3.1 (day 1) p. 261 1–10, 15–23(odd), 25–34

#1 Not exponential, $y = x^8$ is a monomial function

#2 Exponential, $y = 3^x$, x is in the exponent spot
initial value is 1 w/ a base of 3 $y = ab^x$

#3 Exponential, $y = 5^x$, x is in the exponent spot
initial value is 1 and base is 5

#4 Not exponential, it's a constant function

#5 Not exponential,

#6 Not exponential

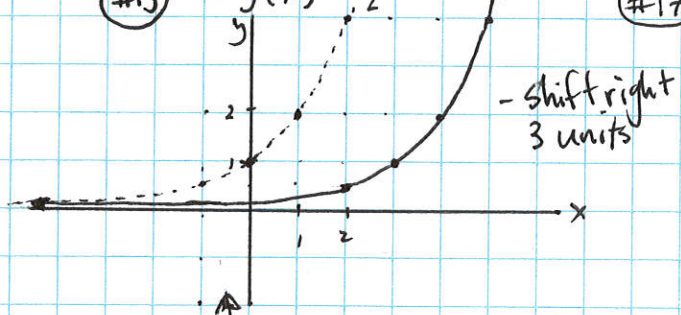
#7 $f(x) = (3)(5^x) = (3)(5^0) = 3(1) = \boxed{3}$

#8 $f(x) = 6(3^x) = 6(3^{-2}) = 6\left(\frac{1}{3^2}\right) = 6\left(\frac{1}{9}\right) = \frac{6}{9} = \boxed{\frac{2}{3}}$

#9 $f(x) = -2(3^x) = -2\left(3^{\frac{1}{3}}\right) = \boxed{-2\sqrt[3]{3}}$

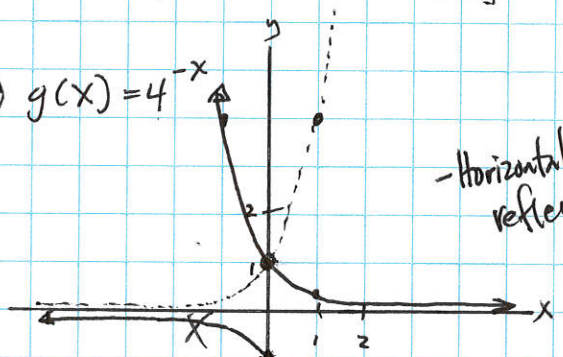
#10 $f(x) = 8(4^x) = 8\left(4^{-\frac{3}{2}}\right) = 8\left(\frac{1}{4^{\frac{3}{2}}}\right) = \frac{8}{\sqrt[2]{4^3}} = \frac{8}{2^3} = \frac{8}{8} = \boxed{1}$

#15 $g(x) = 2^{x-3}$



- shift right 3 units

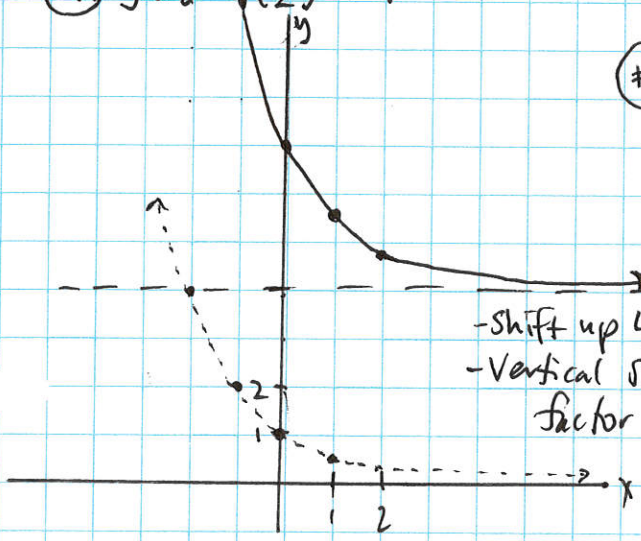
#17 $g(x) = 4^{-x}$



- Horizontal reflection

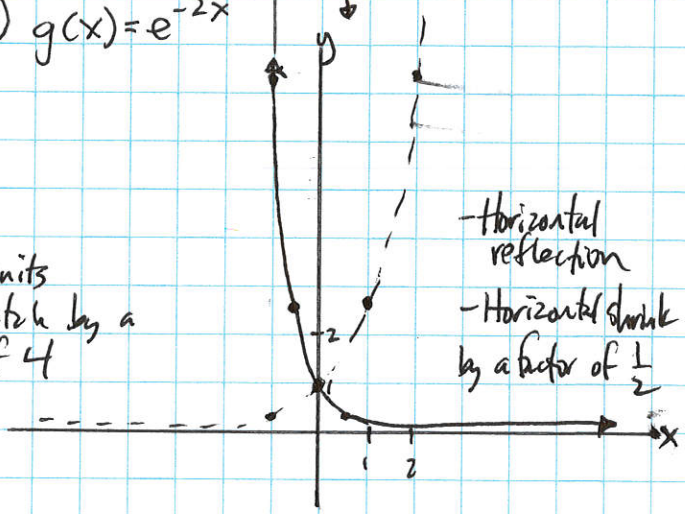
oops wrong!

