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|---|--|---|-------------|
| Candidate surname | | Other names | |
| Centre Number | | Candidate Number | |
| Pearson Edexcel Level 1/Level 2 GCSE (9–1) | | <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> | |
| Thursday 16 May 2019 | | | |
| Morning (Time: 1 hour 45 minutes) | | Paper Reference 1CH0/1H | |
| Chemistry Paper 1 | | | |
| Higher Tier | | | |
| You must have: Calculator, ruler | | | Total Marks |

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk (*)**, marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

**Some questions must be answered with a cross in a box \boxtimes .
If you change your mind about an answer, put a line through the box \boxtimes and then
mark your new answer with a cross \boxtimes .**

- 1** In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.
- (a) The overall reaction occurring in this fuel cell is a reaction of hydrogen with oxygen.
Write the balanced equation for this reaction. (2)
- (b) The electrodes of a fuel cell are in contact with water and air.
The electrodes are made of platinum rather than iron.
- (i) State why iron is not a suitable metal for the electrodes of the cell. (1)
- (ii) Platinum acts as a catalyst.
State, in terms of its position in the periodic table, why you would expect
platinum to act as a catalyst. (1)



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(c) Some metal objects are electroplated.

State **two** reasons for electroplating a metal object.

(2)

(Total for Question 1 = 6 marks)

- 2 In Figure 1, the letters **A**, **E**, **G**, **J**, **X** and **Z** show the positions of six elements in the periodic table.

These letters are not the symbols of the atoms of these elements.

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|----------|---|--|--|--|--|--|----------|--|--|--|--|----------|---|---|----------|---|----------|
| | | | | | | | | | | | | | | | | | |
| A | | | | | | | | | | | | E | | | G | | |
| J | | | | | | | | | | | | | | | | | X |
| | | | | | | | Z | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

Figure 1

- (a) Using the letters **A**, **E**, **G**, **J**, **X** and **Z**

(i) give the letters of the **two** elements that are non-metals

(1)

(ii) give the letters of **two** elements in period 2

(1)

(iii) give the letter of an element that normally forms an ion with a charge of +1.

(1)

- (b) Element **E** has an atomic number of 5.

In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

(ii) All atoms of element **E** in this sample contain

(1)

- ☐ **A** 5 protons
- ☐ **B** 5 neutrons
- ☐ **C** 6 protons
- ☐ **D** 6 neutrons

(c) Element **X** has an atomic number of 18.

State the electronic configuration of an atom of element **X**.

(1)

(d) In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

(Total for Question 2 = 10 marks)

- 3 (a) Water, acidified with sulfuric acid, is decomposed by electrolysis.
The water is decomposed to produce hydrogen and oxygen.

- (i) A sample of hydrogen is mixed with air and ignited.

State what would happen.

(1)

- (ii) Throughout the experiment the volume of hydrogen and the volume of oxygen are measured at two-minute intervals.

The results are shown in Figure 2.

| time in minutes | volume of hydrogen in cm ³ | volume of oxygen in cm ³ |
|-----------------|--|--|
| 0 | 0 | 0 |
| 2 | 4 | 2 |
| 4 | 8 | 4 |
| 6 | 12 | 6 |
| 8 | 16 | 8 |

Figure 2

Describe, using the data in Figure 2, what the results show about the volumes of hydrogen and of oxygen produced in this experiment.

(2)



(b) Molten lead bromide is electrolysed.

The products of this electrolysis are

(1)

- ☐ A hydrogen and bromine
- ☐ B hydrogen and oxygen
- ☐ C lead and bromine
- ☐ D lead and oxygen

(c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.

Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

(d) When molten zinc chloride is electrolysed, zinc ions, Zn^{2+} , form zinc atoms.

Write the half equation for this reaction.

(2)

(Total for Question 3 = 8 marks)

- 4 Calcium carbonate decomposes on heating to form calcium oxide and carbon dioxide.



- (a) 8.000 g of CaCO_3 was heated strongly for about 10 minutes. 6.213 g of solid remained. Calculate the mass of carbon dioxide gas given off.

(1)



- (b) A second sample of calcium carbonate is strongly heated in a crucible until there is no further loss in mass.

The mass of calcium oxide remaining in the crucible is 5.450 g.

- (i) The theoretical yield of calcium oxide in this experiment is 5.600 g.

Calculate the percentage yield of calcium oxide.

(2)

- (ii) The mass of solid left in the crucible is less than the theoretical mass of calcium oxide that should be obtained.

A possible reason for this is that

(1)

- ☐ **A** some solid was lost from the crucible
- ☐ **B** the solid remaining absorbed some water from the air
- ☐ **C** some carbon dioxide remained in the crucible
- ☐ **D** the decomposition was incomplete

- (c) Another sample of calcium carbonate is heated and the mass of solid remaining is measured each minute.

