NAME _____ DATE _____

# Half Life

## *Practice Problems (Level 1)*

Refer to half lives listed in Appendix 12, page 200, for the solution of the following problems.

1. A piece of uranium 238 weighs 1.000 kg. How much of this isotope will remain about $36 \times 10^9$ years?

2. Polonium 218 has a half life of 3.0 m. A sample weighing 50.0 g is stored on a laboratory shelf. How much of the isotope will remain after 15 minutes have passed?

$2 \times 10^5$ years

3. A certain rock sample is found to contain 35 g of the radioactive isotope, technetium 99. How much of the isotope will remain in the rock after a period of 1,000,000 years?

4. A block of radium 226 weighs $1.0 \times 10^4$ kg. How much of this radioisotope will remain after 6500 years have passed?

28.8 years

5. How long will it take a piece of strontium 90, weighing exactly 1.000 kg, to be reduced to only 10.0 g?

6. A sample of cesium 138 is produced in a laboratory. The sample weighs 100.0 g at the time it is produced. How long will it take before this sample is reduced to only 20.0 g? The half life of cesium 138 is 32.2 m.

7. A hospital purchases 80.0 kg of cobalt 60 to use in cancer therapy. How long will it be before there remains only 15 kg of this radioisotope?

8. A sample of oxygen gas contained within a glass tube includes 7.4 g of the radioisotope oxygen 15. At what later time will the amount of oxygen 15 be reduced to only 0.5 g?

NAME _____ DATE _____

# Half Life

## *Practice Problems (Level 2)*

Refer to Appendix 12, page 200, for half lives needed for the solution of the following problems.

45 days **1.** A meteorite strikes the earth in western Wyoming. Chemical analysis shows that it contains 44.62 kg of radioactive iron 59. How much of this isotope will remain in the meteorite after 220 days?

78 hours **2.** A sample of gallium 67 was ordered by a research laboratory sometime ago. When received in the lab, it weighed 492 g. Today it weighs only 15 g. How long ago was the gallium 67 received in the laboratory?

**3.** A 100.0 g sample of radiophosphorus ($^{32}P$) was ordered and received at the same time as the gallium 67 (problem 2). When its weight is reduced to 20.0 g, a new sample must be ordered. How long after the radiophosphorus was received will a new order have to be placed?

**4.** How much time will be required for a sample of radioactive tritium to lose 75% of its radioactivity?

**5.** A sample of pure radium 226 is donated to a museum in the year 1990. The sample weighs 5.0 mg. The museum decides to replace the sample after it has been reduced in weight to 0.62 mg. In what year will the sample have to be replaced?

**6.** A radioactive isotope of radon has a half life of 3.8 days. How long will it be be before only 1/16 of the original sample of radon remains?

**7.** A piece of wood is known to be 34,320 years old. At the present time, the wood contains 4.0 g of radiocarbon ($^{14}C$). How much carbon 14 was in the wood originally?

**8.** The decay of a sample of tritium gas has been carefully monitored for just slightly more than 37 years. The weight of the tritium in the sample today is 6.4 g. What was the weight of the tritium in the sample originally?

NAME _____ DATE _____

# Half Life

## *Practice Problems (Level 3)*

Refer to Appendix 12, page 200, for half lives needed for the solution of the following problems.

1. What fraction of the uranium 235 originally present at the creation of the universe is still in existence today? Use a value of $8.0 \times 10^9$ years for the age of the universe.
2. You plan on using radioactive sulfur 38 in an experiment in your laboratory. It will take 15 hours to ship the sulfur 38 from the producer to your lab. If you want to have 5 g of the isotope to use in the experiment, how much should you order from the producer? The half life of sulfur 38 is 3.0 hr.
3. A sample of sodium 24 was received in your laboratory 1 day 22 hours after being shipped from the producer. The weight of the sample when it reached you was 2.0 g. Did the producer ship the 24.0 g of sodium 24 you had requested?
4. A radioactive isotope decays to one eighth of its original activity in 60 years. What is the half life of this isotope?
5. A sample of selenium 83 registers $10^{12}$ disintegrations per second when it is first tested in a laboratory. What rate of disintegration would you predict for this isotope 12 hours later? The half life of selenium 83 is 25 minutes.
6. An order for phosphorus 32 has been placed for some studies on plant growth. How much of the isotope will remain one month after it has been produced? Six months later? (Express your answers as percents of the original amount.)
7. In studies to determine the half life of an isotope, 10.0 g of the isotope is found to decay to 0.625 g over a period of 6.0 hours. From this information, calculate the half life of the isotope.
8. In an experiment to determine the half life of an isotope, a very precise clock is set at $00^h\ 00^m\ 00.000^s$ the moment the isotope is produced. At the instant the clock reads $00^h\ 00^m\ 14.846^s$, 8.0% of the isotope remains unchanged. From this information, calculate the half life of the isotope.

# Appendix M

## HALF LIVES OF SOME COMMON RADIOACTIVE ISOTOPES

| *Isotope* | *Half Life* |
|---|---|
| $^{3}H$ | 12.3 y |
| $^{14}C$ | 5730 y |
| $^{15}O$ | 124 s |
| $^{24}Na$ | 15.0 h |
| $^{32}P$ | 14.3 d |
| $^{40}K$ | $1.28 \times 10^{9}$ y |
| $^{51}Cr$ | 27.8 d |
| $^{55}Fe$ | 2.6 y |
| $^{60}Co$ | 5.26 y |
| $^{85}Sr$ | 70 m |
| $^{99m}Tc$ | 6.0 h |
| $^{131}I$ | 8.1 d |
| $^{198}Au$ | 2.7 d |
| $^{226}Ra$ | 1600 y |
| $^{234}Th$ | 24 d |
| $^{235}U$ | $7.1 \times 10^{8}$ y |
| $^{238}U$ | $4.5 \times 10^{9}$ y |
| $^{239}Np$ | 2.35 d |
| $^{239}Pu$ | 24,400 y |
| $^{260}Ku$ | 0.3 s |