



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

CHEMISTRY

9701/31

Paper 31 Advanced Practical Skills

October/November 2008

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, first-aid and the disposal of chemicals.

'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 *For each candidate*

2 × 50 cm³ burettes
2 × burette clamps
2 × stands
2 × funnels for filling burettes
1 × 250 cm³ graduated (volumetric) flask, labelled **FA 3**, with stopper
1 × 250 cm³ conical flask
1 × 25 cm³ pipette
1 × pipette filler
1 × white tile
1 × wash-bottle containing distilled water
1 × heat-proof mat
1 × Bunsen burner
1 × test-tube holder
1 × hard glass (*Pyrex* or other borosilicate) boiling-tube
access to a balance weighing to 0.1 g or better
5 × test-tubes
2 × boiling-tubes
1 × test-tube rack
2 × teat/squeeze/dropping pipettes
1 × glass rod
1 × spatula
paper towels

A reserve of hard glass boiling-tubes should be available as replacement tubes in case of breakage.

Where access to a balance is limited some candidates should be instructed to start with question 1, a second group with question 2 and a third group with question 3.

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 are for the raw materials.)
[C]	FA 1	80 cm ³	0.525 mol dm ⁻³ ethanoic acid	Dissolve 31.50 g of freshly purchased glacial ethanoic acid [C] in each dm ³ of distilled water.
[H]	FA 2	150 cm ³	0.085 mol dm ⁻³ sodium hydroxide	Dissolve 3.40 g of freshly purchased NaOH [C] in each dm ³ of distilled water. <i>Issue this solution in a stoppered container or beaker covered with 'clingfilm' or 'gladwrap' to prevent absorption of carbon dioxide.</i>
[F]	phenolphthalein indicator	10 cm ³	phenolphthalein indicator	Dissolve 1.0 g of solid phenolphthalein [H] in 600 cm ³ of ethanol (IMS) [F] and dilute the resulting solution to 1 dm ³ with distilled water. Alternatively use commercially produced indicator solution.
Check Titre. Pipette 100.0 cm ³ of FA 2 into a conical flask and add 3–4 drops of phenolphthalein indicator. Titrate with FA 1 until the solution just turns colourless. Adjust the concentration of FA 1, if necessary, to give a titre of 16.2 ± 0.2 cm³.				
	FA 4	4–5 g	magnesium sulphate crystals	Provide 4–5 g of freshly purchased MgSO ₄ ·7H ₂ O in a stoppered test-tube labelled FA 4. <i>Reserve tubes should be available.</i>
[H]	FA 5	0.5 g	solid manganese(IV) oxide, MnO ₂	
[H]	FA 6	15 cm ³	0.1 mol dm ⁻³ iron(II) sulphate	Dissolve 27.8 g of freshly purchased FeSO ₄ ·7H ₂ O [H] in 100 cm ³ of 1 mol dm ⁻³ sulphuric acid [H] and make up to 1 dm ³ with distilled water. <i>To prevent aerial oxidation it is best to use boiled distilled water in preparing this solution and to keep it stoppered or covered before issue to candidates.</i>
[H]	FA 7	20 cm ³	10 volume aqueous hydrogen peroxide	Dilute 1 part of 100 volume (30% w/w, 8.3 mol dm ⁻³) hydrogen peroxide [C] [O] with 9 parts distilled water OR Dilute 1 part of 20 volume (6% w/w, 1.7 mol dm ⁻³) hydrogen peroxide [H] [O] with 1 part of distilled water.
	starch solution	10 cm ³	2% w/v starch solution	Make a paste from 20 g of soluble starch and 50 cm ³ of distilled water taken from 1 dm ³ of water. Boil the remaining water and pour the paste into the boiling water. Stir well and allow to cool.
[H]	10% potassium iodide solution	10 cm ³	10% w/v potassium iodide solution	Dissolve 100 g of KI [H] in each dm ³ of distilled water.

- 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 are for 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]	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.
[H]	aqueous ammonia	2.0 mol dm ⁻³ NH ₃	Dilute 112 cm ³ of concentrated (35% w/w) ammonia [C] [N] to 1 dm ³ .
[T]	0.1 mol dm ⁻³ barium chloride [or 0.1 mol dm ⁻³ barium nitrate]	0.1 mol dm ⁻³ barium chloride [or 0.1 mol dm ⁻³ 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]	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.

5

- 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 are for 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]	acidified aqueous potassium dichromate(VI)	0.05 mol dm ⁻³ K ₂ Cr ₂ O ₇ 0.05 mol dm ⁻³ H ₂ SO ₄	Dissolve 14.8 g of K ₂ Cr ₂ O ₇ [T] [N] in 50 cm ³ of 0.1 mol dm ⁻³ sulphuric acid [H]. Make the solution up to 1 dm ³ with distilled water. <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 Question 1 and Question 2** 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 and Question 2** 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 to 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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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
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CHEMISTRY

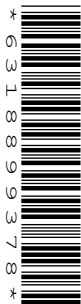
9701/32

Paper 32 Advanced Practical Skills

October/November 2008

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

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.

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, first-aid and the disposal of chemicals.

