Grade 9
Subject Bulletin
Science

Alberta Provincial Achievement Testing **2023–2024**

Alberta

This document was written primarily for

Students

Teachers   ✓   Grade 9 Science

Administrators   ✓

Parents

General Audience

2023–2024 Science 9 Subject Bulletin

Contents

You can find [provincial achievement test-related materials](#) on the Alberta Education website.

Grade 9 Science Provincial Achievement Test

General description

The *Grade 9 Science Provincial Achievement Test* is based on science learnings in which the nature of science, technology, and society are integrated components.

Knowledge and skill components are integrated in the test. Knowledge components relate to a fundamental understanding of both the concepts and the processes of science. Skill components relate to the application of science processes and the use of higher-level thinking to solve problems. Skill components consist of three types of skill:

- inquiry skills
- technological problem-solving skills
- societal decision-making skills

This assessment consists of 55 machine-scored questions: 50 multiple-choice questions, each worth one mark, and five numerical-response questions, each worth one mark. The five numerical-response questions are interspersed among the multiple-choice questions.

The following briefly describes the two item formats:

- Multiple-choice items provide students with four response options, of which only one is correct.
- Numerical-response items require students to generate a response (in symbolic form) to a particular problem rather than selecting a response from a list of four options.

The test is developed to be completed in 75 minutes; however, students have up to 150 minutes to complete the test should they need it.

Students record their answers on a tear-out answer sheet.

Students require HB pencils and erasers. A calculator is recommended. A ruler and protractor are not required for successful completion of the assessment but are permitted.

Students may not use a dictionary, a thesaurus, or other reference materials when writing the test.

If a word that warrants a definition is used on a test, it will be defined on the page on which it appears.

A tear-out data sheet will be included with the *Grade 9 Science Provincial Achievement Test*. A sample data sheet is included in the appendix.

Description of Grade 9 Science provincial assessment standards

The following statements describe what is expected of Grade 9 students at the acceptable standard and the standard of excellence based on outcomes in the program of studies. These statements represent examples of the standards against which student achievement is measured. It is important to remember that one test cannot measure all the outcomes in the program of studies.

Acceptable Standard	Standard of Excellence
Students who meet the acceptable standard in Grade 9 Science have a basic understanding of the conceptual and procedural knowledge outlined in the program of studies. They are able to	Students who meet the standard of excellence in Grade 9 Science have an exceptional understanding of the conceptual and procedural knowledge outlined in the program of studies. They are able to

Acceptable Standard:

- apply concepts and basic procedures to simple and familiar situations, but they may be challenged when applying these concepts and procedures to unfamiliar or complex situations. For example, students are able to describe ongoing changes in biological diversity through extinction and extirpation of native species, but they may have difficulty interpreting the role of environmental factors in causing these changes.
- use basic skills to show what they know and solve novel, real-life problems that are simple or that require single-step solutions
- apply more advanced skills or follow multi-step procedures to solve familiar real-life problems in which they have had experience. For example, in a problem-solving activity to identify problems in developing technology for life in space, these students will be able to describe technologies for life-support systems. However, students likely will not interpret the scientific principles on which the technologies are based.
- use the basic procedures of scientific inquiry, technological problem solving, and societal decision making. However, they may have difficulty with the application of more advanced skills, and they may have limited ability to make connections between science, technology, and society.

Standard of Excellence:

- apply knowledge in complex and novel situations. For example, not only can they identify the chemical factors that affect the health and distribution of living things, but they can also predict the possible outcomes of changing chemical factors on living things and evaluate their effects on the quality of the environment.
- apply higher-level thinking skills to unfamiliar situations. In addition, they can easily and quickly solve problems that they have direct experience with and that require single-step or multi-step solutions.
- solve problems in more than one way and see more than one solution to some problems. Their problem-solving approach may involve more than one manipulated variable and may include logical explanations of procedures and results.
- persistently solve problems and view a situation from a number of perspectives. Not only do they have a high level of awareness and understanding of how science and technology affect them personally, but they can also apply this awareness and understanding to societal issues.
- skillfully use the basic procedures of scientific inquiry, technological problem solving, and societal decision making
- use advanced skills and make connections between science, technology, and society

Blueprint

The blueprint below shows the topics and reporting categories under which questions are classified. The number of questions in each reporting category is approximate.

