1. $f(x)=x-3\sin x \Rightarrow f'(x)=1-3\cos x$

3. $y=\sin x+10\tan x \Rightarrow y'=\cos x+10\sec^2 x$

5. $g(t)=t^3\cos t \Rightarrow g'(t)=t^3(-\sin t)+(\cos t)\cdot 3t^2=3t^2\cos t-t^3\sin t$ or $t^2(3\cos t-t\sin t)$

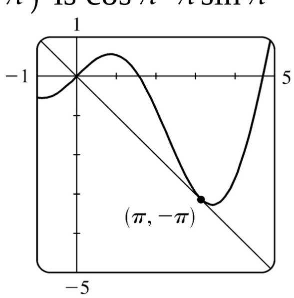
9. $y=\dfrac{x}{\cos x} \Rightarrow y'=\dfrac{(\cos x)(1)-(x)(-\sin x)}{(\cos x)^2}=\dfrac{\cos x+x\sin x}{\cos^2 x}$

17. $\dfrac{d}{dx}(\csc(x))=\dfrac{d}{dx}\left(\dfrac{1}{\sin x}\right)=\dfrac{(\sin x)(0)-1(\cos x)}{\sin^2 x}=\dfrac{-\cos x}{\sin^2 x}=-\dfrac{1}{\sin x}\cdot\dfrac{\cos x}{\sin x}=-\ x\cot x$

23. $y=x+\cos x \Rightarrow y'=1-\sin x$ . At $(0,1)$ , $y'=1$ , and an equation of the tangent line is $y-1=1(x-0)$ , or $y=x+1$.

24. $y=\dfrac{1}{\sin x+\cos x} \Rightarrow y'=-\dfrac{\cos x-\sin x}{(\sin x+\cos x)^2}$ [ Reciprocal Rule]. At $(0,1)$ , $y'=-\dfrac{1-0}{(0+1)^2}=-1$ , and an equation of the tangent line is $y-1=-1(x-0)$ , or $y=-x+1$.

25. **(a)** $y=x\cos x \Rightarrow y'=x(-\sin x)+\cos x(1)=\cos x-x\sin x$ . So the slope of the tangent at the point $(\pi,-\pi)$ is $\cos\pi-\pi\sin\pi=-1-\pi(0)=-1$ , and an equation is $y+\pi=-(x-\pi)$ or $y=-x$ .

**(b)** 


29. $f(x)=x+2\sin x$ has a horizontal tangent when $f'(x)=0 \Leftrightarrow 1+2\cos x=0 \Leftrightarrow \cos x=-\dfrac{1}{2} \Leftrightarrow$ $x=\dfrac{2\pi}{3}+2\pi n$ or $\dfrac{4\pi}{3}+2\pi n$ , where $n$ is an integer. Note that $\dfrac{4\pi}{3}$ and $\dfrac{2\pi}{3}$ are $\pm\dfrac{\pi}{3}$ units from $\pi$. This allows us to write the solutions in the more compact equivalent form $(2n+1)\pi\pm\dfrac{\pi}{3}$ , $n$ an integer.

31. **(a)** $x(t)=8\sin t \Rightarrow v(t)=x'(t)=8\cos t$

**(b)** The mass at time $t=\frac{2\pi}{3}$ has position $x\left(\frac{2\pi}{3}\right)=8\sin\frac{2\pi}{3}=8\left(\frac{\sqrt{3}}{2}\right)=4\sqrt{3}$ and velocity $v\left(\frac{2\pi}{3}\right)=8\cos\frac{2\pi}{3}=8\left(-\frac{1}{2}\right)=-4$. Since $v\left(\frac{2\pi}{3}\right)<0$, the particle is moving to the left.

35.

$$\begin{aligned}
\lim_{x\to 0}\frac{\sin 3x}{x} &= \lim_{x\to 0}\frac{3\sin 3x}{3x} && \text{[ multiply numerator and denominator by 3 ]}\\
&= 3\lim_{3x\to 0}\frac{\sin 3x}{3x} && \text{[ as } x\to 0\text{ , } 3x\to 0\text{ ]}\\
&= 3\lim_{\theta\to 0}\frac{\sin\theta}{\theta} && \text{[ let } \theta=3x\text{ ]}\\
&= 3(1) && \text{[ Equation 2]}\\
&= 3
\end{aligned}$$