

# DEFINITION OF THE EVALUATION DOMAIN

Adult General Education

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Diversified Basic Education Program

Physics

DYNAMICS AND TRANSFORMATION OF MECHANICAL ENERGY

PHY-5062-2

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## Introduction

The Definition of the Evaluation Domain (DED) ensures consistency between a course and the related evaluation instruments. The DED is used to select, organize and describe the essential and representative elements of the course. The DED is based on the program of study and the course, but should by no means replace them in the planning of instructional activities.

All the DEDs produced after June 30, 2014, by the Ministère de l'Éducation, de l'Enseignement supérieur et de la Recherche (MEESR) are prescriptive. Consequently, they are the reference documents to be used in the development of all examinations, be they ministerial or those developed by adult education centres or by Société GRICS (BIM). The DEDs thus serve as a model for preparing multiple equivalent versions of examinations that are valid across the province.<sup>1</sup>

In addition, as set out in the *Policy on the Evaluation of Learning*, adult learners must know what they will be evaluated on and what is expected of them.<sup>2</sup> The DEDs and the criterion-referenced rubrics (contained in the evaluation instruments) may be used for this purpose.

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<sup>1</sup> Québec, Ministère de l'Éducation du Québec, *Policy on the Evaluation of Learning* (Québec: Gouvernement du Québec, 2003), 47.

<sup>2</sup> *Ibid.*, 9.

## Evaluation Content

<b>General Information</b>			
<p><b>Broad Areas of Learning<sup>3</sup></b></p> <ul style="list-style-type: none"> <li>• Health and Well-Being</li> <li>• Career Planning and Entrepreneurship</li> <li>• Environmental Awareness and Consumer Rights and Responsibilities</li> <li>• Citizenship and Community Life</li> </ul> <p><b>Subject Area</b></p> <ul style="list-style-type: none"> <li>• Mathematics, Science and Technology</li> </ul> <p><b>Families of Situations</b></p> <ul style="list-style-type: none"> <li>• Research</li> <li>• Expertise</li> </ul>	<p><b>Program of Study</b></p> <ul style="list-style-type: none"> <li>• Physics</li> </ul> <p><b>Course</b></p> <ul style="list-style-type: none"> <li>• Dynamics and Transformation of Mechanical Energy</li> </ul>		
<b>Essential Elements Targeted by the Evaluation</b>			
<p><b>Subject-Specific Competencies</b></p> <ol style="list-style-type: none"> <li>1. Seeks answers or solutions to problems involving physics</li> <li>2. Makes the most of his/her knowledge of physics</li> <li>3. Communicates ideas relating to questions involving physics, using the languages associated with science and technology</li> </ol>	<p><b>Categories of Knowledge</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>General concepts:</p> <ul style="list-style-type: none"> <li>• Dynamics</li> <li>• Transformation of energy</li> </ul> </td> <td style="width: 50%; vertical-align: top;"> <p>Techniques:</p> <ul style="list-style-type: none"> <li>• Laboratory work</li> <li>• Measurement</li> </ul> </td> </tr> </table>	<p>General concepts:</p> <ul style="list-style-type: none"> <li>• Dynamics</li> <li>• Transformation of energy</li> </ul>	<p>Techniques:</p> <ul style="list-style-type: none"> <li>• Laboratory work</li> <li>• Measurement</li> </ul>
<p>General concepts:</p> <ul style="list-style-type: none"> <li>• Dynamics</li> <li>• Transformation of energy</li> </ul>	<p>Techniques:</p> <ul style="list-style-type: none"> <li>• Laboratory work</li> <li>• Measurement</li> </ul>		
<b>Evaluation Criteria</b>			
<p><b>Evaluation Criteria for Competencies 1 and 3</b></p> <ol style="list-style-type: none"> <li>1.1 Appropriate representation of the situation</li> <li>1.2 Development of a suitable plan of action</li> <li>1.3 Appropriate implementation of the plan of action</li> <li>1.4 Development of relevant explanations, solutions or conclusions</li> </ol> <p><b>Evaluation Criteria for Competencies 2 and 3</b></p> <ol style="list-style-type: none"> <li>2.1 Accurate interpretation of the problem</li> <li>2.2 Appropriate use of knowledge of physics</li> <li>2.3 Suitable production of explanations</li> </ol>	<p><b>Proficiency in Subject-Specific Knowledge</b></p> <p>Proficiency in subject-specific knowledge presupposes its acquisition, understanding, application and mobilization, and is therefore linked with the evaluation criteria for the competencies.</p>		

<sup>3</sup> The broad areas of learning are stated exactly as in the course. However, the person who designs the evaluation instrument may choose other broad areas of learning.

## Explanation of the Evaluation Content

### Evaluation Criteria

The evaluation criteria are stated exactly as in the course, except for Criterion 2.1, which is based on Competencies 2 and 3.

