1. Find the derivative of the following functions:

$y = \tan(3x)$

$y = 4\sec(5x)$

$y = \cos(x^3)$

$y = \cos^3 x$

$y = \tan(x^2) + \tan^2 x$

$y = \cos(\tan x)$

$y = \sin(\sin x)$

$y = \sqrt{1 + 2\tan x}$

$y = \cot(\sqrt[3]{1+x^2})$

$\sin^3 x + \cos^3 x$

$y = \sin^2(\cos(4x))$

$y = \sin(\frac{1}{x})$

$y = \sin(\tan(\sqrt{\sin x}))$

$y = \sqrt{\cos(\sin^2 x)}$

$y = \ln(\csc(5x))$

$y = \ln(\sec^2 x)$

$y = \arcsin(\frac{x-1}{x+1})$

$y = \arctan(\arcsin(\sqrt{x}))$

$g(x) = e^{-5x}\cos(3x)$

$h(\theta) = e^{\sin(5\theta)}$

$y = e^{x\cos x}$

$y = \tan(e^{3x-2})$

$y = \sec(e^{\tan(x^2)})$

$f(x) = \cos(\ln x)$

$h(y) = \ln(y^3 \sin y)$

$y = (\ln(\sin x))^3$

$f(x) = \arcsin(2x-1)$

$g(x) = \arctan(x^3)$

$y = (\arcsin x)^2$

$y = \arcsin(x^2)$

$h(x) = (\arcsin x)\ln x$

$H(x) = (1+x^2)\arctan x$

$f(t) = \frac{\arccos t}{t}$

$g(t) = \arcsin(\frac{4}{t})$

$F(t) = \sqrt{1-t^2} + \arcsin t$

$G(t) = \arccos(\sqrt{2t-1})$

$y = \arccos(\frac{b + a\cos x}{a + b\cos x}), 0 \le x \le \pi, a > b > 0$

$y = \arctan(\frac{x}{a}) + \ln(\sqrt{\frac{x-a}{x+a}})$

$f(x) = \arccos(\arcsin x)$

$y = \frac{\sin^2 x}{\cos x}$

2. Find y' and y'' if $y = \ln(\sec x + \tan x)$.

3. Find f' in terms of g' if $f(x) = g(\tan(\sqrt{x}))$.

4. For each of the following, find the equation of the tangent line to the given curve at the given point.

   (a) $y = \sin x + \cos(2x)$, $(\frac{\pi}{6}, 1)$
   (b) $y = e^{-x} \sin x$, $(\pi, 0)$
   (c) $y = 2 \sin x$, $(\frac{\pi}{6}, 1)$
   (d) $y = \tan x$, $(\frac{\pi}{4}, 1)$
   (e) $y = \sec x - 2\cos x$, $(\frac{\pi}{3}, 1)$

5. An object with weight W is dragged along a horizontal plane by a force acting along a rope attached to the object. If the rope makes an angle θ with the plane, then the magnitude of the force is

$$F = \frac{\mu W}{\mu \sin\theta + \cos\theta},$$

   where μ is a constant called the *coefficient of friction.* Find the rate of change of F with respect to θ.

6. For each of the following curves, find the points at which the tangent line is horizontal.

   (a) $y = \sin x + \cos x$ for $0 \le x \le 2\pi$
   (b) $f(x) = 2\sin x + \sin^2 x$
   (c) $y = \sin(2x) - 2\sin x$
   (d) $f(x) = x + 2\sin x$
   (e) $y = \frac{\cos x}{2+\sin x}$

7. The displacement of a particle on a vibrating string is given by the equation

$$s(t) = 10 + \frac{1}{4}\sin(10\pi t),$$

   where s is measured in centimeters and t in seconds. Find the velocity of the particle after t seconds.

8. If the equation of motion of a particle is given by $s = A\cos(\omega t + \delta)$, the particle is said to undergo *simple harmonic motion.*

   (a) Find the velocity of the particle at time t.
   (b) When is the velocity 0?

9. A mass attached to a vertical spring has position function given by

$$y(t) = A\sin(\omega t),$$

where A is the amplitude of its oscillations and ω is a constant. Find the velocity and acceleration as functions of time.

10. Find h' in terms of f' and g' if $h(x) = f(g(\sin(4x)))$.

11. For each of the following functions find

    - the intervals of increase or decrease,
    - the local maximum or minimum values,
    - the intervals of concavity, and
    - the x-coordinates of the points of inflection.

