

## Chemistry: Written examination I

### GENERAL COMMENTS

The new examination criteria used for the first time in 2000 were:

1. understanding of qualitative and quantitative aspects of chemical reactions, including acid-base and redox reactions and their application in the analysis of a variety of consumer products by a range of common laboratory techniques and modern instrumental methods
2. understanding of the principles of equilibrium, reaction rate and energy change and their relationships to the outcomes of chemical reactions, including those in living systems and small scale laboratory reactions
3. understanding of chemical reactions and the relevant concept in the production of important industrial chemicals, including sulfuric acid and substances derived from petroleum
4. knowledge of experimental measurement and observations
5. analysis, interpretation and synthesis of information.

Items 3 (27% correct), 5 (35%), 12 (45%) and 20 (42%) discriminated effectively in favour of good students. Item 13 (16%) also discriminated at the upper end of the scale, but the spread of responses over the distractors in Item 13 indicated a need for more effective learning about rate and yield in equilibrium reactions.

### Section A

| Item | Criterion 1 | Criterion 2 | Criterion 3 | Criterion 4 | Criterion 5 | Correct response | % of correct responses | Area of Study reference |
|------|-------------|-------------|-------------|-------------|-------------|------------------|------------------------|-------------------------|
| 1    |             |             | ✓           |             |             | B                | 79                     | 3.3                     |
| 2    |             |             | ✓           |             |             | C                | 44                     | 3.3                     |
| 3    | ✓           |             |             |             |             | D                | 27                     | 2.10                    |
| 4    | ✓           |             |             |             |             | B                | 76                     | 2.10                    |
| 5    | ✓           |             |             |             |             | C                | 35                     | 2.10                    |
| 6    | ✓           |             |             | ✓           |             | B                | 91                     | 1.5                     |
| 7    | ✓           |             |             | ✓           | ✓           | B                | 78                     | 1.5                     |
| 8    | ✓           |             |             |             |             | C                | 67                     | 1.4                     |
| 9    | ✓           |             |             |             |             | B                | 48                     | 1.4                     |
| 10   | ✓           |             |             | ✓           | ✓           | D                | 63                     | 1.5, 1.6, 1.7           |
| 11   |             | ✓           |             |             | ✓           | B                | 49                     | 2.6, 2.9, 2.10          |
| 12   |             | ✓           |             |             | ✓           | C                | 45                     | 2.3, 2.6                |
| 13   |             | ✓           | ✓           |             |             | C                | 16                     | 2.7, 3.1                |
| 14   |             | ✓           |             |             |             | B                | 74                     | 2.4, 2.5, 3.1           |
| 15   |             | ✓           |             |             |             | A                | 78                     | 2.1, 2.2                |
| 16   |             | ✓           |             |             | ✓           | A                | 63                     | 2.6, 2.7                |
| 17   |             |             | ✓           |             |             | B                | 84                     | 3.2                     |
| 18   |             |             | ✓           |             |             | A                | 54                     | 3.3                     |
| 19   | ✓           |             |             |             |             | C                | 64                     | 1.2, 3.1                |
| 20   | ✓           |             |             |             |             | D                | 42                     | 2.8                     |

## SPECIFIC INFORMATION

### Item 3

Only 27 per cent gave the correct response (D). Forty-six per cent gave response C which would have been correct if barium hydroxide had only *one* hydroxide ion per mole. A very simple item that indicated students have only a fragile grasp of stoichiometric principles.

### Item 5

Thirty-five per cent gave the correct response (C). It is noteworthy that 24 per cent chose D, which would be obtained by 'arithmetically averaging' the pH values of the two solutions mixed – clearly some moderately good students chose this, perhaps due to a lack of understanding of the principles of logarithms.

### Item 11

This was thought to be a very difficult question. It required a three stage calculation – conversion of a pH to a concentration, perceiving that the nitrite ion concentration was the same as the hydrogen ion concentration and then applying the equilibrium law. An impressive 49 per cent correctly chose B.

### Item 12

Forty five per cent correctly chose C. Students were required to combine a simple calculation of concentration with an ability to formulate the equilibrium law.

### Item 13

Sixteen per cent of students gave the correct answer. Many who did not were otherwise high-achieving students. The most popular response was B (42%), where the respondents presumably confused the rate at which equilibrium could be achieved with the extent to which the reaction would proceed, i.e. the yield. Forty-five per cent got the high temperature right (A or C) but only half realised that the low flow rate would allow greater contact time with the catalyst and hence a more rapid achievement of equilibrium.

### Item 16

Sixty-three per cent got the correct response (A) confirming (see Section B Question 6) that students now handle problems requiring the application of Le Chatelier's principle very well indeed.

