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Introduction

These exemplar answers have been chosen from the summer 2018 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but do illustrate how the mark scheme has been applied.

Please always refer to the specification https://www.ocr.org.uk/qualifications/by-subject/chemistry/ for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2018 Examiners’ report or Report to Centres available from Interchange https://interchange.ocr.org.uk/Home.mvc/ Index

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2019. Until then, they are available on OCR Interchange (school exams officers will have a login for this and are able to set up teachers with specific logins – see the following link for further information http://www.ocr.org.uk/administration/support-and-tools/interchange/managing-user-accounts/).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.
Question 1

Exemplar 1

1 Which of these pH values shows the pH of a strong acid?
   
   A  1
   B  5
   C  7
   D  10

Your answer [A] [1]

Examiner commentary

A strong acid has a low pH, the lowest pH in the responses is 1, the correct answer is A.

B is a weak acid, C is neutral and D is a moderately strong alkali.
**Examiner commentary**

Non-metals are found on the right hand side of the Periodic Table, the correct answer is D. Metals are found on the left hand side of the Periodic Table hence A, B and C are incorrect.
Question 9

Exemplar 1

9  Which statement about covalent bonding is true?

A  Electrons are transferred from one atom to another.

B  Electrons are delocalised.

C  Electrons are shared between atoms.

D  Ions are formed.

Your answer  A

[1]

Examiner commentary

Covalent bonding occurs when atoms share electrons, the correct response is C.

Electrons transferring, response A, and ions forming, response D, both describe ionic bonding and so are incorrect.

Electrons delocalising describes the structure of a metal and so B is an incorrect response.
**Examiner commentary**

Nanoparticles are not smaller than atoms, response A is not correct.

Nanoparticles have a very large surface area to volume ratio, response C is the reverse and is incorrect.

Nanoparticles have associated risks with their use, response D is incorrect.

Nanoparticles, due to their large surface area to volume ratio, are excellent catalysts, response B is correct.
16 A student investigates the energy changes during some chemical reactions.

She measures the temperature at the start and end of each reaction.

Look at her results.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Temperature at start (°C)</th>
<th>Temperature at end (°C)</th>
<th>Temperature change (°C)</th>
<th>Type of reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20</td>
<td>25</td>
<td>+5</td>
<td>Exothermic</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>10</td>
<td>-8</td>
<td>Endothermic</td>
</tr>
<tr>
<td>C</td>
<td>21</td>
<td>35</td>
<td>+14</td>
<td>Exothermic</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>No reaction</td>
</tr>
</tbody>
</table>

(a) Complete the table.  [3]

Examiner commentary

The temperature change for A is (25 − 20) = +5 °C, since this is a positive number the omission of the positive sign is condoned, candidate has this temperature change correct.

The temperature change for D is (20 − 20) = 0 °C, candidate has this temperature change correct.

Both of these temperature changes are correct.

(The temperature change for B is (18 − 10) = −8 °C candidate has this temperature change correct.

The temperature change for C is (35 − 21) = +14 °C candidate has this temperature change correct.)

Reaction B has a temperature decrease and so is termed an endothermic reaction, candidate has the correct term.

Reaction C has a temperature increase and so is termed an exothermic reaction, candidate has the correct term.
Question 17(a)

Exemplar 1

2 marks

17 Look at the diagram. It shows the displayed formula of succinic acid.

(a) Complete the table to show the number of atoms of each element in this displayed formula.

<table>
<thead>
<tr>
<th>Element</th>
<th>Number of atoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>H</td>
<td>6</td>
</tr>
<tr>
<td>O</td>
<td>4</td>
</tr>
</tbody>
</table>

Examiner commentary

The question requires the numbers of each type of atom to be summed. There are 4 carbons, 6 hydrogens and 4 oxygens, the candidate is credited two marks for all three numbers correct.
Question 17(b)

Exemplar 1

(b) What is the empirical formula of succinic acid?

\[
\text{C}_4\text{H}_6\text{O}_4
\]

[1]

Examiner commentary

The question requires the empirical formula for succinic acid which is the simplest whole number ratio of its constituent atoms. The candidate has given the molecular formula and so does not gain credit. This was a popular misconception amongst candidates.
Question 17(c)

Exemplar 1

2 marks

(c) Succinic acid has a melting point of 184 °C and a boiling point of 235 °C.

