** (∑ bond energies of products =) 2 x 431 **OR** 862(kJ) | | |
| | **M3** – 184 = 436 + X – 862 **OR** X = – 184 + 862 – 436 | **ALLOW M3** ECF if 431 for **M2**<br><br>If not used (-)184 in **M3** can only score M1 M2<br><br>**M3** subsumes **M1 M2** | |
| | **M4** X = 242 (kJ/mol) | **ALLOW M4** ECF on **M3** as long as **M3** involves 436, X, 862 (or 431) and (-)184 | |

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 7 (c) | An explanation that links the following three points | | 3 |
| | **M1** energy needed to break bonds / bond-breaking is endothermic | **ALLOW** energy is absorbed/taken in | |
| | **M2** energy given out when bonds are formed / bond-forming is exothermic | **ALLOW** energy is released | |
| | **M3** energy given out is greater than energy needed (so exothermic) OWTTE | **M3 DEP M1 M2**<br><br>more energy released when new bonds are formed (in products) than is needed to break the bonds (in reactants) OWTTE scores **M1 M2 M3**<br><br>If any contradictory statements max 1 | |
| (d) | **M1** horizontal line to show products below reactants and to the right of reactants and labelled 2HCl | **ALLOW** products for 2HCl | 4 |
| | **M2** vertical line from $H_2$ + $Cl_2$ level to 2HCl/products level and labelled enthalpy change/ΔH/ -184 | **ACCEPT** double headed arrow or arrow pointing from $H_2$ + $Cl_2$ level to 2HCl/products level<br><br>**REJECT** arrow pointing from 2HCl/products level to $H_2$ + $Cl_2$ level | |
| | **M3** curve with hump/peak shown on diagram going up from $H_2$ + $Cl_2$ line and ending at 2HCl/products line | | |
| | **M4** vertical line from $H_2$ + $Cl_2$ level to top of hump level and labelled activation energy/$E_a$ | **ACCEPT** double headed arrow or arrow pointing from $H_2$ + $Cl_2$ level to top of hump<br><br>**REJECT** arrow pointing from top of hump to $H_2$ + $Cl_2$ level<br><br>If endothermic diagram shown, can score **M2 M3** (peak/hump must be above products line) and **M4** | **Total 12** |

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