Definition of the domain
for summative evaluation

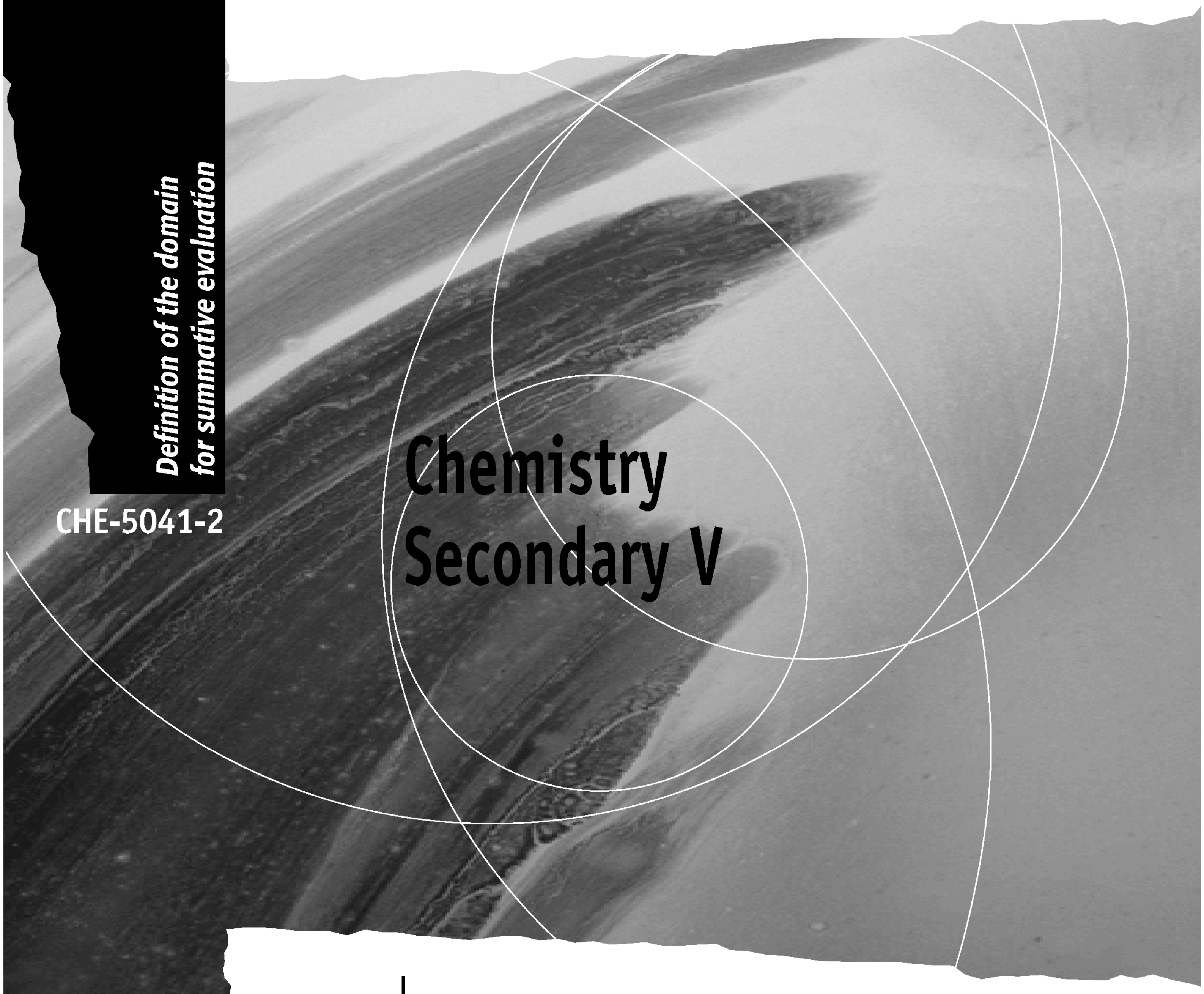
CHE-5041-2

Chemistry
Secondary V

Gases

Reach for your Dreams

Québec



Definition of the domain
for summative evaluation

CHE-5041-2

Chemistry
Secondary V

Gases

Formation professionnelle et technique
et formation continue

Direction de la formation générale
des adultes

ISBN 2-550-41878-6

Legal deposit — Bibliothèque nationale du Québec, 2004
CE DOCUMENT REMPLACE LE DOCUMENT 38-8791A PUBLIÉ EN NOVEMBRE 1999.

