

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 disposable 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 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 concentrations accurate to within one part in two hundred of those specified.

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.

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 in preparing 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 gloves should be used where necessary.

3 *For each candidate*

- 2 × 250 cm³ beakers
- 1 × glass rod
- 1 × metal spatula
- 1 × 250 cm³ volumetric (graduated) flask and stopper
- 2 × dropping pipettes
- 1 × 50 cm³ burette
- 1 × burette clamp and stand
- 1 × small funnel for filling burette
- 1 × 25 cm³ pipette
- 1 × pipette filler
- 2 × 250 cm³ conical flasks
- 1 × white tile
- 1 × foamed plastic (expanded polystyrene) cup
- 1 × –10 to +50 °C thermometer with divisions of 0.5 °C or better.
- 1 × 25 cm³ measuring cylinder
- 1 × Bunsen burner
- 1 × heat-proof mat
- 4 × test-tubes
- 3 × hard-glass tubes – suitable for heating solids
- 1 × test-tube holder
- 1 × test-tube rack
- 1 × wash bottle of distilled water
- paper towels

access to balance, single-pan, direct reading, minimum accuracy 0.1 g (1 per 8–12 candidates)

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 symbols given in this column refer to the raw materials.) |
|--|-------------|---------------------|--|---|
| [H] | FA 1 | 3g | mixture of sodium carbonate and sodium hydrogencarbonate | Each candidate should be provided with a mixture of exactly 2.00g of Na ₂ CO ₃ [H] and 1.00g of NaHCO ₃ in a stoppered bottle. |
| | FA 2 | 150 cm ³ | 0.2 mol dm ⁻³ HCl | Dilute 2.0 mol dm ⁻³ HCl [H] ten-fold. (see notes for FA 4) |
| [H] | FA 3 | 2g | mixture of sodium carbonate and sodium hydrogencarbonate | Each candidate should be provided with a mixture of exactly 1.40g of Na ₂ CO ₃ [H] and 0.60g of NaHCO ₃ in a stoppered bottle. |
| Suitability of reagents: Adding 2.00g of Na ₂ CO ₃ [H] to 25cm ³ of 2.0 mol dm ⁻³ HCl should produce a temperature increase of at least 5 °C. If the temperature increase is less than 5 °C, the sodium carbonate should be heated in an evaporating basin with a gentle flame for 30 minutes and allowed to cool in a desiccator. Adding 2.00g of NaHCO ₃ to 25 cm ³ of 2.0 mol dm ⁻³ HCl should produce a temperature decrease of at least 4 °C. | | | | |
| [H] | FA 4 | 100 cm ³ | 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 . |
| | FA 5 | 2g | hydrated magnesium chloride | Each candidate should be provided with approximately 2g of MgCl ₂ ·6H ₂ O in a stoppered tube. |
| | FA 6 | 2g | basic zinc carbonate | Each candidate should be provided with approximately 2g of 2ZnCO ₃ ·3Zn(OH) ₂ in a stoppered tube. |
| | FA 7 | 2g | sodium nitrate | Each candidate should be provided with approximately 2g of NaNO ₃ in a stoppered tube. |
| | FA 8 | 25 cm ³ | 0.1 mol dm ⁻³ sodium chloride and 0.1 mol dm ⁻³ sodium sulfite | Dissolve a mixture of 5.84g of NaCl and 12.6g of sodium sulfite, Na ₂ SO ₃ [H] in each dm ³ of solution. Keep the solution in a stoppered flask . Provide 25cm ³ for each candidate in a stoppered flask . The solution should be freshly prepared as close as possible to the time of the examination. |

2 Particular requirements (continued)

| | | | | |
|-----|--------------------------------|---------------------|-------------------------|--|
| [H] | methyl orange indicator | 10 cm ³ | methyl orange indicator | Dissolve 0.4 g of solid [T] in 200 cm ³ of ethanol (IMS) [F] [H] and make up to 1 dm ³ with distilled water. |
| | distilled water | 300 cm ³ | distilled water | |

- 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 Invigilator should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates.

| hazard | label | identity | notes |
|---------|---|---|---|
| [H] | dilute hydrochloric acid | 2.0 mol dm ⁻³ HCl | (Hazards symbols given in this column refer to the raw materials.) 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/v) acid [C] [O] to 1 dm ³ . |
| [H] | dilute sulfuric acid | 1.0 mol dm ⁻³ H ₂ SO ₄ | Cautiously pour 55 cm ³ of concentrated (98%) sulfuric 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 cm ³ of concentrated (35%) 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 is exothermic and any concentrated solution is very corrosive. |
| [H] [N] | aqueous silver nitrate | 0.05 mol dm ⁻³ silver nitrate | Dissolve 8.5 g of AgNO ₃ [C] [N] in each dm ³ of solution. |
| [T] [N] | 0.1 mol dm⁻³ lead(II) nitrate | 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] | aqueous barium chloride or aqueous 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] in each dm ³ of solution. or 26.1 g of Ba(NO ₃) ₂ [H] [O] in each dm ³ of solution. |
| [T] [N] | 0.1 mol dm⁻³ potassium chromate(VI) | 0.1 mol dm ⁻³ potassium chromate(VI) | Dissolve 19.4 g of K ₂ CrO ₄ [T] [N] in each dm ³ of solution. |
| | 1.0 mol dm⁻³ sodium carbonate | 1.0 mol dm ⁻³ sodium carbonate | Dissolve 286.1 g of Na ₂ CO ₃ ·10H ₂ O [H] in each dm ³ of solution. |

4 The following materials and apparatus should be available.

| red and blue litmus papers, plain filter paper strips for use with dichromate(VI), aluminium foil for testing nitrate/nitrite, wooden splints, the apparatus normally used in the Centre for use with limewater in testing for carbon dioxide | | notes |
|---|--|---|
| hazard | label | identity |
| [H] | limewater | saturated aqueous calcium hydroxide |
| [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 |
| | | (Hazards symbols given in this column refer to the raw materials.) Prepare fresh limewater by leaving distilled water to stand over solid Ca(OH) ₂ [H] for several days, shaking occasionally. Decant or filter the solution. Dissolve 14.8 g of K ₂ Cr ₂ O ₇ [T] [N] in 50 cm ³ of 1 mol dm ⁻³ sulfuric acid [H]. Make the solution up to 1 dm ³ with distilled water. <i>The use of disposable gloves may be considered to prevent contact with skin.</i> |

Responsibilities of the Supervisor during the Examination

- 1 The Supervisor, or other competent chemist **must carry out the experiments in questions 1, 2 and 3** 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 11 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 12 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 each 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 11 and 12).
- 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 to 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.

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REPORT FORM

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 **Questions 1, 2 and 3** 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 candidate 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 candidate 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 candidate 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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