    (a) $f(\theta) = \sin^2\theta$ for $0 \leq \theta \leq 2\pi$

    (b) $f(t) = t + \cos t$ for $0 \leq t \leq 2\pi$

1). $\frac{d}{dx}[\tan(3x)] = \underline{3\sec^2(3x)}$

$\frac{d}{dx}[4\sec(5x)] = \underline{\underline{20\sec(5x)\tan(5x)}}$

- $\frac{d}{dx}[\cos(x^3)] = \underline{\underline{-3x^2\sin(x^3)}}$
- $\frac{d}{dx}[\cos^3 x] = \underline{\underline{-3\cos^2 x\sin x}}$
- $\frac{d}{dx}[\tan(x^2) + \tan^2 x]$
  $= \sec^2(x^2)2x + 2\tan x\sec^2 x$
  $= \underline{\underline{2x\sec^2(x^2) + 2\tan x\sec^2 x}}$
- $\frac{d}{dx}[\cos(\tan x)]$
  $= \underline{\underline{-\sin(\tan x)\sec^2 x}}$
- $\frac{d}{dx}[\sin(\sin x)]$
  $= \underline{\underline{\cos(\sin x)\cos x}}$
- $\frac{d}{dx}[\sqrt{1+2\tan x}]$
  $= \frac{1}{2}(1+2\tan x)^{-\frac{1}{2}}(2\sec^2 x)$
  $= \underline{\underline{\frac{\sec^2 x}{\sqrt{1+2\tan x}}}}$
- $\frac{d}{dx}[\cot(\sqrt[3]{1+x^2})]$
  $= -\csc^2(\sqrt[3]{1+x^2})\frac{1}{3}(1+x^2)^{-\frac{2}{3}}(2x)$
  $= \underline{\underline{-\frac{2}{3}x(1+x^2)^{-\frac{2}{3}}\csc^2(\sqrt[3]{1+x^2})}}$
- $\frac{d}{dx}[\sin^3 x + \cos^3 x]$
  $= 3\sin^2 x\cos x - 3\cos^2 x\sin x$
  $= \underline{\underline{3\cos x\sin x(\sin x - \cos x)}}$
- $\frac{d}{dx}[\sin^2(\cos(4x))]$
  $= 2\sin(\cos(4x))\cos(\cos(4x))(-\sin(4x)4)$
  $= \underline{\underline{-8\sin(4x)\cos(\cos(4x))\sin(\cos(4x))}}$
- $\frac{d}{dx}[\sin(\frac{1}{x})]$
  $= \cos(\frac{1}{x})(-\frac{1}{x^2}) = \underline{\underline{-\frac{\cos(\frac{1}{x})}{x^2}}}$
- $\frac{d}{dx}[\sin(\tan(\sqrt{\sin x}))]$
  $= \cos(\tan(\sqrt{\sin x}))\sec^2(\sqrt{\sin x})$
  $\cdot \frac{1}{2}(\sin x)^{-\frac{1}{2}}\cos x$
  $= \underline{\underline{\frac{\cos x\sec^2(\sqrt{\sin x})\cos(\tan(\sqrt{\sin x}))}{2\sqrt{\sin x}}}}$
- $\frac{d}{dx}[\sqrt{\cos(\sin^2 x)}]$
  $= \frac{1}{2}(\cos(\sin^2 x))^{-\frac{1}{2}}(-\sin(\sin^2 x))$
  $\cdot \cancel{2}\sin x\cos x$
  $= \underline{\underline{\frac{-\cos x\sin x\sin(\sin^2 x)}{\sqrt{\cos(\sin^2 x)}}}}$

