SOME USES OF RADIOACTIVITY

by
Peter Signell

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Title: Some Uses of Radioactivity

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Version: 2/1/2000 Evaluation: Stage B0

Length: 1 hr; 8 pages

Input Skills:

1. Use the exponential decay law and rate of decay data to deduce
   decay parameters and also rates at other times (MISN-0-311) or
   (MISN-0-264).

Output Skills (Knowledge):

K1. Starting from the exponential decay law, derive the relationship
    between the “disintegration constant” (also called “decay con-
    stant”) and the “half-life.”

K2. Solve these problems in Physics, Alonso and Finn: 22.14c (includ-
    ing a numerical check), 22.16, and 22.17. Closed book, no answers
    provided.

External Resources (Required):

   this module’s Local Guide for availability.

Post-Options:

1. “Quantum Tunnelling Through a Barrier: Pictures, Probability
   Flow, Reactions” (MISN-0-250).

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(iv) to be adapted quickly to specific user needs ranging from single-skill
instruction to complete custom textbooks.

New authors, reviewers and field testers are welcome.

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use policies see:

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1. Procedure
Read Sections 22.1, 22.2, 22.7, 22.8 in Physics, by M. Alonso and E. J. Finn (Addison-Wesley, 1970) (see this module’s Local Guide for availability).\(^1\)

2. Problems
22.13 There are 3.15 \(\times 10^7\) sec/yr.

22.14 In addition, compute the activity of the short-lived and long-lived substances separately, numerically, at the solution-time. Check the ratio.

22.16 (revised): Find:
   a. no. Fe\(^{59}\) atoms at \(t = 0\);
   b. no. Fe\(^{59}\) atoms at \(t = 12\) days;
   c. no. Fe\(^{59}\) atoms in oil sample;
   d. no. Fe\(^{59}\) atoms in all oil;
   e. fraction of all Fe\(^{59}\) atoms which are in the oil;
   f. mass of Fe in oil.

3. Answers
22.13: Book answer is OK.
22.16: 1.874 \(\times 10^{15}\), 1.558 \(\times 10^{15}\), 5.514 \(\times 10^9\), 2.095 \(\times 10^{11}\), 1.345 \(\times 10^{-4}\), 3.4 mg.
22.17: 1160 B.C.

\(^1\)For an examination of the microscopic details of the nuclear \(\alpha\)-decay process see “Quantum Tunnelling Through a Barrier: Pictures, Probability Flow, Reactions” (MISN-0-250).
MODEL EXAM

1. See Output Skill K1 in this module’s ID Sheet.

Brief Answers:

1. See this module’s textual material.
2. See this module’s ANSWERS section.