What is the state of succinic acid at 25 °C?

Explain your answer.

It is a solid at 25 °C. This is because the melting point of succinic acid is 184 °C and 25 °C comes before it. [2]

Examiner commentary

The candidate states correctly that the state is solid, marking point 1 is credited. The explanation describes the temperature as "coming before" the melting point, "coming before" is condoned as being equivalent to being lower than and so the response is correct.
Question 18(a)

Exemplar 1

2 marks

18 A student is separating some mixtures. She wants to make pure water from a solution of salt water. She filters the mixture.

Her method does not work.

(a) Explain why her method does not work and describe the method she should use.

Salt is soluble in water, so if she filters the solution, salt won't be separated. To separate the mixture, she should use simple distillation method by placing the. So, she can get pure water in a separate container.

Examiner commentary

Soluble is correct for the first marking point, the reference to salt solution would also be correct for this marking point. Separation by simple distillation is credited the second marking point as would distillation alone.

Some candidates did not appreciate that it was the pure water which was required and described how to obtain the salt.
Question 18(b)

Exemplar 1  

2 marks

(b) The student wants to separate a mixture of two liquids.

The liquids are:

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Boiling point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>100</td>
</tr>
<tr>
<td>Ethanol</td>
<td>78</td>
</tr>
</tbody>
</table>

Which separation technique should she use?

Explain how the method works...

She should use fractional distillation... As the liquid with low boiling point (ethanol) will evaporate first which will be cooled down in condenser and collected in a beaker. If the... water starts evaporating, the fraction column will cool it down quicker as the molecules of water will be heavier then ethanol and so will remain in the flask.

Examiner commentary

Fractional distillation is correct for marking point 1. Since there are only two substances in the mixture low boiling point is condoned for different boiling points; the low in this instance implies that the other must be different from it.

Many candidates gave distillation.
Question 18(c)(i)

Exemplar 1  1 mark

(c) The student separates two solid substances A and B. She wants to check that they are pure.

(i) What is meant by a pure solid?

Substance with only one type of element or compound.  

Examiner commentary

Contains only one type of element is correct as is contains only one type of compound. The candidate's response contains both responses but either one would gain credit.
Question 18(c)(ii)

Exemplar 1

(ii) The student measures the melting points of four samples of solid A.

Look at her results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>119</td>
</tr>
<tr>
<td>3</td>
<td>114-118</td>
</tr>
<tr>
<td>4</td>
<td>120-122</td>
</tr>
</tbody>
</table>

She knows that a pure sample of solid A has a melting point of 120 °C.

She concludes that sample 4 is the purest sample of solid A.

Do the results support her conclusion?

Explain your answer using evidence from the table.

The results do support her conclusion because sample 4 is the purest because its melting point is 120-122 °C. However, it could be argued that sample 3 is the purest because it isn’t a range of melting points like sample 4. Also, it can’t be sample 2 because it starts with a rather low melting point.

Examiner commentary

Sample 2 is chosen as the most pure because it does not have a range of melting temperature and Sample 3 is discarded as the melting temperature is too low, thus the answer is credited 3 marks. The first sentence is incorrect but is ignored and condoned as not a contradictory since the melting temperature is within the range and the candidate has not supported this statement with any incorrect arguments.
(ii) The student measures the melting points of four samples of solid A.

Look at her results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>119</td>
</tr>
<tr>
<td>3</td>
<td>114–118</td>
</tr>
<tr>
<td>4</td>
<td>120–122</td>
</tr>
</tbody>
</table>

She knows that a pure sample of solid A has a melting point of 120°C.

She concludes that sample 4 is the purest sample of solid A.

Do the results support her conclusion?

Explain your answer using evidence from the table.

