1. Tabulate station elevations for an equal-tangent parabolic curve for the data given. A 200-ft. Curve, $g_1 = -1.50\%$, $g_2 = +1.25\%$, VPI station 132 + 00, VPI elevation = 1345.00, stakeout at quarter-stations. Determine the station and elevation of the low point so that you can place a set of catch basins at that point.

**SKETCH** the curve, labeling critical points.

\[
y = y_{VPC} + g_1 x + \left(\frac{g_2 - g_1}{2L}\right) x^2
\]

\[
y = 1346.50 - 1.50 x + \frac{1.25 - (-1.50)}{2(2)} x^2
\]

\[
y = 1346.50 - 1.50 x + 0.6875 x^2
\]

<table>
<thead>
<tr>
<th>STATION</th>
<th>VPC ELEV</th>
<th>$x$</th>
<th>$x^2$</th>
<th>$-1.50x$</th>
<th>$0.6875x^2$</th>
<th>ELEV</th>
<th>1ST DIFF</th>
<th>2ND DIFF</th>
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</table>

\[
\frac{dy}{dx} = -1.50 + 1.375x = 0 \quad \text{and} \quad x = 1.0909 \text{ stations}
\]

\[
1345.68 \quad \text{LOW POINT ELEV}
\]

\[
132+09.09 \quad 1346.50 \quad 1.0909 \quad -1.636 \quad +0.818
\]

\[
\text{LOW POINT STATION}
\]
2. Field conditions require a highway curve to pass through a fixed point. Compute a suitable equal-tangent vertical curve. List the curve length, VPC and VPT stations. Grades of $g_1 = -2.50\%$ and $g_2 = +1.50\%$, VPI elevation 2430.00 ft. at station 315 + 00. Fixed elevation 2436.50 ft. at station 314 + 00.

\[ \text{VPC ELEV} = 2430.00 + 2.5(4/2) = 2430.00 + 1.25L \]

\[ x_{314} = \frac{L}{2} - 1 \]

\[ \frac{y}{g} = \text{VPC ELEV} + \frac{g_1}{2} \cdot \frac{g_2 - g_1}{2} \cdot \frac{L}{2} \]

\[ 2436.50 = 2430.00 + 1.25L - 2.50 \left( \frac{L}{2} - 1 \right) + \frac{1.5 - (2.5)}{2} \left( \frac{L}{2} - 1 \right) \]

\[ 6.50 = 1.25L - 1.25L + 2.50 + \frac{L}{2} \left( \frac{L}{2} - \frac{2L}{2} + 1 \right) \]

\[ 4.00 = \frac{L}{2} - 2 + \frac{L}{2} \]

\[ g = \frac{L}{2} + \frac{L}{2} \]

\[ 6L = \frac{L}{2} + L \]

\[ \frac{L}{2} - 6L + 2 = 0 \]

\[ \frac{L}{2} - 12L + 4 = 0 \]

\[ L = \frac{12 \pm \sqrt{(-12)^2 - 4(1)(4)}}{2} = \frac{12 \pm 11.3197}{2} = 11.0569 \pm 0.6432 \]

So $L = 11.0569$ stations = 1165.69 ft. since 0.6432 < 0.8452<br>

\[ \text{VPC} = 315 - \frac{11.0569}{2} = 309 + 17.16 \]

\[ \text{VPT} = 315 + \frac{11.0569}{2} = 320 + 82.84 \]

\[ \text{diff} = 1165.69 \]