Problem 1:

Model 4 is an autonomous, linear, non-homogeneous and first order differential equation. dAc/dt is rate of change of the account balance. R is the annual interest rate between 0 and 1. Ac stands for account balance with continuous interest rate. P is the rate of we pay off the debt.

Problem 4:

I would say this would be a very accurate model for n= 365, because the larger the n is, the closer the graph will get. If you take a look at the two graphs we included, it should be obvious that the two functions merge together. If the rate is 6.9%, it will take 107 years for the difference between model 1 and model 2 to be greater than a dollar. If the rate is 12.99%, it will take 53 years for the difference between model 1 and model 2 to be greater than a dollar. If the rate is 19.99%, it will take 33 years for the difference between model 1 and model 2 to be greater than a dollar.

Problem 5:

There are two equilibriums solution for 4, the first one is at 0, which did not give us too much information, because if you start with 0 balances, it wills just starts at 0. The second equilibrium solution is at dAc/dt=200. At that point, the payoff rate is the same as the account interest rate. See graph shown below.

Problem 6:

After you plot r=10% and P=20, the differential equation becomes a straight line. See group below. When dAc/dt<0, the debt is decreasing. When the dAc/dt>0, the debt is increasing.

Problem 7:

On the slope field, we plotted two solution curves to demonstrate if you start Ac>200, your account balance will go to infinity as t gets larger and larger. If you start Ac<200, as t gets larger and larger, you will eventually pay off your debt.

Problem 8:

Applying MATLAB to solve this first order differential equation, we obtain the solution is (P - C2\*exp(r\*t))/r. After that, we apply the Ac(0)=Ao to solve the initial value problem in MATLAB.The equation we obtained log((P - A\*r)/(P - Ao\*r))/r.

Problem 9:

In problem 9, we solve for t as a function of P. We use Ao=1,r=10% and assume that the balance is held fixed at Ac(t)=2, we obtained a weird looking graph.

Problem 12:

We think model 4 is a reasonable model; the strength of this model is there is an option that you could making payments and starts to pay off the debt. The shortcoming of this model is there is an equilibrium point in this model, so if you are paying exactly 200 dollars each year, your account balance will stick at 200 forever. The improvement I would say is increases your payment to be greater than 200 and pay it in a shorter period of time, it will help you pay off the debt sooner.

Problem 13:

In this model, you are changing the sign of the P value, which means that you increase your saving exponentially. This model will be similar to the model 4, except that our account balance will increases in saving instead of increases in debt.