

2007 Senior External Examination



Chemistry

Paper Two — Question book

Wednesday 24 October 2007

1:00 pm to 3:10 pm

Directions

1. Perusal time: **10 minutes**.

You may write in this book during perusal time.
A page for planning is on the reverse of this cover.

2. Working time: **2 hours**.

3. Materials provided:

- Paper Two — Resource book
- Paper Two — Response book.

4. Equipment allowed:

- any hand-held, solar- or battery-operated non-programmable calculator
- pens (blue or black ink). Do not use pencil
- normal writing implements
- other QSA-approved equipment.

Paper Two is an **open book** examination. You may refer to any paper-based written or printed material that you have brought into the examination room. You may make notes on your material at any time during the examination.

5. Paper Two has **four** complex reasoning processes questions.

You are required to respond to all **four** questions.

6. You may take this book with you when you leave the examination room.

Notes

Assessment:

Paper Two assesses the following criterion published in the 1998 senior external syllabus for Chemistry:

- Complex reasoning processes.

Standards for assessment are at the end of this book.

Planning space

There are **four** complex reasoning processes questions in this paper. All questions are of equal value.

You are required to respond to all **four** questions.

Write your responses in the response book provided.

Assessment criteria specific to each question are printed 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 throughout your study of the subject.

Refer to page 1 of the response book for instructions on how to use and identify any sources of information that you use in your responses.

Question 1 — Identification of element by isotopic analysis

An element X has been found to have three isotopes with the following information:

Isotope	Number of protons	Number of neutrons	Number of atoms per 100 natural atoms
A	12	12	79
B	12	13	10
C	12	14	11

- Identify the element.
- Using only the above information, deduce other facts about the element.
- Using other available information (for example, your resource material brought into the examination), state at least six other facts or properties of this element. These must be explained and justified in terms of your knowledge of chemistry.

Question 2 — Identifying an organic substance

An organic chemist determined the molecular structure of an unknown organic substance in the following tests.

- The substance, a colourless liquid, was first purified by distillation from a suitable solvent. Adequate **purity** was indicated when the boiling point test showed a constant reading of 90 °C after repeated attempts to purify it further.
- Next, the **elements present** in the substance were identified by qualitative analysis. The substance was burned in air. The products of the combustion were tested with lime-water to show the presence of carbon dioxide **and** with dried copper (II) sulphate which turned blue, demonstrating the presence of water. Further, the liquid did **not** have the unpleasant smell of many organic sulfur or nitrogen compounds. Also, tests for halogens in the products of the combustion were negative.
- Then a **quantitative analysis** was conducted. In an experiment using an excess of air, 15 g of the substance on combustion produced 18 g of water absorbed in a container of concentrated sulphuric acid and 33 g of carbon dioxide absorbed by sodalime.
- The **molar mass** of the substance was found to be 60 g from a suitable determination.

From these experiments there is sufficient data to narrow down the compound to three possible substances.

What substances are possible for the data **and** how might the chemist conduct further tests to identify which one of the three is the sample?

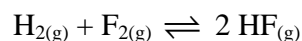
Question 3 — Common gas properties

Physical properties common to gases include pressure, diffusion, compressibility, solubility in water, but in varying degrees. The differences in properties between gases can be explained with the Kinetic Theory.

Use the Kinetic Theory of gases to **critically** examine the common gas properties listed above.

Question 4 — An equilibrium system

At a certain temperature, the equilibrium constant for the reaction



is $K = 1.0 \times 10^2$.

In an experiment at that temperature, 2.0 mol of hydrogen and 2.0 mol of fluorine were introduced into a 1.0 L flask.

Calculate the concentrations of all three gases when equilibrium was reached.

End of Paper Two

Minimum standards associated with exit criteria

Criterion	Very High Achievement	High Achievement	Sound Achievement	Limited Achievement	Very Limited Achievement
Complex reasoning processes	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.	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.	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.		

Acknowledgments

Houghton Mifflin Company, USA, for material from *Chemistry* by Stephen S Zumdahl, 1986, published by DC Heath, USA.

Random House Group, London, for a table from *Problems in Modern Chemistry* by JC Mathews, published by Hutchinson Educational, London, 1971.

Every reasonable effort has been made to contact owners of copyright material. We would be pleased to hear from any copyright owner who has been omitted or incorrectly acknowledged.