Solve:

1) At 23% interest per year compounded continuously, how long will it take for an initial investment of \$300 to become \$700?

$A = Pe^{rt}$

$700 = 300e^{.23t}$

$\frac{7}{3} = e^{.23t}$

$\ln\left(\frac{7}{3}\right) = \ln e^{.23t}$

$\ln\left(\frac{7}{3}\right) = .23t$

$t = \frac{\ln\left(\frac{7}{3}\right)}{.23} = \boxed{3.7 \text{ years}}$

2) If \$300 is borrowed at 10% interest, find the amount due at the end of 4 years if the interest is compounded continuously.

$A = 300 \cdot e^{.10 \cdot 4}$

$= \boxed{\$447.55}$

3) A bacteria culture initally contains 100 members and grows at a rate proportional to its size. One month later, it contains 700 members. Find the number of bacteria after 2 months.

$700 = 100e^{k \cdot 1}$

$7 = e^{k}$

$\ln 7 = k$

$k = 1.946$

$y = 100e^{1.946 \cdot 2}$

$= \boxed{4,900.881}$

4) The half life of Roentgenium is 10 minutes. We began with a 1100 mg sample, and now we have a 100 mg sample. Find the amount of time that has past.

$10 = \frac{\ln 2}{k}$

$k = \frac{\ln 2}{10} = .069$

$100 = 1,100e^{-.069t}$

$.091 = e^{-.069t}$

$\ln .091 = -.069t$

$t = \frac{\ln .091}{-.069} = \boxed{34.7 \text{ min.}}$

5) The half life of Seaborgium is 1.94 hours. Find a formula for the amount of Seaborgium left after t hours if we started with 100 mg.

$1.94 = \frac{\ln 2}{k}$

$k = \frac{\ln 2}{1.94} = .357$

$\boxed{A = 100e^{-0.357t}}$

6) The half life of Berkelium is 1379 years. If we start with 300 mg, find the amount that will be left after 5 years.

$1379 = \frac{\ln 2}{k}$

$k = \frac{\ln 2}{1379} = .000503$

$A = 300e^{-.000503 \cdot 5}$

$= \boxed{299.246 \text{ mg}}$

7) The half life of Darmstadtium is 4 minutes. We began with a 1100 mg sample, and now we have a 400 mg sample. Find the amount of time that has past.

$4 = \frac{\ln 2}{k}$

$k = \frac{\ln 2}{4} = .173$

$400 = 1100e^{-.173t}$

$.364 = e^{-.173t}$

$\ln .364 = -.173t$

$t = \frac{\ln .364}{-.173} = \boxed{5.8 \text{ min.}}$