



Higher National Unit specification

General information

Unit title: Biomechanics (SCQF level 8)

Unit code: H93C 35

Superclass: PE

Publication date: August 2015

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

The purpose of this Unit is to give learners underpinning knowledge and practical skills in biomechanics and to apply the principles of biomechanics to human movement. This Unit will be relevant for learners who are studying at HND level or learners wishing to go on to study biomechanics at diploma/degree level, or, specialists with an interest in biomechanics, eg physiotherapists and sports scientists.

Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Demonstrate knowledge and understanding related to biomechanics.
- 2 Collect, report and analyse information from experiments or simulations related to biomechanics.

Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

Recommended entry to the Unit

Entry is at the discretion of the centre, however it is recommended that learners should have completed the HN Unit *Mathematics for Science 1* or equivalent, or have experience of Mathematics at National 5 level and mechanics.

Higher National Unit specification: General information (cont)

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Core Skills

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill	None
Core Skill component	Critical Thinking at SCQF level 6 Using Number at SCQF level 6

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.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher National Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

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. Learners 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

Demonstrate knowledge and understanding related to biomechanics.

Knowledge and/or Skills

- ◆ Weight, mass, centre of mass, density
- ◆ Newton's laws of motion
- ◆ Free body diagrams
- ◆ Resolution of forces, vectors and scalars
- ◆ Resultant of orthogonal and non-orthogonal forces by numerical methods
- ◆ Moments involving rigid limbs
- ◆ Inertial forces in moving limbs
- ◆ Circular motion — angular displacement, velocity and acceleration, moment of inertia, inertial torque and radius of gyration
- ◆ Body segment parameters — length, mass, centre of mass, radius of gyration
- ◆ Muscle groups involved in maintaining equilibrium
- ◆ Stages of gait cycle
- ◆ Force — time graphs in gait analysis

Outcome 2

Collect, report and analyse information from experiments or simulations related to biomechanics.

Knowledge and/or Skills

- ◆ Setting up relevant equipment
- ◆ Safe methods of usage of equipment regarding Health and Safety regulations
- ◆ Presentation of scientific information
- ◆ Recording of procedures, observations and measurements
- ◆ Experimental uncertainties — systematic and reading
- ◆ Evaluation

Higher National Unit specification: Statement of standards (cont)

Unit title: Biomechanics (SCQF level 8)

Evidence Requirements for this Unit

Learners must meet the level of performance specified in the Evidence Requirements for both Outcomes to achieve the Unit.

Outcome 1

Using a holistic assessment, a learner's response can be judged to be satisfactory provided evidence is sufficient to meet the requirements for each item by showing the learner can:

- ◆ Calculate, when given horizontal and vertical motion information, ground reaction resultant forces acting on a foot.
- ◆ Calculate the resultant of two orthogonal or non-orthogonal forces using numerical methods.
- ◆ Solve problems involving simple moments at joints on lower or upper limbs for orthogonal and non-orthogonal forces.
- ◆ Draw free body diagrams, showing all forces acting on a limb.
- ◆ Solve problems involving inertial force.
- ◆ Solve problems involving circular motion applied to a rotating limb.
- ◆ Calculate a body segment parameter, from a given table with whole-body mass and height information.
- ◆ Name the major muscle groups that are used to maintain equilibrium and state whether these are tending to flex, extend, abduct or adduct the limb.
- ◆ Describe stages of normal gait: heel strike, flat foot, mid stance, heel raise, toe off, mid swing and heel strike and the relative positions of ankle, knee and hip positions during each stage.
- ◆ Interpret a graph of vertical force (as a % of body weight) against time in gait analysis.

Evidence should be gathered using a written/oral assessment under closed-book conditions. Learners can only have access to the *SQA Databook for HN Physics* or any suitable replacement when sitting the assessment. Evidence for Outcome 1 can be demonstrated on a sample basis with 8 out of 12 Knowledge and/or Skills covered in each assessment occasion. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Higher National Unit specification: Statement of standards (cont)

Unit title: Biomechanics (SCQF level 8)

Outcome 2

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

- ◆ Set up and perform the experiment/simulation from the instructions correctly.
- ◆ Describe the experimental procedures accurately, clearly and concisely.
- ◆ Record relevant measurements and observations in an appropriate format accurately.
- ◆ Analyse recorded information and present information in an appropriate format.
- ◆ Treat uncertainties appropriately.
- ◆ Draw valid conclusions.
- ◆ Evaluate the experimental procedures with supporting evidence.

Evidence for this Outcome will be provided by the learner performing one experimental assignment or simulation related to the theory in Outcome 1. Learners should be assessed on their performance in carrying out the experiment, on their ability to record the observations and measurements correctly, the analysis and conclusions provided and the quality of their laboratory report. Learners will need to successfully meet all the requirements for this Outcome in order to pass the Unit.



Higher National Unit Support Notes

Unit title: Biomechanics (SCQF level 8)

Unit Support Notes are offered as guidance and 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 likely to form part of a Group Award, designed to prepare learners for employment in a science related post. This is a specialist Unit that can be used as a stepping stone for learners wishing to study biomechanics, bioengineering prosthetics and other related courses, at a higher level. It may also be of interest to learners studying sports science.

Outcome 1 provides the underpinning knowledge of mechanics and applies it to the study of motion and forces acting on the human body.

