4. (a) $\frac{d}{dx}(\cos x)^2 = 2\cos x(-\sin x) = -2\cos x \sin x$

(b) $\frac{d}{dx}\cos(x^2) = -\sin(x^2)(2x) = -2x\sin(x^2)$

(c) $\frac{d}{dx}(x(\tan x)^2) = (1)(\tan x)^2 + x(2\tan x(\sec^2 x)) = \tan^2 x + 2x\tan x\sec^2 x$

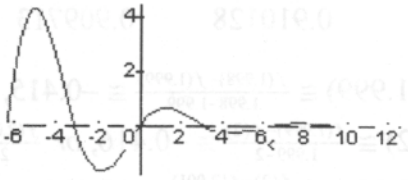
(d) $\frac{d}{dx}(\sin(x^4))^3 = 3(\sin(x^4))^2\cos(x^4)4x^3 = 12x^3\sin^2(x^4)\cos(x^4)$

(e) $\frac{d}{dx}(7[\cos(5x)+3]^x) = \frac{d}{dx}7e^{x\ln(\cos(5x)+3)} = 7e^{x\ln(\cos(5x)+3)}[\ln(\cos(5x)+3) + x\frac{1}{\cos(5x)+3}(-\sin(5x)5)]$

$= 7(\cos(5x)+3)^x[\ln(\cos(5x)+3) - \frac{5x\sin(5x)}{\cos(5x)+3}]$

5. (a) $f'(x) = (-0.3)e^{-0.3x}\sin x + e^{-0.3x}\cos x$

$= e^{-0.3x}(-0.3\sin x + \cos x)$ hence the critical points are when $\tan x = \frac{10}{3} \Rightarrow x \cong 1.28 + k\pi$



(b) $f(x)$ is not periodic

(d) Max value is attained at $x = \tan^{-1}(\frac{10}{3})$ of value $f(\tan^{-1}(\frac{10}{3})) = e^{-0.3\tan^{-1}(\frac{10}{3})}\sin(\tan^{-1}(\frac{10}{3}))$

The sin function oscillates but the exponential decreases as x increases so this function has its maximum at the first relative maximum.

7. (a) $\frac{d}{dx}u(x)\cos x = u'(x)\cos x - u(x)\sin x$

(b) $\frac{d}{dx}\tan(u(x)) = \sec^2(u(x))\frac{d}{dx}(u(x)) = \sec^2(u(x))u'(x)$

(c) $\frac{d}{dx}u(x)\tan x = u'(x)\tan x + u(x)\sec^2 x$

9. $\frac{d}{dx}\cos^2(\sin x) = 2\cos(\sin x)(-\sin(\sin x)\cos x) = -2\cos(\sin x)\sin(\sin x)\cos x$

15.(a) $y' = \frac{1\sin x - x\cos x}{\sin^2 x}$

(b) $y' = 9\tan^2(x^2)\sec^2(x^2)2x = 18x\tan^2(x^2)\sec^2(x^2)$

(c) $y' = \sec^2(\frac{x}{3})(\frac{1}{3})\sec(3x) + \tan(\frac{x}{3})\sec(3x)\tan(3x)3$

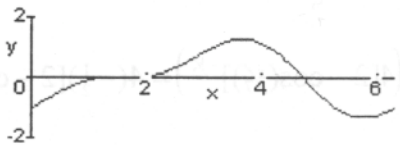
21.3 Applications

2. (a) $\cos x$ has period 2π, $\sin 2x$ has period π, so it also repeats in 2π, so f has period 2π.

(b) $f'(x) = \sin x + \cos 2x = \sin x + 1 - 2\sin^2 x = (1+2\sin x)(1-\sin x) = 0 \Leftrightarrow x = \frac{\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

f' + 0 + 0 - 0 +

$\frac{\pi}{2}$ $\frac{7\pi}{6}$ $\frac{11\pi}{6}$



$\frac{\pi}{2}$ is a stationary point, $\frac{7\pi}{6}$ is a global maximum point and $\frac{11\pi}{6}$ is a global minimum point.

6. $f' = e^x\sin x + e^x\cos x = e^x(\sin x + \cos x) = 0$

$\Leftrightarrow \tan x = -1 \Rightarrow x = \frac{3\pi}{4}, \frac{7\pi}{4}$