#19 $g(x) = 3\left(\frac{1}{2}\right)^x + 4$



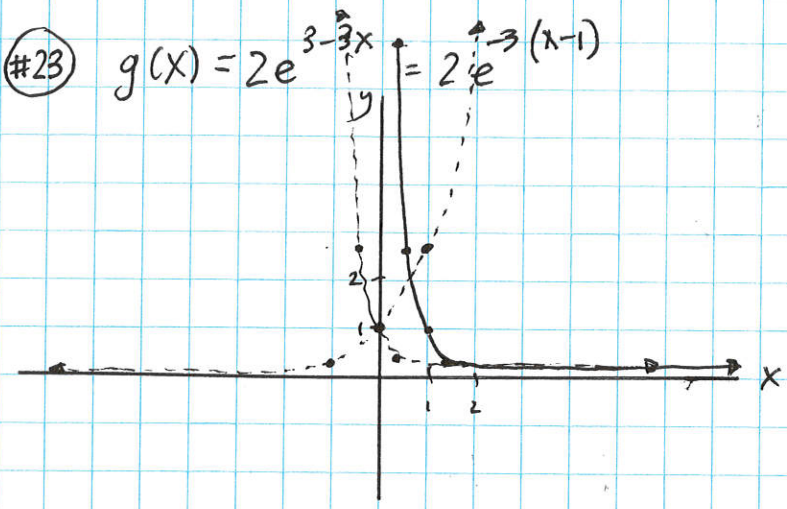
- shift up 4 units
- Vertical stretch by a factor of 4

#21 $g(x) = e^{-2x}$



- Horizontal reflection
- Horizontal shrink by a factor of $\frac{1}{2}$

#23 $g(x) = 2e^{3-3x} = 2e^{-3(x-1)}$



#25 $y = 3^x$ matches a initial value of 1 Base of 3

#26 $y = 2^{-x}$ matches d horizontal reflection

#27 $y = -2^x$ matches c vertical reflection

#28 $y = -(\frac{1}{2})^x$ matches e Decay but vertical reflection

#29 $y = 3^{-x} - 2$ matches ~~b~~ b ~~vertical~~ Horizontal reflection and shift down

#30 $y = 1.5^x - 2$ matches f growth base w/ a shift down.

#31 $f(x) = 3^{-2x}$

exponential decay $\lim_{x\to\infty} f(x) = 0$ $\lim_{x\to-\infty} f(x) = \infty$

#32 $f(x) = \left(\frac{1}{e}\right)^x$

exponential decay $\lim_{x\to\infty} f(x) = 0$ $\lim_{x\to-\infty} f(x) = \infty$

#33 $f(x) = 0.5^x$

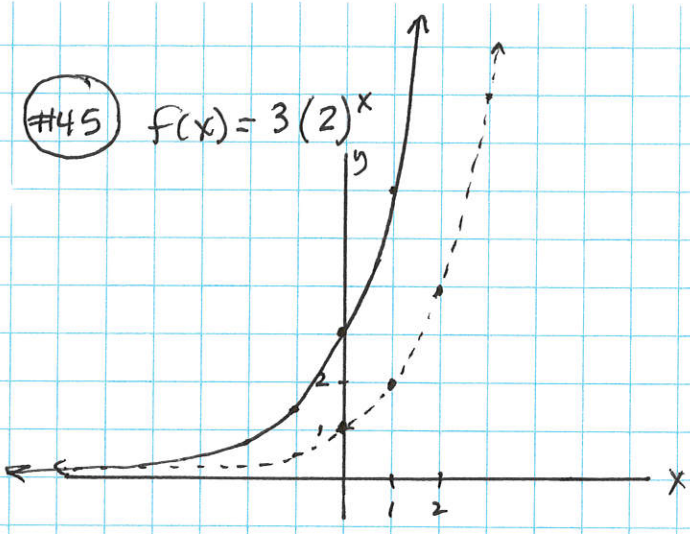
exponential decay $\lim_{x\to\infty} f(x) = 0$ $\lim_{x\to-\infty} f(x) = \infty$

#34 $f(x) = 0.75^{-x}$

exponential growth $\lim_{x\to\infty} f(x) = \infty$ $\lim_{x\to-\infty} f(x) = 0$

