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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 5

Exemplar 1

1 mark

Look at the equation.

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \]

Which substance is the oxidising agent in this reaction?

A CH₄
B CO₂
C H₂O
D O₂

Your answer [ ]

Examiner commentary

The agent which causes oxidation in this reaction is oxygen, response D.

Many candidates thought the oxidising agent to be the substance that is oxidised, hence A was a popular incorrect response.
Question 8

Exemplar 1 0 marks

8 A student separates a dye using thin layer chromatography.

She puts a thin layer of solid alumina onto a glass plate. She puts the dye on the pencil line. She puts the glass plate into a tank containing water.

Which of the following is the stationary phase?

A Alumina
B Glass
C Pencil line
D Water

Your answer [B] [1]

Examiner commentary
The dye adsorbs onto the stationary phase (absorbs onto the surface of the stationary phase), the correct response is Alumina, A.

Glass is the medium used to support the stationary phase and was a common incorrect response.
11 Magnesium is heated in a crucible.

The mass of the crucible and magnesium increases.

Which statement is the best explanation for this?

A  Oxygen is given off.
B  The magnesium melts.
C  The magnesium is oxidised to magnesium oxide.
D  The magnesium reacts to make magnesium carbonate.

Your answer  C

[1 mark]

Examiner commentary

When magnesium reacts with oxygen in the air, magnesium oxide is formed and the mass increases, the correct response is C. Many candidates thought that oxygen is evolved, A was a common incorrect response.
Question 14

1 mark

14 What is the approximate size of a nanoparticle?

A 0.07 nm  
B 0.40 nm  
C 50 nm  
D 1000 nm

Your answer  C

Examiner commentary

A nanoparticle has a size between 1 and 100 nm, C is the correct response.
Question 15

Exemplar 1

1 mark

15 Look at the diagram of a methane molecule.

Which statement about methane is correct?

A  Electrons are transferred from hydrogen atoms to carbon atoms.

B  The covalent bonds in methane are weak.

C  The force of attraction between methane molecules is weak.

D  The ionic bonds between carbon and hydrogen are very strong.

Your answer C

Examiner commentary

Methane is covalently bonded, responses A and D discuss ionic bonding.

The covalent bonds within the molecule are very strong. The forces between the molecules are weak, hence it takes little energy to break these intermolecular forces and so methane is a gas. The correct response is C.
Question 16(a)(i)

Exemplar 1

16 Magnesium is an element. It is solid at room temperature.

(a) (i) **Solid** magnesium cannot be compressed.

Why?

The particles are already as close as possible, i.e. [1] solid.

Examiner commentary

The answer needs to be in terms of particles being very close together, this is awarded 1 mark.
Question 16(a)(ii)

Exemplar 1 3 marks

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

Explain why.

Examiner commentary

The answer needed to be in terms of particles. In a solid the atoms are in fixed positions is awarded marking point 1, the atoms are vibrating is credited marking point 2.

Atoms in a liquid move around each other is credited marking point 3.

'Intermolecular forces being weaker' would not have gained a mark, however 'forces between the atoms being weaker in the liquid' would have been credited marking point 4.

Exemplar 2 0 marks

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

Examiner commentary

Magnesium consists of atoms or ions but for this question Intermolecular forces are ignored.

The answer needs to be in terms of particles so whilst this answer discusses movement in liquid and fixed positions in solid, there is no reference to particles. No marks are credited.
Question 16(a)(iii)

Exemplar 1

1 mark

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

Explain why.

Magnesium gas has no forces of attraction between particles, so they have random movement in straight lines, so fill up their container as they do not come into contact with each other. [2]

Examiner commentary

The answer needs to be in terms of particles, the atoms have random movement is credited marking point 1.

No forces between particles was a popular misconception, marking point 4 is not credited.

