Version A

1. (a) $\quad 3x^2 \left(\dfrac{3}{x} + 6x^2 + 9 \right) + (x^3 + 5) \left(-\dfrac{3}{x^2} + 12x \right)$

(b) $\quad \dfrac{12x^2}{4x^3 + 7} + 5e^{x^2+6x}(2x + 6)$

(c) $\quad -\dfrac{3x + 2}{(5y + 7)}^2 \cdot 5$

(d) $\quad e^{y^2} + e^{x^2} + xe^{x^2} \cdot 2x$

2. $f'(x) = 3x^2 - 2x - 5 = 0$ if $x = -1$ or $x = \frac{5}{3}$.

x	$f(x)$	
-1.5	9.875	local min.
-1	11	local max
5/3	1.5185...	global min
4	36	global max

3. (a) $\quad \dfrac{\partial z}{\partial x} = -6x - 10 + 12y$

$\dfrac{\partial z}{\partial y} = -10y + 3 + 12x$

(b) Setting the partial derivatives in part (a) equal to zero and solving gives us the one candidate
$$x = \frac{16}{21}, y = \frac{17}{14}$$

(c) $h'(12) = -81$ and $k'(1) = -64$ so the graph of k is steeper in the sense that is more positively sloped.

4. (a) $P(x, y) = 0.25x + 0.07y$

(b) The vertices are $(0, 1785.7), (80, 0),$ and $(48.36, 1581.9)$.

(c) Since $P(80, 0) = 20$, $P(48.36, 1581.9) = 122.8$, and $P(0, 1785.7) = 124.95$, the most protein is had with $x = 0$ and $y = 1785.7$.

Version B

1. (a) $\quad \dfrac{12x^3}{3x^4 + 12} - 5e^{x^3+9}(3x^2)$

(b) $\quad 2x \left(\dfrac{5}{x} + 3x^6 + 8 \right) + (x^2 + 2) \left(\dfrac{-5}{x^2} + 18x^5 \right)$

(c) $\quad \dfrac{\partial k}{\partial y} = -\dfrac{2x + 2}{(5y - 3)^2}$

(d) $\qquad \dfrac{\partial z}{\partial x} = e^{y^3} + e^{3x+y} + xe^{3x+y} \cdot 3$

2. $f'(x) = 3x^2 - 2x - 8 = 0$ if $x = -4/3$ or $x = 2$.

x	$f(x)$	
-2	15	local min.
-4/3	17.5185	global max
2	-1	global min
3	5	local max

3. (a) $\qquad \dfrac{\partial z}{\partial x} = 10x + 7 + 7y$

$\qquad\qquad \dfrac{\partial z}{\partial y} = -2y + 2 + 7x$

(b) Setting the partial derivatives in (a) equal to zero and solving the system we find the one candidate

$$x = -\frac{28}{69}, y = -\frac{29}{69}$$

(c) The slope of $h'(5) = -22$ and $k'(8) = 108$, so $k(s)$ is steeper.

4. (a) $P(x, y) = 0.26x + 0.05y$

(b) The vertices are $(0, 1538.46)$, $(70, 0)$, and $(43.29, 1335)$.

(c) Since $P(70, 0) = 18.2$, $P(43.29, 1335) = 78.0$, and $P(0, 1538.5) = 76.925$, the most protein is had with $x = 43.29$ and $y = 1335$.