1. \( x^2 + y^2 = D^2 \), so
\[
2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0
\]
When the plane is 3 miles away, \( D = 3 \)
\[
2(2) \frac{dy}{dt} = 2(3) \frac{dx}{dt}
\]
so
\[
\frac{dx}{dt} = \frac{dy}{dt} = 400 \text{ m/hour}
\]
\[
\frac{dy}{dt} = \frac{0.8 \cdot 400}{3} \approx 397.12 \text{ m/hour}
\]
The distance is increasing at a rate of about 397.12 m/h.

2. \( 400^2 + (L+T)^2 = D^2 \), so
\[
2(400)(46) = 2D \frac{dD}{dt}
\]
\[
\frac{dD}{dt} = \frac{4}{t} \text{ ft/sec}
\]
\[
\frac{dL}{dt} = 6 \text{ ft/sec}
\]
\[
L = 68.4 = 40 \text{ ft}
\]
\[
T = 13.6 = 78 \text{ ft}
\]
\[
D = 141.7 \text{ ft}
\]
The distance is increasing at a rate of about 2.83 ft/sec.

3. \( r = \frac{4}{3} h \)
\[
V = \frac{1}{3} \pi r^2 h
\]
\[
V = \frac{1}{3} \pi \left( \frac{4}{3} h \right)^2 h = \frac{16}{27} \pi h^3
\]
Use \( h = 2 \), \( \frac{dV}{dt} = 1 \text{ cubic in/min} \)
\[
\frac{dV}{dt} = \frac{16 \pi}{27} \cdot 2 \frac{dh}{dt}
\]
so
\[
\frac{dh}{dt} = \frac{1}{\frac{16 \pi}{27}} = \frac{27}{16 \pi} \approx 0.435 \text{ ft/sec}
\]
The water is rising at a rate of about 0.043 ft/sec.
4. \[ D^2 = x^2 + y^2, \text{ but } y = \sqrt{x}, \text{ so } \]
\[ D^2 = x^2 + (\sqrt{x})^2 \text{ or } \]
\[ D^2 = x^2 + x \rightarrow 2D \frac{dD}{dx} = 2x \frac{dx}{dt} + \frac{dx}{dt} \]
\[ \text{When } x = 9, \quad D = \sqrt{81 + 9} = 9\sqrt{10} = 31.62 \]
\[ \text{so } \frac{dx}{dt} = 2 \]
\[ 2 \cdot 31.62 \cdot \frac{dx}{dt} = 2 \cdot 9.2 + 2 \]
\[ \frac{dD}{dt} = \frac{38}{6 \cdot 10^3} \approx 2.003 \text{ m/s} \]

The distance is increasing at a rate of about 2.003 m/s.

5. \[ x = \text{distance M.S. has run} \]
\[ A = \text{distance from M.S. to 2}^{\text{nd}} \text{ base} \]
\[ B = \text{distance from M.S. to 3}^{\text{rd}} \text{ base} \]
\[ x^2 + 90^2 = B^2 \quad (90-x)^2 + 90^2 = A^2 \]
\[ 2x \frac{dx}{dt} = 2B \frac{dB}{dt} - 2(90-x) \frac{dx}{dt} = 2A \frac{dA}{dt} \]
\[ x = 45, B = 92.47 \]
\[ \frac{dx}{dt} = 2.9 \]
\[ \frac{dB}{dt} \approx 10.8 \quad \frac{dA}{dt} \approx -10.8 \]

When M.S. is half way to 1st base, his distance from 2nd base is decreasing at 10.8 ft/sec, and his distance from 3rd base is increasing at 10.8 ft/sec (approximately)
Let's measure height above the center of the Ferris wheel. $	heta$ is the angle shown.

\[
\sin \theta = \frac{h}{24} \quad \text{or} \quad h = 24 \sin \theta
\]

When they are 42 ft. above the ground, $h = 12$, so

\[
\sin \theta = \frac{12}{24} = \frac{1}{2} \quad \text{and} \quad \cos \theta = \frac{\sqrt{3}}{2}
\]

\[
\frac{dh}{dt} = 24 \cdot \frac{\sqrt{3}}{2} \quad \text{or} \quad 21.27 \text{ ft/min}
\]

\[
\approx 130.6 \text{ ft/min or 2.18 ft/sec.}
\]

They are rising at a rate of $\approx 2.18$ ft/sec.
\[ a = \text{distance Harry has traveled.} \]
\[ 2a = \text{distance Harry has traveled (since he is walking twice as fast).} \]

Use Pythagorean theorem to find \( x, y, z \) as labeled:
\[ x = \sqrt{1 + a^2} \]
\[ y = \sqrt{1 + 4a^2} \]
\[ z = \sqrt{4 + a^2} \]

Law of Cosines:
\[ z^2 = x^2 + y^2 - 2xy \cos \theta, \quad \text{or} \]
\[ 4 + a^2 = (1 + a^2) + (1 + 4a^2) - 2 \sqrt{1 + a^2} \sqrt{1 + 4a^2} \cos \theta \]

\[ a^2 \frac{d^2 a}{dt^2} = \frac{(10a + 16a^3)}{(1 + 5a^2 + 4a^4)} \frac{da}{dt} \cos \theta + 2 \sqrt{1 + 4a^2} \sin \theta \frac{d\theta}{dt} \]

\( \theta + \beta + \alpha = \pi, \quad \beta = \arccos(2a), \quad \alpha = \arccos(a), \quad \frac{d\theta}{dt} \)

\( \theta = \pi - \arccos(a) - \arccos(2a) \)

\[ \frac{d\alpha}{dt} = \frac{2a}{1 + a^2} - 2 \frac{da}{dt} \frac{a}{1 + 4a^2} \]

Use \( a \approx 2.96 \text{ ft} \), get
\[ \frac{d\alpha}{dt} = -0.36 \text{ rad/ sec}. \]
\( \theta \) is decreasing at about 0.36 radians per sec.