

INFORMATION DOCUMENT

UNIFORM EXAMINATION

PHYSICAL SCIENCE 416

Secondary IV

556-470

June 2004

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This document is also available on the Internet at the following address:

<http://www.meq.gouv.qc.ca/DGFJ>

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INTRODUCTION

This information document describes and classifies the following aspects of the Physical Science 416 curriculum: those that students may be tested on in uniform examinations for purposes of secondary-school certification (556-470) and those that students may be tested on in laboratory examinations (556-480).

This document takes into account only the knowledge and skills described in the program. This information is to be used to prepare comprehensive examinations (i.e. written examinations consisting of multiple-choice or constructed-response questions and laboratory examinations).

As part of the summative evaluation process for purposes of secondary-school certification, the Ministère de l'Éducation (MEQ) will develop written examinations, whereas school boards and private schools will develop laboratory examinations. To ensure a certain measure of province-wide uniformity, it is important that laboratory examinations take into account the information found in this document. The MEQ provided school boards and private schools with prototype laboratory examinations during the 1999-2000 school year.

This document is to be used to prepare comprehensive examinations for purposes of summative evaluation and may not, under any circumstances, be substituted for the official curriculum.

1 ASPECTS OF THE CURRICULUM

1.1 SKILLS

The following skills will be taken into account in designing evaluation items: mastery of concepts, mastery of applications and mastery of problem solving.

1.1.1 Mastery of Concepts

The student will be able to carry out a written task which shows that he or she knows and understands a concept (element, operation, relationship, model) related to science and technology.

The evaluation items related to this skill may be presented as multiple-choice or constructed-response questions and may involve one of the following:

- identifying or explaining a concept
- identifying or describing examples and counter-examples related to a given concept

1.1.2 Mastery of Applications

The student will be able to carry out a specific written task by applying a combination of scientific and technological concepts (elements, operations, relationships, models) that he or she has already learned.

The evaluation items related to this skill may be presented as multiple-choice or constructed-response questions and may involve one of the following:

- choosing and applying a known combination of concepts
- explaining or justifying a known combination of concepts

1.1.3 Problem Solving

The student will be able to carry out a laboratory task by applying the principles of the scientific method as well as the scientific and technological concepts he or she has learned in this course.

The evaluation items related to this skill ask the student to give a written explanation of all the steps in the scientific procedure he or she has used to achieve the required result.

The student's work must be evaluated according to the following criteria:

- the definition of the problem (stating the purpose of the experiment and the hypotheses, the information, variables and techniques required and the procedures to be used)
- gathering and processing of data (presenting the data, choosing and applying concepts, rules, laws and methods)
- analysis of results and conclusion (identifying the causes of errors, interpreting results and drawing a conclusion)
- written expression (neat and organized presentation, use of good English, use of proper scientific terms and symbols)

2 CONTENT OF THE WRITTEN EXAMINATION (556-470)

The written examination is developed by the MEQ and comprises 25 questions. The following table shows the distribution of the number of questions taking into account the relative importance given to the various components of the curriculum.

SKILL	MODULE		
	Structure and Matter 32%	Electrical Phenomena 40%	Ionic Phenomena 28%
Mastery of Concepts 40%	4	3	3
Mastery of Applications 60%	4	7	4

The examination consists of the following types of questions:

- 19 multiple-choice questions that test the student's mastery of concepts and applications
- 6 constructed-response questions that test the student's mastery of applications

Important Notice

The following curriculum objectives will not be covered in the comprehensive examinations for June and August 2004 and January 2005:

- Terminal Objective 1 of Module I
- Terminal Objectives 1 and 7 of Module II
- Terminal Objectives 1 and 7 of Module III

These exclusions apply only to the uniform examinations prepared by the MEQ.

3 DURATION OF THE WRITTEN EXAMINATION (556-470)

The written examination lasts two (2) hours.

4 AUTHORIZED MATERIALS FOR THE WRITTEN EXAMINATION (556-470)

Only the following materials may be used during the examination:

- drawing instruments
- graph paper
- scientific calculator without a graphic display
- sheet of formulas and quantities included in the examination booklet (see Appendix I)
- periodic table of the elements included in the examination booklet (see Appendix II)

Use of Graphing Calculators

The common practice of using graphing calculators during the Physical Science 416 examination has been the target of growing negative feedback. This is because the memory in this type of calculator can be used to store text (roughly two pages worth in the most popular model) that students can refer to in answering these examination questions. As a result, a potentially unfair situation is created for students who do not have access to this type of calculator.