Topic	QUESTION DISTRIBUTION BY REPORTING CATEGORY		Number (Percentage) of Questions
	Knowledge	Skills	
Biological Diversity	5	6	11 (20%)
Matter and Chemical Change	5	6	11 (20%)
Environmental Chemistry	4	7	11 (20%)
Electrical Principles and Technologies	3	8	11 (20%)
Space Exploration	5	6	11 (20%)
Number (Percentage) of Questions	**22** (40%)	**33** (60%)	**55** (100%)

Preparing Students for the Provincial Achievement Test

Suggestions for preparing students

The best way to prepare students for writing the provincial achievement test is to teach the curriculum well and to ensure that students know what is expected. Many of the skills and attitudes that support test writing are, in fact, good skills and strategies for approaching all kinds of learning tasks.

Note that the questions on the science test are placed in real-life contexts.

Teachers are encouraged to familiarize their students with the types of questions that will appear on the test. Released materials from previously secured tests are available on the Alberta Education website under the Subject area resources heading.

Teachers are also encouraged to share the following information with their students to help them prepare for the *Grade 9 Science Provincial Achievement Test*.

Special-format practice tests

To give students an opportunity to practise provincial achievement test-style questions and content in Braille, audio, large print, or coloured print versions, Alberta Education produces special-format practice tests for all subjects that have a provincial achievement test. Alberta schools with registered Alberta K–12 students may place orders for these tests. Braille versions are available in English and, by request, in French. All tests are provided free of charge, but limits may be placed on order volumes to ensure access for all students.

For the greatest benefit, special-format practice tests should be written under conditions similar to those of the corresponding provincial achievement test. The same rules regarding the use of resources and devices should be followed.

Braille versions must be returned to Alberta Education after use.

For more information or to place an order, contact

Distribution Coordinator, Examination Administration
780-641-9116 or Field.Test@gov.ab.ca

Suggestions for answering questions

- Before you begin, find out how much time you have.

- Ask questions if you are unsure of anything.

- Skim through the whole test before beginning. Find out how many questions there are, and plan your time accordingly.

- Answer the easier questions first; then go back to the more difficult ones.

- Do not spend too much time on any one question. Make a mark (* or ?) beside any questions you have difficulty with, and go back to them if you have time.

- Read each question carefully, underline or highlight key words, and try to determine an answer before looking at the alternatives.

- Read all the alternatives and see which one best fits the answer.

- When you are not sure which answer is correct, cross out any alternatives that are wrong and then select the best of the remaining alternatives.

- If time permits, recheck your answers.

- Double-check to make sure that you have answered everything before handing in the test.

- Read the information given using the strategy that works best for you. You should either
  - look at all the information and think carefully about it before you try to answer the question

  OR
  - read the questions first and then look at the information, keeping in mind the questions you need to answer

- Make sure that you look at all forms of the information given. Information may be given in words, charts, pictures, graphs, or maps.

- When information is given for more than one question, go back to the information before answering each question.

- Check your work when you calculate an answer, even when your answer is one of the alternatives.

- When answering "best answer" questions, be sure to carefully read all four alternatives (A, B, C, and D) before choosing the answer that you think is best. These questions will always include a boldfaced qualifier such as **best**, **most strongly**, or **most clearly** in their stems. All the alternatives (A, B, C, and D) are, to some degree, correct, but one of the alternatives will be "best" in that it takes more of the information into account or can be supported most strongly by reference to the information.

Opportunities to Participate in Test-development Activities

Field testing

All provincial achievement test questions are field tested before use. By "testing" the test questions, students who write field tests have an opportunity for a practice run at answering questions that could be used on future provincial achievement tests. As well, the teachers have an opportunity to comment on the appropriateness and quality of the test questions.

Through the online field-test request system, teachers can create and modify field-test requests and check the status of these requests. Information regarding the field-test process and the request system is available at Provincial Achievement Tests.

Once the completed requests are received by Provincial Assessment, classes will be selected to ensure that a representative and sufficiently large sample of students from across the province take part in the field test. Every effort will be made to place field tests as requested; however, because field tests are administered to a prescribed number of students, it may not be possible to fill all requests.

Working groups

Teacher involvement in the development of provincial achievement tests is important because it helps to ensure the validity and appropriateness of the assessments.