The results are shown in Figure 3.

| time in minutes | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| mass of solid remaining in g | 9.0 | 8.1 | 7.2 | 6.4 | 6.0 | 5.6 | 5.3 | 5.2 |

Figure 3

- (i) Explain the trend shown by the data in Figure 3.

(2)

- (ii) It is impossible to be sure from this data that the reaction is complete.

State why.

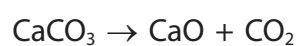
(1)



- (d) (i) Calculate the relative formula mass of calcium carbonate, CaCO_3 .
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

- (ii) Calculate the atom economy for the formation of calcium oxide in this reaction.



You must show your working.

(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

(Total for Question 4 = 11 marks)

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- 5 (a) One way to extract metals from land contaminated with metal compounds is phytoextraction.

When plants grow they absorb metal ions through their roots.

The plants are harvested, dried and burned forming an ash.

The ash contains metal compounds.

Plants were grown in a piece of ground contaminated with nickel compounds.

- (i) 1 kg of the ash from these plants contained 142.0 g of nickel compounds.

Calculate the percentage by mass of nickel compounds in the ash.

(3)

- (ii) Nickel is extracted from nickel compounds.

State an advantage of extracting nickel by phytoextraction rather than from its ore.

(1)

- (b) Some nickel ores contain nickel sulfide.

- (i) In the first stage of extracting nickel from nickel sulfide, the nickel sulfide, NiS, is heated in air to form nickel oxide, NiO, and sulfur dioxide.

Write the balanced equation for this reaction.

(2)



- (ii) In the final stage of the extraction process, a nickel compound is electrolysed to produce pure nickel.

An advantage of producing a metal by electrolysis is that

(1)

- ☐ **A** electrolysis uses a large amount of electricity
- ☐ **B** the metal produced by electrolysis is very pure
- ☐ **C** electrolysis is a very cheap method of extraction
- ☐ **D** electrolysis is the only method of extracting unreactive metals

- (c) In a different method of obtaining nickel, the process produces a mixture of the liquids nickel tetracarbonyl and iron pentacarbonyl.

The boiling point of nickel tetracarbonyl is 43 °C.

The boiling point of iron pentacarbonyl is 103 °C.

These two liquids mix together completely.

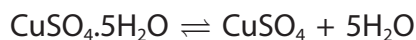
Describe the process used to separate these two liquids.

(3)

(Total for Question 5 = 10 marks)

- 6 (a) Hydrated copper sulfate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, is a blue solid.
Anhydrous copper sulfate, CuSO_4 , is a white solid.

Heat energy is needed to convert hydrated copper sulfate to anhydrous copper sulfate.
This is a reversible reaction.

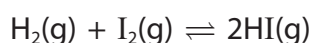


Devise an experiment to show that this is a reversible reaction.

(4)



- (b) Hydrogen reacts with iodine to form hydrogen iodide.
Iodine gas is purple and hydrogen iodide gas is colourless.



Hydrogen and iodine are placed in a sealed container.
The container is left until equilibrium is reached.

The conditions are changed favouring the forward reaction.

Explain what you would **see**.

(2)

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- (c) Calculate the number of atoms combined in one mole of copper iodide, CuI_2 .
(Avogadro constant = 6.02×10^{23})

(2)

(Total for Question 6 = 8 marks)

7 Many metals corrode.

(a) When a metal corrodes

(1)

- ☐ **A** the metal reacts with nitrogen
- ☐ **B** the metal reacts with another metal
- ☐ **C** the metal element decomposes
- ☐ **D** the metal is oxidised

(b) An experiment is carried out to see if magnesium ribbon wrapped around a piece of iron rod has an effect on the rate at which the iron rod rusts.

The apparatus is shown in Figure 4.

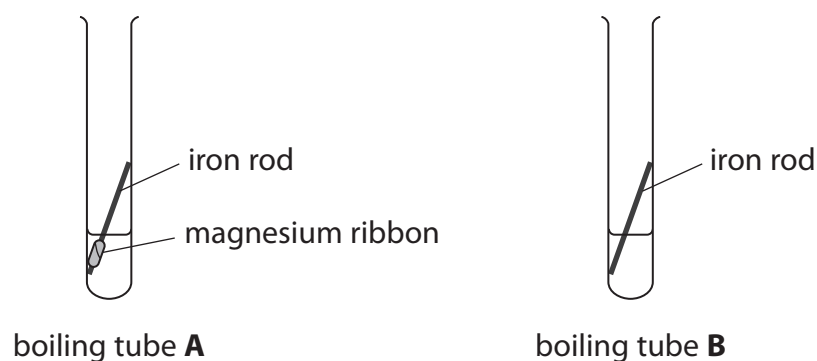


Figure 4

The method used is

- an iron rod, with magnesium ribbon wrapped around it, is placed in a boiling tube labelled **A**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube
- an identical rod but with no magnesium ribbon wrapped around it is placed in a second boiling tube labelled **B**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube.