There is no mention of the particles being far apart or them spreading, marking points 2 and 3 are not credited.
Question 16(b)

Exemplar 1

2 marks

(b) Magnesium reacts with water. Magnesium hydroxide, Mg(OH)₂, and hydrogen, H₂, are made.

Write a balanced symbol equation for this reaction.

\[ \text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2 \]  

Examiner commentary

The species in the equation are correct and it is fully balanced, two marks are credited.
Question 17(a)

Exemplar 1

17 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.

He should first perform a neutralisation reaction by adding an universal indicator to the hydrochloric acid and use a burette to add the sodium hydroxide until the result is neutralised. Then add carbon to remove the colour and filter the carbon off. Next heat the sodium chloride solution until saturated, then leave to cool. Once the crystals in evaporated, cool dry, the crystals to produce the pure, dry sample of sodium chloride. [4]

Examiner commentary

Universal indicator is added to hydrochloric acid, marking point 4 is credited.

Sodium hydroxide in a burette is condoned, marking point 2 is credited.

Adding the hydrochloric acid to the sodium hydroxide is condoned for titration, marking point 1 is credited.

The solution is crystallised, marking point 8 is credited.

Exemplar 2

17 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.

First, the student should mix 10 cm³ of hydrochloric acid and 10 cm³ of sodium hydroxide in a beaker. Then the student should heat up the mixture using a bunsen burner until some of the solid starts to form. After the student should leave the solution to crystallise overnight. Then they should put the crystals of sodium chloride in an oven and let it dry. [4]
Examiner commentary

Mixing hydrochloric acid and sodium hydroxide is condoned for titration, marking point 1 is credited.
The solution is crystallised, marking point 8 is credited.
The detail of apparatus used, use of an indicator to determine the end point of the titration, a method to ensure the product is pure and repetition of the method for improved accuracy are all missing from the method given, no further marks are credited.

Exemplar 3  1 mark

17 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.

1 mark

Include the apparatus he should use and his method.

The student should carefully react the HCl and NaOH together. This will form a solution with a insoluble salt of NaCl. He should make sure none is a shower and use filtration to separate the salt from the solution.

The student should then wash the salt (sodium chloride) in deionised water and should leave it to dry.

Examiner commentary

Reacting hydrochloric acid and sodium hydroxide is condoned for titration, marking point 1 is credited.
The rest of the method is inappropriate, no further marks are credited.
Question 17(b)

Exemplar 1

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

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

Examiner commentary

The reagents are correct but only one of the products has been included in the products, water is missing, no marks are credited.
Question 17(c)

Exemplar 1

(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 sulfate</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>Zinc carbonate</td>
<td>Zinc nitrate</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>Magnesium</td>
<td>Magnesium chloride</td>
</tr>
</tbody>
</table>

[3]

Examiner commentary

All three substances given are correct, three marks are credited.

Copper sulfide in place of copper sulfate was a common error.
**Question 18(a)**

**Exemplar 1**

1 mark

18 A student is measuring the boiling point of some liquids.

![Thermometer](image1)

Buñsen burner

She measures the boiling point of water, petrol and ethanol.

(a) The student’s method is not safe.

Explain why it is not safe and explain how she could improve her method to make it safer.

It is not safe because ethanol is very flammable and so would catch fire.

---

**Examiner commentary**

The flammability of ethanol is appreciated, marking point 1 is credited.

There is no improvement, such as use of a water bath, given; marking point 2 is not credited.

**Exemplar 2**

0 marks

(a) The student’s method is not safe.

Explain why it is not safe and explain how she could improve her method to make it safer.

Use a clamp stand so it can hold the test tube in the same place with no risk of burning. All it would be more safe if it is held in the same place at all times.