1. Introduction

This definition of the domain for summative evaluation describes and classifies the essential and representative elements of the *Chemistry* program – specifically, for the course entitled *Gases*. 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 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 chemistry and either acquire or improve the skills related to the experimental method.	Evaluation items should test the students' knowledge and understanding of the basic concepts of chemistry 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.	Evaluation should involve problem situations that test the students'understanding of various phenomena. Evaluation should not focus solely on calculations and their results.
The program presents scientific knowledge from a historical, technological and social perspective.	Evaluation should also reflect the relationship between the related content and the history-technology-society perspective (HTS).
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 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 *Gases* focuses on familiarizing students with the different aspects of the experimental method.	In the course entitled *Gases*, evaluation items relating to the experimental method should involve having the students analyze data resulting from experiments.

3. Course Content for Purposes of Summative Evaluation

Themes

- **Related Content**

  – States of matter:
    - observable properties
    - molecular motion

  – Melting and boiling points of different substances

  – Role of gases in nature

  – Pressure exerted by gases:
    - definition
    - explanation of the phenomenon

  – Avogadro's principle

  – Identification of a gas

  – Dalton's law of partial pressures

  – Kinetic theory of gases:
    - states of matter
    - diffusion
    - pressure exerted by gases
    - relationship between the pressure and volume of a gas
    - relationships between the temperature and volume of a gas and between its temperature and pressure
    - relationship between the number of moles of a gas and its volume

  – Laws governing the behaviour of gases and limits of their application:
    - relationship between the pressure and volume of a gas
    - relationships between the temperature and volume of a gas and between its temperature and pressure
    - relationship between the number of moles of a gas and its volume
    - ideal gas law

  – Problem solving:
    - relationship between the pressure and volume of a gas
    - relationships between the temperature and volume of a gas and between its temperature and pressure

  - relationship between the number of moles of a gas and its volume
  - ideal gas law and limits of its application

- Chemical bonds in the gaseous state:
  - formation of diatomic and polyatomic gases
  - relationship between formation of gases and chemical stability

- Energy balance of simple chemical reactions occurring in a gaseous state

• **History-Technology-Society perspective (HTS)**

- Relationships between the study of gases and the evolution of chemistry:
  - temperature scales and absolute zero
  - influence of Avogadro's work on our understanding of chemical reactions
  - discoveries resulting from the study of gases

- Technical applications involving the use of gases:
  - those involving a phase change
  - those involving the use of air or other gaseous substances
  - those involving the use of differences in pressure
  - those involving differences in density between two points in the air or between two different gaseous media

- Social changes and environmental consequences related to the industrial production of gaseous substances and the use of gases in general:
  - emission of gaseous pollutants
  - health effects of absorbing a toxic gas
  - technological use of gases

• **Experimental Method**

- Processing and analyzing experimental data:
  - specifying measured and constant parameters
  - specifying independent and dependent variables
  - making tables and drawing graphs
  - interpreting graphs
  - establishing relationship between parameters

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

Themes / Skills	Related Content 65%	HTS Perspective 15%	Experimental Method 20%
Knowing 8%	States of matter (4%) Role of gases in nature (4%) **(1) 8%**		
Understanding 43%	Pressure exerted by gases (4%) Avogadro's principle (4%) Kinetic theory of gases (8%) Laws governing the behaviour of gases (8%) Chemical bonds in the gaseous state (4%) **(2) 28%**	Relationships between the study of gases and the evolution of chemistry (5%) - temperature scales and absolute zero - Avogadro's work - discoveries resulting from the study of gases Technical applications of gases (5%) - phase change - air and other gaseous substances - differences in pressure - density Social changes and environmental consequences related to the industrial production of gaseous substances and the use of gases in general (5%) - emission of gaseous pollutants - health effects - technological use of gases **(4) 15%**	
Analyzing 49%	Melting and boiling points of different substances (4%) Identification of a gas (4%) Dalton's law of partial pressures (4%) Problem solving (12%) Energy balance of reactions occurring in a gaseous state (5%) **(3) 29%**		Processing and analyzing experimental data (20%) - measured and constant parameters - independent and dependent variables - tables and graphs - graph interpretation - relationship between parameters **(5) 20%**

5. Observable Behaviours

Dimension 1

– Given statements explaining concrete examples of states of matter or phase changes, choose those in which observable properties or molecular motion are associated with the three corresponding states of matter. Justify one's choice or correct false statements to make them valid. (4%)

– Match one or more gases with the roles they play in nature. (4%)

Dimension 2

– Given a concrete situation involving pressure, predict the effect of a change in the surface area or in the force or suggest at least one change that makes it possible to increase or decrease the pressure involved. Justify one's answer using the definition of pressure. (4%)

