1. A projectile is fired into the air from the top of a 200.0 m cliff above a valley. Its initial velocity is 60.0 m/s at an angle of 63° above the horizontal. Assume no air resistance.

(a) How long does it take the projectile to reach the ground? \textbf{SHOW ALL WORK}

<table>
<thead>
<tr>
<th>\textbf{x-dir}</th>
<th>\textbf{y-dir}</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x_0 = 0$</td>
<td>$y_0 = 200 \text{ m}$</td>
</tr>
<tr>
<td>$x = ?$</td>
<td>$y = 0$</td>
</tr>
<tr>
<td>$v_{0x} = 60 \cos 63^\circ$</td>
<td>$v_{0y} = 60 \sin 63^\circ$</td>
</tr>
<tr>
<td>$v_x = 60 \cos 63^\circ$</td>
<td>$v_y = ?$</td>
</tr>
<tr>
<td>$a_x = 0$</td>
<td>$a_y = -9.81 \text{ m/s}^2$</td>
</tr>
<tr>
<td>$t = ?$</td>
<td>$t = ?$</td>
</tr>
</tbody>
</table>

\begin{align*}
y &= y_0 + v_{0y}t + \frac{1}{2}a_yt^2 \\
0 &= 200 + 60 \sin 63^\circ t + \frac{1}{2}(-9.81)t^2 \\
0 &= 200 + 53.46t - 4.905t^2 \\
t &= \frac{-53.46 \pm \sqrt{53.46^2 - 4(-4.905)(200)}}{2(-4.905)} \\
t &= 13.84 \text{ s or } -2.945 \text{ s} \\
t &= 13.84 \text{ s}
\end{align*}

(b) How far from the base of the cliff does the projectile land? \textbf{SHOW ALL WORK}

\begin{align*}
x &= x_0 + v_{0x}t + \frac{1}{2}a_xt^2 \\
x &= 0 + 60 \cos 63^\circ t + 0 \\
x &= (27.239 \text{ m/s})(13.84 \text{ s}) \\
x &= 376.99 \text{ m}
\end{align*}