---

**Examiner commentary**

Although there is a mention of burning, there is no mention of what could be burning, use of a clamp stand was a common incorrect response. No marks are credited.
Question 18(b)

Exemplar 1

2 marks

(b) The student looks up some data on melting points and boiling points.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Formula</th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>State at 25°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>C₃H₈</td>
<td>−188</td>
<td>42</td>
<td>Gas</td>
</tr>
<tr>
<td>Hexane</td>
<td>C₆H₁₄</td>
<td>−85</td>
<td>69</td>
<td>Liquid</td>
</tr>
<tr>
<td>Icosane</td>
<td>C₂₀H₄₂</td>
<td>37</td>
<td>343</td>
<td>Solid</td>
</tr>
</tbody>
</table>

Complete the table to show the states of propane and hexane at 25°C.

Examiner commentary

The data in the table has been analysed correctly giving propane as a gas and hexane as a liquid, two marks are credited.
Question 18(c)

Exemplar 1  2 marks

(c) Propane burns in oxygen, \(O_2\). Carbon dioxide and water are made.

Write a balanced symbol equation for this reaction.

\[
\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}
\]

Examiner commentary

The correct species are given and the equation is fully balanced, two marks are credited.
Question 19(c)

Exemplar 1

Examiner commentary

Sulfur has 16 protons and electronic structure 2.8.6.
Boron has 6 neutrons and 5 electrons.
Fluoride ion has 9 protons and (9+1=) 10 electrons.
Lithium ion has (3−1=) 2 electrons and electronic structure 2.
This answer scores 4 marks.

Exemplar 2

Examiner commentary

Sulfur has 16 protons and electronic structure 2.8.6, marking point 1 is credited.
Boron has 6 neutrons and 5 electrons, marking point 2 is credited.
The candidate has given the correct number of neutrons but the number of protons in a fluorine ion instead of the 9 in a fluoride ion, marking point 3 is not credited.
The candidate has given the number of electrons and electronic structure of a lithium atom rather than the 3 and 2 of the lithium ion, marking point 4 is not credited.
Question 19(d)(i)

Exemplar 1

1 mark

(d) (i) The electronic structure of sodium is $2.8.1$. The electronic structure of oxygen is $2.6.2$. Sodium and oxygen react together to make sodium oxide.

Sodium oxide is an ionic compound. 

Draw 'dot and cross' diagrams to show the ions made when sodium reacts with oxygen.

Show the charges on the ions.

Examiner commentary

Sodium is drawn having lost its' outer electron (2.8). Marking point 1 is credited.

Oxide is drawn with only one added electron (2.7) instead of two (2.8). Marking point 2 is not credited.

The 1+ charge on the sodium ion is correct but the charge on the oxide ion should be 2−. Marking point 3 is not credited.
Question 20(a)

Exemplar 1

20 A student has a mixture of three substances.

Look at some information about these substances.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>Solubility in water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>1710</td>
<td>2230</td>
<td>Insoluble</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>801</td>
<td>1413</td>
<td>Soluble</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

(a) Describe how the student can separate the mixture to get pure samples of all three substances.

Explain why each method of separation works.

Place Sand and Sodium Chloride in water. Sodium Chloride will dissolve as it is soluble. You can use filtration to get the Sand as it isn’t soluble in water. However, it is able to filter. When you have Sodium Chloride and water, you can use crystallisation/evaporation to evaporate the water and leave the Sodium Chloride behind.

Examiner commentary

The first step is filtration to separate the sand, marking point 1 is credited.

The candidate explains why the process works, sodium chloride dissolves and sand doesn’t, marking point 2 is credited.

The second step is given as crystallisation/evaporation which is insufficient for distillation, marking point 3 is not credited.

The candidate explains that the water evaporates and leaves the sodium chloride behind, marking point 4 is credited.
Question 20(b)

Exemplar 1

1 mark

(b) The student separates two solid substances A and B.

She wants to check that they are pure.

She measures the melting points of four samples of solid B.

Look at her results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>109</td>
</tr>
<tr>
<td>2</td>
<td>105</td>
</tr>
<tr>
<td>3</td>
<td>104–108</td>
</tr>
<tr>
<td>4</td>
<td>110–112</td>
</tr>
</tbody>
</table>

The student knows that a pure sample of solid B has a melting point of 110 °C.

