(b) $c_i = 3.50$ mol/L

$c_f = 2.50$ mol/L

$v_i = 50.0$ mL

$v_f = ?$

$c_i v_i = c_f v_f$

$v_f = \dfrac{c_i v_i}{c_f}$

$= \dfrac{(3.50 \ \text{mol/L})(50.0 \ \text{mL})}{2.50 \ \text{mol/L}}$

$v_f = 70.0$ mL

The final volume of the diluted nitric acid solution is 70.0 mL.

Applying Inquiry Skills

6. (a) $c_i = 0.25$ mol/L

$c_f = 0.010$ mol/L

$v_f = 250$ mL

$v_i = ?$

$c_i v_i = c_f v_f$

$v_i = \dfrac{c_f v_f}{v_i}$

$= \dfrac{(0.010 \ \text{mol/L})(250 \ \text{mL})}{0.25 \ \text{mol/L}}$

$v_i = 10$ mL

Therefore, 10 mL of the sodium carbonate stock solution is needed to prepare the diluted solution.

(b) Step 1. Place 10.0 mL of sodium carbonate stock solution, $Na_2CO_{3(aq)}$, into a clean, dry 250-mL volumetric flask.
Step 2. Add enough distilled water to bring the volume to the 250-mL mark on the volumetric flask.
Step 3. Place the stopper on the volumetric flask and invert several times to mix.

Making Connections

7. LD_{50} is a test that measures the concentration of a substance that kills 50% of the animals tested. The LD_{50} value is obtained by administering increasing concentrations of a test product until half of the test animals die within 14 days of a single administration. Test animals are usually mice, rats, rabbits, or hamsters. A substance with an LD_{50} between 1 to 50 ppm is considered highly toxic, and a substance with an LD_{50} between 500 to 5000 ppm is considered slightly toxic.

8. Concentrations must be clearly communicated to health care workers to avoid errors when dispensing or administering medications to patients. Concentration units commonly used in the health care field include percentage concentrations in W/V and V/V, mg/100 mL, mg/dL, mol/L, μmol/L, and ppm.

2.6 TECH CONNECT: THE SPECTROPHOTOMETER

CAREER CONNECTION: CHEMICAL LABORATORY TECHNICIAN

(i) Student answers will vary. Educational requirements for admission to a chemical laboratory technician program at Seneca College of Applied Arts and Technology are:
Ontario Secondary School Diploma with a majority of senior credits at the College Preparation (C), University Preparation (U) or University/College Preparation (M) level
Grade 12 English: ENG4 (C) or ENG4 (U)
Grade 11 Biology (C)

Grade 12 Chemistry (C)

Grade 12 Mathematics: MCT4 (C) or any Grade 12 (U) Mathematics

(ii) Ontario Job Futures 2000 rates the outlook for chemical technicians as good over the next five years. Employment for this occupation is expected to grow through the year 2005. Demand for chemical laboratory technicians should increase as chemical companies continue to research and develop new chemicals and as older workers who retire are replaced.

(iii) Student answers will vary. Chemical laboratory technicians have to know about math, chemistry, environmental science, and laboratory safety rules and methods. Chemical laboratory technicians should be patient, adaptable, self-disciplined, and observant. They should also be able to work with a team, work well under pressure, and have creative ability to find solutions to laboratory problems.

TECH CONNECT 2.6 QUESTIONS

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Understanding Concepts

1. (a) Gravimetric analysis is a method used to determine the concentration of a solute in a solution. Gravimetric analysis involves precipitating solutes out of solution, determining the mass of each solute, converting the mass to amount, and calculating the concentration of the solution.
   (b) Gravimetric analysis is not very useful when the concentration of an unknown solute is very low.

2. (a) A spectrophotometer measures the percentage of light of a particular colour (wavelength) that a solution absorbs or transmits. In a spectrophotometer, a beam of white light is dispersed into its various wavelengths (colours). A movable slit allows individual wavelengths to pass through a sample of the solution of unknown concentration. Light that is transmitted by the solution strikes a photocell. The photocell converts the light energy into an electric current, which is then measured and converted to a percent transmittance value. The percent transmittance value is proportional to the concentration of the solution.
   (b) The percent absorbance or transmittance values are used to produce a standard curve of concentration versus percent transmittance or percent absorbance. The percent transmittance or percent absorbance of a sample of the solution of unknown concentration is measured using the spectrophotometer, and this value and the standard curve are used to determine the concentration of the solution.

3. (a) A spectrophotometer measures the percentage of light of a particular colour absorbed or transmitted by a solution. Only coloured solutions absorb or transmit some of the light. Colourless solutions absorb 0% of light and transmit 100% of light. Therefore, they cannot be used in a spectrophotometer.
   (b) Percent transmittance or absorbance values are used to determine the concentration of the solution. Cuvettes are colourless because the container holding the solution in a spectrophotometer should transmit all of the light, so that only the solution being tested absorbs light.

Making Connections

4. (a) Forensic laboratories investigate crimes and determine the identity of drugs and other chemicals recovered from the scene of a crime.
   (b) Forensic researchers use infrared spectrophotometers to identify compounds such as drugs and poisons.
   (c) Spectrophotometers are used to determine the concentrations of substances such as drugs or poisons in blood and other body fluids to determine if people or animals contain abnormal concentrations. They are also used to identify compounds that may have been used in crimes.

2.7 ACTIVITY: DETERMINING THE CONCENTRATION OF A SOLUTION

(Pages 140–141)

Observations

The spectrophotometer wavelength was set at 640 nm.