



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Subsidiary Level and Advanced Level

CHEMISTRY

9701/31

Paper 31 Practical Test

October/November 2007

CONFIDENTIAL INSTRUCTIONS

Great care should be taken to ensure that any confidential information given does not reach the candidates either directly or indirectly.



The Supervisor's attention is drawn to the form on page 7 which must be completed and returned with the scripts.

If you have any problems or queries regarding these instructions, please contact CIE

by e-mail: International@cie.org.uk

by phone: +44 1223 553554

by fax: +44 1223 553558

stating the Centre number, the nature of the query and the syllabus number quoted above.

This document consists of **8** printed pages.



Safety

Supervisors are advised to remind candidates that **all** substances in the examination should be treated with caution. Only those tests described in the question paper should be attempted. Please also see under 'Apparatus' on the use of pipette fillers, safety goggles and plastic gloves.

In accordance with COSHH (Control of Substances Hazardous to Health) Regulations, operative in the UK, a hazard appraisal of the examination has been carried out.

Attention is drawn in particular, to certain materials used in the examination. The following codes are used where relevant.

C corrosive substance	F highly flammable substance
H harmful or irritating substance	O oxidising substance
T toxic substance	N dangerous for the environment

The attention of Supervisors is drawn to any local regulations relating to safety and first-aid.

'Hazard Data Sheets', relating to materials used in this examination, should be available from your chemical supplier.

Before the Examination

1 Access to the question paper is NOT permitted in advance of the examination.

2 Preparation of materials

Where quantities are specified for each candidate, they are sufficient for the experiments described in the question paper to be completed.

In preparing materials, the bulk quantity for each substance should be increased by 25% as spare material should be available to cover accidental loss. More material may be supplied if requested by candidates, without penalty.

All solutions should be bulked and mixed thoroughly before use to ensure uniformity.

Every effort should be made to keep the concentrations accurate to within one part in two hundred of those specified.

Supervisors are asked to carry out any confirmatory tests given on pages 4 and 5 to ensure the materials supplied are appropriate.

If the concentrations differ slightly from those specified, the Examiners will make the necessary allowance. They should be informed of the exact concentrations.

3 Labelling of materials

Materials must be labelled as specified in these instructions. Materials with an **FA** code number should be so labelled **without** the identities being included on the label. Where appropriate the identity of an **FA** coded chemical is given in the question paper itself.

4 Identity of materials

It should be noted that descriptions of solutions given in the question paper may not correspond exactly with the specifications in these Instructions. **The candidates must assume the descriptions given in the question paper.**

5 Size of group

In view of the difficulty of the preparation of large quantities of solution of uniform concentration, it is recommended that the maximum number of candidates per group be 30 and that separate supplies of solutions be prepared for each group.

Apparatus

- 1 In addition to the fittings ordinarily contained in a chemical laboratory, the apparatus and materials specified below will be necessary.
- 2 Pipette fillers (or equivalent safety devices), safety goggles and disposable plastic gloves should be used where necessary.
- 3 Candidates may be expected to rinse and re-use glassware.
- 4 *For each candidate*
 - 1 × 50 cm³ burette labelled **FA 1**
 - 1 × 50 cm³ burette labelled **water**
 - 2 × burette clamps
 - 2 × stands
 - 2 × funnels for filling burettes
 - 1 × 250 cm³ beaker
 - 1 × 10 cm³ measuring cylinder
 - 1 × 25 cm³ measuring cylinder
 - 1 × stop clock (or sight of a laboratory clock capable of measuring time in seconds)
 - paper towels
 - 1 × heat-proof mat
 - 1 × Bunsen burner
 - 1 × test-tube holder
 - 8 × test-tubes
 - 4 × boiling-tubes
 - 1 × test-tube rack
 - 2 × teat/squeeze pipettes
 - 1 × wash bottle of distilled water

Chemicals Required

1 It is **especially important** that great care is taken that the confidential information given below does **not** reach the candidates either directly or indirectly.

