The Open University

Science Supplementary Material
S205 The Molecular World

0208 899 2982

Course and assignment number:

Tutor Marked Assignment

S205 TMA 01

Make sure you know how to complete and send in your TMA and PT3 forms: detailed instructions are given in the booklet *Completing TMA and CMA forms*.

Covering: **Books 2 and 3**

Cut-off date:
Friday 14 March 2003

This assignment is made up of three questions. For each question, the following Table indicates:

when you should attempt the question;

the percentage of the total marks for this assignment allocated to the question;

the box number on the Assignment Form in which your tutor will indicate the marks that you obtain for the question.

Question number	*When to attempt it*	*Percentage of total marks*	*Box No. on Assignment Form*
1	after completing Book 2	30	1
2	after completing Book 3 Part 1	40	2
3	after completing Book 3 Part 2	30	3

Question 1

This question carries 30 per cent of the marks for this assignment, and relates mainly to Learning Outcomes 4, 5, 6, 8, 9 and 13 of Book 2.

(a) (*1 mark*) Identify the element Z, which has the outer electronic configuration $3s^2 3p^4$.

(b) (*1 mark*) The element Z forms two volatile oxides of composition ZO_2 and ZO_3. What will be the nature of the bonding in ZO_2 and ZO_3 giving your reasons?

(c) (*2 marks*) Assuming that Z is the central atom in these molecules, write Lewis structures for ZO_2 and ZO_3 using double bonds rather than dative bonds.

(d) (*8 marks*) Explain how valence-shell electron-pair repulsion (VSEPR) theory can be used to deduce the shape of ZO_2, and explain any deviations from expected bond angles in the molecule.

(e) (*4 marks*) Show how VSEPR theory can be used to predict the different shape of the gaseous molecule ZO_3.

(f) (*5 marks*) The element Z also forms a gaseous compound of composition ZO_2F_2, in which Z is again the central atom. Use VSEPR theory to deduce the shape of the ZO_2F_2 molecule. Illustrate your answer with a flying-wedge representation of the structure and using double bonds between Z and O.

(g) (*1 mark*) Comment on the ∠F–Z–F bond angle (*no more than two sentences*).

(h) (*6 marks*) What structure would you expect for the gaseous molecule ZOF_4?

(i) (*1 mark*) What would you expect the ∠F–Z–F bond angles in ZOF_4 to be?

(j) (*1 mark*) Draw a flying-wedge diagram to illustrate the shape of the ZOF_4 molecule.

Question 2

This question carries 40 per cent of the marks for this assignment, and tests Learning Outcomes 5, 6, 7, 9 and 15 of Book 3, Part 1.

In order to answer this question, you will need to open the WebLab ViewerLite™ structure of zirconia. This can be found on *The Third Dimension* CD-ROM A, in the folder marked 'TMA crystal structures'. For convenience, the zirconia structure is shown here as Figure 1 (*overleaf*).

Using information from the CD-ROM, answer each of the following questions related to the zirconia structure in Figure 1. Include brief explanations in your answers where necessary, and give bond lengths in picometres.

(a) (*3 marks*) Use WebLab ViewerLite to measure the unit cell dimensions in picometres.

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