

3.10 SAFE USE OF ORGANIC SOLVENTS

CAREER CONNECTION: FIREFIGHTERS

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- (i) Pre-services courses are available in many communities in Ontario, mostly in community colleges (such as Northern College in Timmins, Ontario). These courses can be taken on a part-time or full-time basis. Only after completing this course would a candidate be considered for hiring by the various fire departments in Ontario. When hired, the new firefighter is sent to the Ontario Fire College, in Gravenhurst, Ontario, to take the necessary courses to become a qualified firefighter. (NOC code 6262)
- (ii) The average wage for a new firefighter is \$11.98 an hour (compared with the national average, for people of a similar age, of \$11.09). This wage advantage increases with experience, with a firefighter's average hourly wage being over \$23 (national average about \$17). Also, the unemployment rate for firefighters is below the national average.

SECTION 3.10 QUESTIONS

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Understanding Concepts

1. Flammable liquids readily ignite and burn at normal working temperatures. Combustible liquids ignite and burn at higher temperatures.
2. Student answers will vary.

Organic solvent	Use	Storage location
mineral spirits	paint thinners	garage
propanone (acetone)	nail polish remover	bedroom
2-propanol	rubbing alcohol	medicine cabinet in bathroom
tetrachloroethene (perchloroethylene), C ₂ Cl ₄	stain remover	laundry room

Organic solvents should be stored away from other chemicals, in well-ventilated spaces and away from sunlight or heat sources. They should not be stored in a basement or other below-ground locations. Organic solvents should not be used close to heat sources or open flames, and only minimum required quantities should be transferred.

3. It means that, at -9°C , enough liquid solvent will vaporize and mix with air to form a mixture that will burn.

Applying Inquiry Skills

4. Use only the minimum amount needed. Return any unused ethanol to the proper storage container. Keep in a covered container to reduce evaporation. Keep away from sunlight and other heat sources. Do not use near open flames or electrical appliances that may produce a spark. Use in a well-ventilated area or in a fume hood. Avoid inhaling vapours. Dispose of waste ethanol through hazardous waste collection.

Making Connections

5. Student answers will vary.
 - No food or drink of any kind is allowed in a laboratory at any time.
 - No open-toed shoes are allowed in the laboratory. Long hair and loose clothing must be tied back.
 - Safety equipment, such as eye protection and lab aprons, must be worn as directed.
 - Each laboratory is equipped with an eyewash station, a shower, fire extinguishers, fire blankets, and fume hood. The locations of these items are clearly displayed.
 - Material Safety Data Sheets are made available for all chemicals used or stored in the school.
 - A ventilation system for the laboratory is required, and chemical storage cabinets for organic solvents and oxidizing agents must be ventilated to the outside.
 - A school emergency response team is in place to handle any hazardous situations.
 - A hazardous waste disposal system is in place.

6. Student answers will vary, but should include the following recommendations.
- Carefully read and follow the recommendations on the MSDS for every chemical substance that you use.
 - Be aware of the flammability and combustibility of solvents.
 - Use organic solvents in a well-ventilated location, such as outdoors or a room with open windows, away from ignition sources such as electrical sparks, open flames, and hot surfaces.
 - Do not store organic solvents in direct sunlight, near heat sources, or in basements.
 - Return any unused portions of solvents immediately to the appropriate storage containers.
 - Dispose of waste solvents according to environmental restrictions; never pour them down the sink.
 - Some solvents will spontaneously combust; for example, rags soaked in motor oil or linseed oil will ignite if they are stuffed in a container such as a plastic pail. The rags should be hung outside on a clothesline, to allow any heat that is produced to dissipate safely.
 - Do not inhale any solvents.

3.11 CARBOXYLIC ACIDS

TRY THIS ACTIVITY: MAKING A BATH BOMB

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(a) citric acid + sodium hydrogen carbonate \rightarrow sodium citrate + carbon dioxide + water

SECTION 3.11 QUESTIONS

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Understanding Concepts

1. (a)
- $$\begin{array}{c} \text{O} \\ || \\ -\text{C}-\text{OH} \end{array}$$
- carboxyl group
- (b) The hydroxyl group in this functional group is polar and can hydrogen bond, making the molecule soluble in water. The carbonyl group is also polar and, with the hydroxyl group, increases intermolecular attractions and thus raises the melting and boiling points of carboxylic acids.
2. Carboxylic acids contain the carboxyl group, which consists of a carbonyl group and a hydroxyl group. Both carbonyl groups and hydroxyl groups are polar groups, resulting in carboxylic acids being polar molecules.
3. (a)
- $$\begin{array}{c} \text{H} \quad \text{O} \\ | \quad || \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ | \\ \text{H} \end{array}$$
- ethanoic acid
- $$\begin{array}{c} \text{O} \quad \text{O} \\ || \quad || \\ \text{HO}-\text{C}-\text{C}-\text{OH} \end{array}$$
- oxalic acid
- (b) Oxalic acid is a solid at room temperature because, as it is polar, the van der Waals forces between the molecules are stronger than those in ethanoic acid (vinegar). There is also more opportunity for hydrogen bonding among molecules.
4. The gas (A) has the lowest boiling point and must be an alkane, the least polar molecule. The liquid (B) has the next highest boiling point and must be the alcohol, which has a hydroxyl group.