Teacher working groups are used throughout the test-development process to create raw forms of test questions and to review and revise draft forms of provincial achievement tests. These working groups usually meet for one or two days, two or three times per year. Occasionally, these meetings are held on weekends.

To be eligible to serve on a test-development working group, a teacher must currently be teaching the course in question or must have taught the course within the past three years.

Teachers participating in working groups are selected from the working-group nominees approved by superintendents of school jurisdictions. The call for nominations usually occurs in September. However, we will accept further nominations throughout the year. In some subjects, more teachers may be nominated for working groups than are needed. When teachers are selected, there must be a balance of first-time and experienced working-group members and regional representation by zone, school authority, and school. Unfortunately, not everyone whose name is submitted will be selected.

Depth of Coverage

Mechanical energy

A clear understanding of the transformations of energy before its intended use is necessary to discuss efficiency comparisons. The mechanical energy of an object or a system is the sum of the potential and kinetic energy of the object or system.

WHMIS 2015

As of the 2018–2019 school year, any Workplace Hazardous Materials Information System (WHMIS) pictograms that appear on provincial assessments will be WHMIS 2015 pictograms. WHMIS has been used in Canada since 1988 for labelling and classifying hazardous workplace chemicals. Countries around the world are adopting the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) to enable a consistent international chemical classification and labelling system. WHMIS 1988 in Canada was amended in February 2015 to incorporate the GHS. The new system is called WHMIS 2015.

WHMIS 2015 includes changes to

- pictograms
- labels
- hazard classes and categories
- safety data sheets
- education and training

Further information about these changes can be found at Science (7–9) Program Supports under the heading Health and Safety in the Science Classroom.

Pictograms

WHMIS 2015

Flame

For fire hazards

Flame Over Circle

For oxidizing hazards

Gas Cylinder

For gases under pressure

Exploding Bomb

For explosion or
reactivity hazards

**Biohazardous
Infectious Materials**

For organisms or toxins that can
cause diseases in people or animals

Corrosion

For corrosive damage to
metals, as well as skin, eyes

Exclamation Mark

May cause less serious
health effects

Health Hazard

May cause or suspected of
causing serious health effects

Skull and Crossbones

Can cause death or toxicity with
short exposure to small amounts

Science 9 Two-sided Data Sheet (Electricity Formulas on Back)

Periodic Table of the First Eighteen Elements

Key

Atomic number → **3**	**6.94** ← Atomic mass
	1+ ← Most common ion charge
Symbol →	**Li**
	lithium ← Name

Legend for Elements

Solid	Gas	Liquid

Note: The legend denotes the states of elements at a temperature of 25 °C.

1																	18
1 1.01 1+,1− **H** hydrogen	**2**											**13**	**14**	**15**	**16**	**17**	**2** 4.00 − **He** helium
3 6.94 1+ **Li** lithium	**4** 9.01 2+ **Be** beryllium											**5** 10.81 − **B** boron	**6** 12.01 − **C** carbon	**7** 14.01 3− **N** nitrogen	**8** 16.00 2− **O** oxygen	**9** 19.00 1− **F** fluorine	**10** 20.18 − **Ne** neon
11 22.99 1+ **Na** sodium	**12** 24.31 2+ **Mg** magnesium											**13** 26.98 3+ **Al** aluminum	**14** 28.09 − **Si** silicon	**15** 30.97 3− **P** phosphorus	**16** 32.07 2− **S** sulfur	**17** 35.45 1− **Cl** chlorine	**18** 39.95 − **Ar** argon

Electricity Formulas

$$R = \frac{V}{I}$$

$$E = Pt$$

$$P = IV$$

$$Percent\ efficiency = \left(\frac{output}{input}\right) \times 100\%$$

Appendix 2: Example of Grade 9 Science 2023 PAT Instructions Pages

Grade 9 Provincial Achievement Test

Science

Description

- This test consists of 55 machine-scored questions: 50 multiple-choice questions, each worth one mark, and 5 numerical-response questions, each worth one mark.

Time: 75 minutes. You have up to 150 minutes to complete this test should you need it.

You may write in this booklet if you find it helpful. Make sure that your answers are placed on the answer sheet.

2022

Instructions

- Turn to the last two pages of the test booklet. Carefully fold and tear out the 2-sided data sheet and the machine-scored answer sheet along the perforations.

- Calculators are recommended but not required.

- You may **not** use a dictionary, a thesaurus, or other reference materials.

