HALF-LIFE PROBLEMS

Name_____ Block _____

1. An isotope of cesium (cesium-137) has a half-life of 30 years. If 1.0 g of cesium-137 disintegrates over a period of 90 years, how many g of cesium-137 would remain?

2. Actinium-226 has a half-life of 29 hours. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

3. Sodium-25 was to be used in an experiment, but it took 3.0 minutes to get the sodium from the reactor to the laboratory. If 5.0 mg of sodium-25 was removed from the reactor, how many mg of sodium-25 were placed in the reaction vessel 3.0 minutes later if the half-life of sodium-25 is 60 seconds?

4. The half-life of isotope X is 2.0 years. How many years would it take for a 4.0 mg sample of X to decay and have only 0.50 mg of it remain?

5. Selenium-83 has a half-life of 25.0 minutes. How many minutes would it take for a 10.0 mg sample to decay and have only 1.25 mg of it remain?

6. The half-life of Po-218 is three minutes. How much of a 2.0 gram sample remains after 15 minutes? Suppose you wanted to buy some of this isotope, and it required half an hour for it reach you. How much should you order if you need to use 0.10 gram of this material?

<u>HALF-LIFE WORKSHEET</u>   <u>Name</u>_____

Use Reference Table on side to assist you in answering the following questions.
<u>Equations:</u>

½ lifes:
As-81 = 33 seconds
Au-198 = 2.69 days
C-14 = 5730 years

1 How long does it take a 100.00g sample of As-81 to decay to 6.25g?

2. How long does it take a 180g sample of Au-198 to decay to 1/8 its original mass?

3. What percent of a sample of As-81 remains un-decayed after 43.2 seconds?

4. What is the half-life of a radioactive isotope if a 500.0g sample decays to 62.5g in 24.3 hours?

5. How old is a bone if it presently contains 0.3125g of C-14, but it was estimated to have originally contained 80.000g of C-14?

HALF-LIFE CALCULATIONS

Name _____

Half-life is the time required for one-half of a radioactive nuclide to decay (change to another element). It is possible to calculate the amount of a radioactive element that will be left if we know its half-life.

Example: The half-life of Po-214 is 0.001 second. How much of a 10 g sample will be left after 0.003 seconds?

Answer: Calculate the number of half-lives:

$$0.003 \text{ seconds} \times \frac{1 \text{ half-life}}{0.001 \text{ second}} = 3 \text{ half-lives}$$

After 0 half-lives, 10 g are left.
After 1 half-life, 5 g are left.
After 2 half-lives, 2.5 g are left.
After 3 half-lives, 1.25 g are left.

Solve the following problems.

1. The half-life of radon-222 is 3.8 days. How much of a 100 g sample is left after 15.2 days?

   _____

2. Carbon-14 has a half-life of 5,730 years. If a sample contains 70 mg originally, how much is left after 17,190 years?

   _____

3. How much of a 500 g sample of potassium-42 is left after 62 hours? The half-life of K-42 is 12.4 hours?

   _____

4. The half-life of cobalt-60 is 5.26 years. If 50 g are left after 15.8 years, how many grams were in the original sample?

   _____

5. The half-life of I-131 is 8.07 days. If 25 g are left after 40.35 days, how many grams were in the original sample?

   _____

6. If 100 g of Au-198 decays to 6.25 g in 10.8 days, what is the half-life of Au-198?

   _____

3. How many half lives will it take for 50 g of ^{99}Tc to decay to 6.25 g?

4. What fraction of a sample of ^{32}P will be left after 42.9 d?

5. How long will it take for a 28 g sample of ^{226}Ra to decay to 3.5 g?

6. How long will it take for 50% of a sample of ^{131}I to decay?

7. After 9.8×10^{10} y, how many grams will be left from a 256 g sample of ^{232}Th?

8. How long will it take for 500 g of ^{90}Sr to decay to 125 g?

9. What fraction of a sample of ^{3}H will be left after 36.78 y?

Half Life of Radioactive Isotopes

Name: _____

Date: _____

1. Carbon -14 is a radioactive isotope found in small amounts in all living things. When the living thing dies, the carbon -14 begins to decay at a steady rate with a half -life of 5,730 years; meaning that for every 5,730 years that passes, exactly half of the original amount of carbon -14 has decayed. Scientists are able to measure the amount of carbon -14 left in a dead organism and use the half -life to determine the length of time that has passed since the organism died.

- Use the above information to answer the following questions

a) Remains of an ancient caveman are discovered and scientists determine that the level of carbon -14 is about 25% (or ¼ th) the original amount. How long ago did he die?

b) The remains of one of the last Neanderthal man are discovered and found contain about 3% (or 1/32 nd)of the original amount of Carbon -14. How long ago did she die?

c) The remains of a wooly rhinoceros are discovered. Scientists deduce that the sample from the rhinoceros originally had 80g of carbon -14 but now there is only 10 g left. How long ago did the rhinoceros die?

Table N
Selected Radioisotopes

Nuclide	Half-Life	Decay Mode	Nuclide Name
^{198}Au	2.69 d	β^-	gold-198
^{14}C	5730 y	β^-	carbon-14
^{37}Ca	175 ms	β^+	calcium-37
^{60}Co	5.26 y	β^-	cobalt-60
^{137}Cs	30.23 y	β^-	cesium-137
^{53}Fe	8.51 min	β^+	iron-53
^{220}Fr	27.5 s	α	francium-220
^{3}H	12.26 y	β^-	hydrogen-3
^{131}I	8.07 d	β^-	iodine-131
^{37}K	1.23 s	β^+	potassium-37
^{42}K	12.4 h	β^-	potassium-42
^{85}Kr	10.76 y	β^-	krypton-85
^{16}N	7.2 s	β^-	nitrogen-16
^{19}Ne	17.2 s	β^+	neon-19
^{32}P	14.3 d	β^-	phosphorus-32
^{239}Pu	2.44×10^4 y	α	plutonium-239
^{226}Ra	1600 y	α	radium-226
^{222}Rn	3.82 d	α	radon-222
^{90}Sr	28.1 y	β^-	strontium-90
^{99}Tc	2.13×10^5 y	β^-	technetium-99
^{232}Th	1.4×10^{10} y	α	thorium-232
^{233}U	1.62×10^5 y	α	uranium-233
^{235}U	7.1×10^8 y	α	uranium-235
^{238}U	4.51×10^9 y	α	uranium-238

ms = milliseconds; s = seconds; min = minutes;
h = hours; d = days; y = years