Problem 1. The position of a car travelling along the highway t hours after leaving West Lafayette is given in miles by

$$s(t) = 3\cos(t) + 67t.$$

(i) Find the velocity function, $v(t)$.

(ii) At what rate is the car travelling one hour after departure?

(iii) At what rate is the car travelling 30 minutes after departure?

Problem 2. The population kangaroos in a certain region of Australia over time in years is given by

$$p(t) = 3t^2 + t + 60.$$

(i) What is the growth rate when $t = 5$ years?

(ii) How many kangaroos are there when the growth rate is 61 kangaroos per year?

Problem 3. A U.S. student and a Japanese student are participating in an exchange program where each visits the other's university for a semester. The formula

$$D = \frac{1}{218}(Y + 99)$$

relates the price of something in dollars D and in yen Y.

(i) What is the rate of change of D with respect to Y, in dollars per yen?

(ii) What is the rate of change of Y with respect to D, in yen per dollar?

Problem 4. (i) Find the rate of change of the volume V of a sphere with respect to its radius r.

(ii) What is the rate of change when $r = 3$?

(iii) What is the volume when the rate of change is 16π?

Problem 5. A bakery estimates that the number of cookies sold in a week and the number of pounds of chocolate used are related in such a way that

$$S(c) = -\frac{-4}{25}c^2 + 32c,$$

where $S(c)$ is the number of cookies sold and c is the number of pounds of chocolate used, $0 \leq c \leq 200$.

(i) What is the rate of change of cookies sold per pound of chocolate when only 10 pounds of chocolate are used?

(ii) How many pounds of chocolate are used when the rate of change is 24 cookies per pound of chocolate?

(iii) How many cookies are sold when the rate of change is 0 cookies per pound of chocolate?