**Half-life Problems**

![C:\Documents and Settings\kkelley\Local Settings\Temporary Internet Files\Content.IE5\I00G7SPA\MC900287501[1].wmf]()Recall: The half-life of a radioactive substance is the time it takes for half of the material to decay. You are encouraged to make a table in order to generate some of the data for each problem situation below. Solve the following half-life problems by writing an equation and using the equation to find the solution. Make sure you find the initial value for each equation. The first problem has been **partially worked** in order to help you with the remaining problems.

1. A hospital prepared a 100-mg supply of technetium-99m, which has a half-life of 6 hours. Use the table below to help you understand how much of technetium-99m is left at the end of each 6-hour interval for 36 hours. Use this to help write an exponential function to find the amount of technetium-99m that remains after 75 hours.

The amount of technetium-99m is reduced by one half each 6 hours as shown in the table below. Fill in the missing information in the table and in the equation below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of 6-hour Intervals** | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| **Number of Hours Elapsed** | 0 | 6 |  | 18 | 24 |  | 36 |
| **Amount of Technetium-99m (mg)** | 100 | 50 | 25 |  |  | 3.13 |  |

The amount of technetium-99m is an exponential function of the number of half-lives. The initial amount is \_\_\_\_ mg. The decay factor is \_\_\_\_. One half-life equals 6 hours.

Write an explicit equation if x = the number of 6-hour intervals. Y = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

That’s getting really easy to do now! But…what if x = the number of hours elapsed. It would be easier to plug in the number of hours instead of how many “6-hour intervals”, but we would have to change the equation a little.

If x = the number of hours elapsed, then the number of 6- hour intervals (of half-lives) =.

Equation:

Use your equation to find the solution to the question.

 🡪 HINT: When you use rational exponents in your calculator, put ( ) around them!

After 75 hours, about \_\_\_\_\_\_\_\_\_\_ mg of technetium-99 remains.

Use a similar format in order to find the equations and solutions of the 4 remaining problems.

1. Arsenic-74 is used to locate brain tumors. It has a half-life of 17.5 days. Write an exponential decay function for a 90-gram sample. Use the function to find the amount remaining after 6 days. (Hint: Make a table to help you understand the data.)
2. Phospohorus-32 is used to study a plant’s use of fertilizer. It has a half-life of 14.3 days. Write the exponential decay function of a 50-mg sample. Find the amount of phosphorus-32 remaining after 84 days.
3. Iodine-131 is used to find leaks in water pipes. It has a half-life of 8.14 days. Write the exponential decay function for a 200-mg sample. Find the amount of iodine-131 remaining after 72 days.
4. Some radioactive ore which weighed 20 grams 200 years ago has been reduced to 12 grams today.
	1. Use exponential regression on your calculator to write an exponential decay function in order to find the solution.
	2. Based on your equation, what is the half-life of this radioactive ore?
	3. Based on your half-life, write another exponential equation for the data in which the base of the exponent is ½ .
	4. How much will be left in 400 years?

Adapted from Prentice-Hall Mathematics Algebra 2, Pearson Education, Inc., Upper Saddle River, NJ, 2004.

**More Half-Life Problems**

Most things are composed of stable atoms. However, the atoms in radioactive substances are unstable and the break down in a process called radioactive decay. The rate of decay varies from substance to substance. The term **half-life** refers to the time it takes for half of the atoms in a radioactive substance to decay. For example, the half-life of carbon-11 is 20 minutes. This means that 2,000 carbon-11 atoms will be reduced to 1,000 carbon-11 atoms in 20 minutes, and to 500 carbon-11 atoms in 40 minutes.

Half-lives vary from a fraction of a second to billions of years. For example, the half-life of polonium-214 is 0.00016 seconds. The half-life of rubidium-87 is 49 billion years.

In the problems below, write an exponential decay function in order to find the solution to each problem. (Use function notation)

1. Hg-197 is used in kidney scans and it has a half-life of 64.128 hours. Write the exponential decay function for a 12-mg sample. Find the amount remaining after 72 hours.
2. Sr-85 is used in bone scans and is has a half-life of 64.9 days. Write the exponential decay function for an 8-mg sample. Find the amount remaining after 100 days.
3. I-123 is used in thyroid scans and has a half-life of 13.2 hours. Write the exponential decay function for an 45-mg sample. Find the amount remaining after 5 hours.
4. A decaying radioactive ore originally weighs 27 grams and is reduced to 18 grams in 1,000 years. How much will be left in 3,000 years? Write an exponential decay function in order to find the solution.
5. Some radioactive ore which weighed 20 grams 200 years ago has been reduced to 12 grams today. How much will be left 400 years from now? Write an exponential decay function in order to find the solution.