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

Do the results support her conclusion?

Explain your answer using evidence from the table.

The results do not support her conclusion because there is a range in melting points (from 110–112 °C). A pure substance would only have one melting point, which is 110 °C. [3]

Examiner commentary

The candidate has analysed the data in the table and appreciated that the Student must be incorrect as pure substances have one melting temperature, not a range. Marking point 3 is credited.

No further points are discussed.
Exemplar 2

2 marks

(b) The student separates two solid substances A and B.

She wants to check that they are pure.

She measures the melting points of four samples of solid B.

Look at her results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>109</td>
</tr>
<tr>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>3</td>
<td>104–108</td>
</tr>
<tr>
<td>4</td>
<td>110–112</td>
</tr>
</tbody>
</table>

The student knows that a pure sample of solid B has a melting point of 110 °C.

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

Do the results support her conclusion?

Explain your answer using evidence from the table.

No because although the range of boiling point of 4 includes 110 °C, it has a range of 110 °C–112 °C and impure substances boil at a range of temperatures. Sample 1 may be the most pure as it is the closest boiling point to 110 °C without variation, this could be because here temperature readings were inaccurate.

Examiner commentary

The candidate has analysed the data in the table and appreciated that the Student must be incorrect as impure substances have a range of melting temperature, marking point 3 is credited.

The candidate chooses Sample 1 as the most pure, marking point 4 is credited.

To gain further marks the candidate needed to appreciate that a pure sample cannot melt at a temperature higher than the melting point and that impurities in a sample lower the samples melting temperature.
Question 21(a)

Exemplar 1

21 Anhydrous copper sulfate reacts with water to make hydrated copper sulfate.

\[ \text{CuSO}_4 + 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4\cdot5\text{H}_2\text{O} \]

The reaction is exothermic.

(a) Draw and label a reaction profile for this reaction.

Examiner commentary

The reactants and products are shown as horizontal lines with the product line lower and to the right of the reactant line, the labelling would be clearer if the words were written on the lines but the meaning is clear and so the labelling is condoned, marking point 1 is credited.

The enthalpy change is shown as a double headed arrow, marking point 2 is not credited. To show an exothermic energy change the arrow should be pointing downwards.

The activation energy is an upwards arrow from reactants to the top of the curve, marking point 3 is credited.
Exemplar 1

(b) Two students investigate the burning of methane in oxygen.

\[ \text{H}_2\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O} \]

Methane - Oxygen - Carbon dioxide - Water

Look at the table of bond energies.

<table>
<thead>
<tr>
<th>Bond</th>
<th>Bond energy (kJ/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-H</td>
<td>459</td>
</tr>
<tr>
<td>C=O</td>
<td>799</td>
</tr>
<tr>
<td>O=O</td>
<td>484</td>
</tr>
<tr>
<td>C-H</td>
<td></td>
</tr>
</tbody>
</table>

The reaction is exothermic and 802 kJ of energy are given out when 1 mole of methane burns.

The students have looked up the bond energies. They have different values for the C-H bond energy.

Student A thinks the C-H bond energy is \[ \frac{432 kJ}{mol} \]. Student B thinks the C-H bond energy is \[ \frac{411 kJ}{mol} \].

Who is correct?

Use the bond energies and the energy given out in the reaction to calculate the C-H bond energy.

\[
\begin{align*}
4 \times 90 & = 360 \\
4 \times 432 & = 1728 \\
\frac{3434}{1} & = 3434 \\
2632 & = 802
\end{align*}
\]

Answer = \[ \frac{411 kJ}{mol} \]

Examiner commentary

Energy needed to make new bonds is calculated correctly, 3434 kJ, marking point 1 is credited.

Energy needed to break bonds is calculated correctly, 2632 kJ marking point 2 is credited.