– Given a series of statements, choose those that correctly describe chemical reactions occurring in the gaseous state, in the light of Avogadro's principle. Justify one's choice or correct false statements to make them valid. (4%)

– Given a series of statements and considering the kinetic theory of gases, choose those that correctly explain a concrete example of the following: a state of matter, a phase change, diffusion, pressure exerted by a gas, one of the laws governing the behaviour of gases. Justify one's choice or correct false statements to make them valid. (8%)

– Given one or more concrete examples involving gases, explain the phenomena observed and making qualitative and quantitative predictions about the behaviour of the system following a change in any given factor. Justify one's answer by referring to the laws governing the behaviour of gases. The examples may involve experimental situations. (8%)

– Given a series of statements, choose those that correctly describe the formation of diatomic or polyatomic gases and that correctly explain why the formation of these gases is related to a stable electronic structure. Justify one's choice or correct false statements to make them valid. (4%)

Dimension 3

- Arrange at least four substances in increasing or decreasing order of their melting or boiling points. The states of these substances are known at a minimum of two different temperatures. Justify the arrangement. (4%)

- Interpret the results of a laboratory experiment aimed at identifying an unknown gas. The appropriate information is provided with the exam. (4%)

- Solve a problem on Dalton's law of partial pressures. (4%)

- Use the ideal gas law to solve problems involving gaseous substances. (12%)

- Determine the energy balance of a simple chemical reaction occurring in a gaseous state. A list of appropriate bonding energies is provided with the exam. (5%)

Dimension 4

- Explain the relationships between the study of gases and the evolution of chemistry. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

- Explain at least two technical applications of gases. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

- Briefly describe the situation that prevailed before the advent of a technical application involving the use of gases as well as the new possibilities resulting from its implementation. This involves using the information provided with the exam and knowledge acquired during the course. (5%)

Dimension 5

- Given information on one or more experiments, specify the constant parameters, the dependent and the independent variables, make tables of results or draw graphs, interpret graphs and establish a simple relationship between the parameters. (20%)

6. Explanation of the Content and Weighting

In accordance with the objectives of the Secondary V *Chemistry* program, students should acquire a theoretical knowledge of chemistry, 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 20% of the mark obtained in the present 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 65% of this course mark.

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 present course, the relative importance of each skill is as follows:

KNOWING	8%
UNDERSTANDING	43%
ANALYZING	49%

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 4, inclusive, and is worth 80% of the course mark. It consists of restricted-response, short-answer or extended-response items.

– The other part is a written examination covering dimension 5 and is worth 20% of the course mark. It consists of short-answer and extended-response items.

Both parts of the examination are compulsory. All the observable behaviours for each dimension must be taken into account.

B. Characteristics of the Examination

The part covering dimensions 1 to 4 is written in a single session lasting no more than 180 minutes. Students are permitted to use a calculator and must be provided with a periodic table, formulas and appropriate information required by dimensions 3 and 4. Examples of this material are included in Appendix 1 to 3.

The part covering dimension 5 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%.

