

Please check the examination details below before entering your candidate information

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|--|--|--|--|--|--|--|-------------------------------------|--|
| Candidate surname | | | | | Other names | | | |
| Centre Number | | | | | Candidate Number | | | |
| Pearson Edexcel International GCSE | | | | | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> | | | |
| Monday 20 January 2020 | | | | | | | | |
| Afternoon (Time: 1 hour 15 minutes) | | | | | Paper Reference 4CH1/2C | | | |
| Chemistry Unit: 4CH1 Paper 2C | | | | | | | | |
| You must have: Calculator, ruler | | | | | | | Total Marks <input type="text"/> | |

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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The Periodic Table of the Elements

| | | | | | | | | |
|---------------------------------------|---|---|--|--|--|--|--|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | |
| 7 Li lithium 3 | 9 Be beryllium 4 | 11 Na sodium 11 | 12 C carbon 6 | 13 Al aluminium 13 | 14 N nitrogen 7 | 15 O oxygen 8 | 16 F fluorine 9 | 17 Ne neon 10 |
| 19 K potassium 19 | 20 Ca calcium 20 | 23 Sc scandium 21 | 24 Ti titanium 22 | 25 V vanadium 23 | 26 Cr chromium 24 | 27 Mn manganese 25 | 28 Fe iron 26 | 29 Co cobalt 27 |
| 37 Rb rubidium 37 | 38 Sr strontium 38 | 39 Y yttrium 39 | 40 Zr zirconium 40 | 41 Nb niobium 41 | 42 Mo molybdenum 42 | 43 Tc technetium 43 | 44 Ru ruthenium 44 | 45 Rh rhodium 45 |
| 55 Cs caesium 55 | 56 Ba barium 56 | 57 La* lanthanum 57 | 72 Hf hafnium 72 | 73 Ta tantalum 73 | 74 W tungsten 74 | 75 Re rhenium 75 | 76 Os osmium 76 | 77 Ir iridium 77 |
| 87 Fr francium 87 | 88 Ra radium 88 | 89 Ac* actinium 89 | 104 Rf rutherfordium 104 | 105 Db dubnium 105 | 106 Sg seaborgium 106 | 107 Bh bohrium 107 | 108 Hs hassium 108 | 109 Mt meitnerium 109 |
| 133 Cs caesium 55 | 137 Ba barium 56 | 139 La* lanthanum 57 | 178 Hf hafnium 72 | 181 Ta tantalum 73 | 184 W tungsten 74 | 186 Re rhenium 75 | 190 Os osmium 76 | 192 Ir iridium 77 |
| 209 Bi bismuth 83 | 207 Pb lead 82 | 208 Po polonium 84 | 209 At astatine 85 | 210 Rn radon 86 | 211 Fr francium 87 | 212 Ac actinium 88 | 213 Th thorium 89 | 214 Pa protactinium 90 |
| 119 In indium 49 | 120 Tl thallium 81 | 121 Pb lead 82 | 122 Bi bismuth 83 | 123 Po polonium 84 | 124 At astatine 85 | 125 Rn radon 86 | 126 Fr francium 87 | 127 Ac actinium 88 |
| 115 In indium 49 | 116 Tl thallium 81 | 117 Pb lead 82 | 118 Bi bismuth 83 | 119 Po polonium 84 | 120 At astatine 85 | 121 Rn radon 86 | 122 Fr francium 87 | 123 Ac actinium 88 |
| 112 Cd cadmium 48 | 113 In indium 49 | 114 Sn tin 50 | 115 Sb antimony 51 | 116 Te tellurium 52 | 117 I iodine 53 | 118 Xe xenon 54 | 119 Fr francium 87 | 120 Ac actinium 88 |
| 108 Ag silver 47 | 109 Cd cadmium 48 | 110 In indium 49 | 111 Sb antimony 51 | 112 Te tellurium 52 | 113 I iodine 53 | 114 Xe xenon 54 | 115 Fr francium 87 | 116 Ac actinium 88 |
| 63.5 Cu copper 29 | 64 Zn zinc 30 | 65 Ga gallium 31 | 66 Ge germanium 32 | 67 As arsenic 33 | 68 Se selenium 34 | 69 Br bromine 35 | 70 Kr krypton 36 | 71 Rb rubidium 37 |
| 59 Ni nickel 28 | 58 Cu copper 29 | 59 Zn zinc 30 | 60 Ga gallium 31 | 61 Ge germanium 32 | 62 As arsenic 33 | 63 Se selenium 34 | 64 Br bromine 35 | 65 Kr krypton 36 |
| 59 Co cobalt 27 | 58 Ni nickel 28 | 59 Cu copper 29 | 60 Zn zinc 30 | 61 Ga gallium 31 | 62 Ge germanium 32 | 63 As arsenic 33 | 64 Se selenium 34 | 65 Br bromine 35 |
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| 192 Ir iridium 77 | 191 Pt platinum 78 | 192 Au gold 79 | 193 Hg mercury 80 | 194 Tl thallium 81 | 195 Pb lead 82 | 196 Bi bismuth 83 | 197 Po polonium 84 | 198 At astatine 85 |
| 277 Hs hassium 108 | 278 Mt meitnerium 109 | 279 Ds darmstadtium 110 | 280 Rg roentgenium 111 | 281 Uue unbinilium 112 | 282 Uub unbinilium 113 | 283 Uuq unbinilium 114 | 284 Uuo unbinilium 115 | 285 Uuq unbinilium 114 |
| 268 Mt meitnerium 109 | 269 Ds darmstadtium 110 | 270 Rg roentgenium 111 | 271 Uue unbinilium 112 | 272 Uub unbinilium 113 | 273 Uuq unbinilium 114 | 274 Uuo unbinilium 115 | 275 Uuq unbinilium 114 | 276 Uuo unbinilium 115 |
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| 264 Bh bohrium 107 | 265 Hs hassium 108 | 266 Mt meitnerium 109 | 267 Ds darmstadtium 110 | 268 Rg roentgenium 111 | 269 Uue unbinilium 112 | 270 Uub unbinilium 113 | 271 Uuq unbinilium 114 | 272 Uuo unbinilium 115 |
| 186 Re rhenium 75 | 187 Os osmium 76 | 188 Ir iridium 77 | 189 Pt platinum 78 | 190 Au gold 79 | 191 Hg mercury 80 | 192 Tl thallium 81 | 193 Pb lead 82 | 194 Bi bismuth 83 |
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| 192 Ir iridium 77 | 191 Pt platinum 78 | 192 Au gold 79 | 193 Hg mercury 80 | 194 Tl thallium 81 | 195 Pb lead 82 | 196 Bi bismuth 83 | 197 Po polonium 84 | 198 At astatine 85 |
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Answer ALL questions.**1** This question is about elements, compounds and mixtures.

