1. (4 points each)

(a) ANSWER: \( f'(x) = 3x^{11} - 5x^{14} - 4x^{-3/2} \)

(b) HINT: \( w = 9z^{-2} - 6z^{-3} \)
ANSWER: \( \frac{dw}{dz} = -18z^{-3} + 18z^{-4} \)

(c) HINT: \( h(t) = t^3 + 4 + t^2 + 4t^{-1} \). Compute \( h'(1) \).
ANSWER: \( h'(1) = 1 \)

(d) HINT: Compute \( TR'(q) \), set it equal to 0, and solve for \( q \).
ANSWER: \( q = 1146 \)

2. (a) (3 points) HINT: Take \( q_1 = 6 \) and \( q_2 = 11 \). Then \( TC(11) - TC(6) = 165 \) by the formula. Divide by 5.
ANSWER: 33

(b) (4 points) HINT: Take \( q_1 = 0 \) and \( q_2 = 10 \). Then \( TC(10) - TC(0) = 260 \) by the formula. You know \( TC(10) = 457 \) and \( TC(0) = FC \). Solve for \( FC \).
ANSWER: 197

(c) (3 points) HINT: Take \( q_1 = 5 \) and \( q_2 = 5.001 \). Then \( MC(5) = TC(5.001) - TC(5) = 0.026001 \) thousand dollars, by the formula.
ANSWER: 0.026001 thousand dollars OR $26.001

(d) (5 points) HINT: Take \( q_1 = q \) and \( q_2 = q + h \). Then, \( TC(q+h) - TC(q) = (q+h)^2 - q^2 + 16(q+h - q) \). Expand and simplify, divide by \( h \), and let \( h \) go to 0 to get the derivative.
ANSWER: \( TC'(q) = 2q + 16 \)

(e) (2 points) HINT: Evaluate your answer to part (d) at \( q = 2 \) thousand Items.
ANSWER: 20 dollars

3. (a) (2 points) HINT: Balloon A is always decreasing. Its lowest altitude on the interval from \( t = 4 \) to \( t = 13 \) is \( A(13) \).
ANSWER: 240 feet

(b) (5 points) HINT: The ballons are farthest apart when their speeds are the same. Compute \( A'(t) \) and \( B'(t) \), set the derivatives equal to each other and solve for \( t \).
ANSWER: 3.51

(c) (4 points) HINT: Balloon B is rising as long as its derivative is positive. The graph of \( B'(t) \) is a parabola that opens down. It’s positive in between its two roots. So, set \( B'(t) = 0 \) and solve for \( t \).
ANSWER: from \( t = 5 \) to \( t = 8 \)

(d) (3 points) HINT: Balloon B is moving up when \( B'(t) \) is positive. Its fastest upward speed is the highest point on the graph of \( B'(t) \) between \( t = 5 \) and \( t = 8 \). Find the \( t \)-coordinate of the vertex of \( B'(t) \).
ANSWER: \( t = 6.5 \) minutes

(e) (3 points) HINT: \( B'(t) \) is negative and increasing from \( t = 1 \) to \( t = 4 \). So, its fastest downward speed is at \( t = 1 \). Compute \( B'(1) \).
ANSWER: 84 feet per minute