- $\frac{d}{dx}[\ln(\csc(5x))]$
  $= \frac{-5\cot(5x)\csc(5x)}{\csc(5x)}$
  $= \underline{\underline{-5\cot(5x)}}$
- $\frac{d}{dx}[\ln(\sec^2 x)]$
  $= \frac{2\sec x\sec x\tan x}{\sec^2 x}$
  $= \underline{\underline{2\tan x}}$
- $\frac{d}{dx}[\arcsin(\frac{x-1}{x+1})]$
  $= \frac{1}{\sqrt{1-(\frac{x-1}{x+1})^2}} \frac{x+1-(x-1)}{(x+1)^2}$
  $= \underline{\underline{\frac{\frac{2}{(x+1)^2}}{\sqrt{1-(\frac{x-1}{x+1})^2}}}}$
- $\frac{d}{dx}[\arctan(\arcsin(\sqrt{x}))]$
  $= \frac{1}{1+(\arcsin(\sqrt{x}))^2}$
  $\cdot \frac{1}{\sqrt{1-x}}\frac{1}{2\sqrt{x}}$
  $= \underline{\underline{\frac{1}{1+(\arcsin(\sqrt{x}))^2}\left(\frac{1}{2\sqrt{x}\sqrt{1-x}}\right)}}$
- $\frac{d}{dx}[e^{-5x}\cos(3x)]$
  $= -5e^{-5x}\cos(3x)$
  $-3e^{-5x}\sin(3x)$
  $= \underline{\underline{-e^{-5x}[5\cos(3x) + 3\sin(3x)]}}$
- $\frac{d}{d\theta}[e^{\sin(5\theta)}]$
  $= \underline{\underline{5\cos(5\theta)e^{\sin(5\theta)}}}$
- $\frac{d}{dx}[e^{x\cos x}]$
  $= \underline{\underline{(\cos x - x\sin x)e^{x\cos x}}}$
- $\frac{d}{dx}[\tan(e^{3x-2})]$
  $= \underline{\underline{3e^{3x-2}\sec^2(e^{3x-2})}}$
- $\frac{d}{dx}[\sec(e^{\tan(x^2)})]$
  $= \sec(e^{\tan(x^2)})\tan(e^{\tan(x^2)})$
  $\cdot e^{\tan(x^2)}\sec^2(x^2)2x$
  $= 2x\sec^2(x^2)e^{\tan(x^2)}$
  $\underline{\underline{\cdot\sec(e^{\tan(x^2)})\tan(e^{\tan(x^2)})}}$

- $\frac{d}{dx}[\cos(\ln x)]$
  $= -\sin(\ln x)\cdot\frac{1}{x}$
  $= \underline{\underline{-\frac{\sin(\ln x)}{x}}}$
- $\frac{d}{dy}[\ln(y^3\sin y)]$
  $= \frac{3y^2\sin y + y^3\cos y}{y^3\sin y}$
  $= \underline{\underline{\frac{3}{y} + \cot y}}$
- $\frac{d}{dx}[(\ln(\sin x))^3]$
  $= 3(\ln(\sin x))^2\ \frac{\cos x}{\sin x}$
  $= \underline{\underline{3\cot x(\ln(\sin x))^2}}$
- $\frac{d}{dx}[\arcsin(2x-1)]$
  $= \underline{\underline{\frac{2}{\sqrt{1-(2x-1)^2}}}}$
- $\frac{d}{dx}[\arctan(x^3)]$
  $= \underline{\underline{\frac{3x^2}{1+x^6}}}$
- $\frac{d}{dx}[(\arcsin x)^2]$
  $= \underline{\underline{\frac{2\arcsin x}{\sqrt{1-x^2}}}}$
- $\frac{d}{dx}[\arcsin(x^2)]$
  $= \underline{\underline{\frac{2x}{\sqrt{1-x^4}}}}$
- $\frac{d}{dx}[(\arcsin x)\ln x]$
  $= \underline{\underline{\frac{\ln x}{\sqrt{1-x^2}} + \frac{1}{x}\arcsin x}}$
- $\frac{d}{dx}[(1+x^2)\arctan x]$
  $= \underline{\underline{2x\arctan x + 1}}$

- $\frac{d}{dt}\left[\frac{\arccos t}{t}\right]$

$= \frac{d}{dt}[t^{-1}\arccos t]$

$= -\frac{1}{t^2}\arccos t + \frac{-1}{t\sqrt{1-t^2}}$

- $\frac{d}{dt}\left[\arcsin\left(\frac{4}{t}\right)\right]$

$= \frac{-\frac{4}{t^2}}{\sqrt{1-\frac{16}{t^2}}}$

- $\frac{d}{dt}\left[\sqrt{1-t^2} + \arcsin t\right]$

$= \frac{-t}{\sqrt{1-t^2}} + \frac{1}{\sqrt{1-t^2}}$

$= \frac{1-t}{\sqrt{1-t^2}}$

- $\frac{d}{dt}\left[\arccos(\sqrt{2t-1})\right]$

$= -\frac{1}{\sqrt{1-(2t-1)}}\,\frac{1}{\cancel{2}}(2t-1)^{-\frac{1}{2}}\cdot\cancel{2}$