Competency 3 is not specifically evaluated. It is integrated into the other two competencies in evaluation situations designed for certification purposes. The evaluation criteria relating to it are based upon the criteria for the first two competencies in the *Framework for the Evaluation of Learning* in general education in the youth sector.

### Information Clarifying the Evaluation Criteria

#### 1.1 Appropriate representation of the situation

This criterion evaluates the adult learner's ability to develop a representation of a problem related to forces acting on bodies or to the transformation of mechanical energy by restating it in his or her own words, drawing a schematic diagram, dividing it into subproblems, etc. This criterion also evaluates the adult learner's ability to formulate a hypothesis related to the problem to be solved, based on the principles of physics to be considered.

#### 1.2 Development of a suitable plan of action

This criterion evaluates the adult learner's ability to autonomously develop an experimental protocol in which he or she plans the steps, chooses the resources, determines the constant parameters, the independent variable and the dependent variable, and writes instructions for laboratory work with respect to the hypothesis he or she has formulated.

#### 1.3 Appropriate implementation of the plan of action

This criterion evaluates the adult learner's ability to implement a plan of action by carrying out laboratory activities. It thus evaluates his or her ability to handle the selected materials in accordance with the precision of the instruments or tools, to gather data, taking into account the experimental uncertainty associated with numerical data, to apply the applicable safety rules and to adjust his or her plan of action if necessary.

#### 1.4 Development of relevant explanations, solutions or conclusions

This criterion evaluates the adult learner's ability to analyze experimental data using different means of representation (tables or graphs). It thus evaluates his or her ability to identify a significant trend or relationship; to verify the consistency between the problem, his or her hypothesis and the information obtained; and to come up with explanations, solutions or conclusions based on the data gathered and his or her knowledge of physics. It also evaluates the adult learner's ability to draw up a laboratory report, using an outline, and to use the applicable scientific terminology, rules and conventions, as well as mathematical symbolism and formalism, if needed.

#### 2.1 Accurate interpretation of the problem

This criterion evaluates the adult learner's ability to recognize the relevant elements of the problem and the connections between them and to identify the characteristics and principles of physics that underlie the phenomena or technological applications they entail.

## 2.2 Appropriate use of knowledge of physics

This criterion evaluates the adult learner's ability to use concepts, laws, theories or models associated with physics to explain phenomena or technological applications inherent in the problem. It also evaluates the adult learner's ability to identify their interactions, anticipate their impact on the problem and, as needed, use calculations to support his or her explanations.

## 2.3 Suitable production of explanations

This criterion evaluates the adult learner's ability to come up with or justify explanations concerning the role of dynamics or the transformation of mechanical energy in the expression of certain phenomena or the operation of certain applications, while respecting the applicable scientific terminology, rules and conventions. It also evaluates his or her ability to use mathematical formalism.

### **Proficiency in Subject-Specific Knowledge**

Proficiency in subject-specific knowledge is assessed through the evaluation of competencies, using tasks related to the evaluation criteria.

For this course, certain knowledge is explicitly evaluated. The following measurable cognitive skills were selected for evaluation.

#### **Skills**

- Knows
  - Provides evidence of knowledge of manifestations or components of a scientific or technical reality  
E.g. defines, describes, distinguishes, associates, names, chooses, connects
- Understands
  - Uses elements of prior learning and draws information from them  
E.g. explains, combines, discusses, justifies, demonstrates
- Applies
  - Uses a scientific or technological model or principle to establish information  
E.g. uses, represents, applies, determines, calculates

#### **Weighting**

The weighting for the evaluation of the competencies is determined in accordance with the *Framework for the Evaluation of Learning* in general education in the youth sector.

Competency 1, *Seeks answers or solutions to problems involving physics*, and Competency 3, *Communicates ideas relating to questions involving physics, using the languages associated with science and technology*. 40%

Competency 2, *Makes the most of his/her knowledge of physics*, and Competency 3, *Communicates ideas relating to questions involving physics, using the languages associated with science and technology*. 40%

The weighting corresponding to the knowledge that is explicitly evaluated is 20%.

The weighting of the evaluation criteria appears in the assessment tools provided in the *Correction and Evaluation Guide*. Adult learners must be made aware of the evaluation criteria used to evaluate them and the corresponding weighting of each criterion.

## Knowledge

Knowledge includes concepts and techniques.

For the examination as a whole, the two general concepts and the two categories of techniques must be covered. It is not necessary to cover all the compulsory concepts for a given general concept. However, it is necessary to cover all of the techniques, except the use of observational instruments, which should only be suggested.

For the knowledge targeted by the evaluation of the competencies:

- The two general concepts and the two categories of techniques must be covered.
- For the two general concepts, a representative sample of the compulsory concepts must be covered.
- All the techniques must be covered, except the use of observational instruments, which should only be suggested.

For the knowledge targeted by explicit evaluation:

- The two general concepts must be covered. For these general concepts, priority is given to compulsory concepts that were not covered in the evaluation of the competencies.

