

Knowledge

For each question, select the best answer from the four alternatives.

- Which of the following is an example of a theory? (1.1) **K/U**
 - The gravity of Earth pulls objects toward its surface.
 - An atom is made up of smaller particles called protons, neutrons, and electrons.
 - For every action, there is an equal and opposite reaction.
 - Mass is not created or destroyed in normal changes.
- Which scientist discovered that an atom contains a dense core, which became known as a nucleus? (1.2) **K/U**
 - Bohr
 - Chadwick
 - Rutherford
 - Thomson
- Which is the correct sequence for analyzing a sample using a mass spectrometer? (1.4) **K/U**
 - accelerate and deflect the ions → ions hit a detector plate → a computer analyzes the results → ionize the sample
 - ionize the sample → accelerate and deflect the ions → ions hit a detector plate → a computer analyzes the results
 - ionize the sample → ions hit a detector plate → accelerate and deflect the ions → a computer analyzes the results
 - accelerate and deflect the ions → ions hit a detector plate → ionize the sample → a computer analyzes the results
- An element is a soft, silver-coloured solid. It reacts violently and forms a basic solution when it is dropped into water. The element is most likely a member of which of the following groups? (1.5) **K/U**
 - halogens
 - alkali metals
 - alkaline earth metals
 - noble gases
- Which scientist published an early chemistry book that listed several chemical elements? (1.6) **K/U**
 - Antoine Lavoisier
 - Hennig Brand
 - Johann Dobereiner
 - John Newlands
- Which of these properties describes an ionic compound? (2.1) **K/U**
 - solid, liquid, or gas at ambient temperatures
 - low melting point
 - conducts a current in any state
 - high boiling point
- Which types of substances can exist as molecules? (2.2) **K/U**
 - certain elements and compounds
 - all compounds
 - all elements
 - all elements and all compounds
- The difference in electronegativity between two bonded atoms determines what type of bond forms. Which electronegativity difference indicates the presence of an ionic bond? (2.3) **K/U**
 - 0
 - <1.7
 - 1.7
 - ≥ 1.7
- Aluminum chloride is an example of what type of compound? (2.4) **K/U**
 - binary ionic
 - polyatomic ionic
 - hydrate
 - molecular
- Suppose a hydrogen atom forms a polar covalent bond with another atom. Which of the following elements will form the most polar bond with hydrogen? Use the electronegativity values in the periodic table in the back of this textbook to help you. (3.3) **K/U**
 - carbon, C
 - oxygen, O
 - chlorine, Cl
 - bromine, Br
- What is the name for the attraction that exists between molecules? (3.4) **K/U**
 - covalent bond
 - ionic bond
 - intermolecular force
 - electrical attraction
- What is the only substance that regularly exists in all three states of matter on Earth's surface? (3.5) **K/U**
 - air
 - water
 - oxygen
 - hydrogen

Indicate whether each statement is true or false. If you think the statement is false, rewrite it to make it true.

13. IUPAC is an organization that was established to standardize knowledge and procedures in chemistry. (1.1) K/U
14. Bohr–Rutherford diagrams show only the valence electrons in an atom. (1.2) K/U
15. When an atom gains an electron, it becomes a cation. (1.3) K/U
16. Isotopes are atoms of the same element that have different numbers of electrons. (1.4) K/U
17. Meyer’s proposed periodic table left spaces for yet undiscovered elements. (1.6) K/U
18. Atomic radius is a measurement of the size of an atom. (1.7) K/U
19. Ionic compounds form from the attraction between anions and cations. (2.1) K/U
20. A polar covalent bond forms when the electronegativity difference between the atoms is 0. (2.3) K/U
21. Upcycling involves taking a used product and making new, high-value items from it. (3.1) K/U
22. Polar molecules have a negatively charged end and a positively charged end. (3.3) K/U
23. The ability of one substance to dissolve into another substance depends on the polarity of the two substances. (3.4) K/U
24. Bioplastics are frequently recycled into other useful products. (3.6) K/U

Match each term on the left with the appropriate chemical formula on the right.