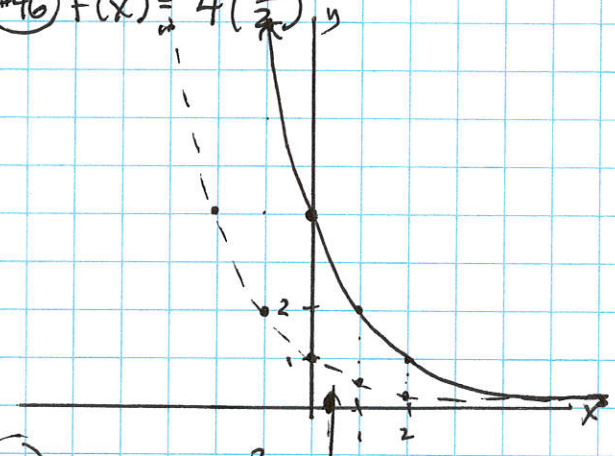
3.1 (day 2) p. 262 45-48, 57-58, 61-64

#45 $f(x) = 3(2)^x$



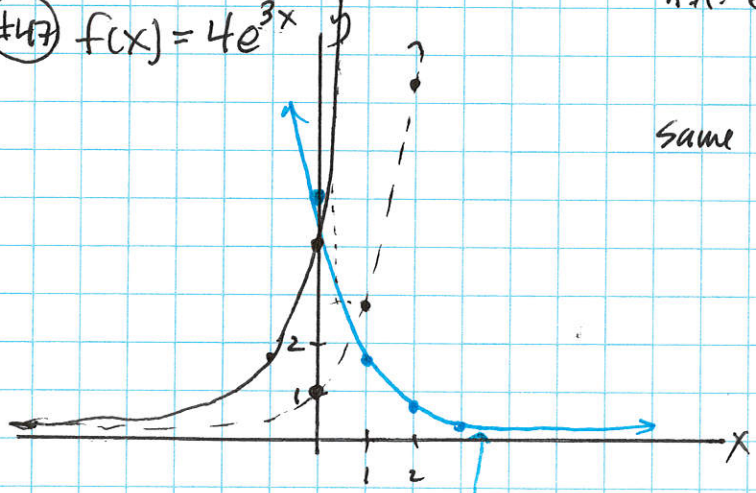
D: $(-\infty, \infty)$
R: $(0, \infty)$
Continuous
$f(x)$ increases on $(-\infty, \infty)$
No Symmetry
Bounded Below
No extrema
H.A. @ $y = 0$
$\lim_{x \to -\infty} f(x) = 0$ $\lim_{x \to \infty} f(x) = \infty$

#46 $f(x) = 4\left(\frac{1}{2}\right)^x$



D: $(-\infty, \infty)$
R: $(0, \infty)$
Continuous
$f(x)$ decreases on $(-\infty, \infty)$
No symmetry
Bounded below
No extrema
H.A. @ $y = 0$
$\lim_{x \to -\infty} f(x) = \infty$ $\lim_{x \to \infty} f(x) = 0$

#47 $f(x) = 4e^{3x}$



Same as #45

#48 $f(x) = 5(e^{-x})$

Same as #46

#57 $B = 100e^{0.693t}$

a) 100 is the initial amount of bacteria

b) $B = 100e^{0.693(6)} = 6394.351$

#58 $C = 20e^{-0.0001216t}$

a) 20 grams

b) $C = 20e^{-0.0001216(10,400)} = 5.647$ grams

$10 = 20e^{-0.0001216x} = 5700.224$ years

graph $y_1 = 20e^{-0.0001216x}$
in calc $y_2 = 10$
use intersect

#61 E

#62 C

#63 A

#64 B

3.2 (day 1) p. 270 2-14 even

#2 Exponential growth
growth rate 1.8%

#4 Exponential Decay
~~growth~~ decay rate .32%

#6 Exponential Decay
decay rate 95%

#8 $f(x) = 52(1.023)^x$

#10 $f(x) = 5(1 - .0059)^x$
$f(x) = 5(.9941)^x$

#12 $f(x) = 502{,}000(1.017)^x$

#14 $f(x) = 15(1 - .046)^x$
$f(x) = 15(.954)^x$

3.2 (day 2) p. 271 29-32, 39, 53-56

#29 ~~f(x) =~~
$P(t) = 736{,}000(1 + 0.0149)^t$
$P(t) = 736{,}000(1.0149)^t$
$1{,}000{,}000 = 736{,}000(1.0149)^t$
$y_1 = 1{,}000{,}000$
$y_2 = 736{,}000(1.0149)^t$
Graph in calculator look for intersect

In 2021

#30 $P(t) = 478{,}000(1 + 0.0628)^t$
$1{,}000{,}000 = 478{,}000(1.0628)^t$
$y_1 = 1{,}000{,}000$
$y_2 = 478{,}000(1.0628)^t$
Graph in calculator look for intersect

In 2012

#31 $P(t) = 6250(1.0275)^t$ ← is $t=0$

In 1915 → $1915 - 1890 = 25 = t$ since 1890

$P(25) = 6250(1.0275)^{25} = 12314$ people

a) In 1940 → $1940 - 1890 = 50 = t$ since 1890

$P(50) = 6250(1.0275)^{50} = 24264$ people

b) $50{,}000 = 6250(1.0275)^t$

$y_1 = 50{,}000$

$y_2 = 6250(1.0275)^t$

graph using calculator and 2ND TRACE FOR INTERSECT

50,000 people in 1966

#32 $P(t) = 4200(1.0225)^t$ ← is $t=0$

In 1930 → $1930 - 1910 = 20 = t$ since 1910

$P(20) = 4200(1.0225)^{20} = 6554$ people

a) In 1945 → $1945 - 1910 = 35 = t$ since 1910

$P(35) = 4200(1.0225)^{35} = 9150$ people

b) $20{,}000 = 4200(1.0225)^t$

$y = 20{,}000$

$y_2' = 4200(1.0225)^t$

20,000 people in 1980 ish

#39 $B = 100e^{0.693t}$

When (looking for t) will bacteria be 200?

