Answers

1) $\frac{d}{dx}\left(\sin(x^2)\right) = \cos(x^2)\cdot 2x = 2x\cos(x^2)$

2) $\frac{d}{dx}\left(e^{x\cos x}\right) = e^{x\cos x}\cdot\frac{d}{dx}(x\cos x) = e^{x\cos x}\cdot(\cos x - x\sin x)$

3) $\frac{d}{dx}\left(\sin^2\left(\frac{n\pi x}{L}\right)\right) = 2\sin\left(\frac{n\pi x}{L}\right)\cdot\cos\left(\frac{n\pi x}{L}\right)\left(\frac{n\pi}{L}\right)$

$= 2\frac{n\pi}{L}\sin\left(\frac{n\pi x}{L}\right)\cos\left(\frac{n\pi x}{L}\right)$

4) $\frac{d}{dt}\left(\frac{1}{1+Ae^{-kt}}\right) = \frac{-1\cdot(Ae^{-kt})(-k)}{(1+Ae^{-kt})^2} = \frac{kAe^{-kt}}{(1+Ae^{-kt})^2}$

5) $\frac{d}{dp}\left(kp\left(1-\frac{p}{m}\right)\right) = \frac{d}{dp}\left(kp-\frac{k}{m}p^2\right) = k - \frac{k}{m}2p$

6) $\frac{d}{dt}\left(3e^{-\frac{t}{2}}\cos\left(\frac{\pi}{8}t\right)\right) = \frac{d}{dt}\left(3e^{-\frac{t}{2}}\right)\cdot\cos\left(\frac{\pi}{8}t\right) +$

$+ 3e^{-\frac{t}{2}}\frac{d}{dt}\left(\cos\left(\frac{\pi}{8}t\right)\right) =$

$= -\frac{3}{2}e^{-\frac{t}{2}}\cdot\cos\left(\frac{\pi}{8}t\right) + 3e^{-\frac{t}{2}}\cdot\left(-\sin\left(\frac{\pi}{8}t\right)\cdot\frac{\pi}{8}\right) =$

$= -\frac{3}{2}e^{-\frac{t}{2}}\cos\left(\frac{\pi}{8}t\right) - \frac{3\pi}{8}e^{-\frac{t}{2}}\sin\left(\frac{\pi}{8}t\right)$

7) $\frac{d}{dx}\left(\sin|x|\cdot\cos(2x)\right) = \cos|x|\cdot\frac{x}{|x|}\cdot\cos(2x) + \sin|x|(-\sin 2x\cdot 2)$

$= \frac{x}{|x|}\cos|x| - 2\sin|x|\sin 2x$ for all $x \neq 0$

8) $\frac{d}{dx}\left(\sqrt{\frac{x-1}{x+1}}\right) = \frac{1}{2}\left(\frac{x-1}{x+1}\right)^{-\frac{1}{2}} \cdot \left(\frac{1\cdot(x+1)-(x-1)\cdot 1}{(x+1)^2}\right) =$

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

9) $\frac{d}{dx}\left(a e^{-\frac{(x-\mu)^2}{2\sigma}}\right) = a \cdot e^{-\frac{(x-\mu)^2}{2\sigma}} \cdot \left(-\frac{1}{\cancel{2}\sigma}\cdot \cancel{2}(x-\mu)\right) =$

$= -\frac{a}{\sigma}(x-\mu)e^{-\frac{(x-\mu)^2}{2\sigma}}$

10) $\frac{d}{dt}\left(\frac{m_0}{\sqrt{1-\frac{[v(t)]^2}{c^2}}}\right) = \frac{d}{dt}\left(m_0\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}\right) =$

$= m_0\left(-\frac{1}{\cancel{2}}\right)\left(1-\frac{v^2}{c^2}\right)^{-3/2} \cdot \left(-\frac{\cancel{2}v}{c^2}\cdot\frac{dv}{dt}\right) =$

$= m_0 \frac{-\frac{v}{c^2}\frac{dv}{dt}}{\left(1-\frac{v^2}{c^2}\right)^{3/2}}$