Section 2.3. Modeling with first order Equations

Exercise 1. (similar to 4p60) A tank with capacity of 500gal originally contains 200 gal of water with 100 lb of salt in solution. Water containing 2 lb of salt per gallon is entering at a rate of 5 gal/min, and the mixture is allowed to flow out of the tank at a rate of 3 gal/min.

1. Find the amount of salt in the tank at any time prior to the instant when the solution begins to overflow.
2. Find the concentration (in pounds per gallon) of salt in the tank when it is on the point of overflowing.
3. Compare this concentration with the theoretical limiting concentration if the tank had infinite capacity.

Exercise 2. (20p64) A ball with mass 0.15 kg is thrown upward with an initial velocity 20m/s from the roof of a building 30m high. There is a force due to air resistance of $|v|/30$, where the velocity v is measured in m/s.

1. Find the maximum height above the ground that the ball reaches.
2. Find the time that the ball hits the ground.
3. Plot the graphs of velocity and position versus time.

Exercise 3. (8p61) A young person with no initial capital invests k dollars per year at an annual rate of return r. Assume that the investments are made continuously and that the return is compounded continuously.

1. Determine the sum $S(t)$ accumulated at time t.
2. If $r = 7.5\%$, determine k so that \$1 million will be available for retirement in 40 years.
3. If $k =$\$ 2000/year, determine the return rate r that must be obtained to have \$1 million available in 40 years.