The C-H bond energy is calculated correctly, 411 kJ, marking point 3 is credited.
Question 22

Exemplar 1

22 Copper oxide can be reduced to copper by reaction with hydrogen.

\[
\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}
\]

\[
\begin{align*}
\text{1.59 g CuO} & \quad \text{0.20 g H}_2 \\
\text{1.27 mol CuO} & \quad \text{0.20 mol H}_2 \\
\end{align*}
\]

A reaction mixture contains 1.59 g of copper oxide and 0.20 g of hydrogen.

1.27 g of copper and 0.36 g of water are made.

Calculate the number of moles of each substance to determine the limiting reactant in this reaction.

Explain your choice.

The relative atomic mass of Cu is 63.5, of O is 16 and of H is 1.

\[
\begin{align*}
\text{CuO} & \quad \text{1.59 g} \div 79.5 = 0.02 \\
\text{H}_2 & \quad \text{0.20 g} \div 2 = 0.1 \\
\text{Cu} & \quad \text{1.27 g} \div 63.5 = 0.02 \\
\text{H}_2\text{O} & \quad \text{0.36 g} \div 18 = 0.02 \\
\end{align*}
\]

The limiting reactant is \text{hydrogen} because \text{it has less mass} so it \text{can run out quicker}.

Examiner commentary

All four moles are calculated correctly, marking points 1 and 2 are credited.

The candidate has chosen hydrogen as the limiting reactant as they have mistaken 0.1 as being smaller than 0.02. Since copper oxide has the smaller number of moles it should have been chosen as the limiting reactant. Marking points 3 and 4 are not credited.
Question 23

Exemplar 1

23 Look at the diagram.

It shows part of Mendeleev’s Periodic Table which was developed in 1871.

Mendeleev arranged the elements in order of relative atomic mass.

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periods</td>
<td>H</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
</tr>
<tr>
<td>1</td>
<td>1.008</td>
<td>6.939</td>
<td>8.012</td>
<td>10.81</td>
<td>12.011</td>
<td>14.007</td>
<td>15.999</td>
</tr>
<tr>
<td>2</td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>CI</td>
</tr>
<tr>
<td>3</td>
<td>22.99</td>
<td>24.31</td>
<td>29.98</td>
<td>28.09</td>
<td>30.974</td>
<td>32.06</td>
<td>35.453</td>
</tr>
<tr>
<td>4</td>
<td>K</td>
<td>Ca</td>
<td>As</td>
<td>Se</td>
<td>Br</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>39.102</td>
<td>40.08</td>
<td>74.92</td>
<td>78.96</td>
<td>79.909</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Cs</td>
<td>Ba</td>
<td>TI</td>
<td>Pb</td>
<td>Bi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>132.90</td>
<td>137.84</td>
<td>204.37</td>
<td>207.19</td>
<td>208.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe the differences between Mendeleev’s Periodic Table and the modern-day version found in the insert.

Mendeleev’s Periodic Table is arranged by relative atomic mass whereas the modern Periodic Table is arranged by atomic number. There is one more period in the modern version and one more group (group 0 or noble gases) in the modern version. Mendeleev’s Table has many more gaps for unknown elements and...

[3]

Examiner commentary

The candidate states that the modern periodic table is organised in order of atomic number, marking point 4 is credited; and has a noble gas group, marking point 1 is credited.

They also state that Mendeleev’s Table contains gaps, marking point 3 is credited.
Question 24(a)

Exemplar 1 2 marks

A student is investigating the electrolysis of copper sulfate solution.

Power pack

He does two experiments.

Experiment 1 uses platinum electrodes. Experiment 2 uses copper electrodes.