- Read each question carefully and choose the **correct** or **best** answer.

- Make sure that the number of the question on your answer sheet matches the number of the question that you are answering.

- Use **only** an **HB** pencil to mark your answer.

- If you change an answer, **erase** your first mark **completely**.

- Try to answer every question.

- When you have completed the test, please answer the **survey question**, which appears after the last test question.

- Now read the detailed instructions for answering multiple-choice and numerical-response questions.

Multiple Choice

- Each question has four possible answers from which you are to choose the **correct** or **best** answer.

- Locate the question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Examples

This test is for the subject of

A.   science
B.   mathematics
C.   language arts
D.   social studies

Answer Sheet
●ⒷⒸⒹ

Which of the following rows identifies the subject and grade level of this test?

Row	Subject	Grade
A.	Science	8
B.	Science	9
C.	Mathematics	8
D.	Mathematics	9

Answer Sheet
Ⓐ●ⒸⒹ

When there are no clouds, during the day the sky appears __i__ and at night the sky appears __ii__ .

The statement above is completed by the information in row

Row	i	ii
A.	blue	blue
B.	blue	black
C.	white	blue
D.	white	black

Answer Sheet
Ⓐ●ⒸⒹ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then by filling in the corresponding circles.

- Enter your answer, one digit per box, beginning in the left-hand box. A decimal point, if needed, goes in its own box. Leave any unused boxes blank.

Examples

Calculation Question and Solution

$$D = \frac{m}{V}$$

What is the density of a liquid if 95.0 g of the liquid has a volume of 15.2 mL?

Density = _____ g/mL

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Answer: 6.25

Record 6.25 on the answer sheet ⟶ $\boxed{6}.\boxed{2}\boxed{5}$

Fill in the corresponding circles

Sequencing Question and Solution

> Listed below are three electrical appliances.
>
> **1** Oven
> **2** Toaster
> **3** Blender

When the appliances listed above are placed in alphabetical order, the order is _____, _____, and _____.

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 312

Record 312 on the answer sheet ➔

Fill in the corresponding circles

Multiple-answer Matching Question and Solution

Continent	Country	Capital City
1 North America	4 France	7 Beijing
2 Europe	5 China	8 Ottawa
3 Asia	6 Canada	9 Paris

Using the numbers above, choose **one continent** and match it with a country in that continent and with that country's capital city. (There is more than one correct answer.)

Number:
Description: Continent (1, 2, or 3) Country (4, 5, or 6) Capital city (7, 8, or 9)

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 168 or 249 or 357

Record 168 on the answer sheet ➔

Fill in the corresponding circles

Note: The answers 168, 249, or 357 will be scored as correct.

Appendix 3: Example of Grade 9 Science Answer Sheet

GRADE 9 SCIENCE

NUMERICAL RESPONSE

MULTIPLE CHOICE

Appendix 4: Examples of Descriptions for Audio Versions of the *Grade 9 Science Provincial Achievement Test*

This appendix has been prepared by Provincial Assessment, Alberta Education. The purpose of this appendix is to provide school staff with examples of the descriptions of diagrams, illustrations, and visuals used in provincial achievement test audio versions, which are available to students as an accommodation. These examples are neither exhaustive nor prescriptive. Test content is shown in black text and descriptions in blue text.

For students who are enrolled with a school, and who typically use audio for their coursework, no application is required to receive this accommodation when writing provincial achievement tests. Such students may have visual impairments, physical disabilities, or learning disabilities. The audio version is used by students in conjunction with a print, digital, or Braille version of the test.

Additional information on how to prepare for science exams can be found on the Alberta Education website under Support documents, Science—General, *Examples of Descriptions Used in Audio Versions of Science Diploma Exams*, at Writing diploma exams.

Units

Unit	Read as
s	seconds
min	minutes
AU or au	astronomical units
m	metres
m^2	square metres
L	litres
mmHg	millimetres of mercury
m/s	metres per second
km/h	kilometres per hour
m/s^2	metres per second squared
g	grams
ppm	parts per million
ppb	parts per billion
°C	degrees Celsius
V	volts
A	amperes
Ω	ohms
W	watts
J	joules

Note: This table includes SI units and non-SI units. Names of SI base units and SI-derived units are from National Institute of Standards and Technology, 2020.