2 Particular requirements

hazard	label	per candidate	identity	notes (Hazard symbols given in this column refer to the raw materials.)
*	FA 1	250 cm ³	0.15 mol dm ⁻³ sodium thiosulphate	Dissolve 37.0 g of Na ₂ S ₂ O ₃ ·5H ₂ O in each dm ³ of distilled water. <i>The distilled water used to make up this solution should be boiled to eliminate dissolved air and covered while cooling to prevent any carbon dioxide dissolving. Acidity in the water can lead to decomposition of the thiosulphate.</i>
[H]	FA 2	100 cm ³	2.0 mol dm ⁻³ hydrochloric acid	Dilute 172 cm ³ of concentrated (35% w/w; approximately 11 mol dm ⁻³) hydrochloric acid [C] to 1 dm ³ .
	distilled water	250 cm ³	distilled water	
[H]	FA 3	30 cm ³	0.1 mol dm ⁻³ ammonium sulphite (<i>ammonium chloride + sodium sulphite</i>)	Dissolve 5.4 g of NH ₄ C ₂ H ₃ O ₂ [H] and 12.6 g of <u>freshly purchased</u> Na ₂ SO ₃ [H] in each dm ³ of solution.
[T] [N]	FA 4	30 cm ³	1.0 mol dm ⁻³ sodium nitrite	Dissolve 69 g of <u>freshly purchased</u> NaNO ₂ [T] [O] [N] in each dm ³ of solution.
[H]	FA 5	30 cm ³	0.1 mol dm ⁻³ barium nitrate	Dissolve 26.1 g of Ba(NO ₃) ₂ [H] [O] in each dm ³ of solution.
[H] [N]	FA 6	30 cm ³	0.1 mol dm ⁻³ manganese(II) sulphate	Dissolve 16.9 g of MnSO ₄ ·H ₂ O [H] [N] in each dm ³ of solution.
[H]	0.1 mol dm ⁻³ sodium sulphite	10 cm ³	0.1 mol dm ⁻³ sodium sulphite	Dissolve 12.6 g of <u>freshly purchased</u> Na ₂ SO ₃ [H] in each dm ³ of solution.

* **NOTE:** The reaction in question 1 will produce a small amount of SO₂ [T] [C], which can cause respiratory distress in some people. The laboratory should be well ventilated.

- 3 The standard bench reagents are set out below. If necessary, they may be made available from a communal supply; however, the attention of the Invigilators should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates.

hazard	label	identity	notes (Hazard symbols given in this column refer to the raw materials.)
[H]	dilute hydrochloric acid	2.0 mol dm ⁻³ HCl	Dilute 172 cm ³ of concentrated (35% w/w; approximately 11 mol dm ⁻³) acid [C] to 1 dm ³ .
[C]	dilute nitric acid	2.0 mol dm ⁻³ HNO ₃	Dilute 128 cm ³ of concentrated (70% w/w) acid [C] [O] to 1 dm ³ .
[H]	dilute sulphuric acid	1.0 mol dm ⁻³ H ₂ SO ₄	Cautiously pour 55 cm ³ of concentrated (98%) sulphuric acid [C] into 500 cm ³ of distilled water with continuous stirring. Make the solution up to 1 dm ³ with distilled water. Care – concentrated H ₂ SO ₄ is very corrosive.
[H]	aqueous ammonia	2.0 mol dm ⁻³ NH ₃	Dilute 112 dm ³ of concentrated (35% w/w) ammonia [C] [N] to 1 dm ³ .
[C]	aqueous sodium hydroxide	2.0 mol dm ⁻³ NaOH	Dissolve 80.0 g of NaOH [C] in each dm ³ of solution. Care – the process of solution is exothermic and any concentrated solution is very corrosive.
[T] [H]	0.1 mol dm ⁻³ barium chloride	0.1 mol dm ⁻³ barium chloride [or barium nitrate]	Dissolve 24.4 g of BaCl ₂ ·2H ₂ O [T] (or 26.1 g of Ba(NO ₃) ₂ [H] [O]) in each dm ³ of solution.
[H] [N]	0.05 mol dm ⁻³ silver nitrate	0.05 mol dm ⁻³ silver nitrate	Dissolve 8.5 g of AgNO ₃ [C] [N] in each dm ³ of solution.

