1.

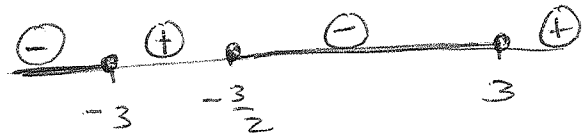
(a) $2x^3 + 3x^2 - 18x - 27 \le 0$

$x^2(2x+3) - 9(2x+3) \le 0$

$(x^2-9)(2x+3) \le 0$

$(x+3)(x-3)(2x+3) \le 0$

Zeroes: $x = -3, 3, -3/2$

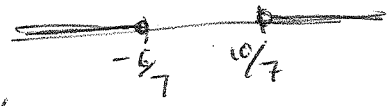


test $x = -4, -2, 0, 4$

$\boxed{(-\infty, -3] \cup [-\frac{3}{2}, 3]}$

(b) $-6|7x-2| \le -48$

$|7x-2| \ge 8$



$\boxed{(-\infty, -6/7] \cup [10/7, \infty)}$

$7x-2 \ge 8$ or ≤ -8

$x \ge 10/7$ or $x \le -6/7$

(c) $3 - 2(x-5) > 8(x-5) + 12x$

$3 - 2x + 10 > 8x - 40 + 12x$

$13 + 40 > 10x + 12x$

$53 > 22x$

$x < \frac{53}{22}$

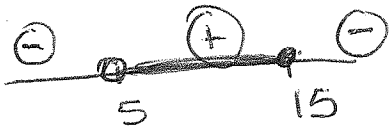
$\boxed{(-\infty, 53/22)}$

(d) $\frac{3x-5}{x-5} \ge 4$

$\frac{3x-5}{x-5} - 4 \ge 0$

$\frac{3x-5-4(x-5)}{x-5} \ge 0$

$\frac{-x+15}{x-5} \ge 0$



$\boxed{(5, 15]}$

2. (16 points) Graph the solution set to the following system of inequalities. *Algebraically find the vertices of the system and label them on your graph.*

