CS C1 H Formulae, hazards and equations

Date:

Time: 17 minutes

Total marks available: 17

Total marks achieved: ______
Questions

Q1.

Carbon dioxide can be formed by the reaction of calcium carbonate, CaCO$_3$, with dilute hydrochloric acid.

Write the balanced equation for this reaction.

...............................................................................................................................

(Total for question = 3 marks)

Q2.

Copper is purified by the electrolysis of copper sulfate solution using an impure copper anode and a pure copper cathode.

Write the half-equation for the formation of a copper atom from a copper ion.

...............................................................................................................................

(Total for question = 2 marks)

Q3.

Dilute hydrochloric acid reacts with silver nitrate solution to form silver chloride and nitric acid.

(i) Complete the sentence by putting a cross (X) in the box next to your answer.

The reaction produces silver chloride as a precipitate.

In an equation this would be shown as

A  AgCl(aq)
B  AgCl(g)
C  AgCl(l)
D  AgCl(s)

(ii) This apparatus is used to investigate the mass of the reactants and the mass of products in this reaction.
The total mass of this apparatus was measured. The flask was shaken to allow the silver nitrate solution and dilute hydrochloric acid to react. After the reaction the total mass of the apparatus was measured again. State how the total mass of the apparatus after the reaction will compare with the total mass of the apparatus before the reaction.

(iii) Write the balanced equation for the reaction of silver nitrate solution, \(\text{AgNO}_3\), with dilute hydrochloric acid to form silver chloride, \(\text{AgCl}\), and nitric acid.

Q4.

**Particles and formulae**

(a) Atoms contain protons, neutrons and electrons. Complete the table to show the relative mass and relative charge of each particle and its position in an atom.

<table>
<thead>
<tr>
<th></th>
<th>relative mass</th>
<th>relative charge</th>
<th>position in atom</th>
</tr>
</thead>
<tbody>
<tr>
<td>proton</td>
<td></td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>neutron</td>
<td>1</td>
<td></td>
<td>in nucleus</td>
</tr>
<tr>
<td>electron</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Complete the sentence by putting a cross (X) in the box next to your answer. An atom of an element **always** contains

- [ ] A more protons than neutrons
- [ ] B equal numbers of protons and neutrons
- [ ] C more electrons than protons
- [ ] D equal numbers of protons and electrons
(c) The symbols for some atoms are given in the box

\[
\begin{array}{cccccc}
\text{Ca} & \text{Cl} & \text{K} & \text{N} & \text{Ne} & \text{O}
\end{array}
\]

From the box, choose the symbol of
(i) an atom in group 2 of the periodic table

..........................................................................................

(ii) an atom that readily forms an ion with a charge of 2−

..........................................................................................

(d) The formula of aluminium nitrate is \( \text{Al(NO}_3\text{)}_3 \)

(i) State the total number of atoms in the formula \( \text{Al(NO}_3\text{)}_3 \)

..........................................................................................

(ii) What is the most likely formula of aluminium nitride?

Put a cross (\( \times \)) in the box next to your answer.

\[\begin{array}{c}
\text{A} & \text{Al(NO}_3\text{)}_2 \\
\text{B} & \text{AlNO}_3 \\
\text{C} & \text{AlNO}_2 \\
\text{D} & \text{AlN}
\end{array}\]

(Total for question = 8 marks)

Q1.
No Examiner’s Report available for this question

Q2.
No Examiner’s Report available for this question

Q3.

\[\text{ii}\]

Many candidates did not score here. Candidates that did not get the mark, did so as they thought that a gas was produced and so the mass decreased. They did not read the question fully and did not take on board that no gases were produced in the reaction and that a bung was in the top of the apparatus. There was also evidence of some fundamental misunderstandings such as the magnesium oxide condensing or water vapour being produced, condensed and therefore increasing the water level.
Results Plus: Examiner Comments
Fine, scores one mark.

Results Plus: Examiner Comments
The candidate has not read the question and realised that no gas has been made or seen that there was a bung on top of the conical flask.

