

## Chapter 4 Case Study

### Tools

- scientific calculator

### Medical Laboratory Assistant

- Ian Curtis enjoyed performing experiments in high school Science classes and was intrigued by some of the laboratory equipment that was demonstrated by his teachers.
- After graduating from high school, he obtained a diploma in a year by enrolling in a college program that included a practicum at a private medical clinic.
- He earns \$30/h and works 35 to 50 h per week.
- Ian's duties include collecting samples and preparing specimens obtained from patients; conducting various tests; and measuring, recording, and sometimes analysing the results.
- He is also responsible for maintaining and operating the laboratory equipment, as well as ensuring that standard safety procedures are followed.

### Questions

1. The pH scale is a logarithmic scale used to represent the degree of acidity or alkalinity of a substance, such as a person's body fluids. The scale ranges from 0 to 14, with 0 representing extreme acidity and 14 representing extreme alkalinity. Each one-point difference in the pH scale represents a ten-fold difference in the hydronium ion concentration in the blood. A greater concentration of positive hydronium ions represents greater acidity. Because the pH of saliva mirrors that of the blood and the spinal fluid, a sample of saliva can be used to test the pH of a patient. The pH value is related to hydronium ion concentration by the equation  $\text{pH} = -\log [H^+]$ , where  $H^+$  is the concentration of hydronium ions, in moles per litre.
  - a) What is the base for this logarithm? Explain why.
  - b) The pH of a healthy person is considered to be between 7.1 and 7.5. The hydronium ion concentration of a certain patient is 0.000 000 04 mol/L. Does this patient have a blood pH within the healthy range?
  - c) Another patient has a pH of 6.5. This indicates a mild calcium deficiency. After receiving the test results from the laboratory, the patient's doctor recommends that she eat more fruits and vegetables, especially green leafy ones. What was the hydronium ion concentration in this patient?
2. Urinary tract infections (UTIs) are commonly caused by *E. coli* bacteria. A patient's urine sample is tested by Ian and is found to contain 5000 organisms/mL.
  - a) If the bacteria double every 2 h, write an equation to model the concentration,  $C$ , of *E. coli* present after  $t$  hours.
  - b) According to this model, what is the concentration of *E. coli* expected to be 24 h later?
  - c) Ian also tested a sample that was collected 24 h before. What was the concentration of *E. coli* then?

