PHYSICS

Secondary V

Kinematics and Momentum

PHS-5042-2

DEFINITION OF THE DOMAIN
FOR SUMMATIVE EVALUATION

JULY 2000

Québec

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Direction de la formation générale des adultes
Service de l'évaluation des apprentissages

ISBN 2-550-36464-3

Legal Deposit — Bibliothèque nationale du Québec, 2000

1. Introduction

This definition of the domain for summative evaluation describes and classifies the essential and representative elements of the Physics Program – specifically, for the course entitled *Kinematics and Momentum*. It presents an overview of the program, but should by no means replace the program itself. The purpose of defining the domain is to ensure that all summative evaluation instruments are consistent with the overall program.

The organization of this definition of the domain is the same as that of those of other courses. The content of each section is, however, specific to the *Kinematics and Momentum* course.

The definition of the domain for summative evaluation is used to prepare examinations that are valid from one version to another, from year to year, and from one school board to another, taking into account the responsibilities shared by the Ministère de l'Éducation and the school boards.

2. Program Orientations and Consequences for Summative Evaluation

Orientations	Consequences
The purpose of this program is to provide students with rigorous training in the use of the scientific method. Students become familiar with the basic concepts of physics and either acquire or improve the skills related to the experimental method.	The evaluation should test the students' knowledge and understanding of the basic concepts of physics and of the experimental method.
Students acquire an understanding of various phenomena that goes beyond the mere ability to apply formulas in solving mathematical problems.	The evaluation should involve problem situations that test the students' understanding of various phenomena. The evaluation should not focus solely on calculations and their results.
The program presents scientific knowledge from a historical, technological and social perspective.	The evaluation should also reflect the relationship between the related content and the history–technology–society (HTS) perspective.
In this program, considerable time is devoted to the experimental approach and students are required to perform experiments.	A major part of the evaluation process should focus on the experimental method. In addition to the items pertaining to objectives that relate to the experimental method, items that test the students' understanding of the related content may refer to laboratory work.
To help students acquire or improve the skills related to the experimental method, the course entitled *Kinematics and Momentum* focuses on having students apply the different aspects of the experimental method.	In the course entitled *Kinematics and Momentum*, evaluation items relating to the experimental method should involve having the students show their understanding of the instructions in an experimental procedure and analyze experimental data, while taking into account the possible sources of experimental error and uncertainty.

3. Course Content for Purposes of Summative Evaluation

Themes

- **Related Content**

  - Perception of motion and immobility

  - Trajectory, displacement, distance travelled and successive positions of a moving object in a Cartesian context

  - Measurement of the speed of a moving object

  - Shape of "position-time", "velocity-time" and "acceleration-time" curves:
    - uniform rectilinear motion
    - rectilinear motion with uniform acceleration

  - Equations for motion:
    - uniform rectilinear motion
    - rectilinear motion with uniform acceleration

  - Motion of a projectile

  - Momentum:
    - definition
    - units of measurement
    - principle of conservation

  - Problem solving relating to:
    - displacement and distance travelled by a moving object
    - uniform rectilinear motion
    - rectilinear motion with uniform acceleration
    - motion of a projectile launched obliquely
    - conservation of momentum

- **History-Technology-Society Perspective (HTS)**

  - Relationships between the history of kinematics and developments in physics:
    - subjects covered by mechanics
    - measurement of the speed of light
    - discoveries in kinematics

  - Use of the principles of kinematics and momentum in practical situations:
    - projectiles
    - conservation of momentum

- Social changes:
  - perception of the universe
  - development of means of rapid transport

- **Experimental Method**

  - Appreciation of experimental procedures

  - Processing and analyzing experimental data:
    - drawing graphs
    - interpreting graphs
    - sources of experimental error

Skills

- **Understanding:** Applying acquired knowledge to deduce information.

- **Analyzing:** Examining the components of a phenomenon in order to determine relationships.

4. Table of Dimensions

Themes **Skills**	**Related Content** **55%**	**HTS Perspective** **15%**	**Experimental Method** **30%**
Understanding **35%**	Perception of motion and immobility (4%) Trajectory, displacement, distance travelled and successive positions of a moving object (4%) Measurement of the speed of a moving object (4%) Motion of a projectile (4%) Momentum (4%) **(1) 20%**	Relationships between the history of kinematics and developments in physics (5%) - subjects covered by mechanics - measurement of the speed of light - discoveries in kinematics Use of the principles of kinematics and momentum in practical situations (5%) - projectiles - conservation of momentum Social changes and environmental consequences (5%) - perception of the Universe - development of means of rapid transport **(3) 15%**	
Analyzing **65%**	Shape of curves (5%) Equations for motion (5%) Problem solving - displacement and distance travelled (5%) - uniform rectilinear motion (5%) - rectilinear motion with uniform acceleration (5%) - motion of a projectile (5%) - momentum (5%) **(2) 35%**		Appreciation of experimental procedures (10%) Processing and analyzing experimental data (20%) **(4) 30%**

5. Observable Behaviours

Dimension 1

- Given a series of statements concerning specific cases of motion, choose those which correctly illustrate the fact that the perception of motion and immobility depends on the point of view of the observer and those which correctly convey the role of the senses in the perception of motion. Justify one's choice or correct false statements to make them valid. (4%)

