PHYSICAL SCIENCE
secondary IV

Electricity :
What's the Connection ?

PSC-4011-2

DEFINITION OF THE DOMAIN
FOR SUMMATIVE EVALUATION

NOVEMBER 1998

Québec

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Direction de la formation générale des adultes
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1. Introduction

This definition of the domain for summative evaluation describes and classifies the essential and representative elements of the *Physical Science* program—specifically, for the course PSC-4011-2: Electricity: What's the Connection. 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 this course.

The goal of the definition of the domain for summative evaluation is to permit the preparation of 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
One aim of the program is to help students acquire scientific knowledge, especially in physics.	The evaluation should verify the students' acquisition of scientific knowledge in physics.
The program also aims to help students become citizens with an understanding of science and technology.	The evaluation should verify the students' understanding of the social, economic and political issues related to scientific and technological development.
It is designed to help students acquire an understanding of physical phenomena rather than have them merely apply formulas.	The evaluation should verify the students' ability to understand physical phenomena and analyze results.
It is also designed to acquaint students with the historical evolution of scientific and technological knowledge.	The evaluation should verify the students' knowledge of the events that led to the modification of certain scientific theories.
The program is intended to help students acquire technological knowledge related to scientific discovery.	The evaluation should verify the students' acquisition of certain technological knowledge.
In the program, the students are asked to analyze the social consequences of certain scientific discoveries and technological changes.	The evaluation should verify the students' understanding of the social consequences of certain scientific discoveries and technological changes.
They are also asked to analyze the relationships between science, technology and society.	The students will be asked to analyze one or more social, economic or political issues related to scientific and technological development.

3. Content of the Program for Purposes of Summative Evaluation

Themes

- **Basic concepts in electricity**
  - Structure of materials (insulators, conductors, semi-conductors)
  - Alternating and direct current
    - Sources
    - Characteristics
    - Uses
  - Evolution of conceptions of:
    - Static electricity
    - Dynamic electricity
    - Magnetism
    - Electromagnetism
  - Magnetic field lines
  - Measuring instruments (ohmmeter, voltmeter, ammeter)
  - Current
  - Ohm's law
  - Coulomb's law
  - Resistance of a conducting wire (length, cross section, resistivity)
  - Power of electric appliances in watts and energy consumption in kilowatt-hours
  - Electrification of matter (rubbing, contact, induction)

- **Electric circuits**
  - Components of an electric circuit and relationships between them
  - Characteristics and uses of series and parallel connections
  - Values of variables in series and parallel circuits
  - Qualitative analysis of a series-parallel circuit
- **Uses of electricity**
  - Power sources (cells, batteries, power supplies)
  - Applications of static electricity, magnetism and electromagnetism
  - Dangers and risks associated with static electricity and electric current
  - Joule effect
    - Exploitation
    - Minimization
  - Transformers
    - Operating principle
    - Role
  - Residential circuits
    - Service lines
    - Distribution
  - Power plants
    - Types
    - Advantages, disadvantages (e.g. environment, cost)

Skills

- **Knowing**: Stating the manifestations or components of a scientific or technical phenomenon.
- **Understanding**: Applying acquired knowledge to deduce information.
- **Analyzing**: Examining the components of a phenomenon in order to determine relationships.

4. Table of Dimensions

In the preceding sections, the content was specified. The following table of dimensions illustrates the specific relationships between the themes and skills.

THEMES / SKILLS	BASIC CONCEPTS IN ELECTRICITY 33%	ELECTRIC CIRCUITS 21%	USES OF ELECTRICITY 46%
KNOWING 12%	• Insulators, conductors, semi-conductors • Alternating and direct current • Evolution of concepts of electricity, magnetism and electromagnetism (1) 9%		• Power sources (5) 3%
UNDERSTANDING 54%	• Measuring instruments (voltmeter, ammeter, ohmmeter) • Current • Ohm's law • Coulomb's law • Resistance of a conducting wire • Power and energy consumption of electric appliances • Electrification of matter • Magnetic fields lines (2) 24%	• Components of a circuit (3%) • Series and parallel connections (6%) (3) 9%	• Joule effect (3%) • Residential circuits (6%) • Applications of static electricity, magnetism and electromagnetism (6%) • Transformers (3%) • Dangers and risks associated with electricity (3%) (6) 21%
ANALYZING 34%		• Series circuits • Parallel circuits • Series-parallel circuits (4) 12%	• Case analysis - Types of power plants - Advantages and disadvantages - Alternatives (7) 22%

5. Observable Behaviours

Dimension 1

Associate the use of certain materials with their insulating, conductive and semi-conductive properties.

Given statements describing sources, characteristics and uses of current, select those that apply to alternating or direct current.

Place discoveries or events related to the history of electricity, magnetism and electromagnetism in chronological order.

Dimension 2

Given a circuit diagram or an appropriate description, determine what measuring instrument (ammeter, voltmeter or ohmmeter) is used, how it is connected and what it measures.

