1  (a) \( f'(x) = \ln(x) \)
(b) \( f_x = 12x^3 - 6y^3 \) and \( f_y = -18xy^2 - e^y \)
(c) \( f_x = \frac{2x}{x^2 - y^2} \) and \( f_y = -\frac{2y}{x^2 - y^2} \)
(d) \( f_y = -\frac{13x}{(4x + y)^2} \)

2  (a) 27
(b) \( \frac{1}{3}(1 - e^{-6}) \)
(c) \( 2e^3 + 1 \)

3  \( g'(x) = 3(x + 9)(x - 5) \) and \( g''(x) = 6(x + 2) \), so the curve has a relative maximum at \((-9, 982)\), an inflection point at \((-2, 296)\) and a relative maximum at \((5, -390)\).

4  \( g \) has three \( x \)-intercepts and only one \( y \)-intercept.

5  \( f(x) = 2e^{2x} + x^2 - 6 \).
6 (a) Here's a picture of the *left sum* $L_4$ for four equal subdivisions for the integral 
\[ \int_2^6 f(x) \, dx: \]

(b) $L_4 = 2.5$

7 The graph shows $g' = f$, which can be seen on the left where $f$ has a positive-to-negative $x$-intercept coinciding with a local maximum for $g$.

8 $y = 12 - 9(x + 1)$

9 Note that $F''(x) = 6x$, so $F''(-1) < 0$. This means that $F$ is concave downward at and near the point in question. This means that the tangent line lies \textbf{ABOVE} the graph of $F$.

10 For each of the following functions, find all the candidate points at which a maximum or a minimum might occur.

Then go on to classify the candidate points as to whether they are high points, low points, or saddles.

(a) One critical point at $(-2, -2)$. It is a local maximum.

(b) One critical point at $(0, 0)$. Even though both $f_{xx}(0, 0) > 0$ and $f_{yy}(0, 0) > 0$, this critical point yields no extreme.
11 Here’s the graph:

\[ \begin{align*}
0 & : f(F) \\
\overline{0} & : f(D) \\
\overline{0} & : f’(F) \\
\overline{0} & : f’(D) \\
\overline{0} & : f’(C) + f(E) \\
\underline{0} & : f’(B) \\
\underline{0} & : \int_{x}^{C} f(x) \, dx \\
\underline{0} & : \int_{x}^{D} f(x) \, dx \\
\underline{0} & : \int_{x}^{F} f(x) \, dx \\
\underline{0} & : f(B) \times f(E) \\
\underline{0} & : f’(C) \times f’(D) \\
\underline{0} & : \frac{f(F) - f(B)}{F - B}
\end{align*} \]

12 \( \frac{dy}{dt} = Ly \), without any steps, immediately yields \( y = Ce^{Lt} \). (Just the same way you would invoke the quadratic formula without deriving it from first principles)

\[ \begin{align*}
y(0) &= 25 \Rightarrow y = 25e^{Lt} \\
y(3) &= 52.925 \Rightarrow L \approx 1/4, \text{so } y(4) \approx 68
\end{align*} \]

13 Tabulating the story as it reads, yields us \( x \) as a function of \( p \). The left side of the table gives us \( \text{run} = 3 \) and and the right side gives \( \text{rise} = -3600 \) so that \( m = -1200 \) and

\[ x = 4800 - 1200(p - 2), \quad \text{or} \quad x = 7200 - 1200p \]

from which

\[ p = 6 - \frac{x}{1200} \]
14

\[ R(x) = px = \left( 6 - \frac{x}{1200} \right) x = -\frac{1}{1200} x(x - 7200) \]

15 Problem 14 leaves revenue as a function of \( x \) rather than of \( p \). The graph of \( R(x) \) is a frowny parabola with \( x \)-intercepts \((0, 0)\) and \((7200, 0)\). Thus the parabola’s axis comes through at \( x = 3600 \). This means that the maximum revenue happens at \( x = 3600 \). From problem 13 we get, correspondingly, \( p = 6 \). This means \( R_{\text{max}} = 6 \cdot 3600 = 21600 \).

Thus revenue is most when the unit price is \$6\). At this price we will sell 3600 units, and take in \$21,600.\)