Periodic Table of the Elements

Alkali metals

Alkaline earth metals

Halogens

Noble gases

Atomic number | Electronegativity value | Symbol | Atomic mass

87 0.7
Fr
Francium
223.019

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1 2.1 H Hydrogen 1.008																	2 He Helium 4.002
3 1.0 Li Lithium 6.941	4 1.5 Be Beryllium 9.012											5 2.0 B Boron 10.811	6 2.5 C Carbon 12.011	7 3.0 N Nitrogen 14.007	8 3.5 O Oxygen 15.999	9 4.0 F Fluorine 18.998	10 Ne Neon 20.180
11 0.9 Na Sodium 22.989	12 1.2 Mg Magnesium 24.305											13 1.5 Al Aluminum 26.982	14 1.8 Si Silicon 28.086	15 2.1 P Phosphorus 30.974	16 2.5 S Sulphur 32.066	17 3.0 Cl Chlorine 35.453	18 Ar Argon 39.948
19 0.8 K Potassium 39.098	20 1.0 Ca Calcium 40.078	21 1.3 Sc Scandium 44.956	22 1.5 Ti Titanium 47.88	23 1.6 V Vanadium 50.942	24 1.6 Cr Chromium 51.996	25 1.5 Mn Manganese 54.938	26 1.8 Fe Iron 55.847	27 1.8 Co Cobalt 58.933	28 1.8 Ni Nickel 58.693	29 1.9 Cu Copper 63.546	30 1.6 Zn Zinc 65.39	31 1.6 Ga Gallium 69.723	32 1.8 Ge Germanium 72.612	33 2.0 As Arsenic 74.921	34 2.4 Se Selenium 78.96	35 2.8 Br Bromine 79.904	36 Kr Krypton 83.800
37 0.8 Rb Rubidium 85.468	38 1.0 Sr Strontium 87.62	39 1.3 Y Yttrium 88.906	40 1.4 Zr Zirconium 91.224	41 1.6 Nb Niobium 92.906	42 1.8 Mo Molybdenum 95.94	43 1.9 Tc Technetium 97.907	44 2.2 Ru Ruthenium 101.07	45 2.2 Rh Rhodium 102.906	46 2.2 Pd Palladium 106.42	47 1.9 Ag Silver 107.868	48 1.7 Cd Cadmium 112.411	49 1.7 In Indium 114.82	50 1.8 Sn Tin 118.710	51 1.9 Sb Antimony 121.757	52 2.1 Te Tellurium 127.60	53 2.5 I Iodine 126.904	54 Xe Xenon 131.29
55 0.7 Cs Cesium 132.905	56 0.9 Ba Barium 137.327		72 1.3 Hf Hafnium 178.49	73 1.5 Ta Tantalum 180.948	74 1.7 W Tungsten 183.85	75 1.9 Re Rhenium 186.207	76 2.2 Os Osmium 190.200	77 2.2 Ir Iridium 192.22	78 2.2 Pt Platinum 195.080	79 2.4 Au Gold 196.967	80 1.9 Hg Mercury 200.59	81 1.8 Tl Thallium 204.383	82 1.8 Pb Lead 207.2	83 1.9 Bi Bismuth 208.980	84 2.0 Po Polonium 208.982	85 2.2 At Astatine 209.987	86 Rn Radon 222.018
87 0.7 Fr Francium 223.019	88 0.9 Ra Radium 226.025		104 Unq (Unnilquadium) (261)	105 Unp (Unnilpentium) (262)	106 Unh (Unnilhexium) (263)	107 Uns (Unnilseptium) (262)	108 Uno (Unniloctium) (265)	109 Une (Unnilennium) (266)	110 Uun (Ununnilium)	111 Uuu (Unununium)	112 Uub (Ununbium)						

57 1.1 La Lanthanum 138.905	58 1.1 Ce Cerium 140.115	59 1.1 Pr Praseodymium 140.907	60 1.1 Nd Neodymium 144.24	61 1.1 Pm Promethium 144.912	62 1.2 Sm Samarium 150.36	63 1.2 Eu Europium 151.965	64 1.1 Gd Gadolinium 157.25	65 1.2 Tb Terbium 158.925	66 1.2 Dy Dysprosium 162.50	67 1.2 Ho Holmium 164.930	68 1.2 Er Erbium 167.26	69 1.2 Tm Thulium 168.934	70 1.2 Yb Ytterbium 173.04	71 1.2 Lu Lutetium 174.967
89 1.1 Ac Actinium 227.027	90 1.3 Th Thorium 232.038	91 1.5 Pa Protactinium 231.036	92 1.4 U Uranium 238.029	93 1.3 Np Neptunium 237.048	94 1.3 Pu Plutonium 244.064	95 1.3 Am Americium 243.061	96 1.3 Cm Curium 247.070	97 1.3 Bk Berkelium 247.070	98 1.3 Cf Californium 251.079	99 1.3 Es Einsteinium 252.083	100 1.3 Fm Fermium 257.095	101 1.3 Md Mendelevium 258.098	102 1.3 No Nobelium 259.100	103 1.3 Lr Lawrencium 260.105

