1. Ch 6, Problem 6.1

A firm uses the inputs of fertilizer, labor, and hothouses to produce roses. Suppose that when the quantity of labor and hothouses is fixed, the relationship between the quantity of fertilizer and the number of roses produced is given by the following table:

<table>
<thead>
<tr>
<th>Tons of Fertilizer per Month</th>
<th>Number of Roses per Month</th>
<th>Tons of Fertilizer per Month</th>
<th>Number of Roses per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>5</td>
<td>2500</td>
</tr>
<tr>
<td>1</td>
<td>500</td>
<td>6</td>
<td>2600</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>7</td>
<td>2500</td>
</tr>
<tr>
<td>3</td>
<td>1700</td>
<td>8</td>
<td>2000</td>
</tr>
<tr>
<td>4</td>
<td>2200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. What is the average product of fertilizer when 4 tons are used?

b. What is the marginal product of the sixth ton of fertilizer?

c. Does this total product function exhibit diminishing marginal returns? If so, over what quantities of fertilizer do they occur?

d. Does this total product function exhibit diminishing total returns? If so, over what quantities of fertilizer do they occur?

2. Ch 6, Problem 6.5

Are the following statements correct or incorrect?

a. If average product is increasing, marginal product must be less than average product.

b. If marginal product is negative, average product must be negative.

c. If average product is positive, total product must be rising.

d. If total product is increasing, marginal product must also be increasing.
3. Ch 6, Problem 6.4

Suppose the production function for lava lamps is given by

$$Q = KL^2 - L^3,$$

where $Q$ is the number of lamps produced per year, $K$ is the machine-hours of capital, and $L$ is the man-hours of labor.

Suppose $K = 600$.

a. Draw a graph of the production function over the range $L = 0$ to $L = 500$, putting $L$ on the horizontal axis and $Q$ on the vertical axis. Over what range of $L$ does the production function exhibit increasing marginal returns? Diminishing marginal returns? Diminishing total returns?

b. Derive the equation for average product of labor and graph the average product of labor curve. At what level of labor does the average product curve reach its maximum?

c. Derive the equation for marginal product of labor. On the same graph you drew for part b, sketch the graph of the marginal product of labor curve. At what level of labor does the marginal product curve appear to reach its maximum? At what level does the marginal product equal zero?

4. Ch 6, Problem 6.12

Suppose the production function is given by the following equation (where $a$ and $b$ are positive constants): $Q = aL + bK$. What is the marginal rate of technical substitution of labor for capital ($MRTS_{L,K}$) at any point along an isoquant?

5. For each of the following production functions, graph a typical isoquant and determine whether the marginal rate of technical substitution of labor for capital ($MRTS_{L,K}$) is diminishing, constant, increasing, or none of these.

a. $Q = LK$

b. $Q = L\sqrt{K}$

c. $Q = L^{2/3}K^{1/3}$

d. $Q = 3L + K$

e. $Q = \min\{3L, K\}$