4. Logarithmic and general transformations

4.1. Logarithmic-transformations, logarithmic plots

PROBLEM 1

Mark the folowing points in logarithmic, double-logarithmic and loglinear coordinate systems, if possible.

- {0,2},{0.5,0.2},{0.5,1.5},{2.2,10},{3.5,15},
- {1,1.5},{0,0.5},{0.6,5.5},{1.5,10},{3,1}
- {0.1,1},{0.5,0.2},{0.5,3},{1.2,12},{3,24}.
- {0,2},{0.5,0.2},{0.5,1.5},{2.2,10},{3.5,15},
- {1,1.5},{0,0.5},{0.6,5.5},{1.5,10},{3,1},
- {0.1,1},{0.5,0.2},{0.5,3},{1.2,12},{3,24}.

PROBLEM 2

Transform either the x or y to straighten the graph of the following functions and plot it in an appropriate logarithmic system.

a) $y = 3^{2x-1}$ b) $y = e^{-2x+2}$ c) $y = 0{,}5 \cdot 4^x$ d) $y = 3 - 3 \cdot \lg x$ e) $y = 0{,}5 \cdot x^{2,5}$

PROBLEM 3

Transform y and plot it in a logarithmic system.

a) $y = 3^{x^2-1}$ b) $y = 2^{\sin x+1}$ c) $y = 10^{1-\cos x}$ d) $y = \exp(2^x-1)$ e) $y = e^{-\operatorname{ctg} x}$

PROBLEM 4

Use logarithmic transformation for x and/or y to straighten the following function, and plot it in an appropriate logarithmic system.

a) $y = 3^{2x-1}$ b) $y = e^{-2x+2}$ c) $y = 0{,}5 \cdot 4^x$ d) $y = 3 - 3 \cdot \lg x$ e) $y = 0{,}5 \cdot x^{2,5}$

PROBLEM 5

Transform y and plot it in a logarithmic system.

a) $y = 3^{x^2-1}$ b) $y = 2^{\sin x+1}$ c) $y = 10^{1-\cos x}$ d) $y = \exp(2^x-1)$ e) $y = e^{-\operatorname{ctg} x}$

PROBLEM 6

Transform either the x or y to straighten the graph of the following functions and plot it in an appropriate logarithmic system. Mark the given points in the same system.

a) $y = 2^{-0,5x-2}$, $(x;y)$: $(0;1)$, $(1;0,25)$, $(2;2)$, $(-1;4)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;0,4)$

b) $y = 10^{x-3}$, $(x;y)$: $(0;1)$, $(1;0,1)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

c) $y = 3^{2x-1}$, $(x;y)$: $(0;1)$, $(1;0,1)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

d) $y = e^{-2x+2}$, $(x;y)$: $(0;1)$, $(1;0,3)$, $(2;e)$, $(-2;1/e^2)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

e) $y = 3 - 3 \cdot \lg x$, $(x;y)$: $(0;1)$, $(1;0,1)$, $(2;2)$, $(-2;100)$, $(-3, -e)$, $(0;0)$, $(-1;3)$, $(4;4)$

f) $y = \log_2 x^3$, $(x;y)$: $(0;1)$, $(1;0,1)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

g) $y = 0,5 \cdot x^{2,5}$, $(x;y)$: $(0;1)$, $(1;0,5)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

h) $y = \dfrac{e}{x^2}$, $(x;y)$: $(0;1)$, $(1;0,2)$, $(2;e)$, $(-2;1/e^2)$, $(3, -e)$, $(0;0)$, $(-1;3)$, $(4;4)$

PROBLEM 7

Transform either the y to straighten the graph of the following functions and plot it in an appropriate logarithmic system. Mark the given points in the same system.