- | | |
|-------------------------|------------------------|
| 25. (a) sodium chlorate | (i) NaClO |
| (b) sodium chlorite | (ii) NaClO_2 |
| (c) sodium hypochlorite | (iii) NaClO_3 |
| (d) sodium perchlorate | (iv) NaClO_4 |
- (1.3, 2.5) K/U

Write a short answer to each question.

26. What is chemistry? (1.1) K/U
27. How did the results of Rutherford’s experiment suggest that an atom contains a dense, positively charged core? (1.2) K/U
28. Write the formula for the ion that forms from each of the following atoms. If necessary, draw Lewis symbols or Bohr–Rutherford models of each atom. (1.3) K/U
 - (a) Br
 - (b) N
 - (c) K
 - (d) Mg
 - (e) S

29. Name each of the following polyatomic ions: (1.3) K/U
 - (a) SO_4^{2-}
 - (b) NO_3^-
 - (c) CO_3^{2-}
 - (d) BrO_3^-
 - (e) ClO_4^-
 - (f) CN^-
 - (g) SO_3^{2-}
30. Write the formulas for each of the following polyatomic ions: (1.3) K/U
 - (a) chlorate
 - (b) ammonium
 - (c) hydrogen carbonate
 - (d) hypochlorite
 - (e) dichromate
 - (f) permanganate
 - (g) hydrogen sulfate
31. Write a sentence that correctly relates the following terms: radioisotopes, nuclear radiation, radioactive decay. (1.4) K/U
32. The term “periodic law” relates observations made about different elements and their location on the periodic table. (1.5) K/U
 - (a) In your own words, state the periodic law.
 - (b) Periodic law is often defined in terms of periodic trends. What is a periodic trend?
33. What contribution to the periodic table was made by Johann Dobereiner? (1.6) K/U
34. If an atom has high ionization energy, what is true about its electron affinity? (1.7) K/U
35. (a) What is an electrolyte?
(b) Why are ionic compounds electrolytes? (2.1) K/U
36. In which state do both ionic and molecular compounds exist under ambient temperatures? (2.2) K/U
37. (a) What is a covalent bond?
(b) How does a covalent bond differ from an ionic bond? (2.2) K/U
38. What is the difference between electronegativity and electron affinity? (2.3) K/U
39. Name each of the following ionic compounds: (2.4) K/U
 - (a) NaBr
 - (b) MgS
 - (c) CuOH
 - (d) SnCl_2
 - (e) K_2SO_3

40. Name each of the following molecular compounds: (2.4) K/U
- SO_3
 - AsCl_3
 - NO
 - CCl_4
 - P_2O_5
41. Write the formula for each of these ionic compounds: (2.4) K/U
- sodium fluoride
 - calcium chloride
 - mercury(I) oxide
 - potassium cyanide
 - ammonium sulfate
 - magnesium nitrate
 - barium phosphate
 - magnesium sulfite
 - nickel(II) perchlorate
 - copper(I) sulfide
42. Write the formula for each of these molecular compounds: (2.4) K/U
- sulfur dioxide
 - carbon tetraiodide
 - silicon dioxide
 - phosphorus trichloride
 - dinitrogen tetroxide
43. What are the two sources of most molecular compounds? (3.1) K/U
44. Contrast reusing and recycling. (3.1) K/U
45. Why is there a need for scientists to develop products such as insect repellents? (3.2) K/U
46. In a molecule of hydrogen bromide, would you expect the electron density to be greater around the hydrogen atom or around the bromine atom? (2.3) K/U
47. Under what circumstances is a molecule that contains polar bonds a non-polar molecule? (3.3) K/U
48. (a) List the three different types of intermolecular forces.
(b) Which of these types are also referred to as van der Waals forces? (3.4) K/U
49. The following three compounds all have similar molecular masses: water, H_2O ; ammonia, NH_3 ; and methane, CH_4 . Why is water a liquid at normal temperatures, yet methane and ammonia are gases? (3.5) K/U
50. What property of water causes it to form beads and droplets? (3.5) K/U
51. What does it mean to say that one aim of “green chemistry” is to increase energy efficiency? (3.6) K/U

Understanding

52. You cannot see thoughts or air. (1.1) K/U T/I
- Are thoughts matter? Explain your answer.
 - Is air matter? Explain your answer.