$= -\frac{1}{\sqrt{2t-1}\sqrt{2-2t}}$

- $\frac{d}{dx}\left[\arccos\left(\frac{b+a\cos x}{a+b\cos x}\right)\right]$

$= -\left[1-\left(\frac{b+a\cos x}{a+b\cos x}\right)^2\right]^{-\frac{1}{2}}$

$\cdot \frac{-a\sin x(a+b\cos x)+b\sin x(b+a\cos x)}{(a+b\cos x)^2}$

$= -\frac{1}{\sqrt{1-\left(\frac{b+a\cos x}{a+b\cos x}\right)^2}}\cdot\frac{(b^2-a^2)\sin x}{(a+b\cos x)^2}$

- $\frac{d}{dx}\left[\arctan\left(\frac{x}{a}\right)+\ln\left(\sqrt{\frac{x-a}{x+a}}\right)\right]$

$= \frac{\frac{1}{a}}{1+\frac{x^2}{a^2}} + \frac{1}{\sqrt{\frac{x-a}{x+a}}}\,\frac{1}{2}\left(\frac{x-a}{x+a}\right)^{-\frac{1}{2}}\,\frac{x+a-(x-a)}{(x+a)^2}$

$= \frac{a}{x^2+a^2} + \frac{1}{\cancel{2}}\,\frac{1}{\frac{x-a}{x+a}}\cdot\frac{\cancel{2}a}{(x+a)^2}$

$= \frac{a}{x^2+a^2} + \frac{a}{(x-a)(x+a)}$

- $\frac{d}{dx}[\arccos(\arcsin x)]$

$= -\frac{1}{\sqrt{1-(\arcsin x)^2}}\cdot\frac{1}{\sqrt{1-x^2}}$

- $\frac{d}{dx}\left[\frac{\sin^2 x}{\cos x}\right]$

$= \frac{d}{dx}[\tan x\sin x]$

$= \sec^2 x\sin x + \tan x\cos x$

$= \sin x(\sec^2 x + 1)$

2) $y = \ln(\sec x + \tan x)$

$y' = \frac{\sec x\tan x + \sec^2 x}{\sec x + \tan x}$

$= \frac{\sec x(\tan x + \sec x)}{\sec x + \tan x}$

$= \sec x$

$y'' = \sec x\tan x$

3) $f(x) = g(\tan(\sqrt{x}))$

$f'(x) = g'(\tan(\sqrt{x}))$

$\cdot \sec^2(\sqrt{x})\,\frac{1}{2\sqrt{x}}$

$= \frac{g'(\tan(\sqrt{x}))\sec^2(\sqrt{x})}{2\sqrt{x}}$

4)(a) $y = \sin x + \cos(2x)$, $(\frac{\pi}{6}, 1)$

$y' = \cos x - 2\sin(2x)$

$y'(\frac{\pi}{6}) = \cos(\frac{\pi}{6}) - 2\sin(\frac{\pi}{3})$

$= \frac{\sqrt{3}}{2} - 2\left(\frac{\sqrt{3}}{2}\right)$

$= -\frac{\sqrt{3}}{2}$

$y = -\frac{\sqrt{3}}{2}x + b$

$1 = -\frac{\pi\sqrt{3}}{12} + b$

$1 + \frac{\pi\sqrt{3}}{12} = b$

$y = -\frac{\sqrt{3}}{2}x + 1 + \frac{\pi\sqrt{3}}{12}$

(b) $y = e^{-x}\sin x$, $(\pi, 0)$

$y' = -e^{-x}\sin x + e^{-x}\cos x$

$= e^{-x}(\cos x - \sin x)$

$y'(\pi) = e^{-\pi}(\cos\pi - \sin\pi)$

$= -e^{-\pi}$

$y = -e^{-\pi}x + b$

$0 = -\pi e^{-\pi} + b$

$y = -e^{-\pi}x + \pi e^{-\pi}$

(c) $y = 2\sin x$, $(\frac{\pi}{6}, 1)$

$y' = 2\cos x$

$y'(\frac{\pi}{6}) = 2\cos(\frac{\pi}{6})$

$= 2\left(\frac{\sqrt{3}}{2}\right) = \sqrt{3}$

$y = \sqrt{3}x + b$

$1 = \frac{\pi\sqrt{3}}{6} + b$

$1 - \frac{\pi\sqrt{3}}{6} = b$

$y = \sqrt{3}x + 1 - \frac{\pi\sqrt{3}}{6}$

(d) $y = \tan x$, $(\frac{\pi}{4}, 1)$

$y' = \sec^2 x$

$y'(\frac{\pi}{4}) = (\sec(\frac{\pi}{4}))^2$

$= 2$

$y = 2x + b$

$1 = \frac{\pi}{2} + b$

$y = 2x + 1 - \frac{\pi}{2}$

(e) $y = \sec x - 2\cos x$, $(\frac{\pi}{3}, 1)$

$y' = \sec x\tan x + 2\sin x$

$y'(\frac{\pi}{3}) = \sec(\frac{\pi}{3})\tan(\frac{\pi}{3}) + 2\sin(\frac{\pi}{3})$