Unit prefixes

Unit Prefix	Read as
k	kilo
m	milli
c	centi
M	mega

Symbols

Symbols	Read as
$+$	plus
$-$	minus
$\pm$	plus or minus
$\div$	divided by
$\times$	times
$<$	is less than
$>$	is greater than
$=$	is equal to
$\$$	dollars
$\%$	percent
$\rightarrow$	produces

Numerical values

Numerical Value	Read as
183.48	one hundred eighty-three decimal four eight
2 321	two thousand three hundred twenty-one
$\dfrac{3}{5}$	three over five
-5	negative five
$+5$	positive five

Note: Common fractions, such as $\dfrac{1}{2}$, may be read as "one over two" or "one half."

Chemical formulas

Chemical Formula	Read as
$Fe(s)$	F E solid
$Mg(s)$	M G solid
$Fe^{2+}(aq)$	F E two positive aqueous
$H_2O(l)$	H two O liquid
$Ni_2O_3(s)$	N I two O three solid
$SO_4{}^{2-}(aq)$	S O subscript four, superscript two negative aqueous
$PO_4{}^{3-}(aq)$	P O subscript four, superscript three negative aqueous
$(NH_4)_2S(aq)$	open bracket N H four closed bracket two S aqueous

Note: Read "subscript" and "superscript" only when a formula has **both** subscripted numbers indicating the number of atoms in the species and superscripted numbers indicating the ion charge (e.g., $PO_4{}^{3-}$).

Tables

Introduce the table starting with the title, and then identify the number of columns and rows. Tables can be read in two different ways. One way is to list the column headings and any corresponding units first. Next, read across each row from left to right, stating the column heading before reading the data in each cell. Read empty spaces in tables as "blank."

Some Common Substances

Chemical Name	Chemical Formula	Common Name
Iron	$Fe(s)$	Iron
Sucrose	$C_{12}H_{22}O_{11}(s)$	Table sugar
Sodium chloride	$NaCl(s)$	Table salt
Magnesium hydroxide	$Mg(OH)_2(s)$	Milk of magnesia

There is a table titled "Some Common Substances" with three columns and four rows. The column headings are "Chemical Name," "Chemical Formula," and "Common Name." The information in the table is as follows:

Chemical Name: Iron; Chemical Formula: F E solid; Common Name: Iron

Chemical Name: Sucrose; Chemical Formula: C twelve H twenty-two O eleven solid; Common Name: Table sugar

Chemical Name: Sodium chloride; Chemical Formula: N A C L solid; Common Name: Table salt

Chemical Name: Magnesium hydroxide; Chemical Formula: M G open bracket O H closed bracket two solid; Common Name: Milk of magnesia

	Earth	Mars
Distance from the Sun	1.0 AU (astronomical unit) (150 000 000 km)	1.5 AU (astronomical unit) (225 000 000 km)
Time required for radio waves to travel from the Sun	8.3 min	?

There is a table with two columns and two rows. The column headings are "Earth" and "Mars." The row headings are "Distance from the Sun" and "Time required for radio waves to travel from the Sun." The information in the table is as follows:

Distance from the Sun: Earth – one A U, or astronomical unit, or one hundred fifty million kilometres; Mars – one decimal five A U or astronomical units or two hundred twenty-five million kilometres.

Time required for radio waves to travel from the Sun: Earth – eight decimal three minutes; Mars – question mark.

For certain tables, such as those found in multiple-answer matching questions, read the information down each column, rather than across rows.

Continent	Country	Capital City
1 North America	4 France	7 Beijing
2 Europe	5 China	8 Ottawa
3 Asia	6 Canada	9 Paris

Using the numbers above, choose **one continent** and match it with a country in that continent and with that country's capital city. (There is more than one correct answer.)

Number: _____ _____ _____
           Continent   Country   Capital city

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

There is a table that has three columns. The column headings are "Continent," "Country," and "Capital City."

Continent— one: North America; two: Europe; three: Asia.

Country— four: France; five: China; six: Canada.

Capital city— seven: Beijing; eight: Ottawa; nine: Paris.

Using the numbers above, choose **one continent** and match it with a country in that continent and with that country's capital city. (There is more than one correct answer.)

