1. a. The best straight line fit found by Trendline for the Lineweaver-Burk plot with $x = 1/[S]$ and $y = 1/R([S])$ is

$$y = 23.005\,x + 0.23434.$$

Thus, the value of $1/V_{max} = 0.23434$, and the slope gives $K_m/V_{max} = 23.005$. It follows that $V_{max} = 4.2673$ and $K_m = 98.169$.

b. The method above for finding the parameters for this experiment on cytochrome P450 mediated demethylation of the substrate $[S]$ amitriptyline (AMI) to nortriptyline (N) by human liver microsomes gives a Michaelis-Menten reaction rate of

$$R([S]) = \frac{4.2673\,[S]}{98.169 + [S]}.$$

This model has $[S]$ and R-intercepts of $(0, 0)$ (as is true of all Michaelis-Menten reaction kinetic models). There is a horizontal asymptote of $R = 4.2673$, which clearly appears high from the experimental data. There are no vertical asymptotes in the domain. The sum of square errors with $V_{max} = 4.2673$ and $K_m = 98.169$ satisfies $SSE = 0.3503$. Below is a table of the data, the model prediction, and the percent error at various concentrations of [AMI]. There is a graph of this model and the one found in the next part at the end of the solutions to this problem.

[AMI] (μM)	N formation nmol/min/mg	MM Model	% Error
15	0.6	0.56561	-5.73
50	1.35	1.4400	6.67
100	2.17	2.1534	-0.77
200	2.68	2.8623	6.80
500	3.12	3.5670	14.33

c. With Excel's Solver, the best fitting parameters are $V_{max} = 3.7384$ and $K_m = 80.632$. The sum of square errors satisfies $SSE = 0.03925$. It follows that the best fitting model is given by

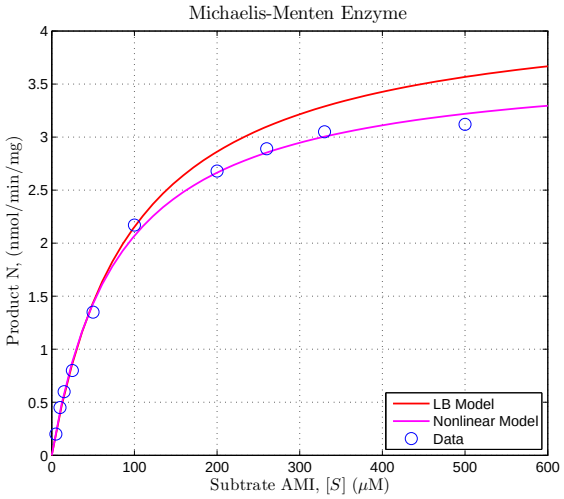
$$R([S]) = \frac{3.7384[S]}{80.632 + [S]}.$$

The percent errors for V_{max} and K_m (assuming these nonlinear ones are the best) are 14.15% and 21.75%, respectively, showing significant variation from the ones computed using the Lineweaver-Burk method.

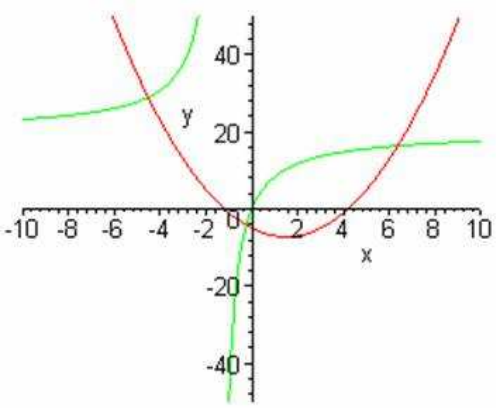
d. With the nonlinear best fit model, the $[S]$ and R-intercepts are $(0, 0)$, and there is a horizontal asymptote of $R = 3.7384$, which matches the experimental data very well. (Again there is no vertical asymptote in the domain.) Below is a table of the data, the model prediction, and the percent error at various concentrations of [AMI]. Note that these errors are better than the ones from the Lineweaver-Burk plot.

[AMI] (μM)	N formation nmol/min/mg	MM Model	% Error
15	0.6	0.5864	-2.27
50	1.35	1.4309	5.99
100	2.17	2.0696	-4.63
200	2.68	2.6643	-0.59
500	3.12	3.2193	3.18

Below is a graph of the data and the two models. Clearly the second model is better because it fits the data over the entire range much better.



Problem 1



Problem 2

2. a. Consider the functions,

$$f(x) = x^2 - 3x - 5 \qquad \text{and} \qquad g(x) = \frac{20x}{1.4 + x}.$$

For $f(x)$, the y-intercept is $(0, -5)$, and the x-intercepts are $(-1.1926, 0)$ and $(4.1926, 0)$. For $g(x)$, the x and y-intercept is $(0, 0)$. The vertex for $f(x)$ is $(1.5, -7.25)$. The function $g(x)$ has a vertical asymptote at $x = -1.4$ and a horizontal asymptote at $y = 20$.

b. There are three points of intersection as can be seen in the graph below. The three points of intersection are $(-4.5189, 28.977)$, $(-0.24347, -4.2103)$, and $(6.3624, 16.393)$.