Results Plus: Examiner Tip
Check that you read the question fully. When practicals are being discussed ensure that you are clear as to what the reactants and the products are.

iii
Candidates showed that they could write equations and many scored here. However candidates that had not learnt the formulae of the common laboratory acids did not score here.

\[ \text{AgNO}_3 + \text{HCl} \rightarrow \text{AgCl} + \text{HNO}_3 \]

Results Plus: Examiner Comments
Fine, 2 marks awarded.

\[ 2\text{AgNO}_3 + 2\text{HCl} \rightarrow 2\text{AgCl} + 2\text{N}_2 + \text{H}_2\text{O} \]

Results Plus: Examiner Comments
Whilst the reactants side of the equation was correct for one mark, this candidate could not recall the formulae of nitric acid, the only other product in the reaction.

Results Plus: Examiner Tip
It is important that candidates can recall the formulae of common laboratory compounds used in the specification such as hydrochloric acid and nitric acid.

Q4.

(a)
As anticipated this opening question on protons, neutrons and electrons provided a good start for most candidates with over 90% gaining 2 or more marks. The most common error was in the mass of the electron whilst some others included charges on the relative mass.
(c)(i)
Most candidates gave the correct answer of Ca but a few did not follow the instructions and gave the name rather than the symbol.

(c)(ii)
Over a third of candidates gave incorrect answers showing a lack of knowledge of the connection between groups and the charge on ions. Instead of the correct answer of O it was common to see K and Cl, with Ne also sometimes being given.

(d)(i)
Many candidates seemed generally confused about different types of atoms and the total number of atoms. There were a wide range of incorrect answers – 3, 9, 10 and 12 all seemed popular. Some even went into the hundreds, perhaps multiplying rather than adding, whilst others were obviously working out a value of the relative formula mass.
Results Plus: Examiner Comments
This candidate was one of quite a few who tried to work out a relative formula mass.

Results Plus: Examiner Comments
Many, as this candidate did, gave the number of different elements present.

Mark Scheme

Q1.

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Additional guidance</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CaCO₃ + 2HCl ↔ CaCl₂ + H₂O + CO₂</td>
<td>Allow 3/4 formulae</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>• all formulae on correct side (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• balancing (1)</td>
<td></td>
<td></td>
</tr>
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</table>

Q2.

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu²⁺ + 2e⁻ → Cu</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>• all species (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• balancing (1)</td>
<td></td>
</tr>
<tr>
<td>Answer</td>
<td>Acceptable answers</td>
<td>Mark</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------</td>
<td>------</td>
</tr>
<tr>
<td><strong>D AgCl(s)</strong></td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>same/no change</td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>HCl + AgNO₃ → AgCl + HNO₃</td>
<td>Ag⁺ + Cl⁻ → AgCl max 1 if any incorrect attempt to balance reject incorrect use of cases and non-subscripts</td>
<td>(2)</td>
</tr>
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</table>

- **Q3.**

- **Q4.**
<table>
<thead>
<tr>
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<th>Answers</th>
<th>Acceptable Answers</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>relative mass</td>
<td>relative charge</td>
<td>position in atom</td>
</tr>
<tr>
<td>proton</td>
<td>1</td>
<td>(+1)</td>
<td>in nucleus</td>
</tr>
<tr>
<td>neutron</td>
<td>(1)</td>
<td>0</td>
<td>(in nucleus)</td>
</tr>
<tr>
<td>electron</td>
<td>1/183</td>
<td>-1</td>
<td>in shells</td>
</tr>
</tbody>
</table>

all 6 correct (3)  
4 or 5 correct (2)  
2 or 3 correct (1)   

<table>
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<th>Mark</th>
</tr>
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<tbody>
<tr>
<td>(b)</td>
<td></td>
<td>D equal numbers of protons and electrons</td>
<td>(1)</td>
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<th>Mark</th>
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<tr>
<td>(c)(i)</td>
<td>Ca</td>
<td>Reject CA / ca /cA ignore calcium</td>
<td>(1)</td>
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<th>Mark</th>
</tr>
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<tbody>
<tr>
<td>(c)(ii)</td>
<td>0</td>
<td>ignore any negative charge on the O</td>
<td>(1)</td>
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<tr>
<td></td>
<td></td>
<td>ignore oxygen</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>reject: oxide/O₂</td>
<td></td>
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<th>Mark</th>
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</thead>
<tbody>
<tr>
<td>(d)(i)</td>
<td>13</td>
<td>Allow correct working even if wrong answer</td>
<td>(1)</td>
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<th>Mark</th>
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<tbody>
<tr>
<td>(d)(ii)</td>
<td>D AIN</td>
<td></td>
<td>(1)</td>
</tr>
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