Yes... the report supports the conclusion...we can see that Sample 1, 2 and 3 have higher melting point than the pure sample...which concludes that Samples 1, 2, and 3 are not pure...Whereas Sample 4 has the melting point of 120–122...which is the same as the pure sample...so this concludes that sample 4 is pure.

Examiner commentary

The candidate misreads the data in the table or the question and states that the melting points of samples 1, 2 and 3 are higher than the melting point of the pure material but they are lower. They then incorrectly equate the range of melting point of sample 4 with the single sharp melting point of the pure material.
(ii) The student measures the melting points of four samples of solid A.

Look at her results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>119</td>
</tr>
<tr>
<td>3</td>
<td>114–118</td>
</tr>
<tr>
<td>4</td>
<td>120–122</td>
</tr>
</tbody>
</table>

She knows that a pure sample of solid A has a melting point of 120 °C.

She concludes that sample 4 is the purest sample of solid A.

Do the results support her conclusion?

Explain your answer using evidence from the table.

No, candidate. Sample 3 and 4 melt over different points which suggest they are a compound; however, sample 1 and 2 have a single melting point. Therefore, they are the purest. [3]

Examiner commentary

The candidate considers samples 3 and 4 not to be the pure sample as they melt over a range of temperatures, however, they then equate this with being a compound rather than discussing purity. This shows confusion between element, compound and purity of a sample. Although the candidate shows appreciation that a pure substance has a single melting temperature they choose sample 1 as well as sample 2 despite sample 1 showing a depression of melting temperature hence indicating it to be impure.
Question 19(a)

Exemplar 1

1 mark

19 Two students heat some calcium carbonate, CaCO₃.

Look at the equation for the reaction.

\[ \text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \]

(a) What is the meaning of (s) in the equation?

- It is in solid state. .............................................................. \[1\]

Examiner commentary

Solid is the correct response.
Exemplar 1

(b) Look at their results.

<table>
<thead>
<tr>
<th>Mass of calcium carbonate (g)</th>
<th>Mass of calcium oxide (g)</th>
<th>Mass of carbon dioxide (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>0.56</td>
<td>0.44</td>
</tr>
<tr>
<td>2.00</td>
<td>1.12</td>
<td>0.88</td>
</tr>
<tr>
<td>3.00</td>
<td>1.68</td>
<td>1.32</td>
</tr>
<tr>
<td>4.00</td>
<td>2.24</td>
<td>1.76</td>
</tr>
</tbody>
</table>

Complete the table. [1]

Examiner commentary

Data in the Table is used correctly to arrive at the correct response: \((4.00 - 2.24) = 1.76\).
Question 19(c)

Exemplar 1

0 marks

(c) Student A states:

‘If I heat 20 g of calcium carbonate, I will make 8.8 g of calcium oxide and 11.2 g of carbon dioxide.’

Is student A correct?

Explain your answer.

Student A is correct because 8.8 + 11.2 = 20 g adds up to make 20 g of calcium carbonate.

------------------------------------------------------------------------------------------------------------------------------------------------- [2]

Examiner commentary

The candidate has appreciated that according to conservation of mass the mass of the products is the same as the mass of the reactants and this was a common response. However, the candidate has not considered the data in the table and so has not appreciated that the masses of the products are reversed. The statement by Student A is incorrect as the values should be 11.2 g of calcium oxide (not 8.8 g) and 8.8 g of carbon dioxide (not 11.2 g).
Question 19(d)(i)

Exemplar 1

(d) Student B investigates another reaction.

Look at the equations.

\[ 2\text{Mg(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{MgO(s)} \]

magnesium + oxygen \rightarrow magnesium oxide

(i) Calculate the relative formula mass of magnesium oxide.

\[ \begin{align*}
\text{Mg} & : 12 \times 2 = 24 \quad 24.3 \times 2 = 48.6 \\
\text{O} & : 16 \times 2 = 32 \\
\text{Answer} & = \ldots 80.6 \ldots \ldots \ldots \ldots \ldots \ldots \ldots [1]
\end{align*} \]

Examiner commentary

The candidate has calculated the mass of 2 moles of magnesium oxide, as it appears in the equation; they should have calculated the relative formula mass of magnesium oxide which would be half of their answer, 40.3.
Question 19(d)(ii)