- 4 The reagents, materials and apparatus to test the gases listed in the syllabus must be available to candidates. If necessary, they may be made available from a communal supply; however, the attention of the Invigilators should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates.

hazard	label	identity	notes (Hazard symbols given in this column refer to the raw materials.)
[H]	limewater	saturated aqueous calcium hydroxide, Ca(OH) ₂	Prepare fresh limewater by leaving distilled water to stand over solid calcium hydroxide [H] for several days, shaking occasionally. Decant or filter the solution.
[T] [N]	aqueous potassium dichromate(VI)	0.1 mol dm ⁻³ K ₂ Cr ₂ O ₇	Dissolve 29.5 g of K ₂ Cr ₂ O ₇ [T] [N] in each dm ³ of solution which should contain about 10% of dilute (1 mol dm ⁻³) sulphuric acid [H]. <i>The use of plastic gloves may be considered to prevent contact with skin.</i>
red and blue litmus paper, plain filter paper strips for use with dichromate, wooden splints, the apparatus normally used in the Centre for use with limewater in testing for carbon dioxide			

Responsibilities of the Supervisor during the Examination

- 1 The Supervisor, or other competent chemist **must carry out the experiments in all parts of Question 1** and complete tables of readings on a spare copy of the question paper which should be labelled 'Supervisor's Results'.

**This should be done for:
each session held and each laboratory used in that session, and each set of solutions supplied.**

N.B. The question paper cover requests the candidate to fill in details of the examination session and the laboratory used for the examination.

It is essential that each packet of scripts contains a copy of the applicable Supervisor's Results as the candidates' work cannot be assessed accurately without such information.

- 2 The Supervisor must complete the Report Form on page 7 to show which candidates attended each session. If all candidates took the examination in one session, please indicate this on the Report Form. A copy of the Report Form must accompany each copy of the Supervisor's Results in order for the candidates' work to be assessed accurately.

The Supervisor must give details on page 8 of any particular difficulties experienced by a candidate, especially if the Examiner would be unable to discover this from the written answers.

After the Examination

Each envelope returned to Cambridge must contain the following items.

- 1 The scripts of those candidates specified on the bar code label provided.
- 2 A copy of the Supervisor's Report relevant to the candidates in 1.
- 3 A copy of the Report Form, including details of any difficulties experienced by candidates (see pages 7 and 8).
- 4 The Attendance Register.
- 5 **A Seating Plan for each session/laboratory.**

Failure to provide appropriate documentation in each envelope may cause candidates to be penalised.

COLOUR BLINDNESS

With regard to colour-blindness – a minor handicap, relatively common in males – it is permissible to advise candidates who request assistance on colours of, for example, precipitates and solutions (especially titration end-points). Please include with the scripts a note of the index numbers of such candidates.

Experience suggests that candidates who are red/green colour-blind – the most common form – do not generally have significant difficulty. Reporting such cases with the scripts removes the need for a 'Special Consideration' application for this handicap.

This form must be completed and sent to the Examiner in the envelope with the scripts.

Centre Number Name of Centre

1 Supervisor's Results

Please submit details of the readings obtained in **Question 1** on a spare copy of the question paper clearly marked 'Supervisor's Results' **and showing the Centre number and appropriate session/laboratory number.**

2 The index numbers of candidates attending each session were:

First Session

Second Session

3 The Supervisor is required to give details overleaf of any difficulties experienced by particular candidates, giving names and index numbers. These should include reference to:

- (a) any general difficulties encountered in making preparation;
- (b) difficulties due to faulty apparatus or materials;
- (c) accidents with apparatus or materials;
- (d) assistance with respect to colour-blindness.

Other cases of hardship, e.g. illness, temporary disability, should be reported direct to CIE on the normal 'Application for Special Consideration' form.



4 A plan of work benches, giving details by index numbers of the places occupied by the candidates for each experiment for each session, must be enclosed with the scripts.

Report on any difficulties experienced by candidates.

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This document consists of **9** printed pages and **3** blank pages.



Safety

Supervisors are advised to remind candidates that **all** substances in the examination should be treated with caution. Only those tests described in the question paper should be attempted. Please also see under 'Apparatus' on the use of pipette fillers, safety goggles and plastic gloves.

In accordance with COSHH (Control of Substances Hazardous to Health) Regulations, operative in the UK, a hazard appraisal of the examination has been carried out.

Attention is drawn in particular, to certain materials used in the examination. The following codes are used where relevant.

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T toxic substance	N dangerous for the environment

The attention of Supervisors is drawn to any local regulations relating to safety and first-aid.

'Hazard Data Sheets', relating to materials used in this examination, should be available from your chemical supplier.

Before the Examination

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2 Preparation of materials

Where quantities are specified for each candidate, they are sufficient for the experiments described in the question paper to be completed.

In preparing materials, the bulk quantity for each substance should be increased by 25% as spare material should be available to cover accidental loss. More material may be supplied if requested by candidates, without penalty.

