Use with textbook pages 302–309.

Radioactive decay

1. Define the following terms.

(a) half-life _time required for ½ the nuclei of radioactive isotope to decay_.

(b) decay curve _curved line graph showing rate of decay of an isotope_.

(c) parent isotope _the isotope that undergoes radioactive decay_

(d) daughter isotope _the resulting stable product of radioactive decay_

2. Complete the following tables.

Half-Life	Percent of parent isotope	Percent of daughter isotope
0	100	0
1	50	50
2	25	75
3	12.5	87.5
4	6.25	93.75

| Half-Life	Fraction of parent isotope	Fraction of daughter isotope
0	1	0
1	½	½
2	¼	¾
3	⅛	⅞
4	1/16	15/16

3. A rock sample contains 120 g of a radioactive isotope. The radioactive isotope has a half-life of 5 years.

(a) Complete the following table.

Half-Life	Time (a)	Mass (g)
0	0	120
1	5	60
2	10	30
3	15	15
4	20	7.5
5	25	3.75

(b) How much of the radioactive isotope if left after 25 years have passed? _3.75 g_

(c) How many half-lives have passed if there is only 15 g of the parent isotope left?
3 half-lives

(d) How many years have passed if there is only 7.5 g of the parent isotope left?
_20 yr_

(e) Use the data in the table to graph a decay curve. Label the x-axis with Time (a) and the y-axis with Mass (g).

125

100

75

Mass
in grams   50

25

0

0   5   10   15   20   25   years
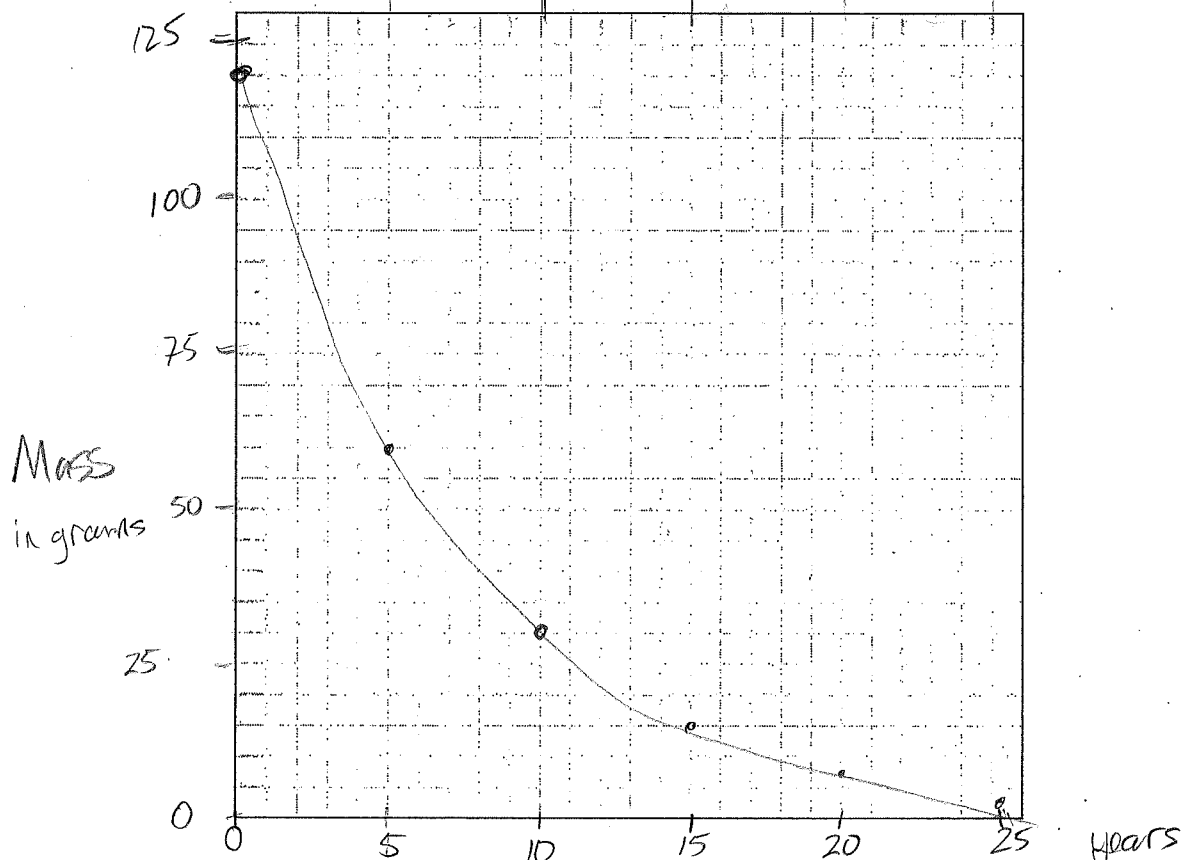
4. A rock sample contains 80 g of a radioactive isotope with a half-life of 20 years.