### Concepts

General Concepts	Compulsory Concepts
Dynamics	<ul style="list-style-type: none"> <li>• Newton's laws</li> <li>• Centripetal force</li> <li>• Free-body diagram</li> <li>• Equilibrium and resultant of several forces</li> <li>• Force of friction</li> <li>• Gravitational acceleration</li> <li>• Gravitational force</li> <li>• Hooke's law</li> <li>• Effective force</li> </ul>
Transformation of energy	<ul style="list-style-type: none"> <li>• Mechanical energy</li> <li>• Relationship between work, force and distance travelled</li> <li>• Relationship between energy, the spring constant and the change in length of a helical spring</li> <li>• Relationship between power, work and time</li> <li>• Relationship between work and energy</li> <li>• Relationship between potential energy, mass, gravitational acceleration and distance travelled</li> <li>• Relationship between kinetic energy, mass and speed</li> </ul>

**Techniques**

<b>Categories of Techniques</b>	<b>Techniques</b>
Laboratory work	<ul style="list-style-type: none"><li>• Safely using laboratory materials and equipment</li><li>• Using observational instruments</li></ul>
Measurement	<ul style="list-style-type: none"><li>• Checking the reliability, accuracy and sensitivity of measuring instruments</li><li>• Interpreting measurement results (significant figures, measurement errors)</li></ul>



## Specifications for the Evaluation Instruments

### Examination: Number of Parts, Sections, Procedure and Duration

The examination consists of two parts that must be administered during different evaluation sessions. Adult learners are responsible for managing the time available to them for each part of the examination.

Total duration: 300 minutes

Practical part\*: Evaluation of Competencies 1 and 3

Duration: 180 minutes

Theory part: Evaluation of Competencies 2 and 3 and Explicit evaluation of knowledge

Duration: 120 minutes

\* All competency evaluation sessions for the practical part are carried out in a laboratory or other appropriate location.

### Examination Content

#### Practical part

This part involves a situation from the *Research* family of situations designed to evaluate the development of Competencies 1 and 3 using Criteria 1.1, 1.2, 1.3 and 1.4. Adult learners must do an experiment to solve a physics problem concerning dynamics or the transformation of mechanical energy. The tasks to be carried out include autonomously developing a procedure, handling laboratory materials, analyzing the problem, discussing the problem and reaching a conclusion concerning the initial problem. Adult learners must draw up a report summarizing these tasks that respects the conventional structure for scientific reports.

#### Theory part

This part has two sections. One section is designed to evaluate the development of Competencies 2 and 3 using Criteria 2.1, 2.2 and 2.3. Adult learners must examine one to three situations from the *Expertise* family of situations involving a problem concerning technological phenomena or applications related to forces acting on bodies or to the transformation of mechanical energy. The tasks to be carried out include demonstrating the principles of physics and using concepts, laws and models to explain the phenomena or applications and transfer the explanations to other phenomena or applications involving the same principles. The other section is devoted to the explicit evaluation of knowledge.

### Information-Gathering Tools

#### Evaluation of the competencies

##### Practical part

- The adult learner carries out an experiment in a laboratory or other appropriate location.

##### Theory part

- The adult learner examines one to three problems.

#### Explicit evaluation of knowledge in the theory part

- The adult learner answers short- or long-answer questions.

## Authorized Materials

For the two parts of the examination

- Periodic table
- Additional blank sheets of paper
- Ordinary or scientific calculator

Information about the calculator:

- The data and programs stored in the calculator's memory must be erased before and after the examination. Before the day of the examination, students must have been given the opportunity to learn how to reset their calculator's memory to zero.

For the practical part of the examination

- Materials and equipment required for the experiment
- Computer, if necessary

## Assessment Tools

For the evaluation of the competencies, the criterion-referenced rubric is the assessment tool used by the teacher. In criterion-referenced interpretation, the information gathered is compared with the outcomes expected of the adult learner.<sup>4</sup> The rubrics are appended to the *Correction and Evaluation Guide* and include the following rating scale:

- *Excellent*
- *Very good*
- *Good*
- *Weak*
- *Very weak*

Checklists may also be provided to make it easier for markers. These checklists can be found in the *Correction and Evaluation Guide*.

Each checklist and rubric focuses on the evaluation of specific competencies:

- checklist and rubric for the evaluation of Competencies 1 and 3, practical part
- checklist and rubric for the evaluation of Competencies 2 and 3, theory part

For the explicit evaluation of knowledge in the theory part, a correction key is provided in the *Correction and Evaluation Guide*.

## Pass Mark

The pass mark is 60% for the examination as a whole.

## Retakes

The adult learner must retake each part (practical or theory) of the examination separately.

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<sup>4</sup> Québec, Ministère de l'Éducation, *Policy on the Evaluation of Learning* (Québec: Gouvernement du Québec, 2003), 28-29.



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