Answers to Test 4C:

1) \(y = 5x^2 + \frac{2}{3}z, \quad y = 5x^2 + 9, \quad y = 5x^2 + 6, \quad y = 5x^2 + 4\)

2) 
\[P(x, y) = 90x - 3x^2 - y^2 + 20y + 7000\]
\[P_x = 90 - 6x = 0, \quad x = 15\]
\[P_y = -2y - 20 = 0, \quad y = 10\]
\[P_{xx} = -6, \quad P_{yy} = -2\]
\[D = P_{xx}P_{yy} - (P_{xy})^2 = (-6)(-2) - (0)^2 > 0\]
Since \(D > 0\) and \(P_{xx} < 0\), we can conclude that the point \(x = 15\) and \(y = 10\) will produce maximum profit.
If the company sells 15 hundred regular animal and 10 hundred deluxe animals, they will make a maximum profit of \(P(15, 10)\) in dollars.

3) a) 
\[L(x, y) = 3x^2 - 2xy - 12y + 18x + 10000 - \lambda(x + y - 180)\]
\[L_x = 6x - 2y + 18 - \lambda = 0\]
\[L_y = -2x - 12 - \lambda = 0\]
\[L_\lambda = -x - y + 180 = 0\]

Solve for \(\lambda\) in \(L_x\) and \(L_y\) and set them equal to each other to get the following:
\[4x - 2y + 18 = -2x - 12\]
\[y = 4x + 15\]
Now substitute into \(L_\lambda\) to get \(-x - (4x + 15) + 180 = 0\)
and solve for \(x\) to get \(x = 33\) and \(y = 147\)

b) Solve for \(\lambda = -2x - 12 = -2(33) - 12 = -78\)
c) If the constraint is increased from 180 to 181, then the minimum value $2395 will decrease to $2313.

4) 
\[ f_{xx} = -3(2) + 2(-2) = -10 \]
\[ f_{yy} = 4(2) + 1 = 9 \]

Since the second derivative with respect to x is negative, that indicates that the graph is probably concave down. The second derivative with respect to y is positive, which indicates that the graph is probably concave up at this point. This point is probably a saddle point.

5) 
   a) \( P(4,2) = 8 \). If Carol Lee sells 4 chocolate creams and 2 angle puffs, they will have a total profit of $8
   b) \[ P(6,1) = 4x - 4 = 4(6) - 4 = 20 \] If the number angle puffs sold is increased from 1 to 2 items and the chocolate creams is held constant at six, the total profit will increase by $20.
   c) \( P(x, 5) = -x^2 + 20x - 20 \)

6) Using the second partials test, Mary decides that the point is really just a saddle point.
\[ D = (3)(2) - (-4)^2 = 14 - 25 < 0 \]

7) 
   a) the point located at September 2002 is a local maximum.
   b) On the table of values draw a line connection all the values of \( C = 48 \) from left to right.