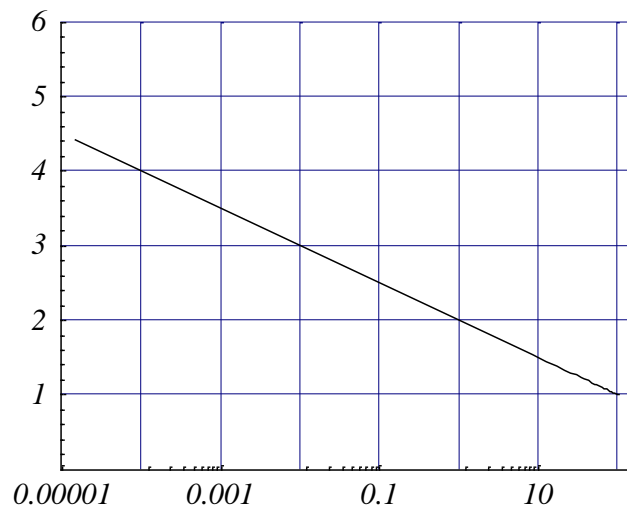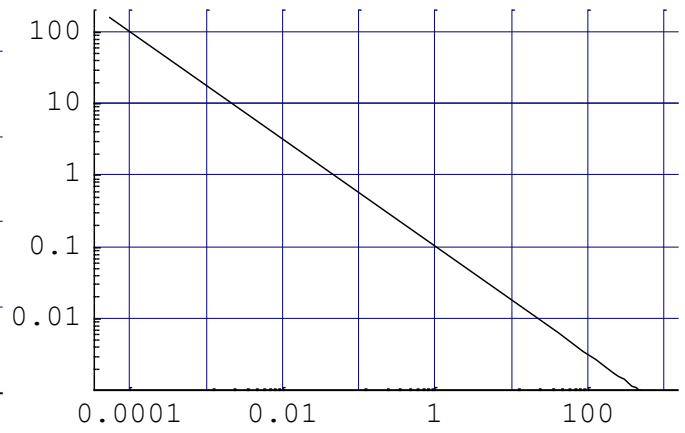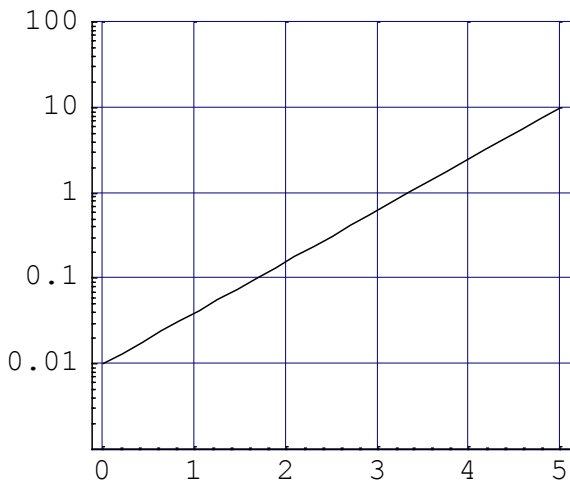a) $y = 3^{x^2-1}$, $(x;y)$: $(0;1)$, $(1;0,01)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$
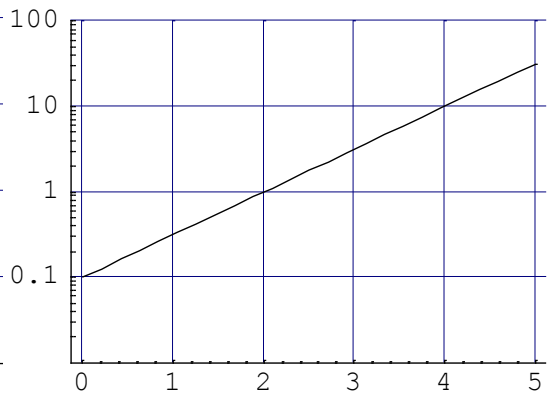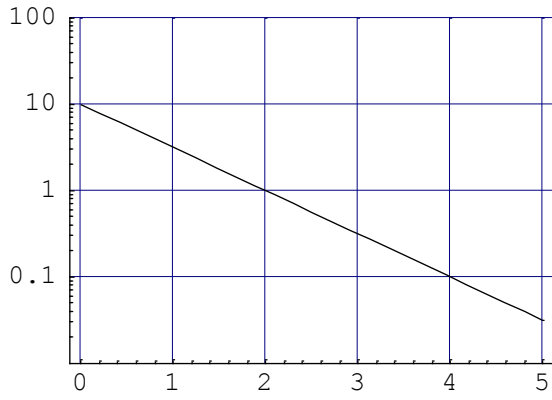
b) $y = 2^{\sin x+1}$, $(x;y)$: $(0;1)$, $(1;0,5)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

c) $y = 10^{1-\cos x}$, $(x;y)$: $(0;1)$, $(1;0,01)$, $(2;2)$, $(-2;100)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

d) $y = \exp(2^x-1)$, $(x;y)$: $(0;1)$, $(1;0,01)$, $(2;e)$, $(-2;1/e^2)$, $(3, -10)$, $(0;0)$, $(-1;3)$, $(4;4)$

