
PHYSICAL SCIENCE

8780/04

Paper 4 Advanced Practical Skills

October/November 2014

CONFIDENTIAL INSTRUCTIONS

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

No access to the Question Paper is permitted in advance of the examination.



The Supervisor's attention is drawn to the form on page 11 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 and paper number.

This document consists of **11** printed pages and **1** blank page.

Safety

Supervisors are advised to remind candidates that **all** substances in the examination should be handled with caution. Only those tests described in the Question Paper should be attempted. Pipette fillers and safety goggles should be used where necessary.

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.

The following hazard 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 Centres 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 These instructions detail the apparatus required for the experiments in the Question Paper. **Access to the Question Paper is NOT permitted in advance of the examination.** The contents of these Confidential Instructions must not be revealed either directly or indirectly to the candidates.

- 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.

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

- 3 **Labelling of materials**

Materials must be labelled as specified in these Confidential Instructions. It may be required for some materials to be labelled but **without** the identities being included on the label.

It should be noted that descriptions of materials given in the Question Paper may not correspond with the specifications in these Instructions. **The candidates must assume the descriptions given in the Question Paper.**

- 4 **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.

- 5 **Number of sets of apparatus**

The minimum number of sets of apparatus provided for each experiment is half the number of candidates taking the examination. There should, in addition, be a few spare sets of apparatus available in case problems arise during the examination.

The Examination

1 Organisation of the Examination

Essential Information relating to the conduct and invigilation of the Practical Examination is given in the Handbook for Centres.

Candidates should be allowed access to the apparatus for each experiment for 45 minutes only. After spending 45 minutes on one experiment, candidates should change over to the other experiment. The order in which a candidate attempts the two experiments is immaterial.

2 Assistance to Candidates

Supervisors should make the following announcement at the start of the examination:

'The Examiners do not want you to waste time when you are unable to do any experiment. Any candidate who is unable to get results with an experiment may ask for help. The extent of this help will be reported to the Examiners, who may make a deduction of marks.'

Assistance should only be given when it is asked for by a candidate, or as directed in the Notes sections of these Instructions, or where apparatus is seen to have developed a fault. Assistance should be restricted to enabling candidates to make observations and measurements. Observations and measurements must not be made for candidates, and no help should be given with data analysis or evaluation.

All assistance given to candidates must be reported on the Supervisor's Report Form.

3 Colour blindness

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 candidate numbers of such candidates. Reporting such cases with the scripts removes the need for a 'Special Consideration' application.

Candidates who are red/green colour blind do not generally have significant difficulty.

4 Faulty apparatus

In cases of faulty apparatus that prevent the required measurements from being taken, the Supervisor may allow extra time to give the candidate a fair opportunity to perform the experiment as if the fault had not been present.

5 Supervisor's Results

If asked to do so in the Confidential Instructions, the Supervisor, or other competent Physical Scientist, should carry out the required experimental work **out of sight of the candidates**. Access to the Question Paper is NOT permitted in advance of the examination.

Supervisor's Results are required for each session and each laboratory used in that session, and each set of solutions supplied. The Question Paper cover requests candidates 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 Supervisor's Results as the candidate's work cannot be assessed accurately without such information.

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 Results if required by the Confidential Instructions,
- 3 the Supervisor's Report, including details of any difficulties experienced by candidates (see pages 11 and 12),
- 4 the Attendance Register,
- 5 a plan of work benches, giving details by candidate number of the places occupied by the candidates for each experiment and session.

Instructions for Preparing Apparatus and Materials

In addition to the fittings ordinarily contained in a Science laboratory, the apparatus and materials specified below will be necessary.

Question 1

Apparatus requirements (per set of apparatus unless otherwise specified)

Connect $4 \times 1.5\text{V}$ cells in series, preferably in a cell holder (AA or C size manganese – alkaline cells are ideal; these must be new). Connect a 10Ω resistor in series with these. The cells and 10Ω resistor should be enclosed in a sealed opaque box with suitable terminals external to the box. The positive and negative terminals should be clearly labelled. The box should be labelled 'power supply'.

1 $\times$ Ammeter. The ammeter must be capable of measuring currents in the range 0 to 1 A to a precision of 0.01 A. Either an analogue or a digital meter is suitable. If multimeters are used, the setting must be fixed (e.g. with insulating tape) and candidates instructed **not** to alter the setting. It is advisable to check that the ammeters are consistent across the set.

3 $\times$ connecting leads.