Exemplar 1  2 marks

(ii) Use the relative formula mass of magnesium oxide and the relative atomic masses of magnesium and oxygen to show if mass is conserved during this reaction.

\[
\begin{align*}
\text{Mg} &= 24.3 \quad \text{and} \quad \text{O}_2 &= 16 \quad \Rightarrow \quad 2 \times 24.3 = 48.6 \\
\text{and} \quad 16 \times 2 &= 32 \quad \Rightarrow \quad 48.6 + 32 = 80.6 \quad \text{which is}
\end{align*}
\]

\[
80.6 = 80.6 \quad \text{Hence proved, mass is conserved.} \quad [2]
\]

Examiner commentary

Candidate has calculated the mass of magnesium oxide on the right hand side of the equation, and the combined masses of the magnesium and oxygen on the left hand side of the equation. They comment that these are equal and so mass is conserved. Both marking points are credited.
20 A student electrolyses dilute sulfuric acid.

Hydrogen gas is made at the cathode.

The student measures the volume of hydrogen made at the cathode every 2 minutes for 10 minutes.

Look at his results.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Volume of hydrogen (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>8.0</td>
</tr>
<tr>
<td>6</td>
<td>14.0</td>
</tr>
<tr>
<td>8</td>
<td>16.0</td>
</tr>
<tr>
<td>10</td>
<td>20.0</td>
</tr>
</tbody>
</table>
Examiner commentary

The points are plotted correctly, marking point 1 is credited.

The line drawn is straight and passes through all of the points except the anomalous point, marking point 2 is credited.
Examiner commentary

The points are plotted correctly and so marking point 1 is credited. However, the line drawn is a "point to point" line and not a line of best fit, second marking point is not credited.
Question 20(b)

Exemplar 1

1 mark

Examiner commentary

The candidate has circled the anomalous point correctly and is credited the mark.

If the points were plotted incorrectly in 20a giving rise to a different line of best fit, it may have been possible for this mark to be credited for circling a different point which was anomalous to their line as an error carried forward from the earlier question part.
Question 20(c)

Exemplar 1

1 mark

(c) Sulfuric acid contains these particles.

\[ \text{H}^+ \quad \text{OH}^- \quad \text{H}_2\text{O} \quad \text{SO}_4^{2-} \]

Which particles are attracted to the anode?

\[ \text{OH}^- \quad \text{SO}_4^{2-} \]

Examiner commentary

Both negative ions have been chosen and so the mark is credited.

Some candidates only gave one of the ions, usually \text{OH}^- and were not credited the mark.
Question 20(d)

Exemplar 1  

2 marks

(d) The student also investigates the electrolysis of some molten (liquid) salts.

Complete the table.

<table>
<thead>
<tr>
<th>Molten salt</th>
<th>Formula</th>
<th>Product at cathode</th>
<th>Product at anode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium chloride</td>
<td>KCl</td>
<td>Potassium</td>
<td>Chlorine</td>
</tr>
<tr>
<td>Lead iodide</td>
<td>PbI₂</td>
<td>……lead……………</td>
<td>Iodine</td>
</tr>
</tbody>
</table>

Examiner commentary

The missing product for potassium chloride is chlorine, marking point 1 is credited. Chloride was a popular incorrect response.

The missing product for lead iodide is lead, marking point 2 is credited.
Question 21(a)

Exemplar 1

21 The diagrams show the structures of diamond and graphite.

Diamond

Graphte

One property of diamond is that it is very hard. One property of graphite is that it is slippery.

(a) Write about the other properties of diamond and graphite.

Diamond

4 covalent bond of each carbon atom. 

Don’t conduct electricity as there are no free electron.

Graphite

3 covalent bond of each carbon atom. They have 1 free electron for every atom so they are a good conductor of electricity.

Examiner commentary

The candidate has given one correct property for diamond, non-conduction of electricity, one mark for diamond is credited. Four covalent bonds of each carbon atom is a correct statement but is not a property and so does not answer the question. The explanation "no free electrons" is not creditworthy, the electrons should be not mobile, not delocalised or all used in bonds in order to be creditworthy.