This problem cannot be settled by allowing students to use a memory aid as in Mathematics 436, since part of the Physical Science 416 examination tests the student's knowledge of concepts. If students were permitted to use a graphing calculator or memory aid, the examination would have to be significantly changed to include problem-solving questions. Note that in Physical Science 416, laboratory examinations are used to test problem-solving abilities.

To resolve this potentially unfair situation, students will be forbidden to use graphing calculators or any other type of calculator that can be used to store the same amount of information during the Physical Science 416 examination.

5 CORRECTION OF THE WRITTEN EXAMINATION (556-470)

In June 2004 and January 2005, the MEQ will score the answers to the 19 multiple-choice questions, but school boards and private schools will score the answers to the 6 constructed-response questions. In August 2004, school boards and private schools will score the entire examination.

For scoring at the local level, the MEQ provides school boards and private schools with an answer key for the multiple-choice questions and a marking guide for the constructed-response questions. The constructed-response questions are scored according to the marking scale in Appendix III. It is suggested that this scale be used throughout the school year.

Each question is worth four (4) marks, and the uniform examination is out of 100 marks. However, the uniform examination is worth 42.5% of the student's final mark.

The result out of 24 marks for the constructed-response questions must be recorded on the students' machine-scored answer sheets.

The MEQ will do all the calculations involved in determining the student's final mark.

6 CONTENT OF THE LABORATORY EXAMINATION (556-480)

This involves assessing the student's knowledge and skills by means of summative laboratory examinations. Students will be evaluated on an individual basis. School boards and private schools are totally responsible for this evaluation.

In the fall of 1999, prototype laboratory examinations developed by the MEQ were sent to school boards and private schools so that they could use them whenever they deem it necessary during the school year. The use of these examinations is optional. However, when one of these examinations is administered, it cannot be modified in any way.

If school boards or private schools decide to administer three summative laboratory examinations per school year, it is recommended that they be weighted as indicated in the following table.

SKILL	RELATED CONTENT		
	Structure and Matter	Electrical Phenomena	Ionic Phenomena
Mastery of Problem Solving	30%	40%	30%

If school boards or private schools decide to administer two summative laboratory examinations per school year, it is recommended that they be weighted as indicated in the following table.

SKILL	RELATED CONTENT	
	Electrical Phenomena	Structure and Matter or Ionic Phenomena
Mastery of Problem Solving	50%	50%

Administering only one summative laboratory examination per school year is not recommended, because this would mean asking one question worth 15% of the student's final mark.

The marking scale to be used for grading the answers to questions in summative laboratory examinations is presented in Appendix IV. The student's version of this marking scale is found in Appendix V. It is suggested that these scales be used during the school year.

7 CORRECTION OF THE LABORATORY EXAMINATION (556-480)

The laboratory examination, which is a local responsibility, is out of 100 marks, but it is worth 15% of the student's final mark. School boards and private schools will score this examination.

The marking scale to be used to evaluate laboratory work is presented in Appendix IV. The student's version of this scale is found in Appendix V. It is suggested that these scales be used throughout the school year.

8 DETERMINING THE FINAL MARK (556-486)

The student's final mark is broken down as follows:

Written Work (556-470)

- mark on the uniform written exam 42.5%
- mark for written work done during the school year 42.5%

Laboratory Work (556-480)

- mark for laboratory exams 15.0%

Final mark (556-486) 100%

LIST OF FORMULAS AND QUANTITIES

FORMULAS	
$\rho = \frac{m}{V}$ <p style="margin-left: 20px;">ρ : density m : mass V : volume</p> $Q = mc\Delta T$ <p style="margin-left: 20px;">Q : quantity of heat m : mass c : specific heat capacity ΔT : change in temperature</p> $R_{eq} = R_1 + R_2 + \dots$ <p style="margin-left: 20px;">R_{eq} : equivalent resistance</p> $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ <p style="margin-left: 20px;">R_{eq} : equivalent resistance</p> $R = \frac{V}{I}$ <p style="margin-left: 20px;">R : resistance V : potential difference I : current intensity</p>	$G = \frac{I}{V}$ <p style="margin-left: 20px;">G : conductance I : current intensity V : potential difference</p> $E = VIt$ <p style="margin-left: 20px;">E : energy V : potential difference I : current intensity t : time</p> $E = Pt$ <p style="margin-left: 20px;">E : energy P : power t : time</p> $P = IV$ <p style="margin-left: 20px;">P : power I : current intensity V : potential difference</p>

Note: Potential difference, V , may be represented by U .

