3.6 EXPLORE AN ISSUE: THE COST OF YOUR COLD DRINK

Understanding the Issue

(Page 203)

1. A coolant repeatedly evaporates and condenses in the cooling coils. The coolant absorbs heat when it evaporates. This heat is extracted from the foods and drinks in the fridge, thus cooling them.
2. Ammonia, methyl chloride, and sulfur dioxide were used in the later 1800s. These substances are toxic. Freon was used in the 1920s. It is nontoxic and unreactive, but causes damage to the ozone layer in the upper atmosphere. Since the 1970s, HCFCs and HFCs have been used. Switching to these compounds may reduce environmental damage.
3. Propane (C_3H_8), butane (C_4H_{10}); since they do not contain halogens, they do not affect the ozone layer.
4. North American consumers prefer larger refrigerators and additional features, such as automatic defrost, that require much larger quantities of coolant. North American manufacturers are also reluctant to abandon older technology in which they have invested time and money.
5. [Sample answer] Consumers can influence manufacturers' decisions by writing to manufacturers, offering concerns and suggestions; organizing information sessions and inviting representatives from manufacturers; writing letters to newspapers; contacting politicians, such as government environmental agencies; informing retail outlets of their preference; and not buying products that do not meet consumers' expectations.

Role Play: Choosing a Refrigerant

(Page 203)

(a) [Sample answer] One other way of measuring cost is the political cost. Local politicians have to think about what is best for their constituents, and what will help them get re-elected. Union reps must consider the political cost, for their union, of supporting one type of coolant over another. If choosing one type of coolant results in fewer fridges being sold, and therefore fewer being ordered and manufactured, the union members might be unhappy with the union reps who chose this course of action, and withdraw their support. If union reps support the most environmentally friendly option, union members might applaud their ethical stand, and support them politically.

(b) [Sample answer] As the local MP, I would be very anxious to bring well-paying jobs to my community. I would probably back the technology that would result in the most jobs, and ensure some stability for those jobs. If we could get a Greenfreeze research lab built in the area, as well as the manufacturing facility, we would have even more jobs. I would win support for helping to preserve the ozone layer. However, I would have to be confident that the Greenfreeze refrigerators would sell well, otherwise my constituents would be laid off from the factory. My popularity would decline and I might lose me my seat in office.

(d) [Sample answer] Points in favour of HFCs and HCFCs: proven technology, minimal changes for manufacturers to production lines, an improvement on the old CFCs, refrigerators are likely to be cheaper and to sell well, HFCs and HCFCs are nontoxic and inert, unlike the butane in Greenfreeze.

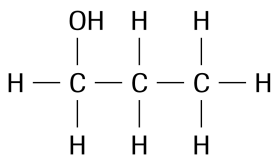
Points in favour of Greenfreeze: even more ozone-friendly than HFCs and HCFCs, long-term health could improve, the technology already exists in Europe, North Americans would have environmentally friendly options when choosing a refrigerator, the publicity of introducing a new technology would help sales.

3.7 ALCOHOLS AND ETHERS

PRACTICE

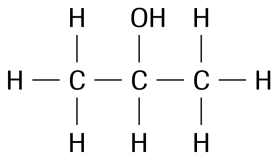
(Page 206)

1. (a)



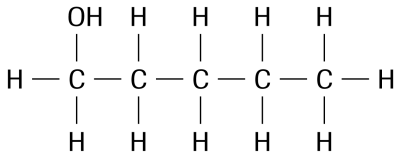
$CH_3CH_2CH_2OH$

(b)



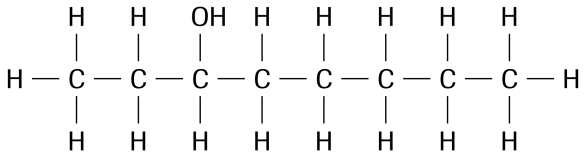
$CH_3CH(OH)CH_3$

(c)



$CH_3(CH_2)_3CH_2OH$

(d)



$CH_3CH_2CH(OH)(CH_2)_4CH_3$

2. (a) 3-pentanol
   (b) 3-heptanol

TRY THIS ACTIVITY: BURNING PAPER

(Page 207)

(a) The paper remains unchanged, possibly because any heat generated by the burning alcohol is absorbed by the water and the alcohol as it evaporates. The paper never becomes hot enough to burn. The alcohol burns off, leaving only water, which extinguishes the flame.

CAREER CONNECTON: PHARMACY TECHNICIAN

(Page 207)

(i) Job description: responsible for preparing and packaging medications; maintains dispensing records for medications, supplies, and equipment; inspects medical areas; maintains storage standards.
Qualifications: secondary school diploma; strong science background; good math skills; knowledge of pharmacy terminology, medication names, and aseptic techniques; pharmacy technician program certification.
Salary: below-average hourly wage of about $13.67 (compared to national average of $16.91).

(ii) [Sample answer]

Human Resources Department
North-Western Hospital
Pine Valley, Ontario

Dear Sir/Madam:

I am writing in response to your advertisement for a Pharmacy Technician, posted in the *Pine Valley Examiner* on Saturday, 29 February. I am very interested in that position. I have recently graduated with excellent marks from Mohawk College's two-year Pharmacy Technician Program. I also have good "people skills," and enjoy working in a team.