Use the definition of current to solve problems related to the use of cells, batteries or power supplies.

Use the formula $V = RI$ to predict the variation or value of a variable following a change of a parameter in a simple circuit.

Use the formula $R = \frac{\rho L}{A}$ to predict the variation of the value of *R* following a change of one or two parameters.

Calculate the power or energy consumption of an electric appliance in kilowatt-hours.

Use the transfer of charges to explain a concrete example of the electrification of matter.

Use the formula $F = k\frac{Q_1 Q_2}{d^2}$ to predict the variation in electric force resulting from a change in the value of one charge or in the distance between the two charges.

On a diagram, draw the magnetic field lines around two magnets or electromagnets or, given the magnetic field lines, identifying the poles of the magnets or electromagnets that produced them.

Dimension 3

Given a series of statements, select those that correctly describe the characteristics or role of the components of a circuit.

In a given situation, explain why certain components of a circuit are connected in series or in parallel.

Dimension 4

Given the diagram or description of a series or parallel circuit and the values of a number of variables, determine the value of one or more missing variables.

Given the diagram of a series-parallel circuit, describe the distribution of voltage or current at various points in the circuit.

Dimension 5

Associate characteristics of power sources, advantages and disadvantages of their use with various types of cells, batteries and power supplies.

Dimension 6

Use the appropriate formulas to explain why and how the Joule effect is used or minimized in a given situation.

Complete a wiring diagram or branch circuit for residential use.

Justify for residental use the choice of outlet, service line, branch circuit, fuse rating or wire gauge.

Describe the characteristics of voltage reducers and boosters and in a given situation determine which one should be used. ($I_1, I_2, N_1, N_2, V_1, V_2$).

State the risks or dangers associated with static electricity or electric current.

Associate generators or electric motors with statements describing their operation or the relevant energy conversions.

Explain how static electricity, magnetism or electromagnetism is used in a given situation.

Dimension 7

Given reference materials related to a real or fictitious projected or existing power plant:

- explain how the plant produces electricity;
- state the advantages and disadvantages of the location and type of plant, the environmental consequences inherent in the construction or operation of the plant and the risks associated with the transportation of electricity;
- analyze alternatives to the project or plant, giving their advantages and disadvantages.

6. Explanation of Content and Weighting

On the basis of the objective of producing enlightened citizens relative to science and technology, the themes have been weighted as follows: 33% for basic concepts in electricity, 21% for electric circuits and 46% for the uses of electricity.

The program aims to help students gain an understanding of physical phenomena and the relationships between science, technology and society. This explains the weighting attributed to the capacity to understand (54%).

Finally, the case analysis should lead the students to consider the social, economic and political issues related to scientific and technological development. This area counts for 22% of the final mark.

On the basis of the tasks prescribed in the terminal objectives, the weighting of the themes and skills has been established as follows:

- Knowing 12%
- Understanding 54%
- Analyzing 34%

- Basic concepts in electricity 33%
- Electric circuits 21%
- Uses of electricity 46%

7. Description of the Examination

7.1 Type of Examination

The summative evaluation consists of an examination in two parts. Both parts should be given at the end of the course.

The first part is a written examination; it covers dimensions 1 through 6 and counts for 78% of the final mark. It consists of objective and short-answer test items. All the observable behaviours for each dimension should be measured. Except for dimensions 3 and 6, the points allotted to a dimension are divided equally between the observable behaviours for that dimension.

The second part is a written examination; it covers Dimension 7 and counts for 22% of the final mark. It includes one or more essay questions.

7.2 Characteristics of the Examination

The first part of the examination should be taken in a single session of no more than 120 minutes. A list of formulas will be provided (see appendix). Calculators are permitted.

The second part of the examination should be taken in a single session of no more than 90 minutes. The relevant information (e.g. numerical data, tables, documentation) should accompany each question.

7.3 Pass Mark

The pass mark is 60 out of 100 for the total of both parts of the examination

FORMULAS

$$I = \frac{Q}{t}$$

I : current (intensity)
Q : charge
t : time

$$V = RI$$

R : resistance
V : voltage (potential difference)
I : current (intensity)

$$R = \frac{\rho L}{A}$$

R : resistance
ρ : resistivity
L : length of the wire
A : cross section of the wire

$$R_{eq} = R_1 + R_2 + R_3 + \ldots \quad \text{(in series)}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + .. \quad \text{(in parallel)}$$

R : resistance
R_{eq} : equivalent resistance

$$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$$

N : number of turns
V : voltage (potential difference)
I : current (intensity)

$$P = VI$$

P : power
V : voltage (potential difference)
I : current (intensity)

$$P = RI^2$$

P : power
R : resistance
I : current (intensity)

$$P = \frac{E}{t}$$

P : power
E : energy
t : time

$$V_1 I_1 = V_2 I_2$$

V : voltage (potential difference)
I : current (intensity)

$$F = k\frac{Q_1 Q_2}{d^2}$$

F : force
k : constant
Q : charge
d : distance between the charges

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