Both boiling tubes are left for a few days.

(i) Explain why iron rod rather than stainless steel rod is used in this experiment.

(2)



- (ii) State why it is not necessary to use a pipette to measure out 10 cm³ water in this experiment.

(1)

- (iii) After a few days the two boiling tubes were examined.

The results are shown in Figure 5.

| | |
|-----------------------|---|
| boiling tube A | the appearance of the iron rod is unchanged the magnesium has started to disappear |
| boiling tube B | a small amount of brown deposit has formed around the rod |

Figure 5

Explain the results of this experiment.

(2)

- (c) Hydrazine, N₂H₄, reacts with oxygen.



A metal in water corrodes faster than an identical piece of metal in the same volume of water containing dissolved hydrazine.

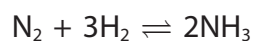
Use the information to explain how hydrazine slows corrosion.

(2)



(d) Ammonia is used to make hydrazine.

In the industrial process to manufacture ammonia, nitrogen and hydrogen are combined in the presence of an iron catalyst.



(i) State the name of the industrial process to manufacture ammonia.

(1)

(ii) Predict the effect that adding the catalyst has on the rate of attainment of equilibrium.

(1)

(iii) Predict the effect that adding the catalyst has on the equilibrium yield of ammonia.

(1)

(Total for Question 7 = 11 marks)

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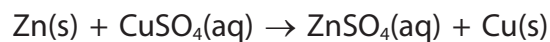
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- 8 Pieces of zinc react with copper sulfate solution.
Zinc sulfate solution is colourless.



- (a) Describe what you would **see** when an excess of zinc is added to copper sulfate solution and the mixture left until the reaction is complete.

(2)

- (b) This reaction is described as a redox reaction.

Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced in this reaction.

(4)



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(c) The copper sulfate solution used has a concentration of 15.95 g dm^{-3} .

Calculate the number of moles of copper sulfate, CuSO_4 , in 50.00 cm^3 of this solution.
(relative atomic masses: O = 16, S = 32, Cu = 63.5)

(3)

(d) In another experiment, 0.043 mol of copper sulfate, CuSO_4 , is used.

Calculate, to one decimal place, the minimum mass of zinc that must be added to
react with all the copper sulfate.
(relative atomic mass: Zn = 65)

(2)

(Total for Question 8 = 11 marks)

- 9 (a) **X** and **Y** are solutions of two different acids.
The concentration of acid in each solution, in mol dm^{-3} , is the same.
Solution **X** has a pH of 3.40 and solution **Y** has a pH of 4.40.

(i) State what could be used to measure these pH values of 3.40 and 4.40.

(1)

(ii) What is the concentration of hydrogen ions in solution **X** compared with that in solution **Y**?

(1)

- ☐ **A** ten times lower
- ☐ **B** lower by a factor of 3.30/4.40
- ☐ **C** higher by a factor of 4.40/3.30
- ☐ **D** ten times higher

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- (b) An experiment is planned to record the change in pH as a powdered base is added to 50 cm³ dilute hydrochloric acid.

The method suggested is

- step 1 add dilute hydrochloric acid up to the 50 cm³ mark on a beaker
- step 2 add one spatula of the base and stir
- step 3 measure the pH of the mixture
- step 4 repeat steps 2 and 3 until the pH stops changing.

- (i) State how you could change the method so that the amounts of dilute hydrochloric acid and of the base can be measured more accurately.

(2)

dilute hydrochloric acid

base

- (ii) During the experiment the pH changes from 2 to 10.
If phenolphthalein indicator is added at the beginning of the experiment, a colour change occurs as the base is added.

State the colour change that occurs.

(1)

colour at start

colour at end

- (iii) Explain, in terms of the particles present, why the pH increases during the experiment.

(2)



*(c) Some properties of four solids, **A**, **B**, **C** and **D**, are shown in Figure 6.

The solids, in no particular order, are copper carbonate, copper oxide, magnesium metal and sodium hydroxide.

| | A | B | C | D |
|---|--|---|---|---|
| colour of solid | black | silver | white | green |
| observation when solid is added to water | black solid remains | a few bubbles appear on surface of solid | solid dissolves and forms colourless solution | green solid remains |
| pH of mixture of solid added to water | 7 | 8 | 13 | 7 |
| observation when solid is added to dilute sulfuric acid | on warming, solid disappears to form blue solution | effervescence solid disappears to form colourless solution | solid disappears to form colourless solution | effervescence solid disappears to form blue solution |

Figure 6

Identify the solids **A**, **B**, **C** and **D**, explaining how the information in Figure 6 supports the identification of each solid.