Number: first blank, Continent

Number: second blank, Country

Number: third blank, Capital city

Record all **three digits** of your answer in the numerical-response section on the answer sheet.
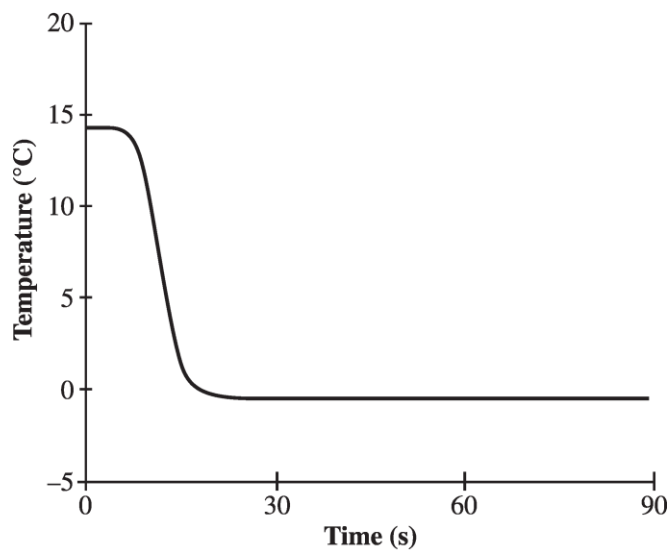
Graphs

Introduce the graph starting with the title, if there is one, and then describe the labels and scales for the horizontal axis and the vertical axis. If there are no marks or scale on the axis, state so. To describe the shape of the line representing the data, reference the axis and use descriptive words such as *top*, *bottom*, *right*, *left*, *downward*, *upward*, *rises*, and *falls*. When there are four graphs for each of the multiple-choice options (A, B, C, and D), describe the labels and scales for the similarities between the graphs, such as the horizontal axis and the vertical axis, and then describe the shape of the line for each of the choices.

Relationship Between Pesticide Application and Insect Death
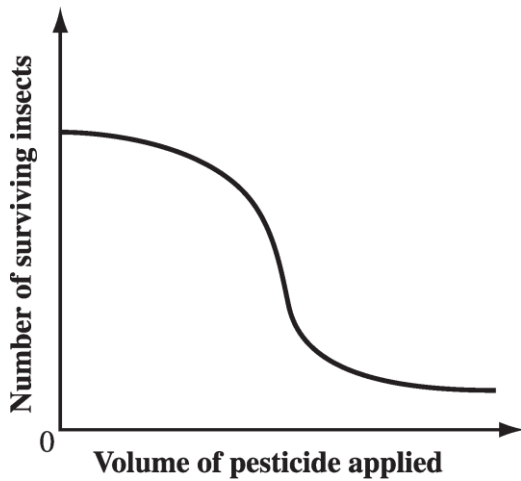
There is a graph titled "Relationship Between Pesticide Application and Insect Death." The horizontal axis is labelled "Volume of pesticide applied" and the vertical axis is labelled "Number of surviving insects." There are no marks or scale on the axes. The line starts nearly horizontal close to the top left of the graph and curves downward until the line is nearly vertical at approximately the centre of the graph. The line then begins to curve upward until it is nearly horizontal close to the bottom right of the graph.

Temperature of a Solution
During a Chemical Reaction

There is a line graph titled "Temperature of a Solution During a Chemical Reaction." The horizontal axis is labelled "Time" in seconds, scaled from zero to ninety, marked and labelled in increments of thirty. The vertical axis is labelled "Temperature" in degrees Celsius, scaled from negative five to twenty, and marked and labelled in increments of five. The line begins on the vertical axis at approximately fourteen degrees Celsius. It then falls at approximately ten seconds to become almost vertical. It then becomes horizontal, once again, at approximately twenty seconds and zero degrees Celsius and remains horizontal until it reaches the right side of the graph.

