

Appendices

The appendices of *Nelson Chemistry 11* are an important feature of the text, enabling students to learn how to learn. The four appendices cover:

- Scientific Inquiry Skills
- Technological Problem Solving
- Decision-Making Skills
- Lab Reports
- Math Skills
- Safety Skills
- Reference Tables
- Answers to Questions

Appendix A1

Observational Studies

Often the purpose of inquiry is simply to study a natural phenomenon with the intention of gaining scientifically significant information to answer a question. Observational studies involve observing a subject or phenomenon in an unobtrusive or unstructured manner, usually with no hypothesis. A hypothesis may, however, be generated, repeated observations, and modified as new information is collected over time.

When the purpose of scientific inquiry is to test a suspected relationship (hypothesis) between two different variables, but a controlled experiment is not possible, a correlational study is conducted. The investigator cannot purposefully change or control the variables but instead must allow them to change naturally. It is often difficult to isolate cause and effect in correlational studies. A correlational inquiry requires large sample numbers and many replicates to increase the certainty of the results.

The flow chart (Figure 3) summarizes the stages and processes of scientific inquiry through observational studies.

Appendix A1

Correlational Studies

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The flow chart (Figure 2) outlines the components that are important in designing a correlational study. An investigation **may** determine cause-and-effect relationships.

Appendix A1

Scientific Inquiry Skills

Planning an Investigation

In our attempts to further our understanding of the natural world, we encounter questions, mysteries, or events that are not readily explainable. We can use controlled experiments, correlational studies, or observational studies to help us look for answers or explanations. The methods used in scientific inquiry depend to a large degree, on the purpose of the inquiry.

Your question forms the basis for your investigation. Controlled experiments are about relationships, on the question could be about what causes the change in variable A. In this case, you might speculate about possible variables and determine which variable causes the change.

Choose a topic that interests you. Determine whether you are going to replicate or revise a previous study or create a new one. Indicate your decision in a statement of the purpose.

Asking the question: Is there a greater percentage of males than females who are colour blind?

Under what conditions would water move into and out of cells?

Three model cells constructed from dialysis tubing have been placed in a beaker of distilled water. One of the cells has distilled water in a beaker of starch suspension. The other two cells are in a beaker of distilled water. Indicate the mass of each cell is recorded and other observations are made at the beginning and after 10 and 20 min.

These measurements and diagrams will be recorded in a table like Table 1.

The results will be analyzed to determine if there were any changes in mass and if there were any observable changes. Changes in mass and/or colour should be used to determine what is happening with the cells.

At this stage of the investigation, you will evaluate the processes that you followed to plan and perform the investigation. Evaluating the processes includes reviewing the design and the procedure. You will also evaluate the outcomes of the investigation, which involves assessing the evidence—whether it supports the hypothesis or not—and the hypothesis itself.

In preparing your report, your objectives should be to describe your design and procedure accurately and to report your observations accurately and honestly.

Figure 1
Where does this go?

Table 4: Inventory of Trees in Sample Areas of Local Region

Tree species (Common and scientific names)	Sample area										Total	
	1	2	3	4	5	6	7	8	9	10		

Table 2: Individual Colourblind Test Results

Participant	Colour plate 1	Modified Colourblind Test
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Table 3: Percentage of Colourblind and Normal by Sex

Sex	Colourblind		Normal	
	Male	Female	Male	Female
Male				
Female				

Table 1: Observations of Model Cells

Model cell	Initial mass (g)	Mass after 10 min (g)	Mass after 20 min (g)	Other observations
Cell 1—dialysis tube with distilled water in beaker of distilled water				
Cell 2—dialysis tube with starch suspension in beaker of distilled water				
Cell 3—dialysis tube with distilled water in beaker of starch suspension				

Figure 2
Where does this go?

Figure 3
Where does this go?

