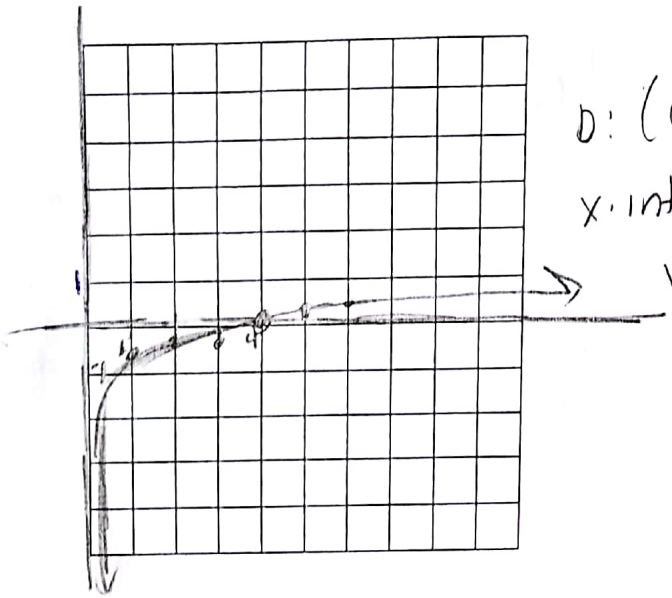
7) Sketch the graph of $f(x) = \log\left(\frac{x}{4}\right)$. Identify the domain, x-intercept, and vertical asymptote.

Base 10

x	0	1	3	4	5	7
f(x)	undef	-0.6021	-0.1249	0	0.0969	0.2430

$\log 0$ $\log\frac{1}{4}$ $\log\frac{3}{4}$ $\log 1$ $\log\frac{5}{4}$ $\log\frac{7}{4}$



D: $(0, \infty)$

x-intercept $(4, 0)$

V.A. $x = 0$

8) Describe the graph as a transformation of the graph of $f(x) = \log_3 x$

State the domain and vertical asymptote.

a) $g(x) = \log_3 x - 3$

- Shift $f(x)$ down 3
- Domain $(0, \infty)$ $x > 0$
- VA $x = 0$

x.int $0 = \log_3 x - 3$

$3 = \log_3 x$

$3^3 = x$ $x = 27$ $(27, 0)$

b) $h(x) = \log_3(x+2)$

- Shift left 2
- Domain $(-2, \infty)$

$x + 2 > 0$

$x > -2$

- VA $x = -2$

x.int $0 = \log_3(x+2)$

$3^0 = x + 2$

$1 = x + 2$ $x = -1$ $(-1, 0)$

on 3.3 Logarithmic Functions and their Graphs

ıe Natural Logarithmic Function

$\ln = \log_e$

The function defined by $f(x) = \log_e x = \ln x, x > 0$ is called the natural logarithmic function.

Inverses: $f(x) = e^x$ and $g(x) = \ln x$

Use a calculator to evaluate the function given by $f(x) = \ln(x) + 1$ for each value of x to four decimal places.

a) x=73.25 b) x=0.4 c) x=-2 d) x= $2+\sqrt{3}$

$\ln(73.25)+1$ $\ln(0.4)+1$ $\ln(-2)+1$ $\ln(2+\sqrt{3})+1$

5.2939 0.0837 not poss. 2.317

Properties of Natural Logarithms

1. $\ln 1 = 0$ because $e^0 = 1$
2. $\ln e = 1$ because $e^1 = e$
3. $\ln e^x = x$ and $e^{\ln x} = x$ (inverse property)
4. If $\ln x = \ln y$ then x=y (one to one property)

9) Use the properties of natural logarithms to simplify each expression.

a) $\ln e^{1/2}$ INV prop $\frac{1}{2}$ $e^? = e^{1/2}$

b) $e^{\ln 8}$ = INV prop 8

c) $15\ln 1$ 15, 0

d) $\frac{\ln e}{6}$ $\frac{1}{6}$

e) $\ln \sqrt[9]{e^5}$ $\ln e^{5/9}$ $\frac{5}{9}$

10) Find the domain of each function.

a) $f(x) = \ln(x+5)$ $x+5 > 0$ $x > -5$ $(-5, \infty)$

b) $f(x) = \ln(3-x)$ $3-x > 0$ $-x > -3$ $x < 3$ $(-\infty, 3)$

c) $f(x) = \ln x^3$ $x^3 > 0$ $x > 0$ $(0, \infty)$

11) Students in a mathematics class were given an exam and then retested monthly with an equivalent exam. The average scores for the class are given by the human memory model $f(t) = 78 - 17\log(t+1), 0 \le t \le 12$, where t is time in months.

a) What was the average score on the original exam (t=0)? $f(0) = 78\%$

b) What was the average score after 3 months? $f(3) = 67.76\%$

c) What was the average score after 11 months? $f(11) = 59.65\%$