The candidate has given one correct property for graphite, conduction of electricity, and has explained the property in terms of delocalised electrons, two marks are credited for graphite. Three covalent bonds of each carbon atom is a correct statement but is not a property of and so would not gain credit.

Many candidates included the properties in the stem which are not creditworthy or discussed the bonding rather than the properties.
Question 21(b)

Exemplar 1

(b) Describe the type of bonding between the carbon atoms in diamond.

1 carbon atom is bonded with 4 other carbon atoms in a giant covalent structure. [1]

Examiner commentary

The bonding is described as covalent, one mark is credited. Giant is correct but describes structure and so is ignored.
Question 21(c)

Exemplar 1

(c) Graphite is slippery.

Use the structure of graphite to explain why.

Graphite...are...bonded...with...3...other...carbon...atoms. This
makes...them...in...a...hexagon...shape...so...they...are...structured...in...flat...layers. Because...of...this...

Examiner commentary

Graphite in layers is credited marking point 1. The candidate then repeats the question stem hence no further marks are credited.

The candidates could have discussed either the layers sliding or the forces between the layers being weak in order to be credited a second mark.
Question 22(c)

Exemplar 1  2 marks

(c) Most of the mass of an atom is in the nucleus.

Explain why.

Cause the mass of the proton and neutron is 1, however, the mass for the electron is \(1/2000\). [2]

 Examiner commentary
The mass of a proton and neutron is 1 is credited marking point 1. Missing relative in relative mass is condoned. The mass of the electron is 1/2000 is credited marking point 2.
Question 22(d)

Exemplar 1

2 marks

(d) Look at these two atoms of chlorine.

\[
\begin{array}{cc}
\text{Cl}^{35}_{17} & \text{Cl}^{37}_{17} \\
\end{array}
\]

What is the relationship between these two atoms of chlorine?

Explain your answer.

They both have different number of neutrons, which makes them an isotope. [2]

Examiner commentary

Isotope is credited marking point 1, different number of neutrons is credited marking point 3. Atoms with the same number of protons is also a correct alternative.
Question 23(a)

Exemplar 1  1 mark

23 A forensic scientist is investigating the ink that has been used to forge the signature on a cheque.

She separates the colours in some inks using paper chromatography.

Look at the diagram of her apparatus.

(a) What is the mobile phase in this experiment?

The water is the mobile phase

Examiner commentary

Water is credited the mark. Ink spots was a common incorrect response.
Question 23(b)

Exemplar 1

(b) Explain how paper chromatography separates the colours in ink.

As they are dipped in the solution, the solute travelled up and at different levels because of their density. [1]

Examiner commentary

Density is not a factor in separating the inks, no mark is credited.

The inks separate because they travel at different speeds up the paper.

The speed depends on the relative solubility of the substance between the water and the paper, this higher level answer could also gain credit.
Question 23(c)(i)

Exemplar 1  2 marks

(c) Look at the results of the scientist’s experiment.

Examiner commentary

The two distances, 2.6 cm to the middle of the spot and 5.2 cm to the solvent front, are credited marking point 1. The calculation correctly evaluated is credited marking point 2.

If one or both of the distances were measured incorrectly but the subsequent calculation evaluated correctly for these distances, then the second marking point could be credited as an error carried forward.
Question 23(c)(ii)

Exemplar 1

(ii) Which ink was used to forge the signature on the cheque?

Explain how you can tell.

A cause all the spots on the paper are at the same point and are the same colour. [2]

Examiner commentary

The candidate has chosen Ink A, marking point 1 is credited. The explanation has all of the spots at the same point, this is condoned for same pattern or spots at the same heights, and is credited marking point 2. The spots having the same Rf values would also have gained marking point 2.
Question 24

Exemplar 1

Level 3, 6 marks

Examiner commentary

All three substances have their bonding correctly named.

The key properties chosen explain the choice of bonding and the choice of substance.