Appendix A1

Appendix A2

Decision-Making Skills

Modern life is filled with environmental and social issues that have scientific and technological dimensions. An issue is defined as a problem that has at least two possible solutions rather than a single answer. There can be many positions, generally determined by the values that an individual or a society holds, on a single issue. Which solution is "best" is a matter of opinion; ideally, the solution that is implemented is the one that is most "appropriate" for society as a whole. The common components involved in the decision-making process are outlined in the graph below.

Examine the issue and think of as many alternative solutions as you can. At this point, do not narrow the solutions seen available. To analyze the alternatives, you should examine the issue from a variety of perspectives. Stakeholders may bring different viewpoints to an issue and these may influence their position on the issue. Brainstorm or hypothesize how different stakeholders would feel about your alternatives. Perspectives that stakeholders may adopt while approaching an issue are listed in Table 1 (p. 76).

Formulate a research question that helps to find, narrow, or define the issue. Then develop a plan to identify and find reliable and relevant sources of information. You may create a flow chart, concept map, or other graphic organizer to outline the scope of your information search. Gather information from a number of different sources.

Begin your search for reliable and relevant sources of information about the issue with a question such as, "What does the research say about the risk associated with possible cause?" or "What are the established positions of various groups on the issue?" Outline the scope of your information search, including setting, selecting, and evaluating relevant information from many sources, including newspapers, magazines, scientific journals, the Internet, and the library.

There are five steps that must be completed to effectively analyze the issue:

1. Evaluate criteria for determining the relevance and significance of the data you have gathered. Using a graphic organizer may assist in both evaluating the information and organizing the perspectives.
2. Evaluate the sources of information. Are you able to confirm the information you find? Determine what perspectives and biases the author brings to the reader.
3. Identify and determine what assumptions have been made, and whether they are supported. If there is not enough supporting evidence, the assumption should be challenged.
4. Determine any causal, sequential, or cyclical relationships that may be associated with the issue. Possible causes may have arisen because of the desire of those people to resolve the ethical aspect of the property distribution, insects, and fungi. A related issue is that people object to a neighborhood that has a parking garage built, because it creates a barrier for and attracts unwanted or dangerous wildlife (pests).
5. Evaluate the alternatives, weighing the positive and negative implications of each. Table 3 (p. 76) shows a risk-benefit analysis of allowing pesticides use in farms.

After analyzing your information, you can answer your research question and take an informed position on the issue. You should be able to defend your position. You can communicate your decision in an appropriate format. For example, you can make a presentation, prepare a debate, or write a supported opinion piece. A presentation paper, a letter, or an editorial is a persuasive or magazine.

The final phase of decision making includes evaluating the decision itself and the process used to reach the decision. Carefully evaluate the thinking that led to your decision. Consider a risk-by-step evaluation of the procedure and processes you used to reach the decision.

Some questions to guide your reflection include:

- How did the information that you have gathered influence your decision?
- What was my initial perspective on the issue? How has my perspective changed since I began to explore the issue?
- How did the information that you gathered influence your decision?
- What information did I consider to be most important in choosing an alternative solution?
- Which perspectives did I consider?
- How did I gather information about the issue? What criteria did I use to evaluate the information?
- How did we make our decision? What process did we use? What roles did we play?
- What are the likely short- and long-term effects of the decision?
- What resources would we need to implement the decision?
- If we had to make this decision again, what would be different?

Table 1: Rating for Refrigerator Designers

Design criteria	Design 1		Design 2	
	1	2	1	2
Energy efficiency	1	2	1	2
Cost	1	2	1	2
Space efficiency	1	2	1	2
Weight	1	2	1	2
Appearance	1	2	1	2
Reliability	1	2	1	2
Total score	19	17		

Figure 2
Where does this go?

Figure 3
Where does this go?

Appendix A2

Appendix A3

Technological Problem Solving Skills

There is a difference between science and technology. The goal of science is to understand the natural world. The goal of technological problem solving is to develop or revise a product or a process in response to a human need. The product or process must fulfill its function but, in contrast, which leads to a clear definition of the problem, and ends with an appropriate solution that addresses the need. It is important to keep in mind that the process itself is an important determinant of effective problem solving. Figure 2 outlines the process of technological problem solving in the cycle below.

