

TEMPLATE ASSESSOR'S GUIDE

The assessor's guide is prepared by the person(s) who creates the assignment/question bank for each exam and is prepared at the same time as the examination questions.

The assessor's guides must be available for the students after the grades have been determined, in accordance with the Higher Education Act § 5-3 (3) - <https://lovdata.no/lov/2005-04-01-15/§5-3>

General information

Course information	
Course code	THP203
Course name	Basic Biomechanics
Academic year and semester	2nd year, spring semester
Credits	15 ECTS
Course responsible	Hannah Rice
Type of examination	School

The template is adapted to the type of examination/assessment form.

Documents that must be available to the assessor in the assessors's guide

- Examination questions (not necessary for FLOWmulti/multiple choice)
- Link to course description
- Information given to students about the specific exam

Learning outcomes

Which learning outcome descriptions is the examination linked to?

- apply the laws of physics and mechanics to understand and describe the movement of biological systems
- use basic mathematics to solve problems in sports
- explain specific biomechanical measurement methods and how these are used in research and practice
- explain the structure and mechanical properties of relevant human tissues and how this relates to function

Syllabus/subject matter

Tissue mechanics

Relevant mathematics

Linear Kinematics

Kinetics

Statics

Rotation

Work, Energy, Power

Applied Biomechanics

Teaching

Lecture plan and/or timetable is attached. If applicable, comment on the emphasis on different parts of the syllabus in the teaching, the teaching methods used, and any other information about the implementation of the teaching/subject that is relevant to be able to assess the answers in the best possible way. In the case of independent assignments, have the students received guidance along the way?

Students have been provided with numerous examples and solutions both in lectures and seminars, as well as additional extra materials to help prepare them.

Summary/suggested solutions/assessment criteria

In the case of specific answer options, define what the candidate must include in their answer to answer each question, e.g. in the form of a summary, or elements from the syllabus in discipline-based exams/oral exams. For individually designed questions, define the points/elements the question should contain.

What are the expectations for an A-answer, a good average answer (i.e. a C-answer) and an E-answer? If the grading scale is pass/fail, what must be included to pass the exam?

The detailed answer scheme and where points can be lost and gained is provided as a separate document ('Exam_THP203_2026_All_Sensorveiledning.docx').

Use of AI-tools

The examiner's guide must provide guidance on how the examiner should respond if the student, in accordance with APA-7 in the chapter on AI-generated text, has stated that AI tools have generated parts of the content (i.e., assertions, statistics, arguments, ideas, artwork, coding, or similar). The following is standard text, which can be adjusted or replaced with subject-specific guidelines for the use of AI tools if these have been developed.

"According to APA-7 in the chapter on AI-generated text, students should briefly describe if and how they have used the tool. The examiner should assess the work presented in the exam submission/master's thesis, and the use of AI tools should not count either positively or negatively."

This is a school-based exam (i.e. not online) where students should have access only to an approved calculator and the formula sheet. Use of AI should not be possible.

Guiding template for content

- Overall criteria for assessment: Learning outcome descriptions and/or assessment criteria set for the individual exam (e.g. practical exam/oral exam, bachelor/master assignments and other major assignments).
- [General grade descriptions for higher education](#) (UHR 6 August 2004, rev. 2011), or a description of the requirements for a pass/fail grade (depending on the grade expression for the individual exam).
- Relevant syllabus for the examination paper. For specific questions, state the syllabus reference for the individual question.
- Expectations for answers. For exams with several specific questions, describe expectations for what gives full credit for each question, or what is expected for a passing grade. The question wording will determine how specific the assessor guidance can be. If scoring is used as an aid in the assessment, a rough description of how the points are distributed is provided.
- Use of academic discretion - holistic assessment should be specified, in relation to general grade expressions and/or assessment criteria for the exam in question.
- Other factors of importance for assessment (e.g. if assignments are to be weighted differently, if some parts of the syllabus are given less weight than other parts, plagiarism control, etc.).