(6)

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(Total for Question 9 = 13 marks)



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10 (a) Nitric acid can be titrated with a solution of ammonia.

(i) State the type of reaction occurring when nitric acid reacts with ammonia.

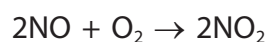
(1)

(ii) What salt is formed in this reaction?

(1)

- ☐ A ammonia nitric
- ☐ B ammonia nitrate
- ☐ C ammonium nitric
- ☐ D ammonium nitrate

(b) In one stage of the production of nitric acid, nitrogen oxide, NO, is reacted with oxygen to make nitrogen dioxide, NO₂.



Calculate the minimum volume of air, measured at room temperature and pressure, required to react with 1000 g nitrogen oxide to form nitrogen dioxide.

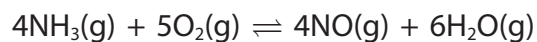
Assume that the air contains 20% oxygen by volume.

(relative atomic masses: N = 14, O = 16

1 mol of gas occupies 24 dm³ at room temperature and pressure)

(4)

- *(c) In another stage in the production of nitric acid, ammonia is reacted with oxygen to form nitrogen oxide and water.



Heat energy is given out when ammonia reacts with oxygen.

The conditions chosen for the reaction are

- excess air, rather than just the right amount
- a pressure of 10 atm, rather than atmospheric pressure
- a temperature of 900 °C, rather than room temperature.

Explain the effect of the conditions chosen on the equilibrium yield of nitrogen oxide and on the rate of attainment of equilibrium.

(6)

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(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS



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The Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------|---|-----------------------------|--|--------------------------------|--|-------------------------------------|--|-------------------------------|--|----------------------------------|--|--------------------------------|---|-------------------------------|---|----------------------------------|---|------------------------------------|--|-----------------------------------|--|---|--|-----------------------------|--|-----------------------------|--|-----------------------------|--|-------------------------------|--|-------------------------------|--|----------------------------|--|
| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 1 H hydrogen 1 | | | | | 4 He helium 2 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | Key | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | relative atomic mass atomic symbol name atomic (proton) number | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 Li lithium 3 | | 9 Be beryllium 4 | | | | | | | | | | | | 11 B boron 5 | | 12 C carbon 6 | | 14 N nitrogen 7 | | 16 O oxygen 8 | | 19 F fluorine 9 | | 20 Ne neon 10 | | | | | | | | | | | |
| 23 Na sodium 11 | | 24 Mg magnesium 12 | | | | | | | | | | | | 27 Al aluminium 13 | | 28 Si silicon 14 | | 31 P phosphorus 15 | | 32 S sulfur 16 | | 35.5 Cl chlorine 17 | | 40 Ar argon 18 | | | | | | | | | | | |
| 39 K potassium 19 | | 40 Ca calcium 20 | | 45 Sc scandium 21 | | 48 Ti titanium 22 | | 51 V vanadium 23 | | 52 Cr chromium 24 | | 55 Mn manganese 25 | | 56 Fe iron 26 | | 59 Co cobalt 27 | | 59 Ni nickel 28 | | 63.5 Cu copper 29 | | 65 Zn zinc 30 | | 70 Ga gallium 31 | | 73 Ge germanium 32 | | 75 As arsenic 33 | | 79 Se selenium 34 | | 80 Br bromine 35 | | 84 Kr krypton 36 | |
| 85 Rb rubidium 37 | | 88 Sr strontium 38 | | 89 Y yttrium 39 | | 91 Zr zirconium 40 | | 93 Nb niobium 41 | | 96 Mo molybdenum 42 | | [98] Tc technetium 43 | | 101 Ru ruthenium 44 | | 103 Rh rhodium 45 | | 106 Pd palladium 46 | | 108 Ag silver 47 | | 112 Cd cadmium 48 | | 115 In indium 49 | | 119 Sn tin 50 | | 122 Sb antimony 51 | | 128 Te tellurium 52 | | 127 I iodine 53 | | 131 Xe xenon 54 | |
| 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 | | 195 Pt platinum 78 | | 197 Au gold 79 | | 201 Hg mercury 80 | | 204 Tl thallium 81 | | 207 Pb lead 82 | | 209 Bi bismuth 83 | | [209] Po polonium 84 | | [210] At astatine 85 | | [222] Rn radon 86 | |
| [223] Fr francium 87 | | [226] Ra radium 88 | | [227] Ac* actinium 89 | | [261] Rf rutherfordium 104 | | [262] Db dubnium 105 | | [266] Sg seaborgium 106 | | [264] Bh bohrium 107 | | [277] Hs hassium 108 | | [268] Mt meitnerium 109 | | [271] Ds darmstadtium 110 | | [272] Rg roentgenium 111 | | Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | | | | | | | | |

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.