The technological problem-solving process is cyclical. Every step in the process involves feedback and evaluation. However, it is important to evaluate the final product using the established criteria, and to evaluate the process you followed while arriving at the solution. Evaluating your product and process may lead to a revision of the solution.

Consider the following questions:

- In what degree does the final product meet the design criteria?
- Can the final product enable us to collect the information needed for the scientific investigation?
- Did we have to make any compromises in the design? If so, are there ways to minimize the effects of the compromise?
- Did we exceed any of the resource parameters?
- Were there any unexpected (positive or negative) outcomes?
- Are there other possible solutions that decrease future considerations?
- How did our group work as a team?
- If we were given a similar task, how would we work differently in our group?

In presenting your solution, you will communicate what your solution is, identify potential applications, and put your solution to use.

Once a decision has been made about the design, the best presentation of the solution is a demonstration of its use—a test under actual conditions. This demonstration can also serve as a further test of the design. Any feedback should be considered for future redesign. Remember that no solution would be considered final. Always consider the possibility of further refinements to improve the performance of the preferred solution.

In this phase, you will construct and test your prototype. You may also complete a risk-benefit analysis of the prototype. To help you decide on the best solution, you can use your potential solutions based on each of the design criteria on a scale of 1 to 5. You can then compare your proposed solutions by totaling the scores.

Constructing/testing solutions

Presenting the preferred solution

Evaluating the solution and process

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Design criteria	Design 1		Design 2	
	1	2	1	2
Energy efficiency	1	2	1	2
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Figure 2
Where does this go?

Figure 3
Where does this go?

Appendix A3

Appendix A4

Lab Reports

Lab reports are a key component of scientific inquiry. They provide a structured way to communicate your findings, methods, and conclusions. The lab report is a record of your work and a tool for learning. It should be written clearly and concisely, following a standard format. The format of a lab report is outlined in the graph below.

For the format of a lab report, see the sample Lab Report in Appendix A4.

Appendix A4

Appendix A5

Math Skills

Math skills are essential for understanding chemistry. This appendix covers various mathematical concepts and techniques used in chemistry, including unit conversions, significant figures, and algebraic manipulation. The topics are outlined in the graph below.

Appendix A5

Lab Reports

SKILLS

When carrying out investigations, it is important that scientists keep records of their plans and results, and share their findings. In order to have their investigations repeated and tested, scientists generally share their work by publishing papers in which details of their design, procedure, evidence, analysis, and evaluation are given.

Lab reports are prepared after an investigation is completed. To ensure that you can accurately describe the investigation, it is important to keep thorough and accurate records of your activities as you carry out the investigation. Investigations use a similar format to their final reports or lab books, although the headings and order may vary. Your lab book or report should reflect the type of scientific inquiry that you used in the investigation and should be based on the following headings, as appropriate. Use Figure 4 for a sample lab report.

Title: At the beginning of your report, write the number and title of your investigation. In this course the title is usually given, but if you are designing your own investigation, create a title that suggests what the investigation is about. Include the date of the investigation and the names of your lab partners (if you worked as a team).

Purpose: State the purpose of the investigation. Why are you doing this investigation?

Questions: This is the specific question that you attempted to answer in the investigation. If it is appropriate to do so, state the question in terms of independent and dependent variables.

Hypothesis and/or Prediction: Based on your reasoning or on a concept that you have studied, formulate an explanation of what should happen (a hypothesis). From your hypothesis make a prediction, a statement of what you expect to observe, before carrying out the investigation. Depending on the nature of your investigation, you may or may not have a hypothesis or prediction.

Design: This is a brief general overview (one to three sentences) of what you did. If your investigation involved independent, dependent, and controlled variables, list them. Identify any control or control groups that was used in the investigation.