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Before the Examination

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2 Preparation of materials

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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 **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 *For each candidate*

2 × 50 cm³ burettes

2 × burette clamps

2 × stands

2 × funnels for filling burettes

1 × 250 cm³ graduated (volumetric) flask, labelled **FB 5**, with stopper

2 × 250 cm³ conical flasks

1 × 10 cm³ measuring cylinder or tube marked to measure approximately 10 cm³

1 × 25 cm³ pipette *A strip of tape should be applied below the graduation mark on the pipette with the top of the tape indicating the graduation line. This instruction may be ignored if the pipette has white graduations.*

1 × pipette filler

1 × white tile

1 × wash-bottle containing distilled water

1 × 100 cm³ (or 1 × 50 cm³) measuring cylinder

1 × spatula

access to a balance **capable of weighing 300g to 0.1 g or better**

1 × heat-proof mat

1 × Bunsen burner

1 × test-tube holder

1 × test-tube rack

10 × test-tubes

2 × stoppers for test-tubes

3 × boiling-tubes

paper towels

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 are for the raw materials.)
	FB 1	150 cm ³	0.145 mol dm ⁻³ sodium thiosulphate	Dissolve 36.0 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][N]	FB 2	85 cm ³	approximately 0.18 mol dm ⁻³ potassium manganate(VII)	Dissolve 28.44 g of KMnO ₄ [O][H][N] in each dm ³ of distilled water.
[H]	FB 3	100 cm ³	1 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]	FB 4	60 cm ³	10% w/v potassium iodide solution	Dissolve 100 g of KI [H] in each dm ³ of distilled water.
	starch indicator	10 cm ³	2% w/v starch solution	Make a paste from 20 g of soluble starch and 50 cm ³ of distilled water taken from 1 dm ³ of water. Boil the remaining water and pour the paste into the boiling water. Stir well and allow to cool.
Check Titre. Pipette (or use a measuring cylinder) 5.0 cm ³ of FB 2 into a conical flask containing 10 cm ³ each of FB 3 and FB 4 . Titrate with FB 1 , adding 1 cm ³ of starch indicator just before the solution goes colourless. Continue the titration drop by drop until the solution goes colourless. Adjust the concentration of FB 1, if necessary, to give a titre of 31.0 ± 0.5 cm³.				
[H]	FB 6	7 g	anhydrous sodium carbonate	Provide 7.0 ± 0.2 g of anhydrous sodium carbonate, Na ₂ CO ₃ , [H] in a stoppered tube labelled FB 6 . <i>Dry the anhydrous sodium carbonate by heating in an oven at 100 °C for several hours, then cooling in a desiccator.</i>
[H]	FB 7	5 g	anhydrous sodium carbonate	Provide 5.0 ± 0.2 g of anhydrous sodium carbonate, Na ₂ CO ₃ , [H] in a stoppered tube labelled FB 7 . <i>Dry the anhydrous sodium carbonate as above.</i>
[H]	FB 8	200 cm ³	2.0 mol dm ⁻³ hydrochloric acid	Dilute 172 cm ³ of concentrated (35% w/w; approximately 11 mol dm ⁻³) acid [C] to 1 dm ³ .

2 Particular requirements (continued)

hazard	label	per candidate	identity	notes (Hazard symbols given in this column are for the raw materials.)
[H]	FB 9	20 cm ³	0.1 mol dm ⁻³ ammonium bromide	Dissolve 5.4 g of NH ₄ Cl [H] and 10.3 g of NaBr in each dm ³ of solution.
	FB 10	20 cm ³	0.1 mol dm ⁻³ aluminium sulphate	Dissolve 63.0 g of Al ₂ (SO ₄) ₃ .16H ₂ O in each dm ³ of solution.
[T][N]	FB 11	20 cm ³	0.1 mol dm ⁻³ lead(II) nitrate	Dissolve 33.1 g of Pb(NO ₃) ₂ [T][O][N] in each dm ³ of solution.
[H]	barium carbonate	1 g	powdered barium carbonate	Provide approximately 1 g of powdered barium carbonate, BaCO ₃ , [H] in a suitable container.
[H]	X₂CO₃	1 g	anhydrous sodium carbonate	Provide approximately 1 g of anhydrous sodium carbonate [H] in a suitable container.

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 given in this column are for 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]	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.
[H]	aqueous ammonia	2.0 mol dm ⁻³ NH ₃	Dilute 112 cm ³ of concentrated (35% w/w) ammonia [C] [N] to 1 dm ³ .
[T]	0.1 mol dm⁻³ barium chloride	0.1 mol dm ⁻³ barium chloride	Dissolve 24.4 g of BaCl ₂ ·2H ₂ O [T] in each dm ³ of solution.
[H]	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 are for 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]	acidified aqueous potassium dichromate(VI)	0.05 mol dm ⁻³ K ₂ Cr ₂ O ₇ 0.05 mol dm ⁻³ K ₂ SO ₄	Dissolve 14.8 g of K ₂ Cr ₂ O ₇ [T] [N] in 50 cm ³ of 0.1 mol dm ⁻³ sulphuric acid [H]. Make the solution up to 1 dm ³ with distilled water. <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(VI), wooden splints, the apparatus normally used in the Centre for use with limewater in testing for carbon dioxide			

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- 5 **A Seating Plan for each session/laboratory.**

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COLOUR BLINDNESS

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Centre Number Name of Centre

1 Supervisor's Results

Please submit details of the readings obtained in **Question 1 and Question 2** 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;
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- (c) accidents with apparatus or materials;
- (d) assistance with respect to colour-blindness.

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