1. Find the equation of the line which goes through the point (0, 7) and is perpendicular to the line given by the equation \(2x + 3y = 10\).

**Answer.** The given equation can be written as \(y = -\frac{2}{3}x + \frac{10}{3}\). This line has slope \(-\frac{2}{3}\), so the line we seek has slope \(\frac{3}{2}\). Then, by the point-slope formula

\[
\frac{y - 7}{x - 0} = \frac{3}{2},
\]

which simplifies to \(3x - 2y = -14\).

2. Find the derivatives of the following functions:

a) \(f(x) = 8x^3 + 3x^2 - \frac{1}{x} = 8x^3 + 3x^2 - x^{-1}\)

**Answer.** \(f'(x) = 24x^2 + 6x - (-1)x^{-2} = 24x^2 + 6x + \frac{1}{x^2}\).

b) \(g(x) = \frac{2x + 5}{x - 1}\)

**Answer.** \(g'(x) = \frac{(x - 1)(2) - (2x + 5)}{(x - 1)^2} = \frac{-7}{(x - 1)^2}\).

3. Find the derivatives of the following functions:

a) \(f(x) = (\sin(2x) + \cos(5x))^2\)

**Answer.** \(f'(x) = 2(\sin(2x) + \cos(5x))(2\cos(2x) - 5\sin(5x))\).

b) \(g(x) = (1 - x^2)^{15}\)

**Answer.** \(g'(x) = (1 - x^2)^{14}(-2x) = -2x(1 - x^2)^{14}\).

4. Find the equation of the line tangent to the curve \(y = x^3 - x^2 + 1\) at \((2,5)\).

**Answer.** The slope of the tangent line at \((x, y)\) is \(dy/dx = 3x^2 - 2x\). At \(x = 2\), the value is \(3(2)^2 - 2(2) = 8\). Thus the equation is

\[
\frac{y - 5}{x - 2} = 8 \quad \text{or} \quad y = 8x - 11.
\]

5. A body is falling toward the surface of the earth. Let \(s(t)\), \(v(t)\) represent the distance fallen and the velocity of the object (relative to its position at time \(t = 0\), where the direction of increasing \(s\) is downward) at time \(t\). Then we have the formula

\[
s(t) = 16t^2 + v(0)t,
\]

If the velocity at time \(t = 0\) is 12 ft/sec, at what time will the object have a velocity of 100 ft/sec?
**Answer.** From the hypotheses, \( v(0) = 12 \), so the equation of motion is \( s(t) = 32t + 12t \). Then

\[
v(t) = \frac{ds}{dt} = 32 + 12.
\]

The velocity is 100 ft/sec at the time \( t \) for which 100 = 32t + 12. Thus \( t = 88 / 32 = 11 / 4 \) seconds.