Materials: This is detailed list of all materials used, including sites and quantities where appropriate. Be sure to include safety equipment such as goggles, lab apron, latex gloves, and tongs, where needed. Draw a diagram to show any complicated setup of apparatus.

Procedure: Describe in detailed step-by-step format, the procedure you followed in carrying out your investigation. This includes all qualitative and quantitative observations that you made. Be as precise as possible when describing quantitative observations. Include any unexpected observations, and present your information in a form that is easily understood. If you have only a few observations, this could be a list; for controlled experiments and for many observations, a table will be more appropriate.

Analysis: Interpret your observations and present the evidence in the form of tables, graphs, or illustrations, each with a title. Include any calculations, the results of which can be shown in a table. Make statements about any patterns or trends you observed. Conclude the analysis with a statement answering the question that initiated the investigation.

Evaluation: The evaluation is your judgment about the quality of information obtained and about the validity of the prediction and hypothesis (if present). This section can be divided into two parts:

- Did your observations provide sufficient and appropriate evidence to enable you to answer the question?
- Were the prediction and hypothesis supported or rejected by the results?

Investigation 2.5 – The Effect of Concentration on Reaction Time

December 15, 2001
By Barry L. and Collin B.

Purpose: The purpose of this investigation is to test one of the ideas of the collision-reaction theory.

Question: How does changing the concentration of hydrochloric acid affect the time required for the reaction of hydrochloric acid with a fixed quantity of zinc?

Hypothesis/Prediction: According to the collision-reaction theory, if the concentration of hydrochloric acid is increased, then the time required for the reaction with zinc will decrease. The reasoning that supports this prediction is that a higher concentration produces more collisions per second between the hydrochloric acid particles and the zinc atoms. More collisions per second would produce more reactions per second and therefore, a shorter time required to consume the zinc.

Design: Different known concentrations of excess hydrochloric acid react with zinc metal. The time for the zinc to completely react is measured for each concentration of acid solution. The independent variable is the concentration of hydrochloric acid. The dependent variable is the time for the zinc to be consumed. The temperature of the solution, the quantity of zinc, the surface area of the zinc in contact with the acid, and the volume of the acid are all controlled variables.

Materials: lab apron safety goggles (4) 10 mL graduated cylinders (6) 150 mL test tubes and test tube rack (6) 150 mL test tubes (one marked second) stock solutions of HCl₁ 2.0 mol/L 1.5 mol/L, 1.0 mol/L, 0.5 mol/L.

Procedure: 1. Put on the lab apron and safety goggles. 2. Transfer 15 mL of 2.0 mol/L HCl₁ into an 18 x 150 mm test tube. 3. Carefully place a piece of Zn(s) into the hydrochloric acid solution and note the starting time of the reaction. 4. Measure and record the time required for all of the zinc to react. 5. Repeat steps 2 to 4 using 1.5 mol/L, 1.0 mol/L, 0.5 mol/L HCl₁. 6. Neutralize any acid remaining in the solutions with a solution of the weak base and then pour them down the sink with large amounts of water.

Figure 1 Lab Report

Lab Report 17

SKILLS

Safety Skills

Although every effort is made to ensure that the science experience is safe, there are some inherent risks. These risks are generally associated with the materials and equipment used, and with the use of safety instructions when conducting investigations. There may also be risks associated with the location of the investigation. Most of these risks pose no more danger than what is normally experienced in everyday life. With an awareness of the possible hazards, knowledge of the rules, appropriate behaviour, and common sense, these risks can be practically eliminated.

Remember, you share the responsibility not only for your own safety, but also for the safety of those around you, always alert the teacher in case of an accident.

