-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

Hanover House
24 Douglas Street
GLASGOW G2 7NQ

NATIONAL CERTIFICATE MODULE DESCRIPTOR

-Module Number- **3171082** **-Session-1992-93**
-Superclass- **RC**

-Title- **MECHANICAL PROPERTIES OF MATTER ($X^1/_2$)**

-DESCRIPTION-

Purpose

This module is designed to extend the skills and knowledge required in the field of mechanical properties of solids, liquids and gases. 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

3171111 Mechanics (x 1/2)
3171151 Properties of Matter (x 1/2) or
Higher Grade Physics and
Higher Grade Mathematics or equivalent.

Outcomes

The candidate should:

1. apply and interpret the concepts of mechanics to explain the mechanical properties of solids, liquids and gases;

2. perform, predict and report on experiments relating to the mechanical properties of solids, liquids and gases.

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 CONCEPTS OF MECHANICS TO EXPLAIN THE MECHANICAL PROPERTIES OF SOLIDS, LIQUIDS AND GASES**

PCs

(a) The use of the given terms in explanations is correct.
(b) The application of the concepts of elasticity, surface tension, fluid flow and viscosity to describe or predict a situation is correct.
(c) The application of the concepts of elasticity, surface tension, fluid flow and viscosity 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 fluid flow phenomena is consistent with the concepts involved.

IA Structured Questions and Assignment

3 structured questions under closed book conditions and an assignment to assess the candidate's ability to apply and interpret the concepts of mechanics to explain the mechanical properties of solids, liquids and gases.

The 3 structured questions should be allocated to Performance Criteria (a), (b) and (c) and the assignment should be allocated to Performance Criterion (d).

There should be one structured question on each of the following topics:

(i) elasticity;
(ii) surface tension;
(iii) fluid flow and viscosity.

All the items listed below must be contained within the 3 structured questions.

(i) (a) terms: stress, strain, elastic limit, Young's modulus of elasticity;
(b) concept: elasticity;
(c) calculation: $Y = \dfrac{F / A}{x / \ell}$

(ii) (a) terms: capillary rise, excess pressure
(b) concept: surface tension
(c) calculations: $\Delta p = \dfrac{2\mathrm{d}}{r}$, $\dfrac{h = 2\mathrm{d}}{rpg}$

(iii) (a) terms: laminar and turbulent flow, viscosity, coefficient of viscosity

(c) calculation:

$1/2\rho v^2 + \rho gh + p$ = constant

The assignment for Performance Criterion (d) must cover an application of Bernoulli's theorem to one of the following:

- measurement of air velocity by Pitot tube
- measurement of liquid flow by a Venturi meter
- flight

The canidate 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 and the assignment.

OUTCOME 2 **PERFORM, PREDICT AND REPORT ON EXPERIMENTS RELATING TO THE MECHANICAL PROPERTIES OF SOLIDS, LIQUIDS AND GASES**

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

2 assignments to assess the candidate's ability to perform, predict and report on experiments relating to mechanical properties.

The candidate will be required to carry out 2 experiments from the following topics:

(i) elasticity;
(ii) surface tension;
(iii) viscosity.

and prepare a scientific report on 1 experiment to cover Performance Criteria (c) to (f). The report must be structured and include the following sections: aims, procedures, readings and results, 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 Performance Criteria (a) and (b) on two occasions and Performance Criteria (c) to (g) on one occasion.

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

CONTENT/CONTEXT

Corresponding to Outcomes 1-2:

1. (a) Correct use of the following terms: stress, strain, elastic, plastic, elastic limit, modulus of elasticity, Hooke's Law, capillary rise, excess pressure, streamline, turbulence, shear stress, shear strain, viscosity, coefficient of viscosity, terminal velocity.

   (b) Application of: area under force/extension graph, surface tension, Bernoulli's theorem.

   (c) Calculations involving: $Y = \frac{F / A}{x / \ell}$, $E = 1/2 \quad Fx$,

   $\Delta p = \frac{2\mathrm{d}}{r}$, $h = \frac{2\mathrm{d}}{r\mathrm{r}\ g}$, $1/2 \quad \mathrm{r}\ v^2 + \mathrm{r}\ gh + p =$ constant

   (d) Phenomena: applications of Bernoulli's theorem.

2. Experiments could include: measurement of Young's modulus, surface tension measurement, measurement of coefficient of viscosity.

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 the 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 candidate 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.