(a) Name the element that burns with a lilac flame.

(1)

(b) Name the technique used to separate the mixture of colours in black ink.

(1)

(c) The box gives the names of some substances.

| | | | | | |
|-----|---------|-----------|------|-----------------|--------|
| air | bromine | magnesium | neon | sodium chloride | sulfur |
|-----|---------|-----------|------|-----------------|--------|

Choose substances from the box to answer these questions.

(i) Identify the compound.

(1)

(ii) Identify the mixture.

(1)

(iii) Identify the non-metal element that is a solid at room temperature.

(1)

(Total for Question 1 = 5 marks)

2 Crude oil is a mixture of hydrocarbons.

(a) Name the process used to separate crude oil into fractions.

(1)

(b) Give one use of the kerosene fraction.

(1)

(c) One of the hydrocarbons in the refinery gas fraction is an alkane with the structural formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

(i) Give the name of this alkane.

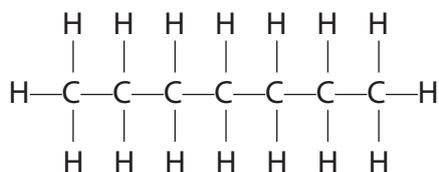
(1)

(ii) Calculate the relative molecular mass (M_r) of this alkane.

(1)

$M_r = \dots\dots\dots$

(d) One of the alkanes in the gasoline fraction has the displayed formula



(i) Determine the molecular formula of this alkane.

(1)

(ii) Give the general formula for the alkanes.

(1)

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(e) Catalytic cracking is used to convert long-chain alkanes into shorter-chain alkanes.

(i) Name the catalyst used in catalytic cracking.

(1)

(ii) Explain why it is necessary to convert long-chain alkanes into shorter-chain alkanes.

(2)

(f) Catalytic cracking also produces alkenes.