All solutions should be bulked and mixed thoroughly before use to ensure uniformity.

Every effort should be made to keep the concentrations accurate to within one part in two hundred of those specified.

Supervisors are asked to carry out any confirmatory tests given on pages 4, 5 and 6 to ensure the materials supplied are appropriate.

If the concentrations differ slightly from those specified, the Examiners will make the necessary allowance. They should be informed of the exact concentrations.

3 Labelling of materials

Materials must be labelled as specified in these instructions. Materials with an **FB** code number should be so labelled **without** the identities being included on the label. Where appropriate the identity of an **FB** coded chemical is given in the question paper itself.

4 Identity of materials

It should be noted that descriptions of solutions given in the question paper may not correspond exactly with the specifications in these Instructions. **The candidates must assume the descriptions given in the question paper.**

5 Size of group

In view of the difficulty of the preparation of large quantities of solution of uniform concentration, it is recommended that the maximum number of candidates per group be 30 and that separate supplies of solutions be prepared for each group.

Apparatus

- 1 In addition to the fittings ordinarily contained in a chemical laboratory, the apparatus and materials specified below will be necessary.
 - 2 Pipette fillers (or equivalent safety devices), safety goggles and disposable plastic gloves should be used where necessary.
 - 3 Candidates may be expected to rinse and re-use glassware.
 - 4 *For each candidate*
 - 1 × 50 cm³ burette labelled **FB 3**
 - 1 × 50 cm³ burette labelled **FB 4**
 - 2 × burette clamps
 - 2 × stands
 - 2 × funnels for filling burettes
 - 1 × 250 cm³ conical flask
 - 1 × measuring cylinder to measure 25 cm³ – **labelled A**
 - 1 × measuring cylinder to measure 25 cm³ – **labelled B**
 - 2 × 100 cm³ beakers
 - 1 × stop clock (or sight of a laboratory clock capable of measuring time in seconds)
 - 1 × heat proof mat
 - 1 × Bunsen burner
 - 1 × test-tube holder
 - 8 × test-tubes
 - 2 × boiling-tubes
 - 1 × test-tube rack
 - paper towels
 - 1 × spatula
 - 1 × stirring-rod
 - 2 × teat/squeeze pipettes
 - the apparatus normally used in the Centre, for heating a flammable liquid in a boiling-tube
- At least one of these must be a 25 cm³ cylinder, not a larger or smaller cylinder.*

Chemicals Required

1 It is **especially important** that great care is taken that the confidential information given below does **not** reach the candidates either directly or indirectly.

2 Particular requirements

hazard	label	per candidate	identity	notes (Hazards given in this column are for the raw materials.)
[H]	FB 1	200 cm ³	1 mol dm ⁻³ sulphuric acid	Cautiously pour 55 cm ³ of concentrated (98%) sulphuric acid [C] into 500 cm ³ of distilled water with continuous stirring. Make the solution up to 1 dm ³ with distilled water. Care – concentrated H ₂ SO ₄ is very corrosive
	FB 2	150 cm ³	0.1 mol dm ⁻³ potassium iodide	Dissolve 16.6 g of KI [H] in each dm ³ of distilled water.
	FB 3	70 cm ³	0.1 mol dm ⁻³ sodium thiosulphate	Dissolve 24.8 g of Na ₂ S ₂ O ₃ ·5H ₂ O in each dm ³ of distilled water. <i>The distilled water used to make up this solution should be boiled to eliminate dissolved air and covered while cooling to prevent any carbon dioxide dissolving. Acidity in the water can lead to decomposition of the thiosulphate.</i>
[H]	FB 4	120 cm ³	0.1 mol dm ⁻³ hydrogen peroxide	Prepare from freshly purchased 100 volume (30% w/w, 8.3 mol dm ⁻³) [C] [O] or 20 volume (6% w/w, 1.7 mol dm ⁻³) [C] [O] hydrogen peroxide. (Dilute 200 cm³ of 100 volume solution to 1 dm³ of 20 volume solution, then) dilute 59 cm³ of 20 volume solution to 1 dm³ of 0.1 mol dm⁻³ solution. <i>This solution should be prepared as late as possible and stored in a cool part of the laboratory to prevent decomposition.</i>
	starch indicator	20 cm ³	2% starch solution	Mix 2 g of soluble starch with a little cold water until a smooth paste is obtained. Add 100 cm ³ of boiling water and stir. Boil until a clear solution is obtained (about 5 minutes).
	distilled water	200 cm ³	distilled water	
[H]	FB 5	20 cm ³	0.1 mol dm ⁻³ nickel(II) sulphate	Dissolve 26.3 g of NiSO ₄ ·6H ₂ O [H] in each dm ³ of solution.