(a) Complete the table to show the products at each electrode:

<table>
<thead>
<tr>
<th>Experiment</th>
<th>What happens at cathode (−)</th>
<th>What happens at anode (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Copper is deposited</td>
<td>Oxygen made</td>
</tr>
<tr>
<td>2</td>
<td>Copper deposited</td>
<td>The anode dissolves</td>
</tr>
</tbody>
</table>

Examiner commentary

The candidate has copper deposited at the anode and the anode dissolving, marking points 1 and 2 are credited.
24 A student is investigating the electrolysis of copper sulfate solution.

He does two experiments.

Experiment 1 uses platinum electrodes. Experiment 2 uses copper electrodes.

(a) Complete the table to show the products at each electrode.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>What happens at cathode (−)</th>
<th>What happens at anode (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Platinum deposited</td>
<td>Oxygen made</td>
</tr>
<tr>
<td>2</td>
<td>Copper deposited</td>
<td></td>
</tr>
</tbody>
</table>

Examiner commentary

The candidate has platinum deposited at the cathode, this was a common incorrect response, marking point 1 is not credited.

The candidate has oxygen made at the anode, this was a common incorrect response, marking point 2 is not credited.
Question 24(d)

Exemplar 1  1 mark

(d) The student also electrolyses sodium chloride solution using platinum (inert) electrodes.

At the cathode, hydrogen gas is made rather than sodium metal.

Explain why.

Hydrogen gas is made because sodium is more reactive than hydrogen so you get hydrogen from $\text{Na}^+\text{ ions}$. [2]

Examiner commentary

The candidate has chosen hydrogen, marking point 1 is credited; but has not explained their choice, marking point 2 is not credited. Many candidates did not explain that hydrogen is discharged before the sodium.
**Question 25**

**Exemplar 1**  

**Level 3, 6 marks**

25* 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>&gt;3000</td>
<td>&gt;4000</td>
<td>no</td>
<td>3.5</td>
</tr>
<tr>
<td>C</td>
<td>801</td>
<td>1413</td>
<td>Solid does not conduct but conducts when melted or dissolved in water</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Explain the type of bonding present in each substance A, B and C.

**Substance A is a simple molecular substance. It has a low melting and boiling point because it does not have strong intermolecular forces between molecules. It also has a low density and does not conduct electricity as there are no free ions or electrons. In substance B, it is covalent bonding and a giant covalent substance. This is because it has a very high melting and boiling point as the are very strong covalent bonds which take lots of energy to break. It also has a high density and does not conduct electricity as there are no free ions or electrons. Substance C is an ionic substance with ionic bonding. This is because it can conduct electricity when melted or dissolved as the ions can...**

25) Are you sure: and carry current. However, it cannot conduct electricity when solid as the ions are fixed in place so cannot move. It is also ionic bonding as there is a strong high melting and boiling point as it takes a lot of energy to overcome the electrostatic forces of attraction between oppositely charged ions.
Examiner commentary

The candidate has identified all three types of bonding correctly, they have given detailed information in support of each of their identifications and explained how the forces and bonds involved relate to the properties and the bonding.

All the information is relevant, the line of reasoning is clear and logically reasoned.

The candidate is awarded 6 marks.

This answer although gaining 6 marks could have been more concise. Candidates should be encouraged to write concisely and to try and fit their answer within the answer lines provided.

Exemplar 2

25* Look at the data about some substances.

<table>
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<td>Solid does not conduct but conducts when melted or when dissolved in water</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Explain the type of bonding present in each substance A, B and C.

Relate the type of bonding to the properties of each substance.

The type of bonding present in substance A is Simple Covalent as it doesn't conduct electricity and has an extremely low melting point. This is because a simple covalent bond has weak intermolecular forces. Substance B is a giant covalent structure as it does not conduct electricity and has an extremely high boiling and melting point. This is because it has very strong intermolecular forces. Substance C has ionic bonding when present as it conducts electricity when in molten form or as a solid.

Examiner commentary

The candidate has identified the bonding in all three substances correctly.

For A they have listed several of the properties in support of their identification and have explained these partially in terms of the forces present.

