Chapters 1 to 3 Review

Student Text Pages
214 to 217

Suggested Timing
60–75 min

Tools
- grid paper
- graphing calculator

Related Resources
- G–1 Grid Paper

Using the Chapters 1 to 3 Review

Each question reviews different skills and concepts. Students might work independently to complete the Chapters 1 to 3 Review, then in pairs to compare solutions. Alternatively, the Chapters 1 to 3 Review could be assigned for reinforcing skills and concepts in preparation for a specific chapter Practice Test.

This is an opportunity for students to assess themselves by completing selected questions and checking their answers against the answers in the back of the student textbook. They can then revisit any questions with which they had difficulty.

Task

Student Text Pages
218

Suggested Timing
75 min

Tools
- grid paper
- graphing calculator
- computer with graphing software (optional)
- computer with Internet access (optional)

Related Resources
- G–1 Grid Paper
- BLM 3–12 Task: Radioactive Isotopes Rubric

Ongoing Assessment

Use **BLM 3–12 Task: Radioactive Isotopes Rubric** to assess student achievement.

Radioactive Isotopes

Teaching Suggestions

- Students should review the concepts of radioactive decay and half-life that were introduced in Section 3.2.
- Spreadsheets and graphing technology are especially useful for the comparison between half-life and effective half-life in part b).
- Access to the library and/or Internet is recommended for part c).

Hints for Evaluating a Response

Student responses are being assessed for the level of mathematical understanding they represent. As you assess each response, consider the following questions:

- Can the student use the given information to develop an equation to model this radioactive decay?
- Does the student use an algebraic model to answer questions related to the amount of radioactive material remaining at the given times?
- Can the student produce a graphical model for the situation?
- Is the student able to determine effective half-lives based on the given information?
- Does the student make competent comparisons between half-lives and effective half-lives numerically, graphically, and algebraically?
- Does the student demonstrate proper use of mathematical conventions and forms?
- Has the student applied effective research strategies to discover additional information concerning radioactive isotopes and related issues?
- Has the student presented his or her findings in a clearly written, error-free report, with sources of information properly cited?

Level 3 Sample Response

a) i) The radioactivity of I-131 is decreasing by $\frac{1}{2}$ every 8.065 days, so this situation can be modelled as exponential decay, using an equation of the form $A = ab^x$, where x is the number of half-lives that have elapsed since 12:00 p.m. on September 5, and A is the amount of I-131 remaining after x half-lives. Since the half-life of I-131 is 8.065 days, $b = \frac{1}{2}$ and $x = \frac{t}{8.065}$, where t is the time, in days, since the sample has arrived. Find the value of a that gives 380 MBq at 12:00 p.m. on September 10.

Substitute the known values into the equation.

$$A = a\left(\frac{1}{2}\right)^{\frac{t}{8.065}}$$

$$380 = a\left(\frac{1}{2}\right)^{\frac{5}{8.065}}$$

$$a \doteq 584$$

Therefore, the equation that models the radioactivity of the sample t days after 12:00 p.m. on September 5 is $A = 584\left(\frac{1}{2}\right)^{\frac{t}{8.065}}$.

ii) On delivery day, the isotope will have the original radioactivity of 584 MBq. Twenty days after delivery would be 12:00 p.m. on September 25, and 6:00 a.m. on that day is 6 h, or 0.25 days, earlier. Therefore, 6:00 a.m. on September 25 is 19.75 days after September 5.

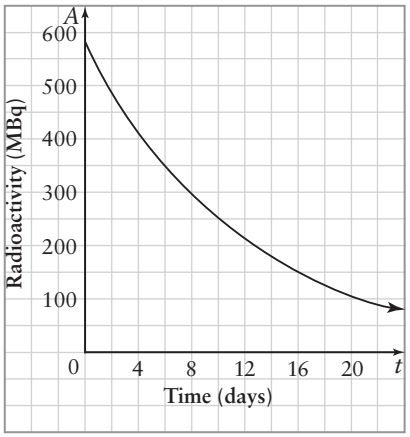
Substitute $t = 19.75$ into the equation.

$$A = 584\left(\frac{1}{2}\right)^{\frac{19.75}{8.065}}$$

$$\doteq 106.96$$

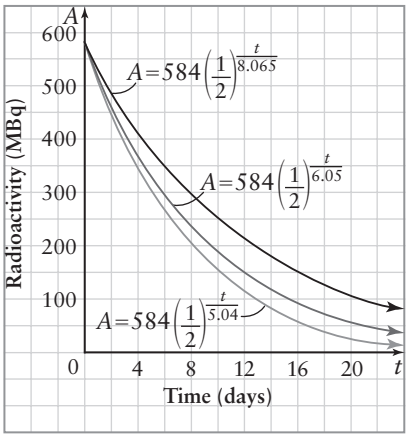
On September 25, the isotope will have a radioactivity of approximately 106.96 MBq.

iii)



b) The half-life of I-131 is 8.065 days, the half-life of I-131 in patients with Graves disease is 62.5% of that value, and the half-life in patients with toxic nodular goitre is 75% of that value. Therefore, the half-life of I-131 for patients with Graves disease is $0.625(8.065) \doteq 5.04$ days, and the half-life of I-131 for patients with toxic nodular goitre is $0.75(8.065) \doteq 6.05$ days.

Where A is the amount of I-131 remaining in a patient after t days, the level of radioactivity in typical patients is given by the equation $A = 584\left(\frac{1}{2}\right)^{\frac{t}{8.065}}$. The radioactivity in patients with Graves disease is given by the equation $A = 584\left(\frac{1}{2}\right)^{\frac{t}{5.04}}$, and the radioactivity for patients with toxic nodular goiter is give by $A = 584\left(\frac{1}{2}\right)^{\frac{t}{6.05}}$.



c) Answers may vary.

Level 3 Notes

Look for the following:

- A correct exponential equation is developed
- Calculations are generally correct, but may have one or two minor errors (e.g., using 20 instead of 19.75 for the September 25 calculation in part a) ii))
- Graphs are generally correct, but may have one or two minor issues with form
- The student understands how to modify the half-life to correctly determine effective half-lives
- Numerical, graphical, and algebraic comparisons are evident
- Evidence of relevant research is present
- Findings are presented clearly and accurately

What Distinguishes Level 2

- The algebraic model is used effectively, but not consistently
- Graph contains several minor issues with form
- Effective half-life calculations contain one or two minor errors
- Numerical, graphical, and algebraic comparisons are mostly, but not entirely, evident, or contain some minor inconsistencies
- Evidence of research is present, but incomplete
- Presentation of findings is slightly inaccurate or unclear

What Distinguishes Level 4

- A correct exponential equation is developed with steps and variables explained and identified
- All calculations are error-free
- Numerical, graphical, and algebraic comparisons are evident, with clear connections drawn between the different representations
- Evidence of thorough research is evident
- Findings are presented in a clear, accurate, and thought-provoking fashion