This is an excellent answer, the type of bonding present in all 3 substances is identified and there is a detailed explanation for each of them. This is a Level 3 answer, credited 6 marks.

This is a good example where bullet points have been used to produce a clear Level 3 answer.
Exemplar 2

Level 1, 2 marks

24. Look at the data about some substances.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>Does it conduct electricity?</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>100</td>
<td>No</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>1085</td>
<td>2562</td>
<td>Good conductor</td>
<td>9.0</td>
</tr>
<tr>
<td>C</td>
<td>801</td>
<td>1413</td>
<td>Solid does not conduct but conducts when melted or when dissolved in water</td>
<td>2.2</td>
</tr>
</tbody>
</table>

What is the type of bonding present in each of substances A, B and C?

Explain how you can tell.

Substance B was metalloid bonding as it is very dense, has a high melting and boiling point due to the electrostatic forces of attraction being strong and can conduct electricity as it has delocalised electrons. Substance A is water, it is a polar bond as it is between a metal and a non-metal, conduct to form

Examiner commentary

The bonding in Substance B is correctly identified and the key properties are chosen to explain the identification.

Substance A is identified as water and an explanation of the selection is given in terms of melting and boiling point but the bonding is described incorrectly as ionic and there is no explanation of properties for this type of bonding.

The bonding in Substance C is not attempted.

The answer identifies the type of bonding in one substance and contains an explanation. This is a Level 1 answer credited 2 marks.
Examiner commentary

Particles packed closely together is credited the mark.

The answer has to be in terms of particles and these need to be close together or touching or tightly packed.
Question 25(a)(ii)

Exemplar 1

(ii) Solid magnesium cannot flow, but liquid magnesium can flow.

Explain why.

[Student's answer]

Examiner commentary

The particles vibrating is credited marking point 2 and them sliding past each other is credited marking point 3. The closely packed structure is insufficient to be credited marking point 1 as this needed the idea of the particles being in a fixed position or not moving from place to place.

A description of the forces between the particles being greater in the solid or smaller in the liquid would have been credited marking point 4.
Question 25(a)(iii)

Exemplar 1  
2 marks

(III) Magnesium gas completely fills any container it is put in.

Explain why.

The particles in gas are far apart from each other and can move easily and everywhere. So, magnesium gas can completely fill any container. [2]

Examiner commentary

The particles being far apart is credited marking point 2. The particles moving everywhere is condoned for moving randomly and is credited marking point 1.

The weak forces between the particles would have gained marking point 4 and the fact that it is the particles which spread out would have gained marking point 3.
Question 25(b)
Exemplar 1

2 marks

(b) Magnesium reacts with water. Magnesium hydroxide, Mg(OH)$_2$, and hydrogen, H$_2$, are made.

Write a balanced symbol equation for this reaction.

\[
\text{Mg} + \text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2
\]

Examiner commentary

All four formulae are correct and at the appropriate sides of the arrow, marking point 1 is credited.

The equation is balanced, marking point 2 is credited.
Question 25(c)

Exemplar 1

1 mark

(c) Magnesium nitrate has the formula Mg(NO₃)₂.

Calculate the relative formula mass of magnesium nitrate.

\[
\begin{align*}
\text{Mg} & = 2(24.3) = 48.6 \\
\text{N} & = 2(14) = 28 \\
\text{O} & = 3(16) = 48 \\
\text{Answer} &= 148.3 \\
\end{align*}
\]

Examiner commentary

The atomic masses of the appropriate number of each atom \(((1 \times 24.3) + (2 \times 14) + (6 \times 16))\) are added together correctly to give 148.3, the mark is credited.

Using 24 for Mg leading to a relative formula mass of 148 would also have been credited the mark.
Question 26(a)

Exemplar 1  2 marks

26 A student has a solution of hydrochloric acid, HCl, and a solution of sodium hydroxide, NaOH.

He wants to make a pure, dry sample of sodium chloride.

(a) Describe how he can do this.

Include the apparatus he should use and his method.