53. Suggest a reason why neutrons were discovered later than electrons and protons. (1.2) T/I
54. Copy and complete **Table 1** in your notebook. (1.2) K/U T/I

Table 1 Atomic Data for Three Elements

	Cobalt	Iron	Silver
atomic number	27		
mass number	59	56	
number of protons		26	47
number of neutrons			61

55. (a) What is an octet?
(b) State the octet rule.
(c) How does the octet rule relate to the formation of ions? (1.3) K/U
56. When mercury forms a compound, the mercury atom forms an ion with a valence of either +1 or +2. Using the IUPAC system of naming, name the following compounds: (1.3) K/U T/I
- HgCl
 - HgO
 - HgNO_3
57. (a) What are the three most common types of nuclear radiation?
(b) Describe each type of nuclear radiation. (1.4) K/U
58. Naturally occurring uranium is composed of three major isotopes. Most uranium is uranium-238, which makes up 99.28 % of all natural uranium. Because it undergoes a known pattern of decay, U-238 is important in dating objects. Uranium also exists as uranium-235, which makes up 0.71 % of all natural uranium. U-235 is the form of uranium used in nuclear reactors. Small amounts of uranium-234 (0.0054 %) are also present. From this information, calculate the atomic mass of uranium. (1.4) T/I
59. Examine Figure 3 in Section 1.5. Imagine that the square representing boron, B, is empty and does not contain a diagram. (1.5) T/I
- How might you use the squares to the right and the left of the empty square to draw the Bohr–Rutherford diagram for boron?
 - How might you use the square for aluminum, Al, to check that your Bohr–Rutherford diagram is correct?
60. Contrast the modern periodic table and the periodic table proposed by Dmitri Mendeleev. (1.6) K/U T/I
61. Are Dobereiner’s triads more similar to a group on the periodic table or a period? Explain your answer. (1.7) K/U T/I

62. (a) What is a chemical bond?
 (b) What is an ionic bond?
 (c) Why is an ionic bond a type of chemical bond?
 (2.1) K/U T/I
63. Refer to the structure of ionic compounds to explain the following properties of ionic compounds: (2.1) K/U
 (a) high melting point
 (b) hardness
 (c) breaks when struck with a hammer
 (d) electrical conductivity when dissolved
64. The type of covalent bond formed depends on the number of electron pairs shared. For each type of covalent bond below, explain the bond and how it forms. Give an example of each type of bond. (2.2) K/U
 (a) single covalent bond
 (b) double covalent bond
 (c) triple covalent bond
65. Using Figure 5 in Section 2.3 and the electronegativity values on the periodic table in the back of this textbook, identify what type of bond forms when each of these pairs of atoms reacts: (2.3) K/U
 (a) H and C
 (b) N and O
 (c) K and Br
 (d) O and O
 (e) H and O
66. Compare and contrast non-polar covalent bonds and polar covalent bonds. (2.3) K/U T/I
67. Molecular compounds do not follow the same method of naming used by ionic compounds. Why is a different naming convention necessary? (2.4) T/I
68. (a) How does the energy content of an artificial sweetener compare to that of sugar?
 (b) How does the sweetness of the two types of compounds compare? (2.5) T/I
69. Why are compostable or biodegradable products generally considered to be more environmentally friendly than non-biodegradable products? (3.1) K/U T/I
70. (a) Why do you think insect repellents are often applied directly to the skin?
 (b) Why are insecticides usually applied to the environment instead of directly on a person?
 (3.2) T/I A
71. What two factors determine whether or not a molecule is polar? (3.3) K/U
72. (a) Explain what dipole–dipole forces are.
 (b) What types of molecules contain the strongest dipole–dipole forces? (3.3, 3.4) K/U T/I
73. (a) Which type of intermolecular force exists between all molecules, whether they are polar or not?
 (b) Are these forces more noticeable between polar molecules or between non-polar molecules?
 Explain your answer. (3.4) K/U T/I
74. Create a graphic organizer of your choice to demonstrate the relationships among the following terms and any other relevant terms:
- covalent bond
 - ionic bond
 - chemical bond
 - van der Waals forces
 - dipole–dipole forces
 - London dispersion forces
 - hydrogen bond
 - intermolecular bond
 - single covalent bond
 - double covalent bond
 - electronegativity
 - polar bond
 - polar molecule (3.4) K/U C
75. “Green chemistry” involves materials that are less toxic than formerly used materials. In what two ways must toxicity be considered in developing and using green materials? (3.6) T/I A