$C_{11}H_{24}$ can undergo cracking to give pentane (C_5H_{12}) and two different alkenes.

Complete the equation for this cracking reaction.

(2)



(Total for Question 2 = 11 marks)

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3 This question is about copper and its compounds.

(a) Copper is a metal used for electrical wiring.

Explain why copper is a good conductor of electricity.

(2)

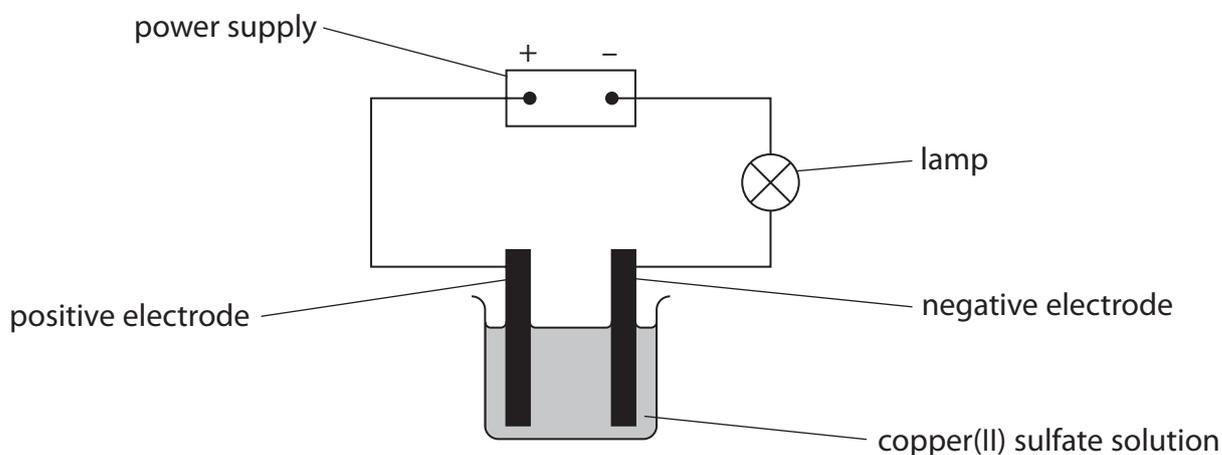
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(b) This apparatus is used to investigate the electrolysis of copper(II) sulfate solution with graphite electrodes.



Copper forms at the negative electrode and oxygen forms at the positive electrode.

(i) State what would be observed at each electrode.

(2)

negative electrode

positive electrode

(ii) The ionic half-equation for the reaction at the negative electrode is



State why this is a reduction reaction.

(1)

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(iii) Explain why the copper(II) sulfate solution becomes paler blue during the electrolysis. (2)

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(c) When hydrated copper(II) sulfate crystals are heated, anhydrous copper(II) sulfate forms.

A mass of 12.5 g of hydrated copper(II) sulfate crystals is heated in a crucible until all the water of crystallisation is removed.

A mass of 8.0 g of anhydrous copper(II) sulfate forms.

Show by calculation that the formula of hydrated copper(II) sulfate is $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

[M_r of $\text{CuSO}_4 = 159.5$ M_r of $\text{H}_2\text{O} = 18$]

(4)

(Total for Question 3 = 11 marks)



- 4 A student investigates the reaction between sodium hydroxide solution and dilute sulfuric acid. He does a titration to find the concentration of the sulfuric acid.

This is his plan for the titration. There are some mistakes and omissions in his plan.

- rinse a conical flask with the sodium hydroxide solution
- use a measuring cylinder to measure out 25 cm^3 of the sodium hydroxide solution and add it to the conical flask
- add a few drops of methyl orange indicator to the conical flask
- rinse a burette with water and then fill it with the sulfuric acid
- add the acid from the burette to the conical flask until the indicator changes colour at the end-point of the titration
- record the final burette reading

- (a) Give the colour change of the methyl orange indicator at the end-point. (2)

from to

- (b) Describe four changes that the student could make to improve his plan. (4)

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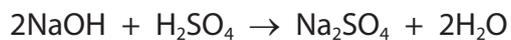
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(c) The student then does the titration correctly.

He finds that 16.70 cm^3 of the dilute sulfuric acid neutralises 25.0 cm^3 of sodium hydroxide solution of concentration 0.200 mol/dm^3

The equation for the reaction is



Calculate the concentration, in mol/dm^3 , of the sulfuric acid.