Formulas

$$PV = nRT$$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

$$P_{\text{total}} = P_1 + P_2 + P_3 + P...$$

P pressure

V volume

n number of moles

R molar gas constant

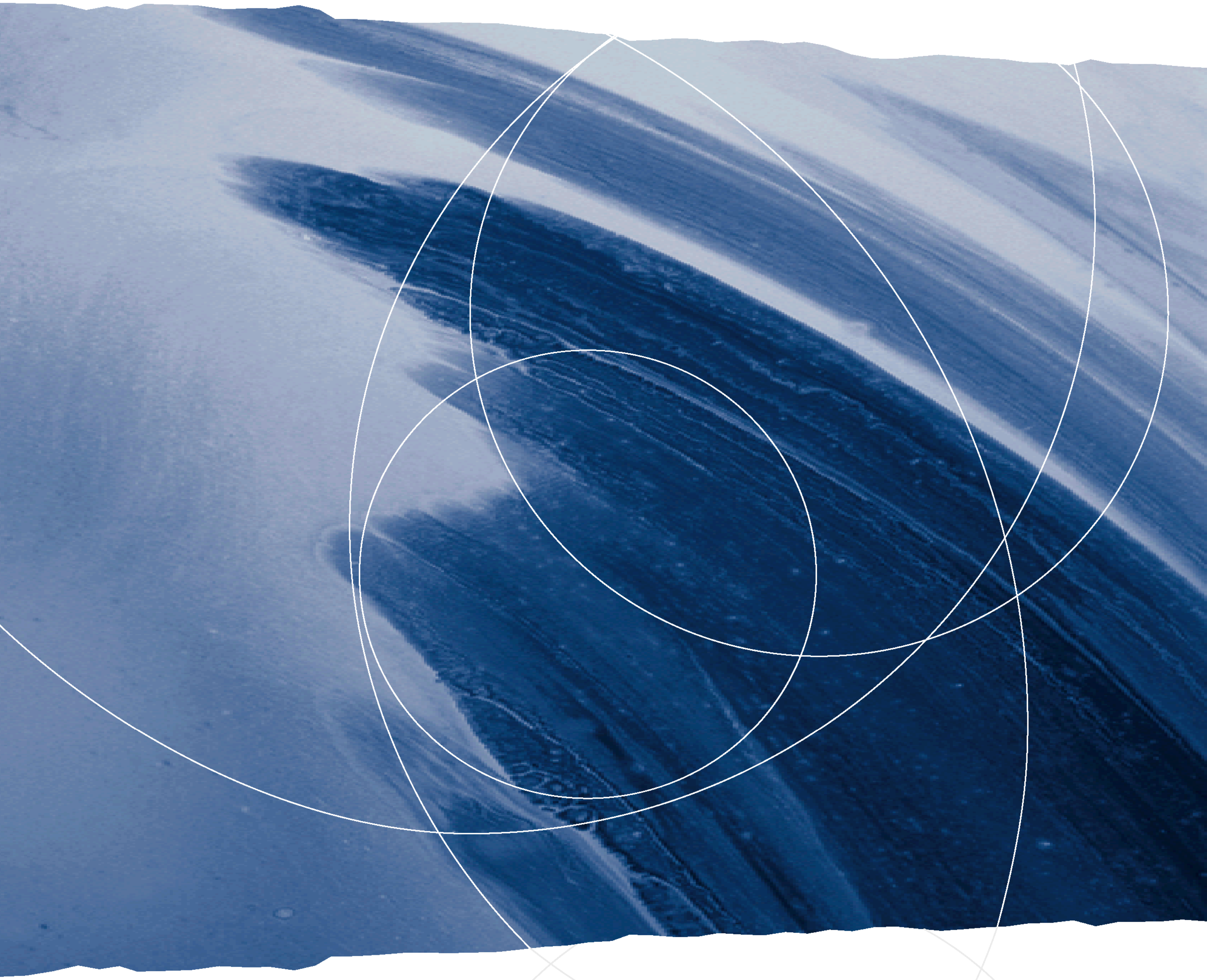
T temperature

Constant

Molar Gas Constant (R) = 8.31 kPa•L/(mol•K)

Characteristics of Gases

Substance	Description	Density	Molar Mass
Nitrogen Gas **N_2**	Colourless, odourless and usually inert gas; extinguishes a glowing splint; does not turn limewater cloudy; does not conduct electricity; virtually insoluble in water.	0.001 25 g/ml	28.014 g/mol
Carbon Dioxide **CO_2**	Colourless, odourless gas; extinguishes a glowing splint; turns limewater cloudy; does not conduct electricity; soluble in water.	0.001 98 g/ml	43.991 g/mol
Helium **He**	Inert, colourless, odourless gas; extinguishes a glowing splint; does not turn limewater cloudy; does not conduct electricity; slightly soluble in water.	0. 000 18 g/ml	4.003 g/mol
Hydrogen Gas **H_2**	Colourless, odourless gas; makes a popping sound in the presence of a lighted splint; does not turn limewater cloudy; does not conduct electricity; slightly soluble in water.	0.000 09 g/ml	2.016 g/mol
Oxygen Gas **O_2**	Colourless, odourless gas; revives a glowing splint; does not turn limewater cloudy; does not conduct electricity; not very soluble in water.	0.001 43 g/ml	31.998 g/mol



Éducation
Québec

41-9010-A