### Item 18

Fifty-four per cent correctly chose A. The next most popular choice was B which was methyl propanoate. In other words, over seventy per cent of the students correctly identified the correct hydrocarbon fragments – but a significant minority got the functional group 'back to front'.

### Item 20

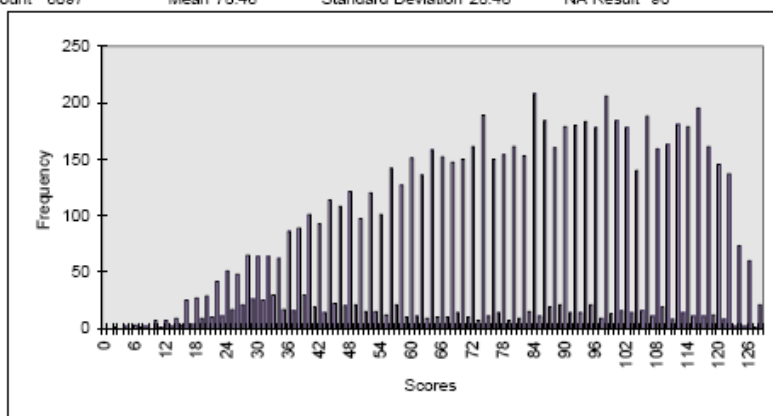
Forty-two per cent correctly chose D. It required students to perceive that an equilibrium constant was indeed a constant at a particular temperature. (Compare them to the other more 'predictable' equilibrium questions such as Item 16 and Section B Question 6.)

## Section B

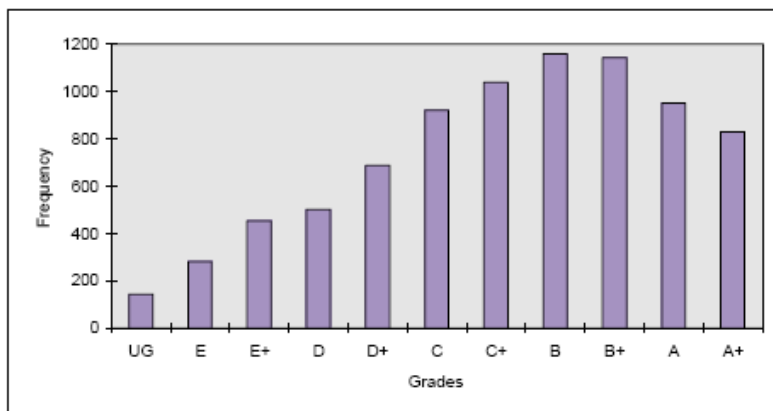
| Question | Criterion 1 | Criterion 2 | Criterion 3 | Criterion 4 | Criterion 5 | Average mark           | Area of Study reference      |
|----------|-------------|-------------|-------------|-------------|-------------|------------------------|------------------------------|
| 1        | ✓           |             |             | ✓           |             | 3.47/7                 | 1.4                          |
| 2        | ✓           |             |             |             | ✓           | 4.54/8                 | 1.3, 1.6                     |
| 3        |             |             | ✓           |             |             | 2.57/4                 | 3.2, 3.4                     |
| 4        |             |             | ✓           |             |             | a-b 3.50/6<br>c 3.74/5 | 3.2, 3.3                     |
| 5        |             |             |             | ✓           | ✓           | a-c 1.79/4<br>d 1.49/3 | 1.1, 1.2, 1.3                |
| 6        |             | ✓           |             |             |             | 5.16/7                 | 2.1, 2.2, 2.3, 2.5, 2.6, 2.7 |



CH031 CHEMISTRY WRITTEN EXAMINATION 1  
 HISTOGRAM OF TOTAL SCORES 2000  
 Count 8097 Mean 78.48 Standard Deviation 28.48 NA Result 96



HISTOGRAM OF TOTAL GRADES 2000  
 Count 8097 Mean 6.21 Standard Deviation 2.60 NA Result 96



| ENROLMENTS |      | %    |
|------------|------|------|
| Female     | 4434 | 54.1 |
| Male       | 3760 | 45.9 |
| Total      | 8194 |      |

### GLOSSARY OF TERMS

|                           |                                                                                                |
|---------------------------|------------------------------------------------------------------------------------------------|
| <b>Count</b>              | Number of students undertaking the assessment. This excludes those for whom NA was the result. |
| <b>Mean</b>               | This is the 'average' score; that is all scores totalled then divided by the 'Count'.          |
| <b>Standard Deviation</b> | This is a measure of how widely values are dispersed from the average value (the mean).        |