Higher National Unit specification

General information for centres

Unit title: Physics Principles: Mechanics

Unit code: F3XE 34

Unit purpose: This Unit will provide candidates with the underpinning knowledge and problem solving skills associated with the principles of physics mechanics.

On completion of the Unit the candidate should be able to:

1 Apply the concepts of vectors.
2 Apply Newton's Laws of motion.
3 Apply the concepts of work and energy.
4 Apply the concepts of impulse and momentum.

Credit points and level: 1 HN credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the centre however, it is recommended that candidates have completed the NQ Unit Higher Physics (C069 12), or equivalent.

Core Skills: There are opportunities to develop the Core Skills in *Numeracy*, and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: Outcome 1, 2, 3 and 4 could be assessed together using a supervised assessment once all have been completed. The assessment could entail a mixture of short answer and structured questions.

Higher National Unit specification: statement of standards

Unit title: Physics Principles: Mechanics

Unit code: F3XE 34

The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Apply the concepts of vectors

Knowledge and/or Skills

- Vector notation
- Component method
- Kinematic Equations
- Displacement
- Velocity
- Acceleration
- Newton's laws of motion

Evidence Requirements

Evidence for this Outcome will be provided on a sample basis with candidates being required to provide evidence for four of the seven Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- identify the key elements of vector notation. The identification must include magnitude and direction, and that vectors can be separated in components.
- apply addition and subtraction by component method to calculation of displacement; velocity and acceleration.
- derive three kinematic equations of motion using integral calculus: displacement, velocity and acceleration.
- apply the differential and average form of kinematic equations to the calculation of displacement, velocity and acceleration.
- state and apply Newton's Laws of motion: inertial and non inertial frame; gravitation; attraction of bodies with spherical symmetry.

Where calculations are performed, the candidate must:

- apply appropriate formulae.
- apply the principles of the calculation.
- show all working through a calculation.
- provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment Guidelines

A holistic assessment for Outcome 1, 2, 3 and 4 is recommended. This could be composed of an appropriate balance of short answer, restricted response and structured questions designed to meet the Evidence Requirements for each Outcome.

Outcome 2

Apply Newton's Laws of motion

Knowledge and/or Skills

- Hooke's Law
- Simple harmonic motion
- Motion of a body in a circular path
- Static and kinetic friction

Evidence Requirements

Evidence for this Outcome will be provided on a sample basis with candidates being required to provide evidence for two of the four Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- describe, apply and perform calculations involving Hooke's law
- perform calculations involving simple harmonic motion, centrifugal force and deceleration
- apply and perform calculations involving Newton's laws of motion to systems of particles elastically constrained
- apply and perform calculations involving Newton's laws of motion to systems of particles circularly constrained
- apply and perform calculations involving Newton's laws of motion to systems of particles frictionally retarded

Where calculations are performed, the candidate must:

- apply appropriate formulae.
- apply the principles of the calculation.
- show all working through a calculation.
- provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment Guidelines

A holistic assessment for Outcome 1, 2, 3 and 4 is recommended. This could be composed of an appropriate balance of short answer, restricted response and structured questions designed to meet the Evidence Requirements for each Outcome.

Outcome 3

Apply the concepts of work and energy

Knowledge and/or Skills

- Work and energy equations
- Calculations relating work and energy

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- derive relations between work and energy. This must include derivation of work done, equal change in kinetic energy $\int F\,ds = 1/2mv22 – ½\ mv12$ Conservation and non-conservation forces. Potential energy Potential Energy $V = \int Fx\,ds$; $Fx = dV/dx$. Elastic and gravitational Potential Energy. Conservation of energy.
- perform at least three calculations involving work and energy.

Where calculations are performed, the candidate must:

- apply appropriate formulae.
- apply the principles of the calculation.
- show all working through a calculation.
- provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment must be conducted under supervised conditions.

Assessment Guidelines

A holistic assessment for Outcome 1, 2, 3 and 4 is recommended. This could be composed of an appropriate balance of short answer, restricted response and structured questions designed to meet the Evidence Requirements for each Outcome.