My resume is attached, with all my contact information.

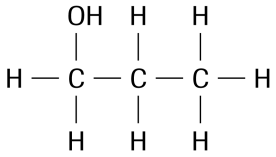
I look forward to hearing from you to arrange an interview.

SECTION 3.7 QUESTIONS

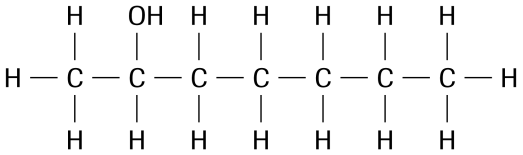
(Page 208)

Understanding Concepts

1. The presence of a hydroxyl group in methanol makes the molecule more polar than methane, and allows hydrogen bonding between molecules. Hydrogen bonding results in a higher boiling point for methanol.
2. (a)

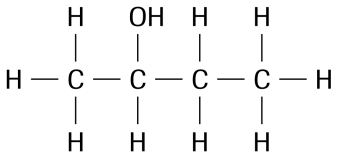
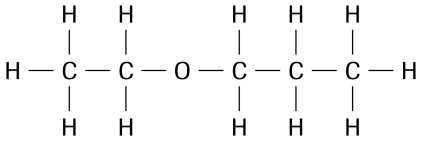


(b)



3. In 4-hexanol, the –OH group is on carbon atom 4, on a six-carbon backbone. The carbon chain should be numbered in the opposite direction to give the lowest possible number for the functional group. The correct name is 3-hexanol.
4. butane, 1-butanol, octane, 1-octanol (lowest to highest boiling point)
5. (a) $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$
   (b) $2\ CH_3CH(OH)CH_3 + 9\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$
6. (a) Ethoxypropane will evaporate at a lower temperature because, unlike 1-pentanol, it does not have a polar –OH group.
   (b) Ethoxypropane has a higher solubility in a nonpolar solvent because it is less polar than 1-pentanol.
7. Student answers for the examples will vary.

Front:

Family name and general formula	**Examples**		
	IUPAC name	**Common name**	**Structural formula**
Alcohols R–OH	2-butanol	none	
Ethers R–O–R′	ethoxypropane	none	

Back:

Family	**Characteristic properties**	**Characteristic functional groups**	**Intermolecular forces**
Alcohols	soluble in water and some nonpolar solvents; react with carboxylic acids to form esters	hydroxyl group	hydrogen bonds, van der Waals forces
Ethers	soluble in nonpolar solvents	oxygen atom bonded to two alkyl groups	van der Waals forces

8. Glycerol is an alcohol with a three-carbon chain, and a hydroxyl group on each carbon atom. The extra hydroxyl groups form extra hydrogen bonds with water, which results in extra water molecules being held to the glycerol molecules, keeping the water from freezing.

Making Connections

9. (a) IUPAC name: 1,2-dihydroxyethane
   (b) Uses: most commonly used as an antifreeze, but also has many other product applications, including polyester resin (PET), film and fibres, and heat transfer and hydraulic fluids.
   (c) Properties: clear, colourless, odourless, viscous liquid with a sweet taste. Properties are a result of the two –OH groups (sweetness) and the formation of hydrogen bonds (a viscous liquid with a fairly high melting point and boiling point).

3.8 INVESTIGATION: PROPERTIES OF ALCOHOLS

PART 1: TRENDS IN PROPERTIES OF ALCOHOLS

(Pages 209–210)

Prediction

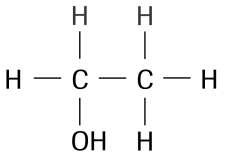
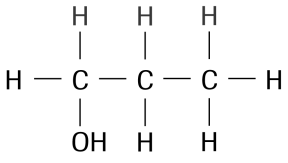
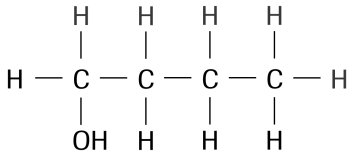
(a) Order of increasing melting points and boiling points: ethanol, 1-propanol, 1-butanol
Solubility in mineral oil (nonpolar solvent) and water (polar solvent): All three compounds are similarly soluble in polar solvents and very slightly soluble in nonpolar solvents.
Acidity: All three alcohols are basic (blue in litmus).

Hypothesis

(b) Melting point and boiling point: Each alcohol has a single hydroxyl group, so each one has similar hydrogen-bonding capabilities. The increasing size of the molecules increases the strength of the van der Waals forces, thus increasing the melting and boiling points.
Solubility: Since each alcohol has a single hydroxyl group, each one will be similarly soluble in polar solvents. Since they have small alkyl groups, they will be only slightly soluble, if at all, in nonpolar solvents.
Acidity: All three alcohols will also have similar basic properties due to the single hydroxyl group.

Observations

(c) and (d)

Property	Ethanol	1-Propanol	1-Butanol
structural formula	 ethanol	 1-propanol	 1-butanol
melting point	–117ºC	–126ºC	–89ºC
boiling point	78ºC	97ºC	117ºC
solubility in mineral oil	slightly soluble	slightly soluble	slightly soluble
solubility in water	soluble	soluble	soluble
colour with litmus	blue	blue	blue