The Dixie Dazzler attempts to launch himself out of a cannon and land safely in a pile of straw. He is launched from the top of an 8 meter building, at a speed of 30 m/s, and at an angle of 20°.

a) What are vertical and horizontal components of The Dazzler’s launched velocity?

\[
x = 30 \cos \theta = 28.2 \text{ m/s}
\]
\[
y = 30 \sin \theta = 10.3 \text{ m/s}
\]

b) What is The Dazzler’s maximum height reached from the ground?

\[
\begin{align*}
V_f &= 0 \\
V_i &= 10.3 \text{ m/s} \\
\max a &= -9.8 \text{ m/s}^2 \\
x &= (10.3)^2 + 2(-9.8) \Delta y \\
\Delta y &= \frac{V_f^2 - V_i^2}{2a} \\
\Delta y &= \frac{0 - (10.3)^2}{2(-9.8)} \\
\Delta y &= 5.37 \text{ m}
\end{align*}
\]

13.37 m (From ground)

\[
\begin{align*}
\Delta y &= 5.37 \text{ m} \\
\max &= 10.3 \text{ m/s} \\
\end{align*}
\]

1.05 s

c) How much time does it take The Dazzler to reach a maximum height?

\[
\begin{align*}
V_f &= 0 \\
V_i &= 10.3 \text{ m/s} \\
\max a &= -9.8 \text{ m/s}^2 \\
x &= (10.3)^2 + 2(-9.8) \Delta y \\
\Delta y &= \frac{V_f^2 - V_i^2}{2a} \\
\Delta y &= \frac{0 - (10.3)^2}{2(-9.8)} \\
\Delta y &= 5.37 \text{ m}
\end{align*}
\]

13.37 m

\[
\begin{align*}
t &= 1.05 \text{ s} \\
\end{align*}
\]

d) How far should the pile of straw be placed from the edge of the building so The Dazzler lands safely?

\[
\begin{align*}
\Delta y &= -13.37 \text{ m} \\
V_i &= 0 \text{ m/s} \\
\max a &= -9.8 \text{ m/s}^2 \\
\Delta y &= V_i t + \frac{1}{2} at^2 \\
-13.37 &= 0 + \frac{1}{2}(-9.8)t^2 \\
t &= 1.65 \text{ s} \\
\Delta x &= \frac{\Delta x}{t} \\
28.2 &= \frac{\Delta x}{1.05} \\
\Delta x &= 76.14 \text{ m}
\end{align*}
\]

13.37 m

e) How far from the base of the building should a flaming hoop be placed to take The Dazzler’s trick to the next level?

\[
\begin{align*}
\Delta y &= 5.37 \text{ m} \\
\max a &= -9.8 \text{ m/s}^2 \\
\Delta y &= V_i t + \frac{1}{2} at^2 \\
-13.37 &= 0 + \frac{1}{2}(-9.8)t^2 \\
t &= 1.65 \text{ s} \\
V_x &= \frac{\Delta x}{t} \\
28.2 &= \frac{28.2}{1.05} \\
29.61 \text{ m} &= x
\end{align*}
\]
Starting from rest, a car drives towards the end of a 70 m cliff. The car takes off with an acceleration of \(8 \text{m/s}^2\) from the cliff's edge.

(a) With what speed does the car drive off the cliff?

\[
V_f = ? \quad \text{and} \quad V_f = 0 + 2a\Delta x
\]

\[
V_f^2 = 0 + 2(8)(30)
\]

\[
V_f = 21.9 \text{ m/s}
\]

(b) How long is the car in the air?

\[
\Delta y = -70 \quad \text{m}
\]

\[
a = -9.8 \text{ m/s}^2
\]

\[
y = v_i t + \frac{1}{2} a t^2
\]

\[
-70 = 0 + \frac{1}{2}(-9.8)t^2
\]

\[
t = 3.78 \text{ s}
\]

(c) How far from the base of the cliff does the car land?

\[
V_x = \frac{\Delta x}{t}
\]

\[
21.9 \text{ m/s} = \frac{\Delta x}{3.78}
\]

\[
\Delta x = 82.78 \text{ m}
\]

(d) What is the velocity of the car 2 seconds after it leaves the cliff?

\[
V_f = ?
\]

\[
\frac{V_f - V_i}{t} = a
\]

\[
\frac{V_f - 0}{2} = -9.8 \text{ m/s}^2
\]

\[
V_f = -19.6 \text{ m/s}
\]