Name _____ Hour _____

Radioactive Dating Lab

Carbon-14 dating is used for determining the age of biological samples. As long as a plant or animal is living it will constantly incorporate small amounts of carbon-14 into its cells. Once the plant or animal dies it no longer takes up ^{14}C. By comparing the amount of ^{14}C present in a sample to the amount that occurs in living cells, chemists can determine the approximate age of the sample. The ratio of ^{206}Pb to ^{208}Pb is used for dating mineral samples. Because the half-life of uranium (the radioactive "parent" of ^{208}Pb) is so much longer than that of carbon, this dating method is useful for aging samples that are much older than those that can be aged with ^{14}C dating.

Artifact Information

Radioactive isotope	stable isotope	% radioactive at formation	half-life
Gold	Blue	25%	1200 yrs
Red	Black	50%	9000 yrs
Green	Orange	60%	850 yrs
Turquoise	White	80%	17,000 yrs
Yellow	Purple	10%	1,200,000 yrs

Procedure

1. ***Indicate the colors of beads used in the sample in the appropriate column of the data table.***
2. ***Count the number of each color of beads in the sample.***
3. ***Multiply the total number of beads by the percent that would have been radioactive when the sample was formed.***
4. ***Divide the answer to #3 by two until the answer matches the number of radioactive beads actually in the sample. Each time you divide by two represents another half life of time elapsing.***
5. ***Multiply the number of half lives elapsed by the length of one half life to determine the approximate age of the sample.***

Example: Sample X contains 60 particles, of which three are turquoise and the rest are white. Approximately how old is the sample? (The turquoise "atoms" turn into white "atoms" as time goes by, but the total number of "atoms" stays the same)

Solution: Sample X, composed of turquoise and white particles, should have been 80% turquoise upon formation, or 60 x 0.80 = 48 turquoise particles. After one half-life, there would have been 24 turquoise particles, after two there would have been 12 turquoise particles, after three half lives there would have been 6 turquoise particles, and after 4 half-lives, there would have been 3 turquoise particles, like the sample actually has. Therefore, the sample is approximately four half-lives, which is … (4 half lives x 17,000 years/half life =) 68,000 yrs old.

For each sample, determine the relative age of the sample.

Sample Number	Colors of isotopes (beads) in sample	Total # of isotopes (beads)	Today's # Radioactive Isotope	# of Radioactive Isotope Upon Formation	Number of Half-Lives Elapsed	Age of Artifact (years)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Questions

1. What assumptions are made in the radioactive dating techniques simulated in this procedure?

2. A few of the samples did not have an even number of half-lives elapsed. How did you solve this problem? Is there a more accurate way?

3. Based on the data in your table, calculate the rate constant, k, and the reaction rate for the rqadioactive decay of the red/black pair.