Analysis and Application

76. Explain how the electron energy levels proposed by Niels Bohr are similar to the rungs on a ladder. (1.2) T/I
77. A small quantity of the element selenium is essential to good health in humans. Among other purposes it is used for proper functioning of the thyroid gland. However, larger quantities of this element are toxic. Most selenium atoms contain 34 protons and 45 neutrons. (1.2) K/U T/I
 (a) What is the atomic number of selenium? Explain your answer.
 (b) Explain how to calculate the mass number of a selenium atom. Then, calculate it.
78. Radioisotopes can be hazardous. However, they also have many uses. (1.4) K/U A
 (a) What do all isotopes used in medical diagnosis and treatment have in common?
 (b) List three useful radioisotopes. Explain how they are used.
79. Examine Figure 1 in Section 1.5. Note that hydrogen is shown in the same column as the alkali metals. (1.5) K/U T/I
 (a) Why is hydrogen shown in the same column of the periodic table as the alkali metal group?
 (b) Why is hydrogen not considered to be an alkali metal?

80. The periodic trend of atomic radius is different from the periodic trend followed by ionization energy, electron affinity, and electronegativity. (1.7) **T/I**
- Describe how these trends differ.
 - Give a theoretical explanation for the difference in the trends.
81. The size of an atom is not the same as the size of an ion formed from the atom. For both of the following elements, explain what happens when the ion forms, and compare the size of an atom and an ion: (1.7) **K/U T/I A**
- copper
 - sulfur
82. Suppose you want to know how easily an atom forms an ion. For each of the following elements, would you be more concerned with its electron affinity or its ionization energy? Explain each answer. (1.7) **T/I A**
- bromine
 - magnesium
83. Potassium chloride, KCl, is used to make fertilizer, in processing food, and as a salt substitute. (2.1) **K/U A**
- Name and describe the structure of solid potassium chloride.
 - List four properties of potassium chloride that are common to other ionic compounds.
84. Propanol, or propyl alcohol, has the chemical formula C_3H_7OH . Propanol is used in disinfectants such as rubbing alcohol. Draw a Lewis structure and a structural formula for a molecule of propanol. (2.2) **T/I C A**
85. Carbonates are compounds that contain the carbonate polyatomic ion, CO_3^{2-} . They are the main components of limestone and mollusk shells. Draw a Lewis structure and a structural formula for the carbonate ion. (2.2) **T/I**
86. Think about the different types of ions you learned about in Section 1.3. How is it possible that an ionic compound might contain both ionic and covalent bonds? Provide an example of such a compound in your explanation. (2.3) **K/U T/I A**
87. For each of the following compounds, write the chemical formulas for both the anhydrous compound and the hydrate: (2.4) **K/U A**
- Cobalt(II) chloride is blue. When it becomes hydrated, the resulting cobalt(II) chloride hexahydrate is deep rose in colour. As a result of this dramatic colour change, this compound is frequently used to show the presence of water.
 - Magnesium sulfate, when hydrated, forms magnesium sulfate heptahydrate. This hydrate is commonly known as Epsom salt, a product of British Columbia. This hydrate is dissolved in warm water and used to reduce inflammation in human tissue.
88. Sucrose is table sugar, glucose is blood sugar, fructose is fruit sugar, and lactose is milk sugar. If you are checking a food label to see if the food contains sugar, what would you look for to show the presence of a sugar? (2.6) **T/I A**
89. Do you agree with the statement that reusable products are generally more environmentally friendly than any comparable product? Explain your answer. (3.1) **T/I C A**
90. Compare and contrast renewable resources and non-renewable resources. In your answer, provide two examples of each type of resource. (3.1) **K/U T/I**
91. Methane, CH_4 , is the main component of natural gas. (3.3) **K/U T/I**
- Is a methane molecule polar or non-polar?
 - Explain your answer.
92. Environmentalists often mention the “three Rs”: reduce, reuse, recycle. (3.6) **T/I A**
- Explain what each “R” refers to in daily living, giving relevant examples.
 - Rank the “Rs” in order of decreasing importance with regard to protecting the environment. Give reasons for your rankings.
93. Methane, ethanol, and paraffin are all molecular compounds. At ambient temperatures, methane is a gas, ethanol is a liquid, and paraffin is a soft solid. Use this evidence to predict the strengths of the intermolecular forces in these compounds at ambient temperatures. (3.4) **K/U T/I A**