Bar graphs

Introduce the graph starting with the title, describe the label for the horizontal axis, list the label for each bar, and then describe the label and scale for the vertical axis. Describe the height to which each labelled bar rises.

pH of a Variety of Solutions
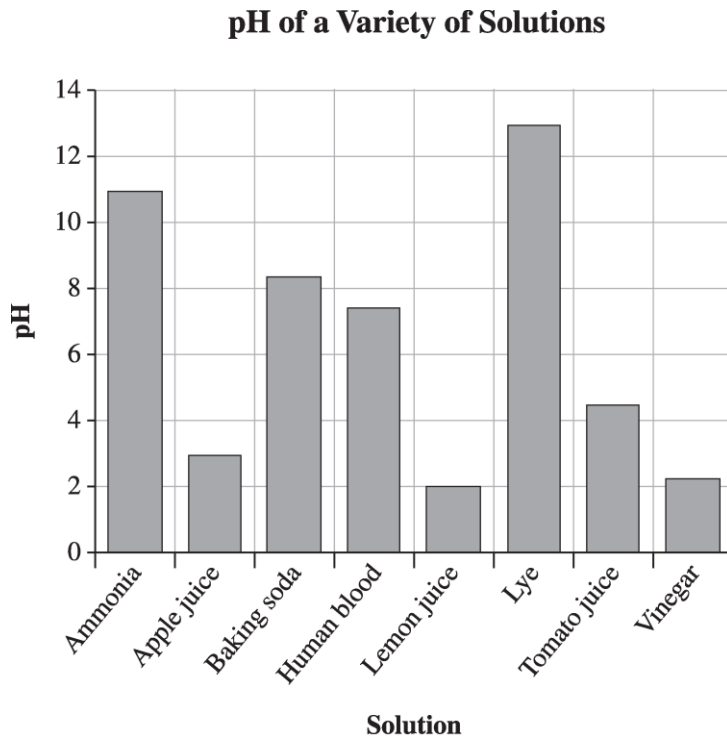
There is a bar graph titled "pH of a Variety of Solutions." The horizontal axis is labelled "Solution" and from left to right the bars are labelled "Ammonia," "Apple juice," "Baking soda," "Human blood," "Lemon juice," "Lye," "Tomato juice," and "Vinegar." The vertical axis is labelled "pH" scaled from zero to fourteen marked and labelled in increments of two.

The bars on the graph read as follows.
Ammonia – pH approximately eleven
Apple juice – pH approximately three
Baking soda – pH approximately eight decimal two
Human blood – pH approximately seven decimal five
Lemon juice – pH exactly two
Lye – pH approximately thirteen
Tomato juice – pH approximately four decimal five
Vinegar – pH approximately two decimal two

WHMIS pictograms

| WHMIS pictogram	Name	Read as
	Gas Cylinder	A diamond containing a gas cylinder
	Flame	A diamond containing flames
	Flame over Circle	A diamond containing a burning letter O
	Corrosion	A diamond containing a test tube spilling a substance onto a surface and a test tube spilling a substance onto a human hand. Where the substance touches the surface and the hand, holes are forming and heat waves are shown.
	Skull and Crossbones	A diamond containing a skull and crossbones
	Health Hazard	A diamond containing the head and upper body of a person with a hole in the centre of the chest. The hole radiates outward in several directions.
	Biohazardous Infectious Materials	A circle containing a biohazard symbol
	Exploding Bomb	A diamond containing an exploding bomb
	Exclamation Mark	A diamond containing an exclamation mark

Circuit diagrams

If the purpose of the question is to interpret the diagram in order to perform a calculation or identify the correct configuration of components, then the components should be identified (e.g., resistor, ammeter, voltmeter). If the purpose of the question is to identify the name or the role of the components shown, then the representation of the components should be described (e.g., a zigzag line, a circle containing an uppercase letter A).
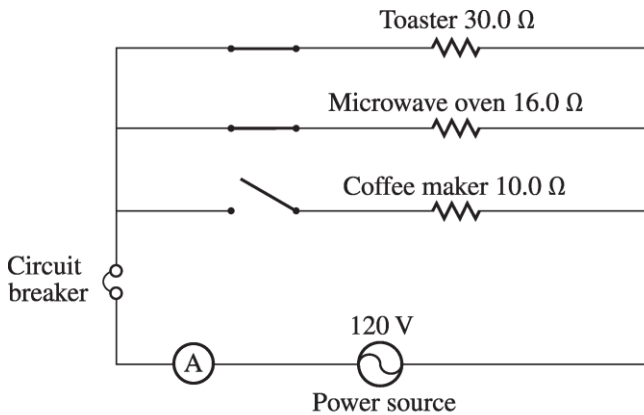
There is a rectangular circuit shown with four horizontal wires and two vertical wires. Each of the top three wires has a switch on the left side and a resistor on the right side. The horizontal wires will be described from top to bottom as follows. On the top wire, the switch is closed and the resistor is labelled "Toaster, thirty decimal zero ohms." On the second wire, the switch is closed and the resistor is labelled "Microwave oven, sixteen decimal zero ohms." On the third wire, the switch is open and the resistor is labelled "Coffee maker, ten decimal zero ohms." The bottom wire shows an ammeter on the left and a power source labelled "Power source, one hundred twenty volts" in the middle of the wire. The vertical wire on the left side contains a labelled "Circuit breaker" located between the third and bottom horizontal wires. There are no components on the vertical wire on the right side.
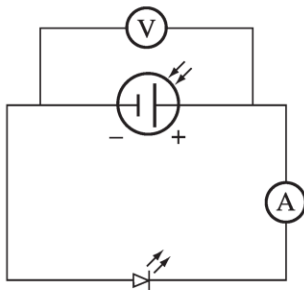
A student constructed a circuit containing an ammeter, a voltmeter, an LED light, and a small panel of photovoltaic cells.