$200 = 100e^{0.693t}$

$y_1 = 200$

$y_2 = 100e^{0.693t}$

$t = 1$ hour

In 1 hour the bacteria will double and every hour after

#53 C

#54 B $1 - .834 = .166 = 16.6\%$

#55 D $P(t) = 1(2)^{\frac{t}{4}}$ ← every 4 days $1000 = 2^{\frac{t}{4}}$ $t = 40$ days ish

or do $P(t) = 1(2)^t$ and remember t = a 4 day time period

#56 E $S(8) = \frac{789}{1 + 16 \cdot e^{-.08(8)}} = 769$

NON Calculator!

3.3 (day 1) p. 281 2-32(even)

(#2) $\log_6 1 = \boxed{0}$ remember $6^? = 1$

Think about exponential form!

$\log_b x = y \iff b^y = x$

(#4) $\log_3 81 = \boxed{4}$ $3^? = 81$

(#6) $\log_6 \frac{1}{\sqrt[5]{36}} =$ first $= \frac{1}{\sqrt[5]{36}} = \frac{1}{36^{\frac{1}{5}}} = 36^{-\frac{1}{5}} = (6^2)^{-\frac{1}{5}} = 6^{-\frac{2}{5}}$

So... $\log_6 6^{-\frac{2}{5}} = \boxed{-\frac{2}{5}}$ $6^? = 6^{-\frac{2}{5}}$

(#8) $\log_{10} 10{,}000 = \log 10^4 = \boxed{4}$ $10^? = 10^4$

(#10) $\log_{10} 10^{-4} = \boxed{-4}$ $10^? = 10^{-4}$

(#12) $\log \frac{1}{\sqrt{1000}} =$ first $\frac{1}{\sqrt{1000}} = \frac{1}{1000^{\frac{1}{2}}} = \frac{1}{(10^3)^{\frac{1}{2}}} = \frac{1}{10^{\frac{3}{2}}} = 10^{-\frac{3}{2}}$

So... $\log 10^{-\frac{3}{2}} = \boxed{-\frac{3}{2}}$ $10^? = 10^{-\frac{3}{2}}$

(#14) $\ln e^{-4} = \boxed{-4}$

remember $\ln e = \log_e e$ So this is like asking $\log_e e^{-4} =$

$e^? = e^{-4}$

(#16) $\ln 1 = \boxed{0}$

$e^? = 1$

(#18) $\ln \frac{1}{\sqrt{e^7}} =$ first $\frac{1}{\sqrt{e^7}} = \frac{1}{e^{\frac{7}{2}}} = e^{-\frac{7}{2}}$

So... $\ln e^{-\frac{7}{2}} = -\frac{7}{2}$ $e^? = e^{-\frac{7}{2}}$

#20 $5^{\log_5 8} = 8$ base of exp = base of log

#22 $10^{\log 14} = 14$ base 10

#24 $e^{\ln(\frac{1}{5})} = \frac{1}{5}$ base e

#26 $\log 0.908 = -0.042$ calculator

#28 $\log(-5.14) =$ Undefined can't do! Domain Restriction!

#30 $\ln(0.733) = -0.311$

#32 $\ln(-3.3) =$ Undefined can't do! Domain Restriction!

3.3 (day 2) p. 281 33-40, 41, 42, 45, 53-55

#33 $\log x = 2$
$10^2 = x = 100$

#34 $\log x = 4$
$10^4 = x = 10{,}000$

#35 $\log x = -1$
$10^{-1} = x = \frac{1}{10}$

#36 $\log x = -3$
$10^{-3} = x = \frac{1}{1000}$

#37 $f(x) = \log(1-x) = \log(-x+1)$
$= \log(-(x-1))$
horizontal reflection
shift right 1 unit
D