$= 2(\sqrt{3}) + \cancel{2}\left(\frac{\sqrt{3}}{\cancel{2}}\right)$

$= 3\sqrt{3}$

$y = 3\sqrt{3}x + b$

$1 = \pi\sqrt{3} + b$

$y = 3\sqrt{3}x + 1 - \pi\sqrt{3}$

5) $F = \dfrac{\mu W}{\mu \sin\theta + \cos\theta}$

$\dfrac{dF}{d\theta} = -\mu W(\mu \sin\theta + \cos\theta)^{-2}(\mu\cos\theta - \sin\theta)$

$= \dfrac{\mu W(\sin\theta - \mu\cos\theta)}{(\mu\sin\theta + \cos\theta)^2}$

6) (a) $y = \sin x + \cos x$, $0 \le x \le 2\pi$

$y' = \cos x - \sin x$

$y' = 0$ for $\cos x = \sin x$

or for $x = \frac{\pi}{4}, \frac{5\pi}{4}$

$\left(\frac{\pi}{4}, \sqrt{2}\right), \left(\frac{5\pi}{4}, -\sqrt{2}\right)$

(b) $f(x) = 2\sin x + \sin^2 x$

$f'(x) = 2\cos x + 2\sin x\cos x$

$f'(x) = 0$ for

$2\cos x + 2\sin x \cos x = 0$

or $\cos x + \cos x \sin x = 0$

or $\cos x(1 + \sin x) = 0$

$\cos x = 0$ for ~~θ~~ $x = \frac{\pi}{2} + k\pi$, for k an integer

$1 + \sin x = 0$ for $\sin x = -1$

or for $x = \frac{3\pi}{2} + 2k\pi$, for k an integer

$f(x)$ has horizontal tangent lines at the points

$\left(\frac{\pi}{2} + 2k\pi, 2\right)$ and

$\left(\frac{3\pi}{2} + 2k\pi, 0\right)$, where k is an integer.

(c) $y = \sin(2x) - 2\sin x$

$y' = 2\cos(2x) - 2\cos x$

$y' = 0$ for $2\cos(2x) = 2\cos x$

or for $\cos(2x) = \cos x$

or for $x = 2k\pi$, where π is an integer.

Also for $x = \pm\frac{2\pi}{3} + 2k\pi$, ~~where k and x =~~ where k is an integer.

The curve $y = \sin(2x) - 2\sin x$ has horizontal tangent lines at the points

$(2k\pi, 0)$, ~~and~~

$\left(\frac{2\pi}{3} + 2k\pi, -\frac{\sqrt{3}}{2} - \sqrt{3}\right)$

$= \left(\frac{2\pi}{3} + 2k\pi, -\frac{3\sqrt{3}}{2}\right)$,

$\left(-\frac{2\pi}{3} + 2k\pi, \frac{3\sqrt{3}}{2}\right)$, where k is an integer.

(d) $f(x) = x + 2\sin x$

$f'(x) = 1 + 2\cos x$

$f'(x) = 0$ for $\cos x = -\frac{1}{2}$

or for $x = \frac{2\pi}{3} + 2k\pi$, $\frac{4\pi}{3} + 2k\pi$, where k is an integer. The curve $f(x) = x + 2\sin x$ has horizontal tangent lines at the points

$\left(\frac{2\pi}{3} + 2k\pi, \frac{2\pi}{3} + 2k\pi + \sqrt{3}\right)$,

$\left(\frac{4\pi}{3} + 2k\pi, \frac{4\pi}{3} + 2k\pi - \sqrt{3}\right)$, where k is an integer.