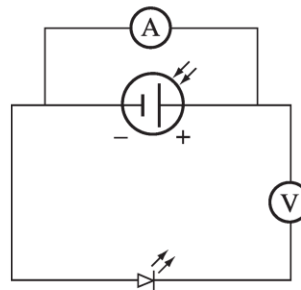**Some Symbols for Components in a Circuit Diagram**

Wire

Ammeter

Voltmeter

LED light

Photovoltaic panel
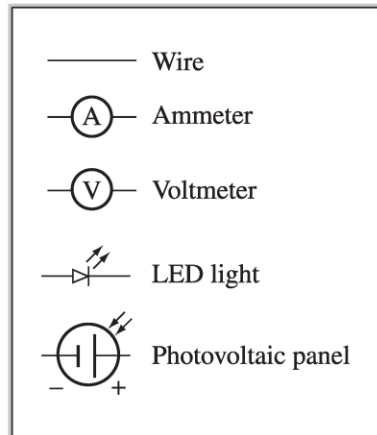
4. Which of the following diagrams shows an ammeter and a voltmeter correctly arranged in the circuit?
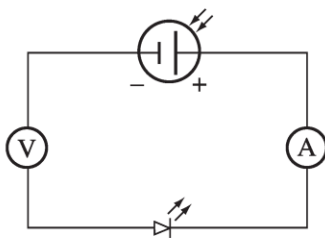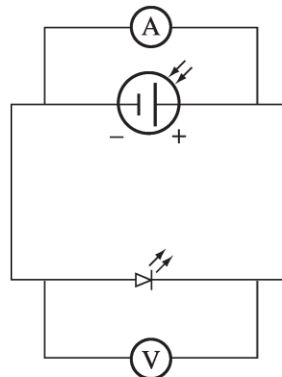
A.

B.

C.

D.

There is a legend titled "Some Symbols for Components in a Circuit Diagram" with five labelled symbols.

"Wire" is represented by a straight horizontal line.

"Ammeter" is represented by a straight horizontal line with a circle containing an uppercase letter A.

"Voltmeter" is represented by a straight horizontal line with a circle containing an uppercase letter V.

"LED light" is represented by a horizontal right-facing arrow pointing toward a short vertical line from which a wire extends from its centre to the right. Two short arrows point upward to the right from just above the short vertical line.

"Photovoltaic panel" is represented by a circle containing a horizontal wire on the left ending at the centre of a short vertical line, a small space, and a longer vertical line, with a wire extending from its centre to the right. Just outside the circle are two diagonal inward-facing arrows pointing from the upper right, a negative sign at the bottom left, and a positive sign at the bottom right.

Question four. Which of the following diagrams shows an ammeter and a voltmeter correctly arranged in the circuit?

For each choice, there is a circuit diagram that contains a photovoltaic panel at the top and an LED light at the bottom.

Choice A. The voltmeter is connected to a second wire connected to the circuit and is located above the photovoltaic panel. On the right side of the circuit is an ammeter.

Choice B. The ammeter is connected to a second wire connected to the circuit and is located above the photovoltaic panel. On the right side of the circuit is a voltmeter.

Choice C. The ammeter is on the right side of the circuit and the voltmeter is on the left side of the circuit.

Choice D. The ammeter is connected to a second wire connected to the circuit and is located above the photovoltaic panel. The voltmeter is connected to a third wire connected to the circuit and is located below the LED light.

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