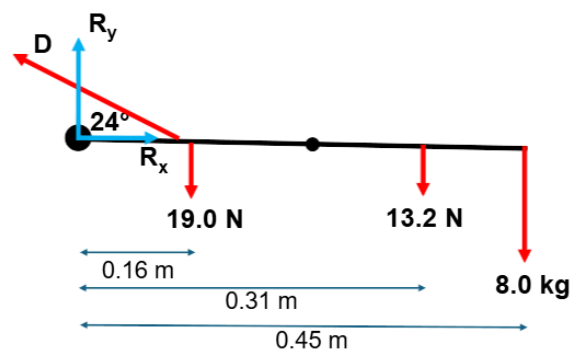
THP203 2026 Exam – Assessment Guide

Section 1 – Physics (70 points)

In this section:

- subtract one point where rounding has been done too early in the calculation or is incorrect at the end. Final answers should be to 2 decimal places where relevant, and 3 in all the workings
- subtract one point when units are not presented in the final answer
- award “follow through” points when errors are made but steps are correct
- award point for a correct diagram

Question 1



a)

$$\sum T = 0$$

$$(D \sin(24) \cdot 0.13) - (19 \cdot 0.16) - (13.2 \cdot 0.31) - (8 \cdot 9.81 \cdot 0.45) = 0$$

$$(D \sin(24) \cdot 0.13) = 42.448$$

$$D = 802.787 \text{ N}$$

(13 points)

b)

$$\sum F = 0$$

Vertically:

$$R_y + D \sin(24) - 19.0 - 13.2 - (8 \times 9.81) = 0$$

$$R_y + 802.787 \sin(24) - 19.0 - 13.2 - (8 \times 9.81) = 0$$

$$R_y = -215.84 \text{ N downwards}$$

(4 points)

Horizontally:

$$R_x - D \cos(24) = 0$$

$$R_x = 733.38 \text{ N to the right}$$

(4 points)

Question 2

$$E_K = \frac{1}{2} mv^2$$

$$v = 3/0.75 = 4 \text{ m}\cdot\text{s}^{-1}$$

$$E_K = \frac{1}{2} 68 \cdot 4^2$$

$$E_K = \frac{1}{2} 68 \cdot 4^2$$

$$E_K = 544 \text{ J}$$

(4 points)

Question 3

a)

$$P = mv$$

$$P_{\text{Total}} = P_1 + P_2 = 0$$

$$P_1 = 94 \cdot -5 = -470 \text{ kgm}\cdot\text{s}^{-1}$$

$$-470 + 5.8 m_2 = 0$$

$$5.8 m_2 = 470$$

$$m_2 = 81.03 \text{ kg}$$

(6 points)

b)

$$F = ma$$

$$\text{Weight} = \text{mass} \cdot \text{gravity}$$

$$\text{Weight} = 81.034 \cdot 9.81$$

$$\text{Weight} = 794.94 \text{ N (or 794.95 if using full unrounded value from above)}$$

(2 points)

Question 4

a)

$$180 \text{ degrees} = \pi \text{ radians}$$

$$180 \text{ degrees} \cdot \text{s}^{-1} = \pi \text{ radians} \cdot \text{s}^{-1}$$

$$1 \text{ degree} \cdot \text{s}^{-1} = \pi/180 \text{ radians} \cdot \text{s}^{-1}$$

$$2830.41 \text{ degrees} \cdot \text{s}^{-1} = 49.400 \text{ radians} \cdot \text{s}^{-1}$$

$$\text{Answer} = 49.40 \text{ radians} \cdot \text{s}^{-1}$$

(3 points)

b)

$$v = r\omega$$

$$v = 0.85 \cdot 49.400$$

$$v = 41.99 \text{ m} \cdot \text{s}^{-1}$$

(3 points)

Question 5

a)

$$v^2 = u^2 + 2as$$

$$0 = 3.41^2 + (2 \cdot -9.81 \cdot s)$$

$$s = 0.593 \text{ m}$$

$$\text{Answer} = 0.59 \text{ m}$$



$$u = 3.41$$

$$a = -9.81$$

$$v = 0$$

$$s = s$$

(6 points)

b)

$$E_P = mgh$$

$$E_P = 73 \cdot 9.1 \cdot 0.593$$

$$E_P = 424.67 \text{ J (or } 424.43 \text{ J if using full unrounded value from above)}$$

(3 points)

c)

Impulse = change in momentum

$$Ft = m(v_f - v_i)$$

$$Ft = 73(3.41 - 0)$$

$$Ft = 248.93 \text{ Ns}$$

(4 points)

Question 6

a)

Work = force x distance

$$\text{Work} = 50 \cdot -9.81 \cdot 0.45$$

$$\text{Work} = -220.73 \text{ J (also ok to report the unit as Nm)}$$

(2 points)

b)