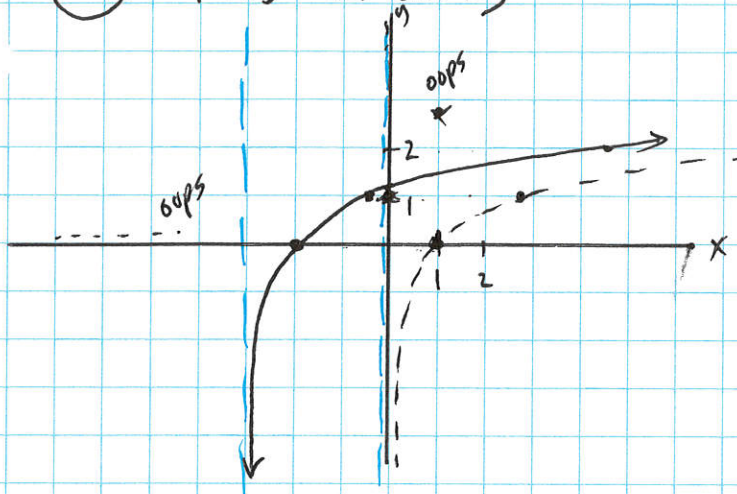
#38 $f(x) = \log(x+1)$
shift left 1 unit
B

#39 $f(x) = -\ln(x-3)$
Vertical reflection
shift right 3 units
A

#40 $f(x) = -\ln(4-x) = -\ln(-x+4)$
$= -\ln(-(x-4))$
vertical reflection
horizontal reflection
shift right 4 units
C

CONSIDER EACH! NEVER USE PROCESS OF ELIMINATION in HW

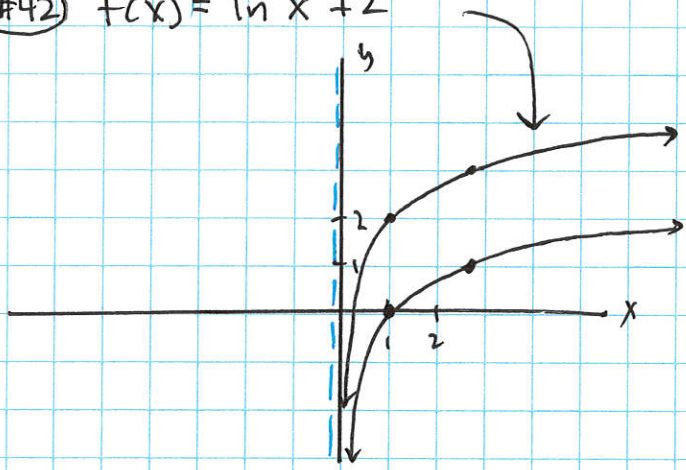
#41 $f(x) = \ln(x+3)$



parent function

* Shift left 3 units

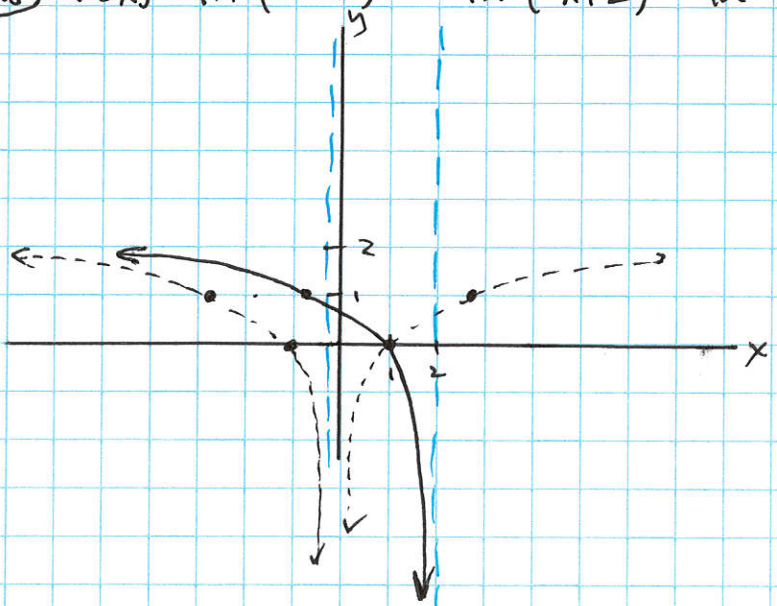
#42 $f(x) = \ln x + 2$



parent function
Should be dotted, oops.