Suitable connectors so that candidates can connect easily to the power supply and the resistances.

24 $\times$ 10Ω resistors with a tolerance of $\pm 5\%$; e.g. wirewound fixed resistors, Rapid Catalogue reference 62-0245. The resistors must have a power rating of at least 3W.

1 $\times$ 6.8Ω resistor with a tolerance of $\pm 5\%$; e.g. Rapid Catalogue reference 62-0275. The resistor must have a power rating of at least 3W.

1 $\times$ heat-proof mat.

The candidates will need to assemble and use the circuit shown in Fig. 1.1.

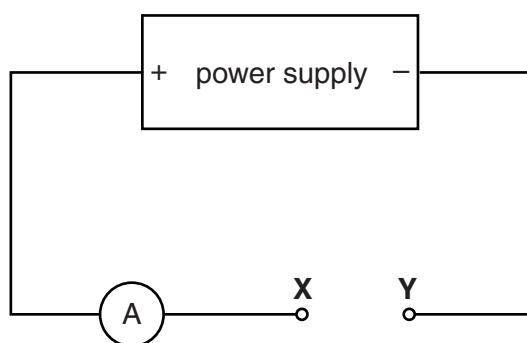


Fig. 1.1

Notes

- 1 1 $\times$ 10Ω resistor connected in series with the cells, the whole enclosed in an opaque box as described above.

- 2 The resistors need to be made up into the following networks. In each case the resistors must be soldered together (rather than just twisted) and the networks labelled as stated below. The networks must **not** be put in boxes. The labels should be attached to the resistor networks.

- $2 \times 10\ \Omega$ in parallel, **labelled $5\ \Omega$**
- $1 \times 10\ \Omega$, **labelled $10\ \Omega$**
- $1 \times 10\ \Omega$, then in series with $2 \times 10\ \Omega$ in parallel, **labelled $15\ \Omega$**
- $2 \times 10\ \Omega$ in series, **labelled $20\ \Omega$**
- $1 \times 10\ \Omega$ and $1 \times 6.8\ \Omega$ in series, then in series with $2 \times 10\ \Omega$ in parallel, **labelled $25\ \Omega$**
- $3 \times 10\ \Omega$ in series **labelled $30\ \Omega$**
- $3 \times 10\ \Omega$ in series, then in series with $2 \times 10\ \Omega$ in parallel, **labelled $35\ \Omega$**
- $4 \times 10\ \Omega$ in series, **labelled $40\ \Omega$**

See Fig. 1.2 for the networks.

The candidates must **not** be able to identify visually the resistance of any individual resistor. Therefore, the resistor value code on each resistor **must** be obscured (e.g. with insulating tape). In particular, the $6.8\ \Omega$ resistor must **not** be visibly different from the remainder.

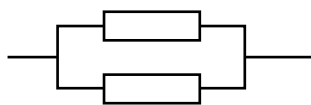
- 3 The parts of the circuit labelled X–Y should be placed on the heat-proof mat.

Action at changeover

Disconnect the circuit and check the cells in the power supply are in good condition. Also check that the networks are still firmly connected and are correctly labelled. Candidates should be reminded **not** to alter any settings on the ammeter nor remove the insulating tape from the resistors.

Networks

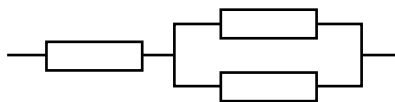
All the resistors should be of resistance $10\ \Omega$, except the one marked $6.8\ \Omega$.



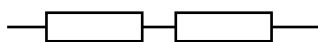
labelled $5\ \Omega$



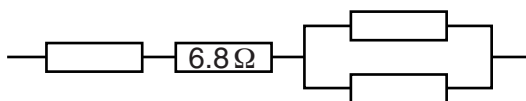
labelled $10\ \Omega$



labelled $15\ \Omega$



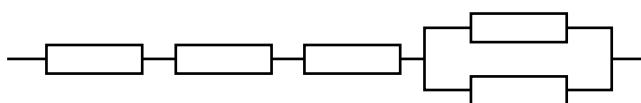
labelled $20\ \Omega$



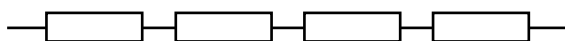
labelled $25\ \Omega$



labelled $30\ \Omega$



labelled $35\ \Omega$



labelled $40\ \Omega$

Fig. 1.2

Question 2

Under no circumstances must the identity of solution P be divulged to candidates.