Power = Work/Time

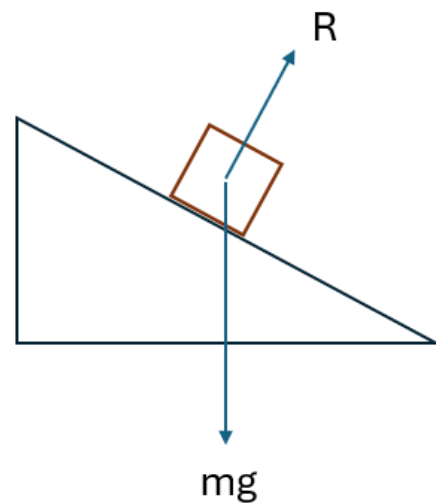
Work = force x distance

$$\text{Power} = (620 \cdot 0.45) / 0.2$$

$$\text{Power} = 1395 \text{ W (also ok to report the unit as J}\cdot\text{s}^{-1} \text{ or Nm}\cdot\text{s}^{-1})$$

(4 points)

Question 7



$$F_{\text{RES}} = F_{\text{WEIGHT}} - F_{\text{DRAG}} - F_{\text{FRICTION}}$$

$$F_{\text{WEIGHT}} = mg \sin (13)$$

$$F_{\text{WEIGHT}} = (55 \cdot 9.81 \cdot \sin (13))$$

$$F_{\text{WEIGHT}} = 121.372 \text{ N}$$

$$F_{\text{FRICTION}} = \mu R$$

$$F_{\text{FRICTION}} = 0.08 \cdot (mg \cos (13))$$

$$F_{\text{FRICTION}} = 0.08 \cdot (55 \cdot 9.81 \cdot \cos (13))$$

$$F_{\text{FRICTION}} = 42.058 \text{ N}$$

$$F_{\text{DRAG}} = 35 \text{ N}$$

$$F_{\text{RES}} = F_{\text{WEIGHT}} - F_{\text{DRAG}} - F_{\text{FRICTION}}$$

$$F_{\text{RES}} = 121.372 - 35 - 42.058$$

$$F_{\text{RES}} = 44.31 \text{ N}$$

(12 points)

Section 2 – Muscle and connective tissue mechanics (20 points)

General Questions

4. Definition of stiffness and Young's modulus:
 - Stiffness: Resistance to deformation when a force is applied (1 point).
 - Young's modulus: Ratio of stress to strain in the linear elastic region of the material (1 point, also accept stiffness expression when force and deformation are normalised).
 - Importance: Young's modulus accounts for tissue dimensions, making it essential for comparing the material properties of different tissues because mechanical properties depend on dimensions (1 point).
5. Stress-strain curve:
 - Toe region, elastic region, plastic region (1 point).
 - Young's modulus calculation (1 point): Slope of the linear elastic region.
 - Elastic energy (1 point): Area under the curve in the elastic region.
6. Safety factor:
 - Ratio of ultimate strength to daily average load (1 point).
 - Relation to injury (1 point): Low safety factor increases the risk of tissue damage.

Bone Mechanics

7. Five types of loading (2 points): Compression, tension, shear, bending, torsion.
8. Five factors influencing bone properties (3 points): Material composition, load type, bone location, load orientation, loading rate, sex, age, structural properties.
9. Muscle contribution to reducing fracture risk (2 points): Muscle contraction alters stress distribution—reduces tensile stress and increases compressive stress, which bone handles better.

Muscle and Tendon Mechanics

9. Procedure for measuring stiffness :

- Isometric contraction on a dynamometer to estimate force, ultrasound to measure tendon deformation (1.5 points).
- Calculation (1.5 points): $\text{Stiffness} = \text{force} / \text{deformation}$.

10. Steps for quadriceps force estimation:

- Estimate hamstring maximal contribution using EMG and flexion torque. (1 point)
- Correct torque for co-activation by assuming a linear relationship between EMG and torque. (1 point)
- Calculate quadriceps force using corrected torque and internal moment arm. (1 point)

Section 3 – Applied biomechanics (10 points)

1. Movements are divided into phases to simplify biomechanical analysis and communication. Examples include acceleration and maximal velocity phases in sprinting.
2. Walking involves continuous ground contact and is described by the inverted pendulum model. Running includes a flight phase and is described by the mass-spring model.
3. Ground reaction force is the force exerted by the ground on the body during contact. It provides information about loading patterns, propulsion, force absorption and injury mechanisms.
4. The plantarflexors contribute to propulsion by generating plantarflexion moments and helping push the body forward.
5. Walking involves out-of-phase fluctuations of kinetic and potential energy and continuous ground contact. Running includes a flight phase and greater elastic energy storage, making the mass-spring model more appropriate.
6. Structures include the Achilles tendon, plantar fascia, quadriceps tendon and other muscle-tendon units.