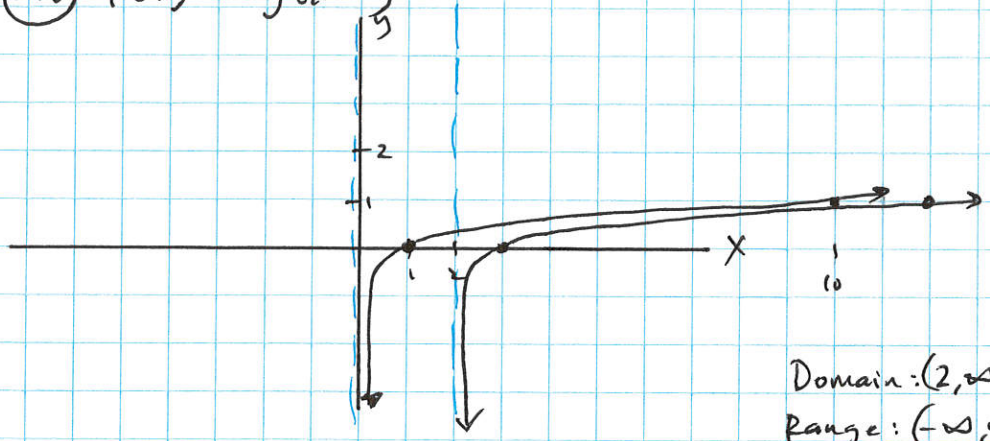
* Shift up 2 units

#45 $f(x) = \ln(2-x) = \ln(-x+2) = \ln(-(x-2))$



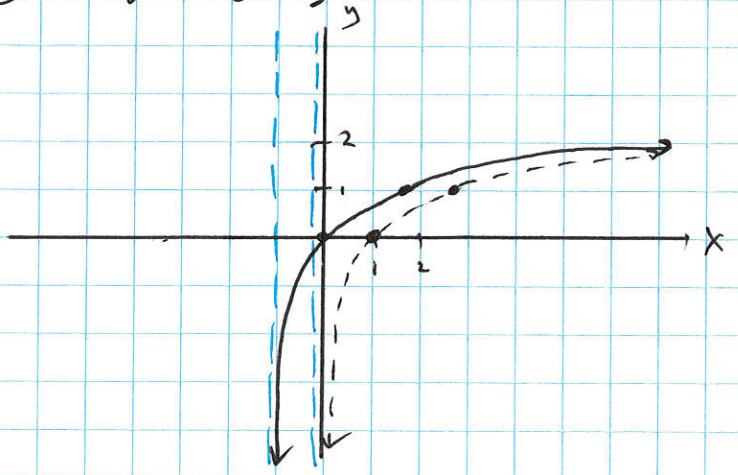
* horizontal reflection
* Shift right 2 units

#53 $f(x) = \log(x-2)$



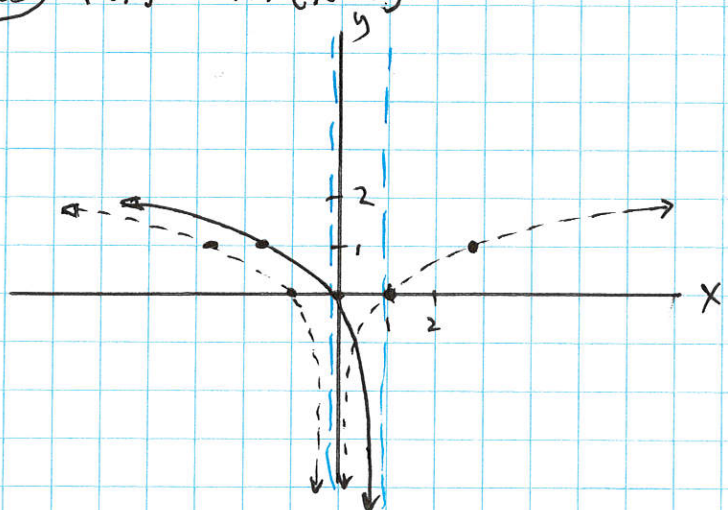
Domain: $(2, \infty)$
Range: $(-\infty, \infty)$
Continuous on its domain
Increasing on $(2, \infty)$
Not bounded
No extrema
V.A. @ $x = 2$ $\lim_{x \to \infty} f(x) = \infty$

#54 $f(x) = \ln(x+1)$



D: $(-1, \infty)$
R: $(-\infty, \infty)$
Continuous on its domain
Increasing on $(-1, \infty)$
Not bounded
No extrema
V.A. @ $x = -1$ $\lim_{x \to \infty} f(x) = \infty$

#55 $f(x) = -\ln(x-1)$



D: $(-\infty, 1)$
R: $(-\infty, \infty)$
Continuous on its domain
decreasing on $(-\infty, 1)$
Not bounded
No extrema
V.A. @ $x = 1$
$\lim_{x \to -\infty} f(x) = \infty$

3.4 (day1) p. 289 1-22, 59-62

#1 $\ln 8x = \ln 8 + \ln x$
$= 3\ln 2 + \ln x$

#2 $\ln 9y = \ln 9 + \ln y$
$= 2\ln 3 + \ln y$

#3 $\log \frac{3}{x} = \log 3 - \log x$

#4 $\log \frac{2}{y} = \log 2 - \log y$

#5 $\log_2 y^5 = 5\log_2 y$

#6 $\log_2 x^{-2} = -2\log_2 x$

#7 $\log x^3y^2 = \log x^3 + \log y^2$
$= 3\log x + 2\log y$

#8 $\log xy^3 = \log x + \log y^3$
$= \log x + 3\log y$

#9 $\ln \frac{x^2}{y^3} = \ln x^2 - \ln y^3$
$= 2\ln x - 3\ln y$

#10 $\log 1000x^4 = \log 1000 + \log x^4$
$= \log 10^3 + 4\log x$
$= 3 + 4\log x$