In this text, chemicals, equipment, and procedures that are hazardous are highlighted in red and are preceded by the appropriate Workplace Hazardous Materials Information System (WHMIS) symbol or by

Safety Conventions and Symbols

WHMIS Symbols and HPS

The Workplace Hazardous Materials Information System (WHMIS) provides workers and students with complete and accurate information regarding hazardous products. All chemical products supplied to schools, businesses, and industries must conform to standard labels and be accompanied by a Material Safety Data Sheet (MSDS) providing detailed information about the product. Clear and standardized labelling is an important component of WHMIS (Table 1). These labels must be present on the product's original container and added to other containers if the product is transferred.

Symbol	Description
	CORROSIVE This material can burn your skin and eyes, if you swallow it, it will damage your throat and stomach.
	FLAMMABLE This product or the gas (if vapour from it can catch fire) quickly ignites this product away from heat, flames, and sparks.
	EXPLOSIVE Container will rupture if it is heated or a hole is punctured in it. Material or gases can fly out and hurt your eyes and other parts of your body.
	POISON If you swallow or lick this product, you could become very sick or die. Some products with this symbol in the label can hurt you even if you breathe or absorb them.

Symbol	Description
	OXIDIZING This material can cause or intensify a fire or explosion.
	IRRITANT This material can irritate or burn your skin, eyes, or respiratory system.
	HAZARDOUS TO THE ENVIRONMENT This material is toxic to aquatic life and may cause long-term adverse effects on the environment.

Figure 1 Hazardous Hazardous Product Symbols

SAFETY SKILLS

Class and type of compound	WHMIS symbol	Risks	Precautions
Class 1: compressed gases (that is normally gaseous and exist in a pressurized container)		• could explode due to pressure • could explode if heated or dropped • possible fire from the heat of explosion and the release of contents	• always container to always secured • store in designated area • do not drop or fall • do not use if damaged
Class 2: flammable and combustible materials (that will continue to burn after being exposed to a flame or other ignition source)		• may release flammable products if allowed to degenerate with other vapour	• store in properly designated area • work in well-ventilated area • avoid sparks and flames • never that electrical sources are safe
Class 3: oxidizing materials (that will cause or intensify a fire or explosion)		• can oxidize skin and eye contacts • increase fire or explosion hazard • may cause combustion to spread or react violently	• store away from combustibles • wear body, hand, face, and eye protection • store in proper container that will not react with acid
Class 4: toxic materials – long term (that will cause death or permanent injury after repeated exposure over a long period)		• may be fatal if inhaled or absorbed • may be absorbed through the skin • small volumes have a toxic effect	• avoid breathing dust or vapours • avoid contact with skin and eyes • wear protective clothing and face and eye protection • work in well-ventilated areas and use breathing protection
Class 5: toxic materials – acute (that will cause death or permanent injury after repeated exposure over a long period)		• may cause death or permanent injury • may cause skin irritation or burns • may cause cancer • may cause respiratory system damage	• special training is required to handle materials • work in designated biological area with appropriate engineering control • use hand, body, face, and eye protection • avoid breathing dust or vapours • avoid contact with skin and eyes • wear protective clothing and face and eye protection • work in well-ventilated areas and use breathing protection
Class 6: hazardous infectious materials (that will cause disease or death)		• may cause anaphylactic shock • includes viruses, yeasts, moulds, bacteria, and protozoa that affect humans • includes fluids containing live products • includes cellular components	• special training is required to handle materials • work in designated biological area with appropriate engineering control • avoid contamination of people • store in special designated areas
Class 7: corrosive materials (that will cause skin burns and eye damage)		• eye and skin irritation or exposure • may cause severe eye damage • may cause severe eye damage • may cause severe eye damage • environmental damage from fumes	• wear body, hand, face, and eye protection • use breathing apparatus • work in well-ventilated area • avoid all direct body contact • avoid all indirect body contact • avoid breathing dust or vapours • avoid contact with skin and eyes • wear protective clothing and face and eye protection
Class 8: dangerous reactive materials (that may have unexpected reactions)		• may react with water • may be chemically unstable • may release toxic or flammable vapours • may vigorously react with acids • may burn unpredictably	• handle with care, avoiding contact with skin, and sudden temperature changes • store in appropriate containers • avoid contact with skin and eyes • store and work in designated area

Safety Skills

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Safety Conventions and Symbols

WHMIS Symbols and HPS

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	EXPLOSIVE Container will rupture if it is heated or a hole is punctured in it. Material or gases can fly out and hurt your eyes and other parts of your body.
	POISON If you swallow or lick this product, you could become very sick or die. Some products with this symbol in the label can hurt you even if you breathe or absorb them.