Common Core Math I Practice Test Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. You take one 1200mg dose of the medicine your doctor prescribed. Assume that your kidneys can filter out 30% of a drug every day.
	1. Make a table showing the amount of the drug remaining at various times.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of Days | 0 | 1 | 2 | 3 | 4 | 5 |
| Amount of Medicine  | 1200 |  |  |  |  |  |

* 1. Write a short description of the pattern.
	2. Write an explicit equation that describe the amount of medicine in the blood.

y = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. Use one of the rules in part c to estimate the amount of medicine left after 5.5 days.
	2. How long will it take the medicine to be reduced to only 1% (1 mg) of its original level in the body?

 2. The sequence below shows the total number of bacteria in a Petri dish after n number of hours that started with 7 bacteria.

Assuming the pattern continued, which function could be used to find the total number of bacteria at the end of *n* number of hours?

A. B. C. D.

**For problems 3-7**, use the following scenario. Each year the local country club sponsors a tennis tournament. Play starts with 128 participants. During each round, half of the players are eliminated.

 3. If we were going to express the number of teams remaining in the tournament in a NOW-NEXT equation, what would that equation be?

 A. B.

C. D.

 4. What would the explicit equation be to predict the number of teams remaining, , after a specific number of rounds,?

A. B. C. D.

 5. If the numbers of teams remaining at the end of each round were represented as a sequence, would the sequence be arithmetic, geometric, or neither?

A. arithmetic B. geometric C. neither D.

 6. How many rounds does it take to get a winner of the entire tournament, meaning there is 1 team remaining?

A. 5 rounds B. 6 rounds C. 7 rounds D. 8 rounds

 7. In the context of the problem, does it make sense to have 10 rounds?

A. yes because you can continue the pattern forever if you wanted to get the # of teams

B. yes because you can put 10 into the equation and get an answer for the # of teams

C. no because the answer you get represents the # of teams and it isn’t possible

D. no because it is too hard

\_\_\_\_\_8. Which of the following sequences is created from the following information: ?

A. B.

C. D.

 9. Jimmy conducted an experiment on the change in the population of a colony of bacteria based on a change in its surrounding temperature. He modeled the change in the population using the function . Which of these statements is *true*?

A. The population decreases at a rate of 10%.

B. The population increases at a rate of 10%.

C. The population decreases at a rate of 80%.

D. The population increases at a rate of 80%.

 10. Identify the correct characteristics of the following geometric sequence.

A. geometric, B. geometric, C. geometric, D. geometric,

 11. When Diana was born, $5000 was put it into an account that gains 3.75% interest compounded monthly. Using the form, how much would she have in her account after 18 years.

A. $14,203,676.34 B. $5,288.85 C. $5,190.76 D. $9,809.83

 12. Samaj didn’t finish his homework assignment last night. He was supposed to write the first 2 terms of a geometric sequence that starts at 2. He wrote 2, 4 and did not finish. What are the next 3 terms of the sequence he was writing?

A. B. C. D.

 13. Whitney wrote a compound interest equation for her sister, Rachel, to explain how their inheritance was growing in their account. Rachel understood most of the numbers in the equation but didn’t understand what the 2 meant. What does the number 2 mean in the equation?

 A. compounded semiannually B. 2% interest C. initially had $2 D. 2 years

 14. May bought a home for $125,000 in 2000. She learned that the area around her home increased the value of her home at a rate of 0.25% per year. Determine the value of her home in 2010.

A. B. C. D. $160,010.57

**For #15 – 20**, use the following equation:

 15. Does the equation represent growth/decay?

A. growth B. decay

 16. What is the initial value?

A. B. C. D.

 17. What is the growth/decay factor?

 A. B. C. D.

 18. What is the rate of growth/decay?

A. B. C. D.

 19. Find ?

A. B. C. D.

 20. For what value of x is the function equal to ?

 A. B. C. D.

 21. The half-life of a radioactive substance is the length of time it takes for one half of the substance to dacay into another substance. To treat some forms of cancer, doctors use radioactive iodine. The half-life of iodine-131 is 8 days. A patient receives a 12-mCi (millicuries, a measure of radiation) treatment. How much iodine-131 is left in the patient 16 days later?

 A. B. C. D.

 22. Cesium-137 has a half-life of 30 years. Suppose a lab stored a 30-mCi sample in 1973. How much of the sample will be left in 2063?

 A. mCi B. C. mCi D. mCi

 23. The half-life of iodine-124 is 4 days. A technician measures a 40-mCi sample of iodine-124. How many half-lives of iodine -124 occur in 16 days?

 A. B. C. D.

 24. The half-life of carbon-11 is 20 minutes. A sample of carbon-11 has 25mCi. How much carbon-11 is in the sample 1 hour after the original sample is measured?

 A. B. mCi C. mCi D. mCi