#11 $\log \sqrt[4]{\frac{x}{y}} = \log \frac{x^{\frac{1}{4}}}{y^{\frac{1}{4}}}$
$= \log x^{\frac{1}{4}} - \log y^{\frac{1}{4}}$
$= \frac{1}{4}\log x - \frac{1}{4}\log y$

#12 $\ln \frac{x^{\frac{1}{3}}}{y^{\frac{1}{3}}} = \ln x^{\frac{1}{3}} - \ln y^{\frac{1}{3}}$
$= \frac{1}{3}\ln x - \frac{1}{3}\ln y$

#13 $\log x + \log y = \log xy$

#14 $\log x + \log 5 = \log 5x$

#15 $\ln y - \ln 3 = \ln \frac{y}{3}$

#16 $\ln x - \ln y = \ln \frac{x}{y}$

#17 $\frac{1}{3}\log x = \log x^{\frac{1}{3}}$
$= \log \sqrt[3]{x}$
$= \log \sqrt[3]{x}$

#18 $\frac{1}{5}\log z = \log z^{\frac{1}{5}}$
$= \log \sqrt[5]{z}$

#19 $2\ln x + 3\ln y =$
$\ln x^2 + \ln y^3 = \ln x^2y^3$

#20 $4\log y - \log z = \log y^4 - \log z$
$= \log \frac{y^4}{z}$

#21 $4\log xy - 3\log yz$
$= \log (xy)^4 - \log (yz)^3$
$= \log \frac{x^4y^4}{y^3z^3} = \log \frac{x^4y}{z^3}$

#22 $3\ln (x^3y) + 2\ln (yz^2)$
$= \ln (x^3y)^3 + \ln (yz^2)^2$
$= \ln \frac{x^9y^3}{y^2z^4} = \ln \frac{x^9y}{z^4}$

#59 B #60 C change of base formula #61 A #62 E

3.4 (day2) p. 289 23-28, 43-50

#23 $\log_2 7 = 2.8074$ #24 $\log_5 19 = 1.8295$ #25 $\log_8 175 = 2.4837$

#26 $\log_{12} 259 = 2.2562$ #27 $\log_{0.5} 12 = -3.5850$ #28 $\log_{0.2} 29 = -2.0922$

#43 $f(x) = \log_4(2-x)$
$= \log_4(-x+2)$
$= \log_4(-(x-2))$
B
$[-5,5]$ $[-3,3]$

#44 $f(x) = \log_6(x-3)$
C $[-2,8]$ $[-3,3]$

#45 $f(x) = \log_{0.5}(x-2)$
D $[-2,8]$ $[-3,3]$

#46 $f(x) = \log_{0.7}(3-x)$
A $[-8,4]$ $[-8,8]$

#47 D: $(0,\infty)$
R: $(-\infty,\infty)$
Continuous on its domain
Increasing on $(-\infty,\infty)$
V.A. @ $x=0$ $\lim_{x\to\infty} f(x) = \infty$

#48 D: $(0,\infty)$
R: $(-\infty,\infty)$
Continuous on its domain
decreasing on $(-\infty,\infty)$
V.A. @ $x=0$ $\lim_{x\to\infty} f(x) = -\infty$

#49 D: $(-\infty,0)\cup(0,\infty)$
R: $(-\infty,\infty)$
Discontinuity at $x=0$
$f(x)$ decreases on $(-\infty,0)$
$f(x)$ increases on $(0,\infty)$
V.A. @ $x=0$
$\lim_{x\to-\infty} f(x) = \infty$ $\lim_{x\to\infty} f(x) = \infty$

#50 D: $(0,\infty)$
R: $(-\infty,\infty)$
Continuous on its domain
Increases on $(-\infty,\infty)$
V.A. @ $x=0$
$\lim_{x\to\infty} f(x) = \infty$

3.5 (day 1) p. 301 1-17 (all)

