1. Let $x$ be the distance (in ft) from the bottom of the ladder to the wall. Then $x = 10 \cos \theta$. Hence
\[
\frac{dx}{dt} = -(10 \sin \theta) \frac{d\theta}{dt} \Rightarrow \frac{d\theta}{dt} = -(10 \sin \theta)^{-1} \left( \frac{dx}{dt} \right).
\]
Since $dx/dt = 1$, $d\theta/dt = -(10 \sin(\pi/3))^{-1} = -\sqrt{3}/15$ s\(^{-1}\) when $\theta = \pi/3$.

2. Use implicit differentiation:
\[
\frac{d}{dx} (x^3y + 2xy^3) = 0
\Rightarrow 3x^2y + x^3 \frac{dy}{dx} + 2y^3 + 6xy^2 \frac{dy}{dx} = 0
\Rightarrow (x^3 + 6y^2) \frac{dy}{dx} + (3x^2y + 2y^3) = 0
\Rightarrow \frac{dy}{dx} = \frac{3x^2y + 2y^3}{x^3 + 6xy^2}
\Rightarrow \left. \frac{dy}{dx} \right|_{(1,1)} = -\frac{5}{7}.
\]
So the tangent line is $5(x - 1) + 7(y - 1) = 0$.

3. 
\[
f'(x) = (2^{3\cos x})' = (2^{3\cos x})(\ln 2)(3\cos x)' = -(2^{3\cos x})(\ln 2)(3\cos x)(\sin x).
\]

4. Let $x$ be the height of the water (in m) and $r$ be the rate of the water being pumped into the tank (in m\(^3\)/min). Then the volume of the water is
\[
V = \frac{1}{12} \pi \left( \frac{4x}{6} \right)^2 x = \frac{1}{27} \pi x^3.
\]
So
\[
\frac{dV}{dt} = \frac{1}{9} \pi x^2 \frac{dx}{dt}
\]
On the other hand
\[
\frac{dV}{dt} = r - 0.01 \text{ and } \frac{dx}{dt} = 0.2.
\]
So when $x = 2$,
\[
r - 0.01 = \frac{0.8\pi}{9}.
\]
So $r = 0.289$ m\(^3\)/min.

5. Since $f(g(x)) = x$, $f'(g(x))g'(x) = 1$. So
\[
g'(e + 1) = \frac{1}{f'(g(e + 1))}.
\]
Since $g(e + 1) = 1$, $g'(e + 1) = 1/f'(1) = 1/(e + 1)$.
6. Use logarithmic differentiation:

\[ \ln f(x) = \frac{1}{2} \ln(\ln x + 1) - \frac{1}{2} \ln(\ln x - 1) \]

\[ \Rightarrow \frac{f'(x)}{f(x)} = \frac{1}{2} \cdot \frac{1}{\ln x + 1} - \frac{1}{2} \cdot \frac{1}{\ln x - 1} \]

\[ \Rightarrow \frac{f''(x)}{f(x)} = -\frac{x(\ln x + 1)(\ln x - 1)}{x(\ln x + 1)(\ln x - 1)} \]

\[ \Rightarrow f'(x) = \frac{-1}{x} \sqrt{1 \over (\ln x + 1)(\ln x - 1)^3} \]

7. Since \( g'(x) = \sec x \tan x \), \( g''(x) = \sec^3 x + \sec x \tan^2 x \) and \( g'''(x) = 5 \sec^3 x \tan x + \sec x \tan^3 x \), \( g'''(\pi/4) = 11\sqrt{2} \).

8. Use logarithmic differentiation:

\[ \ln f(x) = x \ln(\cos^{-1} x) \]

\[ \Rightarrow \frac{f'(x)}{f(x)} = \ln(\cos^{-1} x) - \frac{x}{\sqrt{1 - x^2}(\cos^{-1} x)} \]

\[ \Rightarrow f'(x) = (\cos^{-1} x)^x \left( \ln(\cos^{-1} x) - \frac{x}{\sqrt{1 - x^2}(\cos^{-1} x)} \right) \]

9. Let \( S \) be the surface area and \( x \) be the diameter. Then \( S = \pi x^2 \) and \( dS/dt = 2\pi x (dx/dt) \). So \( dx/dt = -1/(20\pi) \). So the diameter decreases at the rate of \( 1/(20\pi) \) cm/min.

10. The graph of \( f \) has a horizontal tangent at \( f'(x) = 1 - \cos x = 0 \), i.e., \( \cos x = 1 \). So it has a horizontal tangent at \( x = 2k\pi \) for \( k \) any integers.