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Figure 1 Hazardous Hazardous Product Symbols

Math Skills

Scientific Notation

It is difficult to work with very large or very small numbers when they are written in common decimal notation. Sometimes it is possible to accommodate such numbers by changing the SI unit so that the number falls between 0.1 and 1000. For example, 237 000 000 may be expressed as 237 km and 0.000 895 kg can be expressed as 0.895 g. However, this unit change is not always possible, either because an appropriate unit does not exist or because it is essential to use a particular unit of measurement. In these cases, the best method of dealing with very large and very small numbers is to write them using scientific notation. Scientific notation expresses a number by writing it in the form of 1×10^x , where x is the number of digits to the left of the decimal point. Table 1 shows situations where scientific notation can be used.

Expression	Common decimal notation	Scientific notation
12.5 kilometres	12 500 metres	1.25×10^4 m
125 kilometres	125 000 metres	1.25×10^5 m
1250 kilometres	1 250 000 metres	1.25×10^6 m
12 500 kilometres	12 500 000 metres	1.25×10^7 m

In many numbers in scientific notation, multiply the real numbers and add the exponents; the answer is expressed in scientific notation. To divide numbers in scientific notation, divide the real numbers and subtract the exponent of the denominator from the exponent of the numerator. If these marks are 1 cm apart, the random error will be greater and the precision will be less than if the marks are 1 mm apart. Systematic error is associated with an inherent problem with the measuring system, such as the presence of an interfering substance, incorrect calibration, or operator error. For example, if the balance is not zeroed at the beginning, all measurements will have an error. If using a metre stick that has been worn slightly, all measurements will contain an error.

Sometimes the measurements may be very precise because of the graduations of the measuring device. Precision is the place value of the last measurable digit and is determined by the refinement of the scale on the measuring instrument. For example, a measurement of 12.74 cm is more precise than a measurement of 12.4 cm because the first value measures to the hundredths of a centimetre whereas the latter measures to the tenths of a centimetre. When adding or subtracting measurements of different precision, the answer is rounded to the same precision as the least precise measurement. Here is an example:

$$11.7 \text{ cm} + 2.89 \text{ cm} = 0.842 \text{ cm} = 15.532 \text{ cm}$$

The answer must be rounded to 15.5 cm because the first value measures to the tenths of a centimetre. No matter how precise a measurement is, it is still not very accurate. Accuracy refers to how close a value is to its true value. The comparison of the two values can be expressed as a percentage difference. The percentage difference is calculated as follows:

$$\frac{(7.3 \times 10^3) - (5.2 \times 10^3)}{(7.3 \times 10^3 + 5.2 \times 10^3)} \times 100 = 27.5\%$$

On many calculators, scientific notation is entered using a special key, labelled EXP or EE. This key includes 10^x from the scientific notation; you need to enter only the exponent. Here are two examples:

To enter 3.6×10^5 press 3.6 EXP + 5.

Uncertainty in Measurements

There are two types of initial quantities that are used in science: exact values and measurements. Exact values include defined quantities (1 m = 100 cm) and counted values (5 cars in a parking lot). Measurements, however, are not exact because there is some uncertainty or error associated with every measurement.