Apparatus required for each candidate

- 1 × 100 cm³ stoppered conical flask containing 25 cm³ of a freshly prepared solution containing 200 g of hydrated iron(II) ammonium sulfate in each dm³. Labelled **P**.
- 1 × 500 cm³ beaker as a container for a water bath
- 8 × clean test-tubes
- 1 × test-tube rack
- 1 × 25 cm³ measuring cylinder
- 1 × 10 cm³ measuring cylinder
- 4 × teat/squeeze/dropping pipettes
- 1 × piece each of red and blue litmus paper (more needs to be available if required by candidates)
- paper towels
- access to distilled (deionised) water
- access to freshly boiled (very hot) water (could be from a kettle)

Chemicals

See table on page 8.

Notes

- 1 Spare materials and equipment should be available and can be provided without penalty.
Candidates should be made aware of this.
- 2 Safety goggles and disposable plastic gloves should be used where necessary.
- 3 Candidates should be warned of the dangers of using very hot water.

Chemicals Required for Question 2

The following codes are used where relevant:

[C] = corrosive substance
[H] = harmful or irritating substance
[T] = toxic substance

[F] = highly flammable substance
[O] = oxidising substance
[N] = harmful for the environment

Particular requirements

hazard	label	per candidate	identity	notes
	P	25 cm ³ of solution P in a 100 cm ³ conical flask	iron(II) ammonium sulfate solution	Dissolve 200 g of hydrated iron(II) ammonium sulfate, (NH ₄) ₂ Fe(SO ₄) ₂ ·6H ₂ O, in each 1 dm ³ of deionised water. This must be freshly prepared as near to the time of the examination as possible and <u>stoppered</u> in conical flasks to prevent oxidation by the air.
	zinc	3 pieces	granulated zinc	The zinc should be washed in dilute sulfuric acid for a few minutes, then distilled water and dried before the examination.
	Hydrogen peroxide	20 cm ³	20 vol strength hydrogen peroxide	
[H]	Z	10 cm ³	potassium hexacyanoferrate(III) approx 0.1 mol dm ⁻³	Dissolve 33.0 g of freshly purchased potassium hexacyanoferrate(III) (potassium ferricyanide) in each 1 dm ³ of deionised water.

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	per candidate	identity	notes (details for making solutions can be found in the syllabus appendix.)
[O][H]	Barium nitrate	5 cm ³	barium nitrate 0.5 mol dm ⁻³	Barium chloride [T][H] may be used instead
[C]	Silver nitrate	5 cm ³	silver nitrate 0.05 mol dm ⁻³	
[C][O]	Dilute hydrochloric acid	30 cm ³	hydrochloric acid 2.0 mol dm ⁻³	Dilute 170 cm ³ of concentrated (35–37%; approximately 11 mol dm ⁻³) acid [C][O] to 1 dm ³ .
[C]	Sodium hydroxide	30 cm ³	sodium hydroxide 1.0 mol dm ⁻³	Dissolve 40.0 g of NaOH [C] in each dm ³ of solution. Care – the process of solution is exothermic and any concentrated solution is very corrosive.
[C]	Dilute nitric acid	10 cm ³	nitric acid of 1.0 mol dm ⁻³	

This form should be completed and sent to the Examiner with the scripts.

SUPERVISOR'S REPORT FORM

The Supervisor's Report should give full details of:

- (a)** any help given to a candidate (including the nature of the help given and the name and candidate number of the candidate),
- (b)** any cases of faulty apparatus (including the nature of the problem, the action taken to rectify it, any additional time allowed, and the name and candidate number of the candidate),
- (c)** assistance provided in the case of colour blindness,
- (d)** any other difficulties experienced by candidates, or any other information that is likely to assist the Examiner, especially if this information cannot be discovered in the scripts.

Cases of individual hardship, such as illness, bereavement or disability, should be reported direct to CIE on the normal Special Consideration form.

Supervisor's Report



Information required by Examiners

Sample set of numerical results, clearly marked 'Supervisor's Results'. These may be recorded on a spare copy of the Question Paper.

A plan of work benches for each session/laboratory.

Declaration (to be signed by the Supervisor)

The preparation of this practical examination has been carried out so as to maintain fully the security of the examination.

Signed

Name (in block capitals)

Centre Number

Centre Name

If scripts are required by CIE to be despatched in more than one envelope, it is essential that a copy of the relevant Supervisor's report, Supervisor's results and the appropriate seating plan(s) are sent inside **each** envelope.