The Unit makes extensive use of:

- ◆ Force, weight, mass, density, centre of mass
- ◆ Distance, speed, displacement, velocity, acceleration
- ◆ Newton's laws of motion,
- ◆ Vectors including: resultant forces (orthogonal and non-orthogonal forces), resolution into x and y components
- ◆ Inertial forces
- ◆ Simple moments
- ◆ Circular motion including: r , \dot{r} , θ , ω , α , I , T

The Unit will look at the forces required by muscles to maintain equilibrium during various activities, therefore the names of basic muscle groups should be studied for arms, legs, hips and the feet.

Learners should be able to describe the effect of forces as 'tending to'— flex, extend, abduct (move outwards), adduct (move inwards).

In reality, the body moves in three dimensions and control of limbs is by a complex interaction of muscles. These muscles are attached to bones at varying angles. The net effect is studied by resolving moments in 3-D (x, y and z co-ordinate system). Three dimensional analysis is beyond the scope of this Unit, but learners could be made aware of the limitations of the 2-D approach.

Higher National Unit Support Notes (cont)

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Experimental methods and problems associated with collecting data such as body segment parameter data, position data and force data should be considered.

The style of gait including normal, stumble or pathological should be analysed. Graphs of vertical forces (as a % of body weight) are assessed. Graphs of horizontal forces on the foot are not to be assessed however they could be considered for completeness, ie mediolateral (sideways forces that act as the guidance control) and anterior-posterior forces (from toe to heel). The effect of footwear on gait could be analysed.

Outcome 2

Outcome 2 develops a wide range of skills associated with scientific enquiry and practical problem solving. Suggested practical activities could include:

- ◆ Investigation of simple moments
- ◆ Measurement of joint angles, using a goniometer, for a range of actions
- ◆ Gait analysis using a force platform
- ◆ Gait analysis using video recording equipment

The use of computers is a powerful aid to learning and experimenting. When interfaced to suitable sensors, the microcomputer can assist investigations where readings have to be taken very rapidly or over a period of time, or where several different variables have to be recorded simultaneously. Data obtained can be analysed and presented in graphical displays. Care should be taken, however, to ensure that learners fully understand the presentation of such data when computer programmes are utilised.

Guidance on approaches to delivery of this Unit

This Unit forms part of the HND Applied Sciences Group Award which is primarily designed to provide learners with knowledge and skills related to employment and/or further study in science. This Unit should be delivered in a way that refers to applications to the occupational area of bioengineering. Instruments of assessment should be constructed with this in mind.

The practical or simulation work should relate to the theory being considered. It is advisable that several experimental activities are carried out during the delivery of the Unit to enable skills to be developed and practice in recording and reporting on experimental work to be gained.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Where sampling takes place, a learner's response in an assessment can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item specified in the Evidence Requirements.

Higher National Unit Support Notes (cont)

Unit title: Biomechanics (SCQF level 8)

Outcome 1

Outcome 1 could be assessed by a single, closed-book, holistic assessment under supervised conditions. Learners can only have access to the *SQA Databook for HN Physics* or any suitable replacement when sitting the assessment. This assessment could take the form of a mixture of questions requiring a short descriptive answer, a response in the form of a numerical calculation, structured questions or a restricted response. An integrated approach is recommended for the assessment, which should be completed in approximately one hour. Should learners fail to meet the pass criteria they should be offered a second attempt after sufficient remediation.

Integration of the Knowledge and Skills in questions is recommended — for example:

- ◆ Body segment parameters could be integrated in problems involving moments with rigid limbs, or circular motion, or inertial forces.
- ◆ Muscle groups could be added to the end of problems involving moments, inertial forces or circular motion.

Outcome 2

Outcome 2 will be assessed by a practical activity and all Knowledge and/or Skills must be assessed. Learners should be assessed on both their practical activity by observation and on their ability to produce a satisfactory report. Evidence could be recorded in the form of a checklist.

It is recognised that centres will select experiments/simulations based on the equipment available to them however the experiment/simulation chosen must be relevant to biomechanics.

It is strongly encouraged that formative exercises are utilised to enable learners to develop their skills in carrying out and reporting experimental work.

If the practical report fails to meet the required criteria, the report may be returned to the learner and remediation offered. The report may be resubmitted once.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Higher National Unit Support Notes (cont)

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Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

This Unit has the Critical Thinking component of Problem Solving and Using Number of Numeracy embedded in it. This means that when candidates achieve the Unit, their Core Skills profile will also be updated to show they have achieved Critical Thinking and Using Number at SCQF level 6.

History of changes to Unit

Version	Description of change	Date
02	Core Skills component Critical Thinking and Using Number at SCQF Level 6 embedded	Aug 2015

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General information for learners

Unit title: Biomechanics (SCQF Level 8)

This Unit introduces you to the basic concepts of biomechanics.

The human body is basically a machine. The way we move is controlled by the forces exerted by muscles. The muscles ensure that the body remains in equilibrium, and we move in a controlled way.

On completion of the Unit you will have underpinning knowledge of biomechanics, and you will be able to describe styles of gait, and be able to apply the principles of biomechanics to analyse motion of the human body.

This Unit contains some analysis and the maths included is at National 5 level, requiring simple trigonometry (sine, cosine and tangent), and algebra (ability to manipulate formulae).

The Unit will be assessed by an end of Unit assessment and a practical assignment.

The test will be supervised and will last approximately one hour, and could take the form of a mixture of questions requiring a short descriptive answer, a response in the form of a numerical calculation, structured questions or a restricted response.

You will also perform and produce a report on an experiment or simulation.

If necessary, you may receive remediation and resit a different assessment and resubmit your laboratory report once.