There are two types of uncertainty or error. Random error results when an estimate is made to obtain the last significant figure for any measurement. The size of the random error is determined by the precision of the measuring instrument. For example, when measuring length, it is necessary to estimate between the marks on the metric stick. If these marks are 1 cm apart, the random error will be greater and the precision will be less than if the marks are 1 mm apart. Systematic error is associated with an inherent problem with the measuring system, such as the presence of an interfering substance, incorrect calibration, or operator error. For example, if the balance is not zeroed at the beginning, all measurements will have an error. If using a metre stick that has been worn slightly, all measurements will contain an error.

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$$\frac{(7.3 \times 10^3) - (5.2 \times 10^3)}{(7.3 \times 10^3 + 5.2 \times 10^3)} \times 100 = 27.5\%$$

Reference Data Tables

Prefix	Power	Symbol
deca	10 ¹	da
hecto	10 ²	he
kilo	10 ³	k
mega	10 ⁶	M
giga	10 ⁹	G
tera	10 ¹²	T
peta	10 ¹⁵	P
exa	10 ¹⁸	E
zetta	10 ²¹	Z
yocto	10 ⁻²⁴	y
zepto	10 ⁻²¹	z
atto	10 ⁻¹⁸	a
femto	10 ⁻¹⁵	f
picosec	10 ⁻¹²	p
nano	10 ⁻⁹	n
micro	10 ⁻⁶	μ
milli	10 ⁻³	m
centi	10 ⁻²	c
deci	10 ⁻¹	d

Multiple	Prefix
1000	kilo
100	hecto
10	deca
1	base
0.1	deci
0.01	centi
0.001	milli
0.000 001	micro
0.000 000 001	nano
0.000 000 000 001	picosec
0.000 000 000 000 001	zepto
0.000 000 000 000 000 001	yocto

SI Units

Throughout the text and in this reference section, we have attempted to be consistent in the presentation and usage of units, as far as possible. The text uses the International System of Units (SI). However, some other units have been included because of their practical importance, wide usage, or use in specialized fields. For example, Health Canada and the medical profession continue to use millimetres of mercury (mm Hg) in the units for measurement of blood pressure, although the Metric Practice Guide indicates that this unit is not to be used with the SI.

The most recent Canadian Metric Practice Guide (CAN/CSA Z234-1-89) was published in 1989 and reaffirmed in 1995 by the Canadian Standards Association.

Other data in this reference section has been taken largely from: Lang's Handbook of Chemistry, Fifth Edition, McGraw-Hill, 1959.

Quantity	Symbol	Unit Name	Abbreviation
amount of substance	n	mole	mol
electric current	I	ampere	A
length	l, L or m	metre	m
mass	m	kilogram	kg
thermodynamic temperature	T	kelvin	K
time	t	second	s

Quantity	Symbol	Unit	Unit Symbol	SI Base Unit
acceleration	a	metre per second per second	m/s ²	m/s ²
area	A	square metre	m ²	m ²
density	D	kilogram per cubic metre	kg/m ³	kg/m ³
displacement	d	metre	m	m
electric charge	Q, q	coulomb	C	A·s
electric potential	V	volt	V	kg·m ² /s ² ·A
electric field	E	volt per metre	V/m	kg·m/s ² ·A
electric field intensity	E	volt per square metre (Tesla)	V/m ²	kg/s ² ·A
energy	E	joule	J	kg·m ² /s ²
force	F	newton	N	kg·m/s ²
frequency	f	hertz	Hz	1/s
heat	Q	joule	J	kg·m ² /s ²
impulse	I	newton second	N·s	kg·m/s
intensity	I	watt per square metre (Watt)	W/m ²	kg/s ³ ·A
momentum	p	kilogram metre per second	kg·m/s	kg·m/s
period	T	second	s	s
pressure	P	newton per square metre	N/m ²	kg/m·s ²
power	P	watt	W	kg·m ² /s ³
speed	v	metre per second	m/s	m/s
stress	S	newton per square metre	N/m ²	kg/m·s ²
volume	V	cubic metre	m ³	m ³
wavelength	λ	metre	m	m
work	W	joule	J	kg·m ² /s ²