2 Particular requirements (continued)

hazard	label	per candidate	identity	notes (Hazards given in this column are for the raw materials.)
[H]	FB 6	20 cm ³	0.1 mol dm ⁻³ copper(II) chloride	Dissolve 17.0 g of CuCl ₂ ·2H ₂ O [T] in each dm ³ of solution.
[H]	FB 7	20 cm ³	0.1 mol dm ⁻³ chromium(III) chloride	Dissolve 26.6 g of CrCl ₃ ·6H ₂ O [H] in each dm ³ of solution.
[H]	FB 8	2 g	2-hydroxybenzoic acid	2-hydroxybenzoic acid is salicylic acid.
[F]	ethanol	5 cm ³	ethanol	Industrial methylated spirit (IMS) may be used.
[C]	concentrated sulphuric acid	1 cm ³	concentrated sulphuric acid	The acid should be freshly purchased and should not have absorbed moisture from the air. This may be made available from a communal supply if preferred.
[F]	magnesium ribbon	1 cm	magnesium ribbon	

The list of chemicals required is continued overleaf.

- 3** The standard bench reagents specifically required are set out below. If necessary, they may be made available from a communal supply: however, the attention of the Invigilators should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates.

hazard	label	identity	notes (Hazard symbols refer to the raw materials.)
[H]	dilute hydrochloric acid	2.0 mol dm ⁻³ HCl	Dilute 172 cm ³ of concentrated (35% w/w; approximately 11 mol dm ⁻³) acid [C] to 1 dm ³ .
[C]	dilute nitric acid	2.0 mol dm ⁻³ HNO ₃	Dilute 128 cm ³ of concentrated (70% w/w) acid [C] [O] to 1 dm ³ .
[H]	dilute sulphuric acid	1.0 mol dm ⁻³ H ₂ SO ₄	Acid of same concentration as FB 1 .
[H]	aqueous ammonia	2.0 mol dm ⁻³ NH ₃	Dilute 112 dm ³ of concentrated (35% w/w) ammonia [C] [N] to 1 dm ³ .
[C]	aqueous sodium hydroxide	2.0 mol dm ⁻³ NaOH	Dissolve 80.0 g of NaOH [C] in each dm ³ of solution. Care – the process of solution is exothermic and any concentrated solution is very corrosive.
[T] [H]	0.1 mol dm⁻³ barium chloride	0.1 mol dm ⁻³ barium chloride [or barium nitrate]	Dissolve 24.4 g of BaCl ₂ ·2H ₂ O [T] (or 26.1 g of Ba(NO ₃) ₂ [H] [O]) in each dm ³ of solution.
[H] [N]	0.05 mol dm⁻³ silver nitrate	0.1 mol dm ⁻³ silver nitrate	Dissolve 8.5 g of AgNO ₃ [C] [N] in each dm ³ of solution.

- 4** The reagents, materials and apparatus to test the gases listed in the syllabus must be available to candidates. If necessary, they may be made available from a communal supply: however, the attention of the Invigilators should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates.

hazard	label	identity	notes
[H]	limewater	saturated aqueous calcium hydroxide, Ca(OH) ₂	Prepare fresh limewater by leaving distilled water to stand over solid calcium hydroxide [H] for several days, shaking occasionally. Decant or filter the solution.
[T] [N]	aqueous potassium dichromate(VI)	0.1 mol dm ⁻³ K ₂ Cr ₂ O ₇	Dissolve 29.5 g of K ₂ Cr ₂ O ₇ [T] [N] in each dm ³ of solution which should contain about 10% of dilute (1 mol dm ⁻³) sulphuric acid [H]. <i>The use of plastic gloves may be considered to prevent contact with skin.</i>
red and blue litmus paper, plain filter paper strips for use with dichromate, wooden splints, the apparatus normally used in the Centre for use with limewater in testing for carbon dioxide			

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COLOUR BLINDNESS

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Experience suggests that candidates who are red/green colour-blind – the most common form – do not generally have significant difficulty. Reporting such cases with the scripts removes the need for a 'Special Consideration' application for this handicap.

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Second Session

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