94. Some of Earth’s best sport fishing is found in remote lakes in Canada’s Yukon. The sub-arctic climate in this location means that most of these lakes have a thick layer of ice on them for much of the year. What property of water prevents the water in most of these lakes from freezing all the way down to the bottom during the long winter? (3.5) **K/U A**
95. On a sunny summer day a beach heats up faster than the adjacent water, but at night the beach cools off faster than the water. Explain these observations, referring to at least one property of water. (3.5) **K/U T/I A**
96. Which uses energy more efficiently, recycling or upcycling? Explain your answer. (3.6) **T/I A**

Evaluation

97. (a) Explain the difference between theoretical knowledge and empirical knowledge.
(b) Describe an example of theoretical knowledge.
(c) Use an example to explain how empirical knowledge can solve a problem. (1.1) **K/U T/I A**
98. The currently used periodic table classifies elements in many ways. Explain how each of the following terms is used to classify elements on the periodic table: (1.5) **K/U A**
(a) metals
(b) non-metals
(c) metalloids
(d) group
(e) period
99. Imagine a Bohr–Rutherford diagram of a fluorine atom and a Lewis symbol of the same atom. (1.5) **T/I**
(a) What do the diagrams have in common?
(b) When might it be most helpful to use a Bohr–Rutherford diagram?
(c) When might you choose to use a Lewis symbol instead of a Bohr–Rutherford diagram?
100. (a) What is effective nuclear charge?
(b) How does effective nuclear charge affect atomic radius?
(c) How does it affect electron affinity? (1.7) **K/U T/I**
101. Why are Lewis symbols helpful when representing the formation of an ionic bond? (2.1) **T/I C**
102. Use the electronegativity values from the periodic table in the back of this textbook to answer the following questions: (2.3) **T/I A**
(a) Magnesium and iodine react to form magnesium iodide, MgI_2 . Compare the electronegativities of the two elements.
(b) What type of bond forms between a magnesium atom and an iodine atom?
103. Aluminum sulfide, Al_2S_3 , is a binary ionic compound that releases toxic fumes when it is heated or mixed with water. Why is it called a binary compound? (2.4) **K/U**
104. Several types of intermolecular forces attract molecules to each other. (3.4) **K/U**
(a) What type of intermolecular force acts between all molecules?
(b) What type of intermolecular force acts only between polar molecules?
(c) What type of intermolecular force acts between polar molecules that contain hydrogen and a highly electronegative element?
105. (a) In general, what force can be used to explain the unique properties of water?
(b) Several properties of water are unusual, compared to the properties of other compounds of similar mass. List five of these properties. (3.5) **K/U**
106. Plain water penetrates dry, clay-laden soil poorly. When sprinkled on such soil, the water forms beads and will not seep into cracks. Imagine that you are a researcher at a company that makes lawn and garden supplies. You want to create a product that can be applied to lawns with dry clay soils. Your goal is for water that is sprinkled on the soil to mix with the product and, as a result, create a solution that more readily penetrates and dampens the soil. (3.5) **K/U T/I A**
(a) What property of water must your product affect? Explain your thinking.
(b) What substance might you consider as the main ingredients for your product? Explain your choice.
(c) What would you have to find through research or experimentation to be sure that your product will be effective, safe, and environmentally friendly?
107. A relative wants to compost not only kitchen waste and yard trimmings, but also biodegradable plastics such as PLA cups. He plans to buy a standard composting bin that he will put in his backyard. He will let the composting mixture stand in ordinary environmental conditions. His hope is that he will have fully digested compost within a month. Evaluate this plan. Are his expectations reasonable? Explain your answer. If you believe that your relative's plan is not sound, offer an alternative. (3.6) **K/U T/I A**
108. It requires time, effort, and expense to change from materials and processes that have been used for many years to green materials and processes. What are three advantages of converting to green materials and processes? (3.6) **T/I A**