This can be done by crystallisation method. First take two test tubes, one containing HCl and another NaOH. Now put both of them together and in a beaker and mix well. Then both solution will react with each other and produce NaCl + H2O. NaCl is a soluble solid. So now take a test tube, NaCl, take a bunsen burner, put it on a heat proof mat and place put a copper wire looped over it, and...
Examiner commentary

Mixing the hydrochloric acid with the sodium hydroxide is credited marking point 1, as an alternative to the term titration.

Evaporating the water is credited marking point 8.

Although the method is long the key points ensuring purity are missing from the account. Candidates need to practice writing methods concisely, leaving out unnecessary details.

In order to get pure sodium chloride the amounts of hydrochloric acid and sodium hydroxide have to just completely react with each other since there is no easy way to remove an excess of either. This is done by:

- measuring a specified volume of sodium hydroxide into a flask,
- adding an indicator to it,
- adding hydrochloric acid from a burette,
- until just neutral, seen by the indicator just changing colour,
- repeating this to get a more accurate value,
- once the amount of hydrochloric acid needed to just neutralise the given volume of sodium hydroxide, these two amounts are added together with no indicator so that the indicator impurity is not present.

Exemplar 2

26 A student has a solution of hydrochloric acid, HCl and a solution of sodium hydroxide, NaOH.

He wants to make a pure, dry sample of sodium chloride.

(a) Describe how he can do this.

Include the apparatus he should use and his method.

Apparatus: burette, gauze, evaporating basin, gas jar, bunsen burner

Method:

- Pour 50 cm$^3$ of hydrochloric acid into the solution of sodium hydroxide
- After it has reacted to create a solution of sodium chloride, use a burette to squeeze a small sample of the solution onto the evaporating basin.
- Put the gauze on top of the solution and then put the evaporating basin on top of the gauze.
- Turn on the gas jar and light the bunsen burner carefully.
- Let the solution heat up and eventually it will start to boil.
- ...and will produce the salt. [4]

Examiner commentary

Mixing the hydrochloric acid with the sodium hydroxide is credited marking point 1, as an alternative to the term titration.

Whilst the solution is then heated to boil, the water is not removed or evaporated and so the salt is not left and this is not awarded marking point 8.

The key points ensuring purity are missing from the account, as in the earlier example.

In order to get pure sodium chloride the amounts of hydrochloric acid and sodium hydroxide have to just completely react with each other since there is no easy way to remove an excess of either. This is done by:

- measuring a specified volume of sodium hydroxide into a flask,
- adding an indicator to it,
Examiner commentary continued

- adding hydrochloric acid from a burette,
- until just neutral, seen by the indicator just changing colour,
- repeating this to get a more accurate value,
- once the amount of hydrochloric acid needed to just neutralise the given volume of sodium hydroxide, these two amounts are added together with no indicator so that the indicator impurity is not present.
Question 26(b)

Exemplar 1  1 mark

(b) Write a balanced symbol equation for the reaction.

\[
\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}
\]  [1]

Examiner commentary

A complete and balanced equation is credited the mark.
Question 26(c)

Exemplar 1

3 marks

(c) The student also investigates other reactions.

The table shows the salts he can make from different starting materials.

Complete the table.

<table>
<thead>
<tr>
<th>Acid used</th>
<th>Other starting material</th>
<th>Salt made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric acid</td>
<td>Copper oxide</td>
<td>Copper sulphate</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>Zinc carbonate</td>
<td>Zinc nitrate</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>Magnesium oxide</td>
<td>Magnesium chloride</td>
</tr>
</tbody>
</table>

Examiner commentary

Nitric acid is credited marking point 1. Nitrate acid was a common response.

Magnesium oxide is credited marking point 2. Magnesium, magnesium hydroxide and magnesium carbonate would also have been creditworthy.

Copper sulfate is credited marking point 3. Copper sulfide was a common incorrect response.
Question 26(d)

Exemplar 1

0 marks

(d) What type of reaction happens when sulfuric acid reacts with copper oxide?

Acid + Metal oxide → Salt + Water

This is a **neutralisation reaction**. [1]

Examiner commentary

Redox is incorrect, and was a popular answer, mark is not credited. The reaction is a neutralisation reaction.
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