

Making Connections

8. Canada exports approximately 60% of its crude oil—mainly heavy crude oil from western Canada to the United States. Canada also imports light crude oil from the United States by pipeline, or from abroad by tankers. Canada's northern territories—Yukon, Northwest Territories, and Nunavut—have large resources of crude oil. Exploration for crude oil also began in Atlantic Canada about 50 years ago, in Nova Scotia, Newfoundland, New Brunswick, and Prince Edward Island. Alberta remains the focus of the petroleum industry in Canada, producing 70% of the country's crude oil. Crude oil is fractionated, and the collected components are used for fuel such as gasoline, jet fuel, kerosene, diesel oil, and for other purposes, such as lubricating oils, waxes, and asphalt.
9. Motor oils may contain viscosity improvers, anti-wear additives, anti-oxidants, anti-foam agents, and detergents to maintain engine cleanliness. 5W30 and 10W30 are the most commonly used motor oils. They are thin enough for cranking at low temperatures, and thick enough to lubricate satisfactorily at high temperatures. In warmer seasons, use more viscous motor oils (higher numbers). In colder seasons, use less viscous motor oils (lower numbers). The following motor oils are recommended for the lowest expected temperatures listed:

Lowest expected temperature	Type of motor oil	Brand	Cost
0°C	5W20, 5W30, 10W30, 10W40, 20W50		Under \$4/L
-18°C	5W20, 5W30, 10W30, 10W40		Under \$4/L
Below -18°C	5W20, 5W30		Under \$4/L

10. In Canada, fossil fuels provide over 85% of our total energy use. These fuels, which include coal, crude oil, and natural gas, are formed over millions of years from long-dead plant and animal material. That is why they are called fossil fuels. There is a concern about their use because they are non-renewable: when we have exhausted the existing supply, there will be no more fossil fuels available. Another concern about the use of fossil fuels is that, when burned, these hydrocarbons produce carbon dioxide—a product that may be partly responsible for global warming.
11. Student answers will vary. Possible answers include: home heating (service technician, furnace maintenance, air conditioning installation); furniture stripping and refinishing (repairs and restoration); hobby shops—plastic model cars and airplanes (salesperson); painting service (home painting and renovations); hot tubs and spas (service technician and installer); insulation contractors (installers and maintenance technicians); lamination products and services (service personnel); lawn maintenance (fertilizer application); automotive industry (oil changes and lubrication services); packaging services (materials supplier); plastic patio furniture supplier (retail staff); driveway sealing (asphalt sealing); photo finishing (film developing); pipe fabricating (factory staff); plastics (moulders); plumbing contractors (installers); recording services (sound and video technicians); refrigerators and freezers (technicians)

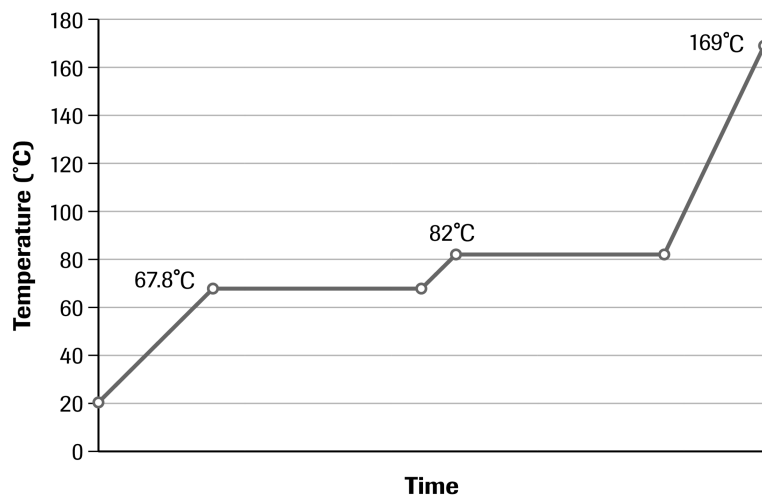
3.4 INVESTIGATION: SEPARATING A MIXTURE BY DISTILLATION

(Pages 197–198)

Prediction

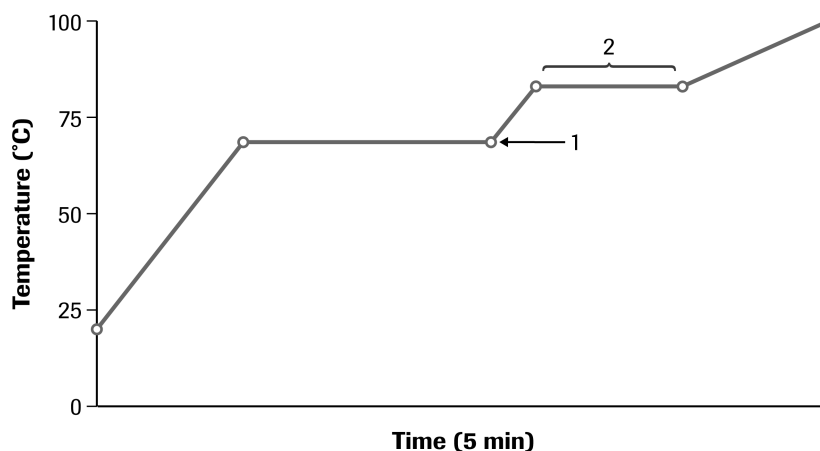
- (a) Substances with the lowest boiling point will be recovered first. Components will be recovered in the following order (from first to last): hexane, 2-methyl-2-propanol, and paraffin wax. The reasons for this order are that propanol contains an -OH group, which causes hydrogen bonding between molecules. Hydrogen bonds are stronger intermolecular forces than the van der Waals forces that exist between hexane molecules. Paraffin wax consists of much longer molecules than either hexane or propanol, and thus has stronger van der Waals forces than the other two hydrocarbons.

- (b) Boiling points:
 hexane: 67.8°C
 2-methyl-2-propanol: 82°C
 paraffin wax: 169°C



Analysis

- (c) to (e)



The temperature remains at the boiling point of the first fraction until it has completely boiled off (arrow 1); then the temperature rises again.

Bracket 2, over the second plateau, indicates the time over which the 2-methyl-2-propanol was boiling off and being collected. During this time, the temperature of the mixture remained constant.

- (f) The boiling points are the temperature readings at the first and second plateaus: 68°C and 82°C .

Evaluation

- (g) There may be a lag in time from the temperature readings graphed and the fractions collected in the flask because it may take time for the vapour to condense and to travel down the condenser. The graph may not show clear plateaus because the difference in boiling points may not be sufficient for a sharp separation. Suggested improvements include gentler, more even heating, and using a longer distillation column.
- (h) Student answer may vary. Discrepancies may be due to impurities in the mixture, heating too rapidly, and sub-optimal apparatus (e.g., insufficient length of column).