For B they have listed some of the properties in support their identification but have used incorrect forces to explain them.
Examiner commentary continued

For C they have listed some of the properties in support of their identification but have not explained these in terms of the bonding involved.

The reasoning has some structure and supported by some evidence.

This answer is Level 2, 3 marks.

Exemplar 3

25* Look at the data about some substances.

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</tbody>
</table>

Explain the type of bonding present in each substance A, B and C.

Relate the type of bonding to the properties of each substance.

A - Simple covalent bond as it has weak bonds and the melting and boiling point is low, meaning it does not take much energy to break them. It also does not conduct electricity.

B - Covalent bond as it has high melting and boiling points so it takes a lot of energy to break the bond.

C - Intermolecular bond. As the melting and boiling point is relatively high compared to A, it also conducts when molten.

Examiner commentary

The candidate has identified the bonding in two of the substances partially and has chosen incorrectly for the third. There are a few properties listed in support of their identification but there are also an incorrect statement about the bonding and other contradictory statements.

This is a Level 1 answer, 1 mark.
26 The value of the Avogadro constant is $6.02 \times 10^{23}$.

(a) What is meant by the Avogadro constant?

The number of molecules in 1 mole of Carbon 12.

[1 mark]

Examiner commentary

Whilst the Avogadro constant is the number of entities in one mole of substance, the entities and the substance need to match. Here the number of molecules in one mole of carbon-12 is incorrect, carbon is an element so it should be the number of atoms in one mole of carbon-12.
Question 26(b)

Exemplar 1

3 marks

(b) Calculate the number of water molecules in 72g of water, H₂O:

Give your answer to 3 significant figures.

\[
\frac{72}{18} \times 4 \times (6.02 \times 10^{23}) \approx 2.41 \times 10^{24}
\]

Answer = \(2.41 \times 10^{24}\) [3]

Examiner commentary

The number of moles is calculated correctly, marking point 1 is credited.

The number of molecules of water is calculated correctly, marking point 2 is credited.

The answer is given to three significant figures, marking point 3 is credited.

The candidate has clearly shown their working so if they had made a mistake and produced an incorrect answer at the end, they still would have gained some marks.
Question 26(c)

Exemplar 1

3 marks

(c) A student is reacting magnesium oxide with nitric acid.

Look at the equation for the reaction.

\[ \text{MgO} + 2\text{HNO}_3 \rightarrow \text{Mg(NO}_3)_2 + \text{H}_2\text{O} \]

The student wants to make 14.8g of magnesium nitrate, \( \text{Mg(NO}_3)_2 \).

Calculate the masses of magnesium oxide and nitric acid that he needs.

\[
\begin{align*}
\text{Mg(NO}_3)_2 & = 24.3 + (14 + (16 \times 3)) \times 2 \\
\frac{14.8}{198.3} & = 0.0997... \text{ mol} \\
\end{align*}
\]

\[
\begin{align*}
\text{Mass of magnesium oxide needed} & = 4.0 \text{ g} \\
\text{Mass of nitric acid needed} & = 12.8 \text{ g} \\
\end{align*}
\]

END OF QUESTION PAPER

\[
\begin{align*}
\text{MgO} & = 40.3 \\
\text{HNO}_3 & = 64 \\
\text{END OF QUESTION PAPER} \\
\end{align*}
\]

Examiner commentary

The RFM of nitric acid is given as 64, marking point 1 is not credited.

The number of moles of magnesium nitrate (equivalent to 0.1) are calculated correctly, marking point 2 is credited.

The mass of magnesium oxide needed (4.0) is calculated correctly, marking point 3 is credited.

The mass of acid needed is calculated correctly from the candidates incorrect RFM for nitric acid, marking point 4 is credited as an error carried forward.

Candidates need to show all of their working in calculations so that if they make a mistake in any one of the steps the later marks are still available if the subsequent answers are consistent with their incorrect answer being used correctly.
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