

Thursday, May 16/13  
Science 122

Announcements
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**\*\* Need an activity re a course topic before the end of May.**

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1. Worksheet - Half-Life, Activity and Decay Constant #1 - HW
2. Electron-volt
3. Quantization of Energy
4. Photoelectric Effect

HW - (2) Worksheets re Activity, Decay Constants, Etc.

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5. Wave-Particle Duality
6. Worksheet - Energy of Photons, Work Function, Etc.



$$\#8. A = 6.0 \times 10^5 \text{ Bq (decays/s)}$$

$$T_{1/2} = 28.5 \text{ yr} \Rightarrow 8.5546 \times 10^8 \text{ s.}$$

$$A = \lambda N$$

$$N = \frac{A}{\lambda} = \frac{A}{\frac{0.693}{T_{1/2}}} = 7.7875 \times 10^{14}$$

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$$n = \frac{N}{N_A}$$

$$n = \frac{m}{M}$$

$$m = \frac{N}{N_A} \cdot M$$

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$$A = \lambda N$$

$$\Rightarrow N = \frac{A}{\lambda}$$

$$\Rightarrow \frac{m N_A}{M} = \frac{A}{\lambda}$$

Science 122  
Half-Life, Activity and Decay Constant

1. In 9.0 days, the number of radioactive nuclei decreases to one-eighth the number present initially. What is the half-life (in days) of the material? (3.0 days)
2. The isotope radium-224 has a decay constant of  $2.19 \times 10^{-6} \text{ s}^{-1}$ . What is the half-life (in days) of this isotope? (3.66 days)
3. How many half-lives are required for the number of radioactive nuclei to decrease to one-millionth of the initial number? (19.9)
4. Iodine-131 is used in diagnostic and therapeutic techniques in the treatment of thyroid disorders. This isotope has a half-life of 8.04 days. What percentage of an initial sample of iodine-131 remains after 30.0 days? (7.53%)
5. Strontium-90 has a half-life of 28.5yr. It is chemically similar to calcium, enters the body through the food chain and collects in the bones. Consequently, strontium-90 is a particularly serious health hazard. How long (in years) will it take for 99.9900% of the strontium-90 released in a nuclear reactor accident to disappear? (379 years)
6. If the activity of a radioactive substance is initially 398 disintegrations/min and two days later it is 285 disintegrations/min, what is the activity four days after the first two days? Give your answer in terms of disintegrations per minute. (146 disintegrations/min)
7. To make the dial of a watch glow in the dark,  $1.000 \times 10^{-9} \text{ kg}$  of radium-226 is used. The half-life of this isotope is  $1.60 \times 10^3$  years. How many kilograms of radium disappear while the watch is in use for fifty years? ( $2.1 \times 10^{-11} \text{ kg}$ )
8. A sample of ore containing radioactive strontium-90 has an activity of  $6.0 \times 10^5 \text{ Bq}$ . The molar mass of strontium-90 is 89.908 g/mol and its half-life is 28.5 years. How many grams of strontium are in the sample? ( $1.2 \times 10^{-7} \text{ g}$ )

Science 122  
Half-Life, Activity and Decay Constant #2

1. The half-life of a radioactive isotope is 2.5 years. If the activity of the original sample of this isotope were  $3.2 \times 10^3$  Bq, what would be its activity after 5.00 years? ( $8.0 \times 10^2$  Bq)
2. What percent of a polonium-210 sample will remain after 172 days if it has a half-life of 138 days? (42.2%)
3. If the activity of a radioactive sample of  $^A\text{X}$  is 28 Bq and 8.0 h later its activity is 18 Bq, what is the half-life of  $^A\text{X}$ ? (13 h)
4. If the half-life of an isotope is 2.7 years, after 9.5 years how would the activity of a sample of this isotope compare to the original activity of the sample (0.087 times)
5. A radioactive isotope ( $T_{1/2} = 4.50$  days) was prepared. This isotope was used 14.0 days later when it had an activity of  $6.00 \times 10^6$  Bq. What was the activity of this isotope when initially prepared? ( $5.18 \times 10^7$  Bq)
6. The iodine isotope iodine-131 is used in hospitals for diagnosis of thyroid function. If 532  $\mu\text{g}$  are ingested by a patient, determine the activity
  - a) immediately. ( $2.44 \times 10^{12}$  decay/s)
  - b) 1.0 hour later when the thyroid is being tested. ( $2.43 \times 10^{12}$  decays/s)

(Note: Iodine-131 has a molar mass of 130.906111 g/mol and a half-life of 8.04 days.)
7. Two radioactive nuclei A and B are present in equal numbers to begin with. Three days later, there are three times as many A nuclei as there are B nuclei. The half-life of B is 1.50 days. Find the half-life of A. (7.23 days)