

ODE APPLICATIONS FOR BEGINNERS

Problem 1. What are the differential equations that model these scenarios?

- (1) The acceleration $\frac{dv}{dt}$ of a supercar is proportional to the difference between 250 mph and the velocity of the car.
- (2) The time rate of change of a population P is proportional to the cube root of P .
- (3) In the city of Gossipville having a fixed population of P persons, the time rate of change of the number N of those persons who have heard a certain rumor is proportional to the number of those who have not yet heard the rumor.

Problem 2. Let $P = P(t)$ denote the population of a culture of bacteria and assume that the growth rate of the population is proportional to the population itself. If the population of the bacteria increased tenfold in 12 hours, how long did it take the population to triple?

Problem 3. A tank initially contains 100 L of brine containing 10 kg of salt. Brine with 2 kg of salt per L flows into the tank at a rate of 10 L per second and the well-mixed solution flows out at a rate of 5 L per second. Find a function $Q = Q(t)$ that describes the amount of salt in the tank at time t (from time $t = 0$ until the tank overflows).