Time allowed

- Perusal time: 10 minutes
- Working time: 2 hours

Examination materials provided

- Paper Two — Question book
- Paper Two — Resource book
- Paper Two — Response book

Equipment allowed

- QSA-approved equipment
- non-programmable calculator

Paper Two is an open book examination. You may refer to any paper-based material that you have brought into the examination room.

Directions

You may write in this book during perusal time.

Paper Two has five questions of equal value (attempt four questions only).

Assessment

Paper Two assesses the following assessment criterion:

- Complex reasoning processes

Assessment standards are at the end of this book.

After the examination session

Take this book when you leave.
Planning space
Complex reasoning processes

Paper Two has five questions of equal value. Attempt four questions only. If you respond to all five questions, only your first four responses will be assessed.

Write your responses in the response book.

In each response, give full reasoning in terms of your knowledge and application of chemistry and use the range of scientific processes and complex reasoning objectives learned during your study of the subject.

Grade descriptions for each question are provided below.

A grade:
- Arrived at a valid response.
- Successfully demonstrated logical reasoning and critical thinking.
- Made few, if any, (minor) errors.

B grade:
- Made substantial progress towards an appropriate response.
- Applied logical reasoning and critical thinking.

C grade:
- Made some progress towards an appropriate response.
- Demonstrated some logical reasoning and critical thinking.

D grade:
- Response is unintelligible or does not satisfy the requirements for any other grade.
Question 1

The following information relates to a liquid organic compound which contains C, H and O only.
- 10.0 g of the compound yields, on combustion, 22.0 g of carbon dioxide and 12.0 g of water.
- When treated with acidic potassium dichromate solution, the end product of the reaction showed no acidic properties.
- Sodium reacts with the liquid organic compound to produce hydrogen gas.
- When 95.0 g of this unknown compound was vaporised under certain conditions, the volume produced was 272.0 mL. This same volume was occupied by 50.0 g of O₂ under the same conditions.

Determine the most likely structural formula for the compound.

Question 2

Chalcocite (Cu₂S) is a very important mineral of copper. It is often found in large ore bodies with another mineral called covellite (CuS).

A 150.0 g sample of ore containing only these two minerals was completely dissolved in concentrated nitric acid and the resulting solution diluted so that its final volume was 200.0 mL.

20.0 mL of this solution was then reacted with 1.0M sodium hydroxide (NaOH) until copper ions had precipitated out as copper hydroxide (Cu(OH)₂(s)).

If 11.545 g of copper hydroxide was formed, what is the percentage of chalcocite in the sample?

Question 3

Use the method of half-cell equations to balance the following oxidation–reduction equation for a reaction which occurs in acid solution.

As₂O₃(s) + NO₃⁻(aq) → H₃AsO₄(aq) + NO(g)

Question 4

Many of the attributes of gases can be explained by their physical properties.

Use the Kinetic Theory of Gases to critically examine the properties of vapour pressure, diffusion, compressibility and solubility in water.

Question 5

x moles of nitrogen and y moles of hydrogen were placed in a five litre container and heated to cause a reaction as described by the equation below. When equilibrium was reached, the container held z moles of ammonia and some nitrogen and hydrogen remained unreacted.

N₂(g) + 3H₂(g) ⇌ 2NH₃(g)

Construct an expression for the equilibrium constant for this reaction in terms of x, y and z.

End of Paper Two
<table>
<thead>
<tr>
<th>Criterion</th>
<th>Very High Achievement</th>
<th>High Achievement</th>
<th>Sound Achievement</th>
<th>Limited Achievement</th>
<th>Very Limited Achievement</th>
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<tbody>
<tr>
<td>Complex reasoning processes</td>
<td>A high ability to use complex reasoning in challenging situations involving the candidate's understanding of subject matter, and a high ability to use scientific processes at an advanced level.</td>
<td>Competence in using complex reasoning in challenging situations involving the candidate's understanding of subject matter, and competence in using scientific processes at an advanced level.</td>
<td>Some success in using complex reasoning in challenging situations involving the candidate's understanding of subject matter, and some success in using scientific processes at an advanced level.</td>
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