1. A particle initially located at the origin has an acceleration of \( \vec{a} = 3.00 \hat{j} \) m/s\(^2\) and an initial velocity of \( \vec{v}_i = 5.00 \hat{i} \) m/s. Find the location of the particle and its speed at \( t = 2.00 \) s.

\[
\vec{r} = \vec{r}_i + \vec{v}_i t + \frac{1}{2} \vec{a} t^2 = (5.00 \hat{i} + \frac{1}{2} 3.00 \hat{j}) m
\]

\[
\vec{v} = \vec{v}_i + \vec{a} t = (5.00 \hat{i} + 3.00 \hat{j}) m/s
\]

So, at \( t = 2s \),

\[
\vec{r} = (10.0 \hat{i} + 6.00 \hat{j}) m
\]

and

\[
\vec{v} = 5.00 \hat{i} + (3.00)(2.00) \hat{j}
\]

or

\[
|\vec{v}| = \sqrt{5.00^2 + 6.00^2} = 7.81 m/s
\]

position = \( \vec{r} = (10.0 \hat{i} + 6.00 \hat{j}) m \)

speed = \( |\vec{v}| = \sqrt{5.00^2 + 6.00^2} = 7.81 m/s \)

2. A gun shoots a projectile with a speed at the end of the barrel of 1,000 m/s. At what angle must the barrel of the gun be held (relative to the horizon) to hit an object 2,000 m away horizontally and 800 m vertically above the gun?

\[
x = v_x t \quad \text{or} \quad 2000 m = (1000 m/s \cos \theta_i) t.
\]

Therefore, \( t = \frac{2.00}{\cos \theta_i} \). Next, \( y = v_y t + \frac{1}{2} a_y t^2 \)

or \( 800 m = (1000 m/s \sin \theta_i) t - \frac{1}{2}(9.8 m/s^2) t^2 \). Substituting \( t \), we get:

\[
800 \cos^2 \theta_i = 2000 \sin \theta_i \cos \theta_i - 19.6.
\]

Using \( \sin \theta = \sqrt{1 - \cos^2 \theta} \), we get:

\[
4.64 \times 10^6 \cos^4 \theta_i - 3.968 \times 10^6 \cos^2 \theta_i + 384 = 0
\]

This has solutions, using the quadratic equation, of

angle = \( \theta_i = 22.4^o \) or \( 89.4^o \)