Reflect on Your Learning

109. (a) What is meant by the statement, “Chemistry is called the central science”?
(b) Give an example of how chemistry connects physics and biology.
(c) Give an example of how chemistry connects biology and Earth science. **K/U T/I A**
110. Think about what you know about a polyatomic ion. **T/I A**
(a) What other terms do you know that contain the prefix *poly*-?
(b) How does the meaning of *poly*- in these terms relate to the meaning of this prefix in “polyatomic ion”?

111. Examine Table 3 in Section 1.3. This table shows several ions, their sources, and their importance to human health. **K/U T/I A**
- From the sources listed, how many of the ions in the table have you ingested today?
 - How do you think what you have eaten today affects your health? Explain, using at least two examples.
112. Radon is a serious health problem when it is present in a home or other building. Examine Figure 8 in Research This in Section 1.4. From the diagram, list four different ways the homeowner could prevent radon gas in the soil from entering the house. **T/I A**
113. Most noble gases do not react because their atoms already have complete valence shells. However, large noble gas atoms can be made to form compounds with active non-metals, such as oxygen and fluorine. **T/I A**
- Xenon, Xe, reacts with fluorine to form XeF_6 . How many valence electrons are around Xe in this compound? Explain your answer.
 - Does this compound follow the octet rule? Explain your answer.
 - Why do you think large noble gas atoms form such compounds but small noble gas atoms, such as those of He or Ne, do not?
114. Section 2.3 compares differences in electronegativity to a tug-of-war. Describe another analogy that might be used to explain the effects of differences in electronegativity between bonded atoms. **T/I A**
115. Choose two compounds that are usually known by their common names, not their IUPAC names. For each compound, provide both its common name and its IUPAC name. **K/U**
116. Think about consumer products that were made by upcycling. Describe one such product. Include in your description at least three reasons why you think the product was made by upcycling instead of by some other method. **T/I A**
117. There are both risks and benefits associated with many products and scientific processes. Discuss with a partner the risks and the benefits of using insect repellents that contain DEET. **T/I C A**
118. Suppose you comb your hair on a cold, dry day. You might notice that some of your hair now stands away from your head and is attracted to the comb. Electrons are transferred from the comb to your hair. The comb becomes positively charged and your hair becomes negatively charged. What do you predict will happen if you run a thin stream of water from a tap and hold the comb alongside? Explain. **K/U T/I A**