- Given a series of diagrams or statements concerning the two-dimensional motion of a moving object or the successive positions of a moving object in a Cartesian context, choose those which are incorrect or incomplete and correct them to make them valid. (4%)

- For a specific case involving the displacement of a moving object, suggest a method for measuring the speed of the moving object. (4%)

- Associate specific cases of projectiles launched horizontally with graphs or statements concerning the motion of these projectiles. (4%)

- Given a series of statements concerning one or more specific cases involving momentum, choose those which correctly explain the momentum or the principle of conservation of momentum. Justify one's choice or correct false statements to make them valid. (4%)

Dimension 2

- Given "position-time", "velocity-time" and "acceleration-time" curves, distinguish between examples of uniform rectilinear motion and examples of rectilinear motion with uniform acceleration and associate each curve with statements describing specific cases of these types of motion. (5%)

- Associate specific cases of uniform rectilinear motion and rectilinear motion with uniform acceleration with the equations for these types of motion. Data are provided in the form of graphs or tables of experimental data. Justify one's answer. (5%)

- Using vector addition, determine the displacement and distance travelled by a moving object. (5%)

- Solve problems related to uniform rectilinear motion, using the proper units of measurement and observing the established sign convention and, if applicable, use vector addition. (5%)

- Solve problems related to rectilinear motion with uniform acceleration, using the proper units of measurement and observing the established sign convention and, if applicable, use vector addition. (5%)

- Solve problems related to projectiles launched obliquely, using the proper units of measurement and observing the established sign convention and, if applicable, use vector addition. (5%)

- Solve problems related to the experimental study of momentum in a one-dimensional system. (5%)

Dimension 3

- Explain the relationships between the history of kinematics and developments in physics. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

- Explain the use of the principles of kinematics and momentum in a practical situation. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

- Briefly describe the situation that prevailed before a given event contributed to the development of mechanics and specify the new possibilities resulting from this development. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

Dimension 4

- Critically examine one or more experimental procedures using the following criteria: appropriateness of the variables chosen, clarity of the instructions, their relationship to the given problem, etc. (10%)

- Given the results of one or more experiments, construct and interpret corresponding graphs and analyze the experimental data taking into account sources of experimental error. (20%)

6. Explanation of the Content and Weighting

In accordance with the objectives of the *Secondary V Physics Program*, students should acquire a theoretical knowledge of physics, while examining the historical, technological and social aspects of this discipline. Students should also acquire or improve the skills related to the experimental method. Summative evaluation instruments will reflect this principle.

Two factors were considered in determining the relative importance of the dimensions pertaining to the experimental method: the progress made in acquiring or improving the skills related to the experimental method and the relative importance of the experimental method in the evaluation scheme used in the youth sector. As in the youth sector, the experimental method accounts for 25% of the overall mark for the three courses in the program. However, the relative importance of this theme varies from one course to another. It accounts for 30% of the mark obtained in the *Kinematics and Momentum* course.

The dimensions related to the history-technology-society perspective account for 15% of the mark obtained in each of the three courses.

Given the relative importance of the previously mentioned dimensions, evaluation pertaining to the related content accounts for 55% of the mark obtained in this course.

The relative importance of any skill to be developed in the course is determined by adding up the weightings given to the observable behaviours pertaining to that skill. In the *Kinematics and Momentum* course, the relative importance of each skill is as follows:

UNDERSTANDING	35%
ANALYZING	65%

7. Description of the Examination

A. Type of Examination

The examination for purposes of summative evaluation will be administered at the end of the course. It consists of two parts:

- One part is a written examination covering dimensions 1 to 3, inclusive, and is worth 70% of the course mark. It consists of restricted-response, short-answer or extended-response items.

- The other part is a written examination covering dimension 4 and is worth 30% of the course mark. It consists of short-answer and extended-response items.

All the observable behaviours for each dimension must be taken into account.

B. Characteristics of the Examination

The part covering dimensions 1 to 3 is written in a single session lasting no more than 120 minutes. Students are permitted to use a calculator and must be provided with formulas and appropriate information required by dimension 3. An example of a list of formulas is given in Appendix 1.

The part covering dimension 4 is written in a single session lasting no more than 90 minutes. The appropriate information must be incorporated into each related item or group of items.

C. Pass Mark

The pass mark for the entire examination is 60%.

Formulas

$$\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t}$$

$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$$

$$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{\vec{a}\Delta t^2}{2}$$

$$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$$

$$v_2^2 = v_1^2 + 2a\Delta d$$

$$\vec{p} = m\vec{v}$$

Δd	displacement
Δt	time interval
Δv	variation of velocity
a	acceleration
m	mass
p	momentum
t	time
v	velocity
v_2	final velocity
v_1	initial velocity
v_{av}	average velocity
$\vec{\ }$	vector quantity

$$\text{sine} = \frac{\text{opposite side}}{\text{hypotenuse}}$$

$$\text{cosine} = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

Constants

c	Speed of light in a vacuum	3.00 x 10^8 m/s
g	Acceleration due to gravity (earth)	9.8 m/s^2

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