II. (32 points. 8 points each.) Differentiate the following functions. DO NOT perform any "algebraic" manipulations to "simplify" your answers.

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

2) $f(x) = \dfrac{e^{3x}}{\ln(x^2+1)}$ $\qquad \dfrac{(3e^{3x})(\ln(x^2+1)) - \left(\frac{2x}{x^2+1}\right)(e^{3x})}{(\ln(x^2+1))^2}$

3) $f(x) = (1+x^2)^x = \left(e^{\ln(1+x^2)}\right)^x = e^{\overbrace{x[\ln(1+x^2)]}^{u}} = e^u$

$f'(x) = e^u \frac{du}{dx} = (1+x^2)^x \left[1 \cdot (\ln(1+x^2)) + x \cdot \frac{2x}{1+x^2}\right]$

4) $f(x) = \int_{x^2}^{e^x} \underbrace{[\sec(u^3)]}_{H'(u)} du = H(e^x) - H(x^2)$

$f'(x) = (H'(e^x))(e^x)' - (H'(x^2))(x^2)'$

$= [\sec((e^x)^3)] \cdot e^x - [\sec((x^2)^3)] \cdot 2x$

III. (44 points. Each part valued as marked.) Perform the following antidifferentiations. SHOW YOUR WORK!

1) (8 points.) $\int \frac{5dx}{9+4x^2} = ?$ $\quad \frac{5}{9}\int \frac{dx}{1+\frac{4}{9}x^2} = \frac{5}{9}\int \frac{dx}{1+\left(\frac{2}{3}x\right)^2}$

$= \frac{5}{9}\int \frac{\frac{3}{2}du}{1+u^2} = \frac{5}{6}\tan^{-1}u + C$

$= \frac{5}{6}\tan^{-1}\left(\frac{2}{3}x\right) + C$

$\frac{2}{3}x = u$

$\frac{2}{3}dx = du$

$dx = \frac{3}{2}du$