1. Find the value of \( x \) where the graphs of these two functions have parallel tangent lines:

\[
f(x) = x^2 - 3x + 2, \quad g(x) = 2x^2 - 11x - 17.
\]

**Solution.** Two lines are tangent if they have the same slope. We find the slope of the tangent lines by differentiating: \( f'(x) = 2x - 3 \), \( g'(x) = 10x - 11 \). So the two graphs have parallel tangent lines at the points where \( f'(x) = g'(x) \). We solve:

\[
2x - 3 = 10x - 11 \quad \text{or} \quad 8x = 8 \quad \text{or} \quad x = 1.
\]

2. Find the derivatives of the following functions:

   a) \( f(x) = (x + 1)(\frac{1}{x} + 1) \)

**Solution.** First write the function in exponential notation: \( f(x) = (x + 1)(x^{-1} + 1) \) and then use the product rule:

\[
f'(x) = (1)(x^{-1} + 1) + (x + 1)(-x^{-2}) = x^{-1} + 1 - x^{-1} - x^{-2} = 1 - x^{-2}.
\]

   b) \( g(x) = (\tan(3x) - 1)^2 \)

**Solution.** Use the chain rule:

\[
g'(x) = 2(\tan(3x) - 1)(\sec^2(3x))(3) = 6(\tan(3x) - 1)(\sec^2(3x)).
\]

3. Find the slope of the line tangent to the curve

\( y = x^2 - 3x + \frac{1}{x} \)

at the point \((3, 1/3)\).

**Solution.** The slope of the tangent line is the value of the derivative at the point \( x = 3 \). Let \( f(x) = x^2 - 3x + x^{-1} \). Then

\[
f'(x) = 2x - 3 - x^{-2} \quad \text{so that the slope is} \quad f'(3) = 2(3) - 3 - 3^{-2} = \frac{26}{9}.
\]
4. Let \( y = x^3 - 48x + 1 \). Find the \( x \) coordinate of the points at which the graph has a horizontal tangent line.

**Solution.** The graph has a horizontal line where \( y' = 0 \). Differentiating: \( y' = 3x^2 - 48 \), and solving \( 3x^2 - 48 = 0 \) we find \( x = \pm 4 \).

2. On the planet Garbanzo in the Weirdoxus solar system, the equation of motion of a falling body is

\[
s = s_0 + v_0 t - 10t^3
\]

where \( s_0 \) is the initial height above ground level and \( v_0 \) is the initial velocity. Distance is measured in garbanzofeet. If a ball is thrown upwards from ground level at an initial velocity of 120 garbanzofeet/second, how high does the ball rise?

**Solution.** We are given \( s_0 = 0 \), \( v_0 = 120 \), so the equation of motion is \( s = 120t - 10t^3 \). Differentiating we get the equation for velocity: \( v = 120 - 30t^2 \). At the height of the motion the velocity is 0, so we have \( 0 = 120 - 30t^2 \), so the ball is at its maximum height in \( t = 2 \) seconds. At this value of \( t \), \( s = 120(2) - 10(2)^3 = 160 \) garbanzofeet.