#1 $\frac{36\left(\frac{1}{3}\right)^{\frac{x}{5}}}{36} = \frac{4}{36}$

$\left(\frac{1}{3}\right)^{\frac{x}{5}} = \frac{4}{36}$

$\left(\frac{1}{3}\right)^{\frac{x}{5}} = \frac{1}{9}$

$\left(\frac{1}{3}\right)^{\frac{x}{5}} = \left(\frac{1}{3}\right)^{2}$

$\frac{x}{5} = 2$

$\boxed{x = 10}$

#3 $\frac{2(5)^{\frac{x}{4}}}{2} = \frac{250}{2}$

$5^{\frac{x}{4}} = 125$

$5^{\frac{x}{4}} = 5^{3}$

$\frac{x}{4} = 3$

$\boxed{x = 12}$

#5 $\frac{2(10^{-\frac{x}{3}})}{2} = \frac{20}{2}$

$10^{-\frac{x}{3}} = 10$

$\frac{-x}{3} = 1$

$-x = 3$

$\boxed{x = -3}$

#7 $\log x = 4$

$10^{4} = \boxed{x = 19{,}000}$

#9 $\log_4(x-5) = -1$

$4^{-1} = x - 5$

$\frac{1}{4} = x - 5$

$+5 \quad +5$

$\frac{1}{4} + 5 = x = \boxed{5\frac{1}{4}}$

#11 $1.06^{x} = 4.1$

$\log_{1.06} 4.1 = \boxed{x = 24.2151}$

#13 $\frac{50e^{0.035x}}{50} = \frac{200}{50}$

$\ln e^{0.035x} = \ln 4$

$0.035x = \ln 4$

$x = \frac{\ln 4}{0.035}$

$\boxed{x = 39.608}$

#15 $3 + 2e^{-x} = 6$

$-3 \qquad -3$

$\frac{2e^{-x}}{2} = \frac{3}{2}$

$\ln e^{-x} = \ln \frac{3}{2}$

$-x = \ln \frac{3}{2}$

$\boxed{x = -0.405}$

#17 $3\ln(x-3)+4=5$

$-4 \quad -4$

$\frac{3\ln(x-3)}{3}=\frac{1}{3}$

$\ln(x-3)=\frac{1}{3}$

$e^{\frac{1}{3}}=x-3$

$+3 \quad +3$

$x=e^{\frac{1}{3}}+3 \approx \boxed{4.396}$

3.5 (day 2) 25-28, 35-38, 61-62

#25 $\log x^2=6$

$\pm\sqrt{10^6}=\pm\sqrt{x^2}$

$\pm 10^{\frac{6}{2}}=x$

$\pm 10^3=x \approx \boxed{\pm 1000}$

#26 $\ln x^2=4$

$\pm\sqrt{e^4}=\pm\sqrt{x^2}$

$\pm e^{\frac{4}{2}}=x$

$\boxed{\pm e^2=x}$

#27 $\log x^4=2$

$\pm\sqrt[4]{10^2}=\sqrt[4]{x^4}$

$\pm 10^{\frac{2}{4}}=x$

$\pm 10^{\frac{1}{2}}=x$

$\boxed{x=\pm\sqrt{10}}$

#28 $\ln x^6=12$

$\sqrt[6]{e^{12}}=\sqrt[6]{x^6}$

$\pm e^{\frac{12}{6}}=x$

$\boxed{\pm e^2=x}$

#35 $\frac{1}{2}\ln(x+3)-\ln x=0$

$\ln(x+3)^{\frac{1}{2}}-\ln x=0$

$\ln\frac{(x+3)^{\frac{1}{2}}}{x}=0$

$e^0=\frac{(x+3)^{\frac{1}{2}}}{x}$

$x\cdot 1=\frac{(x+3)^{\frac{1}{2}}}{x}\cdot x$

$(x)^2=\left((x+3)^{\frac{1}{2}}\right)^2$

$x^2=x+3$

$x^2-x-3=0$

~~(x-2)(x-2)~~

$x=\frac{1\pm\sqrt{1-4(1)(-3)}}{2}$

$x=\frac{1\pm\sqrt{13}}{2}$

$\boxed{x=2.303}$

$x=-1.303$ is extraneous!

#36 $\log x - \frac{1}{2}\log(x+4) = 1$

$\log x - \log (x+4)^{\frac{1}{2}} = 1$

$\log \frac{x}{(x+4)^{\frac{1}{2}}} = 1$

$10^1 = \frac{x}{(x+4)^{\frac{1}{2}}}$

$(x+4)^{\frac{1}{2}}$

$(x+4)^{\frac{1}{2}}$

$\left(10(x+4)^{\frac{1}{2}}\right)^2 = (x)^2$

$100(x+4) = x^2$

$100x + 400 = x^2$

$0 = x^2 - 100x - 400$

$x = \frac{100 \pm \sqrt{10000 - 4(1)(-400)}}{2}$

$= \frac{100 \pm \sqrt{11600}}{2}$

$x = 103.852$

$x = -3.852$ is extraneous

#37 $\ln(x-3) + \ln(x+4) = 3\ln 2$

$\ln(x-3)(x+4) = \ln 2^3$

$\ln(x^2+x-12) = \ln 8$

$x^2 + x - 12 = 8$

$x^2 + x - 20 = 0$

$(x+4)(x+5) = 0$

$x = 4$ ~~$x = -5$~~ extraneous

#38 $\log(x-2) + \log(x+5) = 2\log 3$

$\log(x-2)(x+5) = \log 3^2$

$x^2 + 3x - 10 = 9$

$x^2 + 3x - 19 = 0$

$x = \frac{-3 \pm \sqrt{9 - 4(1)(-19)}}{2}$

$x = \frac{-3 \pm \sqrt{85}}{2}$

~~$x = -3.11$~~

$x = 3.11$

$x = -6.11$ extraneous

#61 B

$2^{3x-1} = 32$

$2^{3x-1} = 2^5$

$3x - 1 = 5$

$x = 2$

#62 B

$\ln x = -1$

$e^{-1} = x$

$\frac{1}{e} = x$