Higher National Unit specification: statement of standards (cont)

Unit title: Physics Principles: Mechanics

Outcome 4

Apply the concepts of impulse and momentum

Knowledge and/or Skills

- Newton's Third Law
- Momentum and impulse equations

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- derive Newton's third law $\int F\,dt = P2 - P1$ and relate it to conservation of momentum and impulse
- apply momentum and impulse equations. Application must include impulsive forces, conservation of momentum and elastic and inelastic collisions in one and two dimensions

Where calculations are performed, the candidate must:

- apply appropriate formulae.
- apply the principles of the calculation.
- show all working through a calculation.
- provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment must be conducted under supervised conditions.

Assessment Guidelines

A holistic assessment for Outcome 1, 2, 3 and 4 is recommended. This could be composed of an appropriate balance of short answer, restricted response and structured questions designed to meet the Evidence Requirements for each Outcome.

Administrative Information

Unit code: F3XE 34

Unit title: Physics Principles: Mechanics

Superclass category: RC

Original date of publication: August 2008

Version: 01

History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Physics Principles: Mechanics

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit is primarily intended as part of the framework for HNC/HND Chemical Process Technology. This Unit is likely to form part of a Group Award, which is designed both to prepare candidates from employment in science related posts and to offer the possibility of articulation into more advanced study. The emphasis therefore should be on ensuring candidates comprehend the basic principles of mechanics.

In Outcome 1, displacement, velocity and acceleration equations might be given in the following form: $v = ds/dt$, $a = dv/dt$, $s = \int v\,dt$. It is possible to include also Uniform acceleration in 1 and 2 dimensions, and non-uniform acceleration. Newton's second Law in forms $F = dp/dt$ and $F = ma$ and mass of earth.

In Outcome 3 derivations of the equations of work and energy could be included.

Guidance on the delivery and assessment of this Unit

Independent study should be encouraged by using candidate centred, resource based methodologies. It is envisaged that ICT based approaches will feature in the delivery of the Unit.

Tutorials and other formative activities can be used throughout the delivery of the Unit to encourage students to apply the principles of mechanics to the resolutions of numerical problems.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skill of *Numeracy* and the component Critical Thinking of the Core Skill of *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Throughout this Unit candidates are required to perform calculations and manage formula and equations which provides the opportunity to develop the Core Skill of *Numeracy* at SCQF level 6. Candidates will also be required to interpret and plot graphs which again provide the opportunity to develop *Numeracy* at SCQF level 6.

The presentation of problems in assessments that candidates require to interpret and work through will also develop the Critical Thinking component of the Core Skill of *Problem Solving* at SCQF level 6.

Higher National Unit specification: support notes (cont'd)

Unit title: Physics Principles: Mechanics

A note on the Evidence Requirements

The Evidence Requirements state that candidates 'must provide a satisfactory response' which includes reasonable answers derived 'from the application of the formula and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

Open learning

If this Unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance.

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.

General information for candidates

Unit title: Physics Principles: Mechanics

This is a single-credit SCQF level 7 Unit, intended to be delivered as part of HNC/HND Chemical Process Technology. It is designed to give you the underpinning knowledge and problem solving skills associated with the principles of physics mechanics.

On completion of this Unit you should be able to:

1 Apply the concepts of vectors.
2 Apply Newton's Laws of motion.
3 Apply the concepts of work and energy.
4 And apply the concepts of impulse and momentum.

The Unit has four Outcomes. You will initially look at the basic concepts of vectors including: notation, addition and subtraction of vectors, the derivation and use of kinematic equations to calculate different magnitudes, and the description of Newton's Laws. You will then study Hooke's Law, simple harmonic motion, centrifugal force and deceleration, and the application of Newton's laws of motion to different systems. You will then examine the relations between work and energy and apply these to numerical problems, before finally looking at Newton's third law, and the momentum and impulse equations.

To complete this Unit successfully, you will have to achieve a satisfactory level of performance during supervised assessment. Assessments may be by individual Outcome or one event at the end of the Unit. You will be advised to complete some formative activities during the delivery of the Unit, in order to support you with your revision for the assessments.

There are opportunities to develop in this Unit the Core Skill of *Numeracy* at SCQF level 6 through the use of calculations and equations. The *Problem Solving* nature of this Unit will provide the opportunity to develop the component of Critical Thinking in the Core Skill of *Problem Solving* at SCQF level6, although there is no automatic certification of Core Skills or Core Skills component.

Throughout the Unit you will also have the opportunity to develop Core Skills in *Numeracy*, and *Problem Solving* at SCQF level 6. Both of these may be developed through performing calculations, managing formulae and equations, work on vectors, derivation and use of kinematic equations to calculate different magnitudes etc.