MATH 112 SOLUTIONS FOR 2.8, P. 186

1. The graphs coincide if a is about 2.7.
2. The graph looks a lot like that of $\cos x$.
3. (b) $2xe^x + x^2e^x$. (c) $-e^{-x}$. (d) $2e^{2x}$. (f) $e^{2x}(2\sin x + \cos x)$. (g) $2x\cos x - x^2 \sin x$. (h) $2\cos^2 x - 2\sin^2 x = 2\cos 2x$. (j) $2\sin x \cos x$. (k) $2(\cos^2 x - \sin^2 x) = 2\cos 2x$.
4. (c) $\dfrac{-3\sin x - 4x^2\cos x - 3x\cos x}{x^2\sin^2 x}$. (f) $2^x(1 + x\ln 2)$. (k) $e^{2x}10^x(2 + \ln 10)$.
5. (a) e^x. (c) $2^x(\ln 2)^2$. (d) $2e^x\cos x$. (e) $\sec x(\tan^2 x + \sec^2 x)$.
6. The first six derivatives of $\sin x$ are $\cos x, -\sin x, -\cos x, \sin x, \cos x, -\sin x$. Hence the fourth derivative of $\cos x$ is the fifth derivative of $\sin x$, which is $\cos x$.
7. $y' = (e^{2x})' = (e^x \cdot e^x)' = e^x \cdot e^x + e^x \cdot e^x = 2e^{2x}$; $y'' = (2e^{2x})' = 2(e^{2x})' = 2(2e^{2x}) = 2^2e^{2x}$; $y''' = (2^2e^{2x})' = 2^2(e^{2x})' = 2^2(2e^{2x}) = 2^3e^{2x}$; ... $y^{(n)} = 2^ne^{2x}$.
8.

$$\frac{d}{dx}(\cos x) = \lim_{h\to 0}\frac{\cos(x+h) - \cos x}{h} = \lim_{h\to 0}\frac{\cos x\cos h - \sin x \sin h - \cos x}{h}$$
$$= \lim_{h\to 0}\left[\frac{\cos h - 1}{h}\cdot\cos x - \sin x\cdot\frac{\sin h}{h}\right] = 0\cdot\cos x - \sin x \cdot 1 = -\sin x.$$

9.

$$\frac{d}{dx}(\tan x) = \frac{d}{dx}\left(\frac{\sin x}{\cos x}\right) = \frac{\cos x\cdot\cos x - \sin x(-\sin x)}{\cos^2 x}$$
$$= \frac{\cos^2 x + \sin^2 x}{\cos^2 x} = \frac{1}{\cos^2 x} = \sec^2 x.$$

11. $\frac{d}{dx}(\sec x) = \frac{d}{dx}(1/\cos x) = \frac{-(-\sin x)}{\cos^2 x} = \frac{1}{\cos x}\cdot\frac{\sin x}{\cos x} = \sec x\tan x$.
13. (f) $v = e^{-t}(-\sin t + \cos t), a = -2e^{-t}\cos t, v(0) = 1, a(0) = -2$.
14. (a) $v(t) = 1 - \cos t, a(t) = \sin t$. (b) $v(t) = 0, t > 0 \Rightarrow \cos t = 1 \Rightarrow t = 2\pi$. (c) $a(t) = 0, t > 0 \Rightarrow \sin t = 0 \Rightarrow t = \pi; v(\pi) = 2$.
15. (c) $y = \pi - x$. (f) $y = \frac{2}{e} - \frac{1}{e}x$.
18. $\frac{d}{dx}(\sinh x) = \frac{d}{dx}[\frac{1}{2}(e^x - \frac{1}{e^x})] = \frac{1}{2}(e^x - \frac{-e^x}{e^{2x}}) = \frac{1}{2}(e^x + e^{-x}) = \cosh x$, and similarly for $\cosh x$.