$$\begin{cases} y > 3|x-2| - 1 \\ -x + y \le 1 \end{cases}$$

$3(x-2) - 1 = x + 1$

$3x - 6 - 1 = x + 1$

$2x = 8,\ y = 5$

$x = 4$

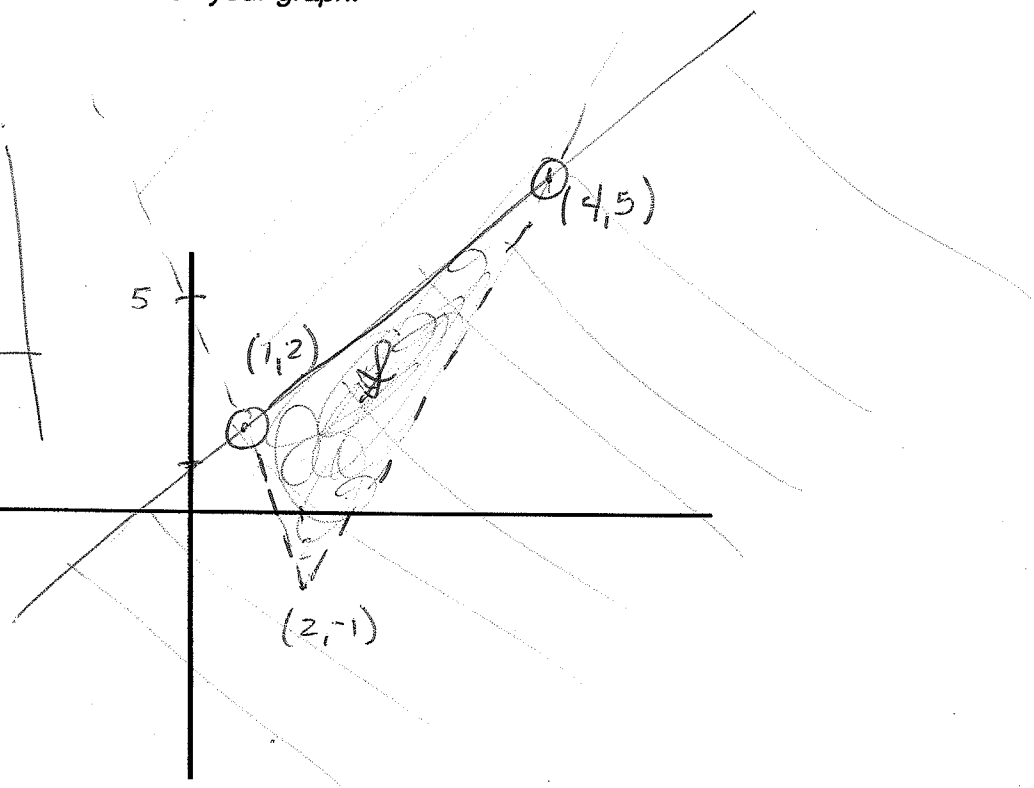
$3(-x+2) - 1 = x + 1$

$-3x + 6 - 1 = x + 1$

$-4x = -4$

$x = 1$

$y = 2$

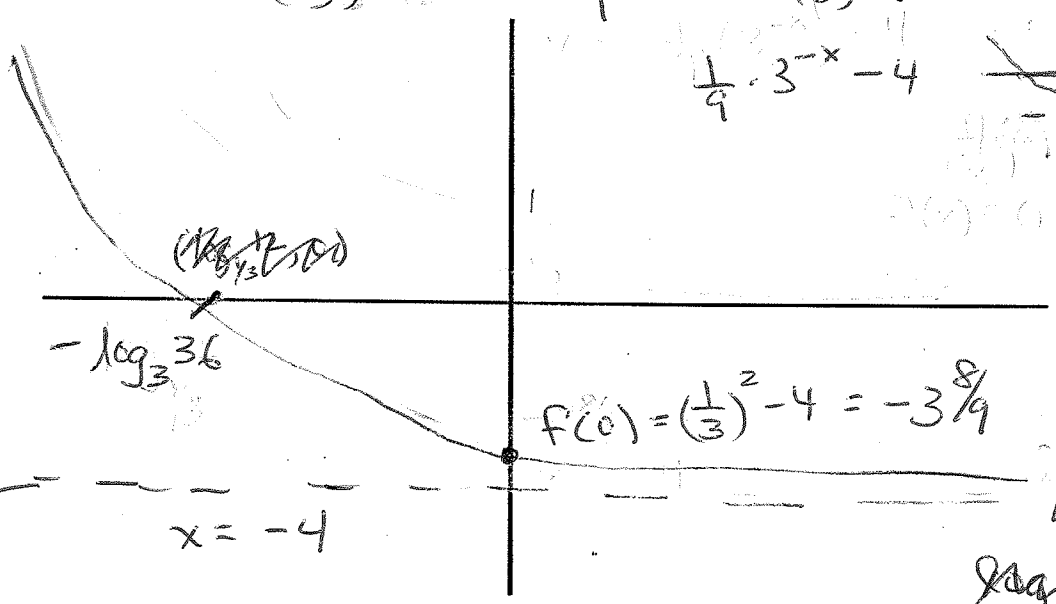


3. (8 points) Graph $f(x) = \left(\frac{1}{3}\right)^{x+2} - 4$ on the axes provided below. Label all intercepts and asymptotes.

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

$\left(\frac{1}{3}\right)^{2}\left(\frac{1}{3}\right)^{x} = \frac{1}{9} \cdot 3^{-x}$

$\frac{1}{9} \cdot 3^{-x} - 4$



$\boxed{x = -\log_3 36}$

root $\left(\frac{1}{3}\right)^{x+2} - 4 = 0$

$\frac{1}{9}\left(\frac{1}{3}\right)^{x} = 4$

$\frac{1}{3}^{x} = 36 \rightarrow 3^{-x} = 36$

$-x \log_3 3 = \log_3 36$

4. (16 points) Solve each system of equations. Express your answers as ordered pairs.

a) $\begin{cases} x = 3y + 6 & (1) \\ 3y = 14 - 9x & (2) \end{cases}$

$3y = 14 - 9(3y + 6)$

$3y + 27y = 14 - 54$

$30y = -40$

$y = -4/3$

$x = 2$ (sub into (1) or (2))

$\boxed{(2, -4/3)}$

b) $\begin{cases} 2x - 5y = 7 \\ -6x + 15y = -21 \end{cases}$

$(3)(2x - 5y) = 7(3) \rightarrow 6x - 15y = 21$

$-6x + 15y = -21$

$0 = 0$

Soln: all (x, y) satisfying either eqn. $\left(x, \frac{2x-7}{5}\right)$

c) $\begin{cases} 4x + y = 2 \\ x^3 - 2 + y = 0 \end{cases}$

$2x = 5y + 7$

$\boxed{\frac{2x-7}{5} = y}$

$y = -4x + 2$

$x^3 - 2 + (2 - 4x) = 0$

$x^3 - 4x = 0$

$x(x^2 - 4) = 0$

$x = 0, 2, -2$

$y = 2, -6, 10$

$\boxed{\begin{matrix} (0,2) \\ (2,-6) \\ (-2,10) \end{matrix}}$

5. (16 points) Evaluate each of the following expressions:

$\log_8 1 =$ 0

$\log_4\left(\frac{1}{16}\right) =$ -2

$5^{\log_5 11} =$ 11

$8^{\log_2 7} =$ 7^3

$2^{3\log_2 7} \rightarrow 2^{\log_2 7^3}$

$\log_4 128 =$ $7/2$

$4^x = 128$

$2^{2x} = 128$

$2x = 7$

$\log_{12}(144) = \log_{12} 36 + \log_{12} 4 =$ 2

$\log_3 81 = \frac{\log_7 81}{\log_7 3} =$ 4

$6 \ln e^{1/2} = 6 \ln \sqrt{e} =$ $3 \cdot 1 = 3$

$\frac{1}{2} \cdot 6 \ln e$

6. (20 points) Solve each of the following equations for x.

a) $4^{2x+3} = 32^{x-1}$

$2^{2(2x+3)} = 2^{5(x-1)}$

$4x + 6 = 5x - 5$

$11 = x$

$\boxed{x = 11}$

Chk: $4^{22+3} \overset{?}{=} 32^{11-1}$

$2^{2(25)} \overset{?}{=} 2^{5(10)}$

$2^{50} = 2^{50}$ ✓

b) $\ln(4x + 13) = 3$

$e^3 = 4x + 13$

$\frac{e^3 - 13}{4} = x$

$\boxed{x = \frac{e^3 - 13}{4}}$

c) $\log_3 x + \log_3(x - 8) = 2$

$\log_3(x^2 - 8x) = 2$

$x^2 - 8x = 3^2$

$x^2 - 8x - 9 = 0$

$(x - 9)(x + 1) = 0$

$\boxed{x = 9}$, $\cancel{-1}$

Chk: $\log_3(9) + \log_3(1) = 2$

$2 + 0 = 2$

d) $6^{x-2} = 7^x$

$\log_6 6^{x-2} = \log_6 7^x$

$x - 2 = x \log_6 7$

$x - x\log_6 7 = 2$

$x(1 - \log_6 7) = 2$

$\boxed{x = \frac{2}{1 - \log_6 7}}$