-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

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NATIONAL CERTIFICATE MODULE DESCRIPTOR

-Module Number- **3171072** **-Session- 1992-93**
-Superclass- **RC**

-Title- **ELECTRIC FIELDS ($X^1/_2$)**

-DESCRIPTION-

Purpose	This module is designed to extend the skills and knowledge required in the area of Electric Fields. It is suitable for candidates in a wide range of occupational areas, and in conjunction with Stage 2 and other Stage 3 Physics modules, could be a preparation for Higher Education.

Preferred Entry Level	3171121 Electricity and 3171111 Mechanics or Higher Grade Physics and Higher Grade Mathematics or equivalent.

Outcomes

The candidate should:

1. apply and interpret the concept of the electric field to explain electrical properties;

2. perform, predict and report on experiments relating to electric fields.

Assessment Procedures

Acceptable performance in this module will be satisfactory achievement of all the Performance Criteria specified for each Outcome.

The following abbreviations are used below:

PC Performance Criteria
IA Instrument of Assessment

Note: The Outcomes and PCs are mandatory and cannot be altered. The IA may be altered by arrangement with SQA. (Where a range of performance is indicated, this should be regarded as an extension of the PCs and is therefore mandatory.)

OUTCOME 1 **APPLY AND INTERPRET THE CONCEPT OF THE ELECTRIC FIELD TO EXPLAIN ELECTRICAL PROPERTIES**

PCs

(a) The use of the given terms in explanations is correct.
(b) The application of the concept of the electric field to describe, or predict a situation is correct.
(c) The application of the concept of the electric field to situations involving calculations or equations is correct with respect to the use of units, and obtaining a solution to the appropriate level of significance.
(d) The explanation of given electric field phenomena is consistent with the concepts involved.

IA Structured Question and Extended Response

2 structured questions and 1 extended response question to assess the candidate's ability to apply and interpret the concept of the electric field to explain electric properties under closed book conditions.

The 2 structured questions should be allocated to Performance Criteria (a), (b) and (c) and the extended response question should be allocated to Performance Criterion (d).

All the items listed below must be contained within the 2 structured questions:

(a) terms: electric field strength (E), permittivity of free space (ε_o).

(b) concepts: relative magnitude and range of gravitational, electric and strong nuclear forces, Coulomb's inverse square law, uniform electric field, charged particle motion at right angles and parallel to the plane of an electric field.

(c) calculations:

$$F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}; \quad E = \frac{v}{d}; \quad F = EQ$$

deflection of a charged particle moving normally to an electric field.

The extended response question must cover: Millikan's oil drop experiment and quantisation of charge. The candidate should produce a report of between 200 and 400 words.

Satisfactory achievement of the Outcome will be demonstrated by the candidate achieving all the Performance Criteria within the 3 questions.

OUTCOME 2 **PERFORM, PREDICT AND REPORT ON EXPERIMENTS RELATING TO ELECTRIC FIELDS**

PCs

(a) The setting up of the equipment is in accordance with the given specification.
(b) The experimental procedures carried out are correct and safe.
(c) The recording of the procedures, relevant observations and measurements is complete and accurate with numerical uncertainties where appropriate.
(d) The presented data is in an appropriate format.
(e) The identification of valid experimental errors in absolute and percentage terms is correct.
(f) The calculation and presentation of the overall uncertainty is correct and in the appropriate format.
(g) The conclusion(s) and prediction(s) drawn are valid within the limits of experimental uncertainty.

IA Assignment

An assignment to assess the candidate's ability to perform, predict and report on experiments relating to electric fields.

The candidate will be required to carry out a specified experiment and prepare a scientific report to cover Performance Criteria (c) to (g). The report must be structured and include the following sections: aims, procedures, readings and results, uncertainties and conclusions.

A checklist should be devised to ensure a reliable interpretation of the candidate's practical performance in relation to Performance Criteria (a) and (b).

Satisfactory achievement of the Outcome will be demonstrated by the candidate achieving all the Performance Criteria.

The following sections of the descriptor are offered as guidance.
They are not mandatory.

CONTENT/CONTEXT

Corresponding to Outcomes 1-2:

(a) Correct use of the following terms: permittivity, permittivity of free space (ε_0), electric field strength (E), equipotential.

(b) Concepts: fundamental forces of nature (gravitational, electric, nuclear), Coulomb's inverse square law, uniform electric field, charging by induction, electrostatic potential, potential difference, charged particle motion in an electric field, quantisation of charge, unification theory of electric and magnetic fields ($C^2 = 1/\mu_0 \varepsilon_0$).

(c) Calculations involving:

$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$, $F = EQ$, work done = QV,

$E = \frac{V}{d}$, $1/2\ mv^2 = QV$.

(d) Application of: Millikan's oil drop experiment, quantisation of charge.

(e) Experiments could include: charged particle motion in an electric field; Millikan's experiment.

SUGGESTED LEARNING AND TEACHING APPROACHES

A candidate-centred, resource-based learning approach is recommended. Concepts should be developed and reinforced by practical work integrated throughout this module. Teaching strategies designed to encourage independent study should be employed.

A range of experimental work should be included within the module to allow a selection of an assignment to be presented for summative assessment purposes. The candidate should be encouraged to document all observations and results of experiments in a folio of work.

During the work of the module candidates should have several opportunities to develop their practical and problem-solving skills. Each candidate should be assessed at appropriate points throughout the module. Where a candidate is unsuccessful in achieving an Outcome, provision should be made for remediation and reassessment.

Safety should be given due consideration at all times.