Differentiate and simplify:

1) $f(x) = \ln(4 + 5x)$

$f(x) = \ln u$, $u = 4 + 5x$, $u' = 5$

$f'(x) = \frac{1}{u} \cdot u' = \boxed{\frac{5}{4+5x}}$

2) $h(x) = \ln\sqrt{4 + 5x}$

$h(x) = \ln u$, $u = \sqrt{4+5x}$

$h'(x) = \frac{1}{u} \cdot u'$, $u' = \frac{1}{2}(4+5x)^{-1/2} \cdot 5$

$= \boxed{\frac{5}{2(4+5x)}}$, $u' = \frac{5}{2\sqrt{4+5x}}$

3) $f(t) = \ln(3t + 1)^2$

$f(t) = \ln u$, $u = (3t+1)^2$

$f'(t) = \frac{1}{u} \cdot u'$, $u' = 2(3t+1) \cdot 3$

$= \boxed{\frac{6}{3t+1}}$, $u' = 6(3t+1)$

4) $g(t) = \ln^2(3t + 1)$

$g(t) = u^2$, $u = \ln(3t+1)$

$g'(t) = 2u \cdot u'$, $u' = \frac{3}{3t+1}$

$g'(t) = \boxed{\frac{6\ln(3t+1)}{3t+1}}$

5) $f(x) = \ln(\sqrt[3]{4 - x^2})$

$f(x) = \ln u$, $u = (4-x^2)^{1/3}$

$f'(x) = \frac{1}{u} \cdot u'$, $u' = \frac{1}{3}(4-x^2)^{-2/3} \cdot -2x$

$= \frac{1}{\sqrt[3]{4-x^2}} \cdot \frac{-2x}{3\sqrt[3]{(4-x^2)^2}}$, $u' = \frac{-2x}{3\sqrt[3]{(4-x^2)^2}}$

$= \boxed{\frac{-2x}{3\sqrt[3]{(4-x^2)^3}}}$ or $\boxed{\frac{-2x}{3(4-x^2)}}$

6) $f(y) = \ln(\sin 5y)$

$f(y) = \ln u$, $u = \sin 5y$

$f'(y) = \frac{1}{u} \cdot u'$, $u' = 5\cos 5y$

$= \frac{5\cos 5y}{\sin 5y}$ or $\boxed{5\cot 5y}$

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

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

$f'(x) = -\sin u \cdot u'$, $u' = \frac{1}{x}$

$= \boxed{\frac{-\sin(\ln x)}{x}}$

8) $G(x) = \ln(\sec 2x + \tan 2x)$

$G(x) = \ln u$, $u = \sec 2x + \tan 2x$

$G'(x) = \frac{1}{u} \cdot u'$, $u' = 2\sec 2x \tan 2x + 2\sec^2 2x$

$= \frac{2\sec 2x(\tan 2x + \sec 2x)}{\sec 2x + \tan 2x} = \boxed{2\sec 2x}$

9) $f(x) = \ln\sqrt{\tan x}$

$f(x) = \ln u$, $u = \sqrt{\tan x}$

$f'(x) = \frac{1}{u} \cdot u'$, $u' = \frac{1}{2}(\tan x)^{-1/2} \cdot \sec^2 x$

$= \boxed{\frac{\sec^2 x}{2\tan x}}$ or $\boxed{\frac{1}{2\sin x \cos x}}$, $u' = \frac{\sec^2 x}{2\sqrt{\tan x}}$

10) $f(w) = \ln\left(\frac{3w+1}{2w-5}\right)$, $u = \frac{3w+1}{2w-5}$

$f(w) = \ln u$

$f'(w) = \frac{1}{u} \cdot u'$, $u' = \frac{3(2w-5) - 2(3w+1)}{(2w-5)^2}$

$= \frac{2w-5}{3w+1} \cdot \frac{-17}{(2w-5)^2}$, $u' = \frac{-17}{(2w-5)^2}$

$= \boxed{\frac{-17}{(3w+1)(2w-5)}}$

11) $f(x) = \frac{x}{\ln x}$ → Quotient Rule

$\frac{x}{\ln x}$

$f'(x) = \frac{\ln x - (x \cdot \frac{1}{x})}{\ln^2 x}$

$= \boxed{\frac{\ln x - 1}{\ln^2 x}}$