119. In this unit you encountered several ways to represent various entities and how they form compounds. List at least three different ways, and explain a benefit of each one. **T/I**
120. Impurities often affect the properties of substances. For example, salt added to water lowers its freezing point, raises its boiling point, and affects its surface tension. Why do you think impurities affect these properties of water? **K/U T/I A**

Research



121. Benzene is a chemical in petroleum. It is also manufactured in chemical plants in Ontario, Alberta, and Québec. **T/I A C**
- What are some uses of benzene?
 - Describe some risks associated with the production of benzene.
 - What are some of the responsibilities that go along with the production, transportation, and use of benzene?
122. Some transition metals have only one valence, but many others have multiple valences. The properties and uses of the compounds containing the element vary depending on the valence of the element in that compound. Research the following transition metals and answer the following questions: **A**
- Compare and contrast the properties and uses of copper(I) chloride, CuCl , and copper(II) chloride, CuCl_2 .
 - Although chromium has valences that include every number from -2 through $+6$, its most common valences are $+3$ and $+6$. What are the names given to chromium when it has each of these valences? What ions contain chromium in each of these valences? How are the different forms of chromium related to human health?
 - Historically, mercury and its compounds had numerous medicinal uses. The toxicity of these substances now limits their uses, especially for children. What are some former medical uses of mercury, mercury(I) chloride, and mercury(II) chloride?

123. The British Columbia Cancer Agency (BCCA) is now producing its own radioisotopes. Research this development and answer the following questions: [T/I](#) [A](#)
- (a) What isotope is BCCA now producing?
 - (b) Why did it need this isotope?
 - (c) How is it now able to produce the isotope?
 - (d) By having the ability to produce radioisotopes, what future advances in cancer diagnosis and treatment might be possible?
124. When IUPAC assigns permanent names to elements, they sometimes decide that the common names should be used as the permanent names. Other names have been chosen to honour different things, such as people or locations. Research each of the following elements. Find out what each name honours. Explain why you think each person or location was important enough to earn this honour. [K/U](#)
- (a) yttrium
 - (b) uranium
 - (c) lawrencium
 - (d) ruthenium
 - (e) curium
125. Canadian chemist Raymond Lemieux was a pioneer in the study of sugars. [T/I](#) [A](#)
- (a) Research Lemieux's work and list at least three of his achievements.
 - (b) Lemieux's work demonstrates the worldwide effect of scientific research. Research the awards Lemieux received. Which countries honoured this scientist?
 - (c) Lemieux investigated oligosaccharides. Research the roots of the different parts of the word. How do the root meanings relate to the structures of the molecules?
126. The charged ends of a polar molecule might be compared to the ends, or poles, of a magnet. [T/I](#) [A](#)
- (a) Research the poles of a magnet. Find out what they are called and why these names were given to them. How do similar poles of magnets act when they are brought near each other? How do opposite poles of magnets act when they are brought near each other?
 - (b) How do things that have the same electrical charge, such as the negative ends of two polar molecules, act when they are near each other? How do two objects that have opposite charges act when they are near each other?
 - (c) Use your research results from (a) and (b) of this question to explain why the terms "pole" and "polar" apply both to magnets and to electrically charged items.
 - (d) Water molecules are polar. From your research, how do you think water molecules are arranged in a sample of liquid water?
127. Research bioplastics to find answers to the following questions: [K/U](#) [T/I](#) [A](#)
- (a) What is the source for approximately half of the bioplastics produced?
 - (b) Technically, all plastics are biodegradable by microbes under the right conditions. Why are traditional plastics considered to be non-biodegradable?
 - (c) Microbes are not the only cause of biodegrading of plastics. What other factors can cause biodegrading of plastics?
 - (d) How might bioplastics have an advantage over other plastics in the field of medicine?
 - (e) How might bioplastics be used effectively in agriculture?