(3)

concentration of sulfuric acid = mol/dm^3

(Total for Question 4 = 9 marks)

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5 Oxygen can be prepared from hydrogen peroxide using a catalyst.

(a) Which is a correct statement about oxygen?

(1)

- A it burns with a squeaky pop
- B it relights a glowing splint
- C it turns blue litmus red
- D it turns limewater milky

(b) Explain how a catalyst increases the rate of a reaction.

(2)

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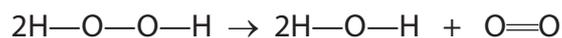
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(c) The equation for the preparation of oxygen from hydrogen peroxide is



This equation can also be written using displayed formulae to show all the covalent bonds in the molecules.



The table gives the bond energies for these bonds.

| | | | |
|------------------------------|-----|-----|-----|
| Bond | H—O | O—O | O=O |
| Bond energy in kJ/mol | 463 | 143 | 498 |

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- (i) Use the values in the table to calculate the enthalpy change, ΔH , for the reaction.

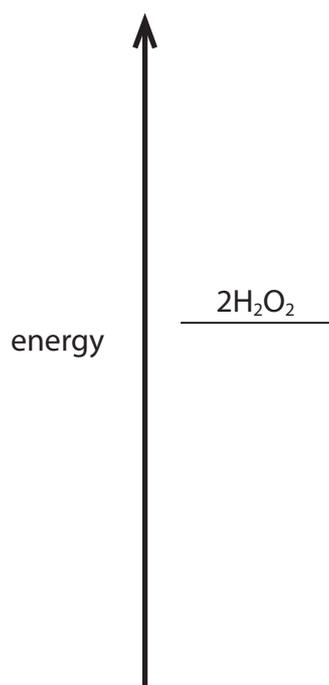
Include a sign in your answer.

(3)

$\Delta H = \dots\dots\dots$ kJ

- (ii) Complete the energy level diagram to show the position of the products and the enthalpy change, ΔH , for the reaction.

(2)



(Total for Question 5 = 8 marks)



6 Ethanol, C_2H_5OH , can be manufactured from ethene and steam using a phosphoric acid catalyst.

(a) (i) State the temperature and pressure used in this manufacturing process.

(2)

temperature

pressure

(ii) Draw the displayed formula of ethanol.

(1)

(b) Ethanol burns in a plentiful supply of air to form carbon dioxide and water.

(i) Give the chemical equation for this reaction.

(2)

(ii) When the air supply is limited, incomplete combustion occurs and carbon monoxide forms.

State why carbon monoxide is poisonous to humans.

(1)

(c) When ethanol reacts with ethanoic acid, an ester forms.

Give the name of this ester.

(1)

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(d) Butanedioic acid and ethanediol react together to form a polyester and water.

(i) Give the name of this type of polymerisation.

(1)

(ii) Complete the equation.

Show only one repeat unit of the polyester.

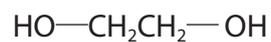
(3)



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(Total for Question 6 = 11 marks)

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7 This question is about some Group 2 elements and their compounds.

(a) Calcium reacts with water to produce calcium hydroxide and hydrogen gas.

(i) Give the word equation for this reaction.

(1)

(ii) State two observations that would be made during this reaction.

(2)

1

2

(b) (i) Describe how a pure, dry sample of the insoluble salt, barium sulfate, could be made from the two solids sodium sulfate and barium chloride.

(5)

(ii) Give an ionic equation for the reaction that occurs.

Include state symbols in your equation.

(2)

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- (c) When magnesium nitrate is heated, magnesium oxide, nitrogen dioxide and oxygen form.

The equation for the reaction is



- (i) What is the name for this type of reaction?

(1)

- A addition
- B combustion
- C decomposition
- D neutralisation

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- (ii) Calculate the **total** volume, in dm^3 , of gas produced at rtp when 7.7 g of magnesium nitrate completely reacts.

[Assume that the molar volume of a gas at rtp is 24 dm^3]

[M_r of $\text{Mg}(\text{NO}_3)_2 = 148$]

Give your answer to two significant figures.

(4)

total volume of gas = dm^3

(Total for Question 7 = 15 marks)

TOTAL FOR PAPER = 70 MARKS

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