PROBLEM 8

Find the formula for the following functions:

4.2. General nonlinear transformations

PROBLEM 9

Plot the following function:

$f(x):=|(x-1)(x-2)|$

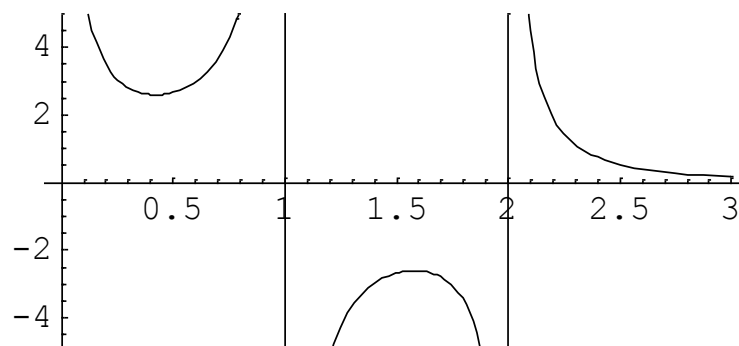### PROBLEM 10

Plot the absolute value of the following function:
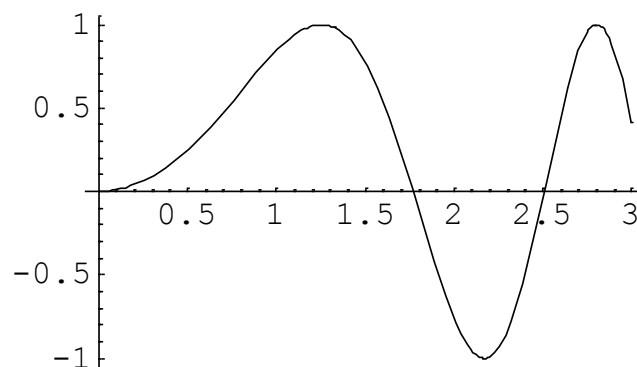
$g(\mathbf{x}\_) := \log_2(x);$

$g(x\_):=(x+2)(x-1)(x-3);$

$g(x\_):=\sin(x);$

$g(x\_):=\tan(x);$

$g(\mathbf{x}\_) := \dfrac{x-1}{x-2};$

PROBLEM 11

Plot the following function:

$f(\mathbf{x}\_) := \dfrac{1}{(x-1)(x-2)^2(x-3)}$

PROBLEM 12

Plot $1/f(x)$ for the following functions:

$$f(\text{x\_}) := x^3 - 1; \quad g(\text{x\_}) := \log_{\frac{1}{2}}(x);$$

$$f(\text{x\_}) := 2^{(x+1)}; \quad g(\text{x\_}) := (1 - x^2)(x - 2);$$

$$f(\text{x\_}) := x^2 \cos(x); \quad g(\text{x\_}) := \sin(x);$$

PROBLEM 13

Plot the following functions:

$$f(\text{x\_}) := \sin\left(\frac{1}{x}\right);$$

$$f(\text{x\_}):=\tan(x); \quad g(\text{x\_}):=\cos(3\ x);$$

$$f(\text{x\_}) := \cos\left(\frac{1}{x}\right); \quad g(\text{x\_}) := x^3 - 1;$$

$$f(\text{x\_}) := \sqrt{x} + 3; \quad g(\text{x\_}) := \sqrt[3]{x - 1};$$

$$f(\text{x\_}) := \log_3(x); \quad g(\text{x\_}) := \log_3(-x);$$

$$f(\text{x\_}) := 2^{-x}; \quad g(\text{x\_}) := 2^x;$$

PROBLEM 14

Plot the graph of $f(|x|)$, $f(1/x)$ and $f(x)^2$, if the graph of $f(x)$ is:

y

x

-1.5 -1 -0.5 0.5 1 1.5

1
0.5
-0.5
-1

1.5
1
0.5
-0.5
-1

-6 -4 -2 2 4 6

1
0.5
-0.5
-1
-1.5
-2

-6 -4 -2 2 4 6

1.2
1
0.8
0.6
0.4
0.2

-4 -2 2 4