6.1.4. Assume that each female rabbit of a colony gives birth to three female rabbits. How many female rabbits of the tenth generation will be descendants of a single rabbit of the first generation?

6.1.5. In a tracer method the potassium isotope $^{42}K$ is used for labeling. The half-life of $^{42}K$ is 12.5 h. If $N_0$ is the original number of atoms, how many are expected to remain after the elapse of two days and two hours? How many hours will it take until only $(1/1024)\,N_0$ atoms remain?

6.1.6. A female moth *(Tinea pellionella)* lays nearly 150 eggs. In one year there may live up to five generations. Each larva eats about 20 mg of wool. Assume that 2/3 of the eggs die and that 50% of the remaining moths are females. Estimate the amount of wool that may be destroyed by the descendants of one female within a year. (The first female belongs to the first generation.)

6.2.1. Plot the graph of the exponential function $y = a \cdot 2^x$ for the parameter values $a = 2, 0.5, -0.5$.

6.2.2. Plot the exponential function $y = q^x$ for the parameter values $q = 2, 1, 0.5$.

6.2.3. Find the increment $\Delta y = f(x+1) - f(x)$ for the exponential function $y = f(x) = aq^x$ and show that this increment is also an exponential function of $x$.

6.2.4. Modify the previous problem by defining $\Delta y = f(x+h) - f(x)$ with a given number $h$.

6.3.1. Draw graphs of the following functions and decide which of them are monotone functions and which are not:

a) $y = 3 - x$ with domain $x \in \mathbb{R}$ ,
b) $y = 4 - x^2$ with domain $-2 \leqq x \leqq +2$,
c) $y = \frac{1}{4}x^2 + x + 1$ with domain $x > -2$,
d) $y = \cos x$ with domain $0 \leqq x \leqq \pi$,
e) $y = \cos x$ with domain $-\pi/2 \leqq x \leqq \pi/2$.

6.3.2. Show that for the following functions inverse functions exist. Find the explicit expressions for these inverse functions.

a) $y = -2x + 3$ with domain $x \in \mathbb{R}$ ,
b) $y = x^2 + 2$ with domain $x \geqq 0$,
c) $y = x^2 + 2$ with domain $x \leqq 0$,
d) $y = 1/x^2$ with domain $x > 0$,
e) $y = 1 + (1/x)$ with domain $x > 0$.

6.4.1. Find the inverse functions of the following exponential functions:

a) $y=2^x$, c) $r=\frac{1}{2}\cdot 5^t$,

b) $y=a\cdot 10^x$ $(a>0)$, d) $Q=2w^x$ $(w>0)$.

What are the widest possible domains and ranges for these functions and their inverses?

6.4.2. Solve the same problem for

a) $w=(0.5)^s$, c) $y=aq^{3x}$ $(a>0,\ q>0)$,

b) $M=a(0.1)^n$ $(a>0)$, d) $z=r^{2s-3}$ $(r>0)$.

6.5.5. The world's population in 1970 is estimated to be $3.7\times 10^9$ persons. The yearly growth rate is approximately 2%. Under the assumption that the current growth rate remains constant, how large would the world's population be in the years 1980, 1990, and 2000?

6.5.6. The population of India amounted to 550 million in 1972. The annual growth rate is 2.4%. Under the assumption that the growth rate remains constant, find a) a formula to represent the population size, b) the year when India's population size will reach 860 million, that is, the presumed population size of China in 1972.

6.5.7. Nevada has the fastest growing population of all states of the USA. The population increased from 291000 in 1960 to 480000 in 1970. Assuming exponential growth, what is a) the annual percent increase, b) the doubling time?

6.5.8. In Western Europe 25% of the required energy was supplied by derivatives of mineral oil in 1950. This proportion increased to 70% on 1970. Assuming exponential growth, what is the factor $q$ of annual increase?

6.5.9. The outcome of a certain experiment with mice is expected to be age dependent. A first group of mice is three weeks old, a second group five weeks old. What are the ages of two more groups, if a geometric sequence of ages is required?

6.5.10. Same situation as in the previous problem. This time only three groups of experimental mice are planned. The youngest group is three weeks old, the oldest 10 weeks old. What age is desirable for the middle group?

6.5.11. To test the content of vitamin A in carrots, pieces of this vegetable are fed to vitamin A deficient rats. The dose levels are arranged in a geometric sequence. If 20 g and 50 g are the first two doses of the sequence, how does the sequence continue?