(e) $y = \dfrac{\cos x}{2 + \sin x}$

$y' = \dfrac{-\sin x(2 + \sin x) - \cos^2 x}{(2 + \sin x)^2}$

$= -\dfrac{-2\sin x - \sin^2 x - \cos^2 x}{(2 + \sin x)^2}$

$= \dfrac{2\sin x + \cos^2 x + \sin^2 x}{(2 + \sin x)^2}$

$= \dfrac{2\sin x + 1}{(2 + \sin x)^2}$

$y' = 0$ for $\sin x = -\frac{1}{2}$ or for

$x = \frac{7\pi}{6} + 2k\pi$, $\frac{11\pi}{6} + 2k\pi$, where k is an integer. The curve $y = \dfrac{\cos x}{2 + \sin x}$ has horizontal tangent lines at the points

$\left(\frac{7\pi}{6} + 2k\pi, \dfrac{-\frac{\sqrt{3}}{2}}{2 - \frac{1}{2}}\right)$

$= \left(\frac{7\pi}{6} + 2k\pi, \frac{-\sqrt{3}}{3}\right)$ and

$\left(\frac{11\pi}{6} + 2k\pi, \dfrac{\frac{\sqrt{3}}{2}}{2 - \frac{1}{2}}\right)$

$= \left(\frac{11\pi}{6} + 2k\pi, \frac{\sqrt{3}}{3}\right)$

7) $s(t) = 10 + \frac{1}{4}\sin(10\pi t)$

$v(t) = s'(t) = \frac{10\pi}{4}\cos(10\pi t)$

$= \frac{5\pi}{2}\cos(10\pi t)$ cm/s.

8) $s(t) = A\cos(\omega t + \delta)$

(a) $v(t) = s'(t) = -A\omega\sin(\omega t + \delta)$

(b) $v(t) = 0$ when $-A\omega\sin(\omega t + \delta) = 0$

or $\sin(\omega t + \delta) = 0$ or

$\omega t + \delta = k\pi$, where k is an integer

or $t = \dfrac{k\pi - \delta}{\omega}$, where k is an integer.

9) $y(t) = A\sin(\omega t)$

$v(t) = y'(t) = \underline{A\omega\cos(\omega t)}$

$a(t) = v'(t) = \underline{-A\omega^2\sin(\omega t)}$

10) $h(x) = f(g(\sin(4x)))$

$h'(x) = \underline{f'(g(\sin(4x)))g'(\sin(4x))4\cos(4x)}$

11) (a) $f(\theta) = \sin^2\theta,\ 0 \le \theta \le 2\pi$

$f'(\theta) = 2\sin\theta\cos\theta = \sin(2\theta)$

$f'(\theta) = 0$ for $\theta = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$

$f''(\theta) = 2\cos(2\theta)$

$f''(\theta) = 0$ for $\theta = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

θ-value	f'	f''	f
0		+	local min.
$0<\theta<\frac{\pi}{4}$	+	+	incr., concave ↑
$\frac{\pi}{4}$			PoI
$\frac{\pi}{4}<\theta<\frac{\pi}{2}$	+	−	incr., concave ↓
$\frac{\pi}{2}$		−	local max.
$\frac{\pi}{2}<\theta<\frac{3\pi}{4}$	−	−	decr., concave ↓
$\frac{3\pi}{4}$			PoI
$\frac{3\pi}{4}<\theta<\pi$	−	+	decr., concave ↑
π		+	local min.
$\pi<\theta<\frac{5\pi}{4}$	+	+	incr., concave ↑
$\frac{5\pi}{4}$			PoI
$\frac{5\pi}{4}<\theta<\frac{3\pi}{2}$	+	−	incr., concave ↓
$\frac{3\pi}{2}$		−	local max.
$\frac{3\pi}{2}<\theta<\frac{7\pi}{4}$	−	−	decr., concave ↓
$\frac{7\pi}{4}$			PoI
$\frac{7\pi}{4}<\theta<2\pi$	−	+	decr., concave ↑
2π		+	local min.

$f(0) = 0$

$f(\frac{\pi}{2}) = 1$

$f(\pi) = 0$

$f(\frac{3\pi}{2}) = 1$

$f(2\pi) = 0$

(b) $f(t) = t + \cos t,\ 0 \le t \le 2\pi$

$f'(t) = 1 - \sin t$

$f'(t) = 0$ for $t = \frac{\pi}{2}$

$f''(t) = -\cos t$

$f''(t) = 0$ for $t = \frac{\pi}{2}, \frac{3\pi}{2}$

t-value	f'	f''	f
0			local min.
$0<t<\frac{\pi}{2}$	+	−	incr., concave ↓
$\frac{\pi}{2}$			PoI
$\frac{\pi}{2}<t<\frac{3\pi}{2}$	+	+	incr., concave ↑
$\frac{3\pi}{2}$			PoI
$\frac{3\pi}{2}<t<2\pi$	+	−	incr., concave ↓
2π			local max.

$f(0) = 1$

$f(2\pi) = 1$