QUANTITIES		
NAME	SYMBOL	VALUE (for water)
Specific heat capacity	c	4190 J/(kg \cdot C) or 4.19 J/(g \cdot C)
Density	ρ	1.0 g/mL or 1.0 kg/L or 1000 kg/m ³

PERIODIC TABLE OF THE ELEMENTS

Appendix II

		Key															VIII A						
		Element Symbol		Atomic number		Atomic Mass												2					
		1 H 1.01		1 H 1.01		1 H 1.01												He 4.00					
1	I A 1	2											13	14	15	16	17	18					
1	H 1.01	II A 2											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18					
2	3 Li 6.94	4 Be 9.01											VIII					5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	III B 3	IV B 4	V B 5	VI B 6	VII B 7	8	9	10	I B 11	II B 12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95					
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80					
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.40	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30					
6	55 Cs 132.91	56 Ba 137.33	57-71 La-Lu	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.20	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.20	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)					
7	87 Fr (223)	88 Ra (226)	89-103 Ac-Lr	104 Rf (261)	105 Ha (262)																		
6			57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 145	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97						
7			89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)						

MARKING SCALE FOR CONSTRUCTED-RESPONSE QUESTIONS

- 4 marks – The student chose an appropriate procedure and applied it correctly; the final answer is correct.

- 3 marks – The student chose an appropriate procedure, but made minor errors in applying it (calculation or transcription errors, incorrect or missing unit of measurement, number rounded off incorrectly); the final answer is incorrect, or it is correct purely by chance.

- 2 marks – The student chose an appropriate procedure, but made major errors in applying it (errors relating to methods, rules, laws, systems or theories); the final answer is incorrect, or it is correct purely by chance.

- 1 mark – The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly); the answer is missing or incorrect, or it is correct purely by chance

- 0 marks – The student showed no work or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

Note: If for any reason this scale cannot be applied in its entirety to a particular question, the relevant changes will be described in the marking guide.

MARKING SCALE FOR LABORATORY WORK
(Teacher's Version)

STEP	RATING				
	Very Good	Good	Average	Poor	Very Poor
Definition of Problem /36	31 to 36	25 to 30	21 to 24	12 to 20	0 to 11
Gathering and Processing of Data /32	28 to 32	23 to 27	19 to 22	12 to 18	0 to 11
Analysis of Results and Conclusion /24	21 to 24	18 to 20	14 to 17	8 to 13	0 to 7
Written Expression /8	8	6 or 7	5	3 or 4	0 to 2

MARKING SCALE FOR LABORATORY WORK

(Student's Version)

STEP	CRITERION	MARK
Definition of Problem	<ul style="list-style-type: none"> – Statement of the purpose of the experiment – The information, variables and techniques you will need to use – Statement of the hypothesis, if applicable – Description of the procedure <ul style="list-style-type: none"> • required materials • steps involved 	/36
Gathering and Processing of Data	<ul style="list-style-type: none"> – Presentation of data – Processing of data <ul style="list-style-type: none"> • Application of: <ul style="list-style-type: none"> • concepts • rules • laws • methods 	/32
Analysis of Results and Conclusion	<ul style="list-style-type: none"> – Interpretation of results – Identification of the causes of errors – Conclusion 	/24
Written Expression	<ul style="list-style-type: none"> – Neat and organized presentation – Use of good English – Use of proper scientific terms and symbols 	/8
		Total /100

ADDITIONAL INFORMATION ON VARIOUS ASPECTS OF THE CURRICULUM

Note: Significant Figures: Students are not required to take significant figures into account when gathering data or giving their answers.

MODULE 1

– DEFINITION OF “CHARACTERISTIC PROPERTY”

A distinctive property of a substance or group of substances which, in and of itself, enables you or helps you to recognize that substance or group of substances.

Examples:

- the density of a substance
- the melting point of a substance
- the fact that metals conduct electricity (group characteristic)
- the fact that acids make litmus paper turn red (group characteristic)

MODULE 2

– DEFINITION OF A “MAGNETIC SUBSTANCE”

A substance with the properties of a magnet, meaning that it attracts or repels other substances.

Examples:

- magnetite
- a bar magnet

– DEFINITION OF A “FERROMAGNETIC SUBSTANCE”

A substance attracted by a magnet though it is not magnetic in and of itself.

Examples:

- iron
- nickel
- cobalt

– DEFINITION OF A “NONMAGNETIC SUBSTANCE”

A substance that is not attracted by a magnet.

Examples:

- paper
- copper

– DIRECTION OF CURRENT

In a diagram, an arrow will not be used to indicate the direction of the current. The student must determine the direction of the current according to the polarity of the terminals, which is indicated on the source.

MODULE 3

– DEFINITION OF “TURNING POINT”

The turning point is the pH range within which the colour of an indicator may change. The turning point is therefore identified by writing the upper and lower limits of the relevant range, separated by a hyphen.

Example: The turning point of bromothymol blue is 6.0 – 7.6.