(a) Complete the following table.

Half-Life	Time (a)	Mass of parent isotope (g)	Mass of daughter isotope (g)
0	0	80	0
1	20	40	40
2	40	20	60
3	60	10	70
4	80	5	75
5	100	2.5	77.5

(b) How much of the parent isotope is left after 4 half-lives? ___5 g___

(c) How much of the parent isotope is left after 100 years? ___2.5 g___

(d) How much of the daughter isotope is present after 60 years? ___70 g___

(e) How much time has passed if 77.5 g of the daughter isotope is present? ___100 y___

(f) What is the ratio of parent isotope to daughter isotope after 2 half-lives? ___1:3___

Use with textbook pages 302–309.

Calculating half-life

1. A radioactive isotope has a half-life of 10 minutes.

   (a) What fraction of the parent isotope will be left after 30 minutes?
   _____ 1/8 _____

   (b) What percent of the parent isotope will be left after 40 minutes?
   _____ 6.25% _____

   (c) What fraction of the daughter isotope will be present after 20 minutes?
   _____ 3/4 _____

   (d) What percent of the daughter isotope will be present after 50 minutes?
   _____ 96.875% _____

2. A 36 g sample of a radioactive isotope decayed to 4.5 g in 36 minutes. How much of the original parent isotope would remain after the first 12 minutes?
   _____ 18 g _____

3. The half-life of a particular radioactive isotope is 8 hours. What percent of the parent isotope would remain after 1 day? _____ 12.5 % _____

4. A radioactive isotope sample has a half-life of 4 days. If 6 g of the sample remains unchanged after 12 days, what was the initial mass of the sample?
   _____ 48 g _____

5. Suppose the ratio of a radioactive parent isotope to a stable daughter isotope within a rock sample is 1:3. The half-life of the parent isotope is 710 million years. How old is the rock sample? _____ 1420 million years old _____

6. A rock sample was dated using potassium-40. Measurement indicates that 1/8 of the original parent isotope is left in the rock sample. How old is the rock sample?
   _____ 3.9 billion years _____

7. When a sample of lava solidified, it contained 28 g of uranium-238. If that lava sample was later found to contain only 7 g of U-238, how many years had passed since the lava solidified? _____ 9 billion years _____

8. After 25 years, the number of radioactive cobalt atoms in a sample is reduced to $\frac{1}{32}$ of the original count. What is the half-life of this isotope? _____ 5 yr _____

9. The half-life of Sr-90 is 28 years. If an 80 g sample of Sr-90 is currently in a sample of soil, how much Sr-90 will be present in the soil 84 years later? _____ 10 g _____

Use with textbook pages 305–309.

Decay curves

1. Use the decay curve to answer the questions.

   (a) What is the half-life of the isotope?
   _2 d_

   (b) How much of the parent isotope remains after 4 days? _20 g_

   (c) How much of the daughter isotope is present after 6 days? _70 g_

   (d) What fraction of the parent isotope remains after 8 days? _1/16_

   (e) How long does it take for the parent isotope to decay to 5 g? _8 d_

Mass of Radioisotope (g) vs. Time (days)
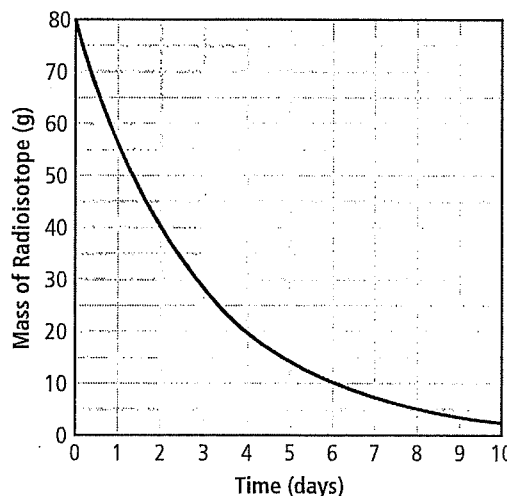
2. Use the decay curve to answer the questions.

   (a) What is the common isotope pair for this decay curve? _potassium-40 Argon-40_

   (b) What is the half-life of the parent isotope? _1.3 billion_

   (c) What does the intersection of the two lines represent? _equal amounts of daughter + parent_

   (d) What fraction of the daughter isotope is present after 5.2 billion years have passed? _15/16_

   (e) What is the ratio of parent isotope to daughter isotope after 2.6 billion years have passed? _1:3_

Isotope remaining or produced (%) vs. Elapsed Time (billion y) / Half-life

— potassium (parent)
— argon (daughter)