All work must be shown to be awarded full credit.
Provide exact solutions to all problems, unless otherwise stated. A scientific calculator is allowed.

Student Name: KEY **ID:**_____
Instructor: _____

Exam Score: _____

1. Find the first derivative of the following functions.

   a. $f(x) = \arctan x^3$

$$f'(x) = \frac{3x^2}{1+(x^3)^2} = \frac{3x^2}{1+x^6}$$

   b. $g(x) = \int_0^{\sin x} \sqrt{t^2+1}\, dt$

$$g'(x) = \cos x \sqrt{\sin^2 x + 1}$$

   c. $f(x) = 7^{x^3} \cdot \sinh x$

$$f'(x) = 3x^2(\ln 7)\, 7^{x^3} \sinh x + 7^{x^3} \cosh x$$

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2. Find the indefinite integrals.

a. $\int \frac{6}{9+25x^2}dx$

$u^2 = 25x^2$, $u = 5x$, $a = 3$

$du = 5dx$

$\frac{1}{5}du = dx$

$$\frac{1}{5}\int \frac{6}{3^2+u^2}du = \frac{6}{5}\left(\frac{1}{3}\right)\arctan\frac{u}{3} + C$$

$$= \frac{2}{5}\arctan\left(\frac{5x}{3}\right) + C$$

b. $\int \frac{x^3-2x^2+3}{x-2}dx$

2	1	-2	0	3
		2	0	0
	1	0	0	3

$$\int x^2 + \frac{3}{x-2}dx = \frac{1}{3}x^3 + 3\ln|x-2| + C$$

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3. Find the derivative of the following function using logarithmic differentiation.

$$y = \frac{x^2\sqrt{3x+2}}{(x^2-1)^2}, \qquad x > -\frac{2}{3}$$

$$\ln y = \ln\left[\frac{x^2(3x+2)^{1/2}}{(x^2-1)^2}\right]$$

$$\ln y = 2\ln x + \frac{1}{2}\ln(3x+2) - 2\ln(x^2-1)$$

$$\frac{y'}{y} = \frac{2}{x} + \frac{1}{2}\left(\frac{3}{3x+2}\right) - 2\left(\frac{2x}{x^2-1}\right)$$

$$y' = \frac{x^2\sqrt{3x+2}}{(x^2-1)^2}\left[\frac{2}{x} + \frac{3}{6x+4} - \frac{4x}{x^2-1}\right]$$

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4. Find the area under the curve $f(x) = e^{\cot x}(\csc x)^2$ between $x = \frac{\pi}{4}$ and $x = \frac{\pi}{2}$.

$$A = \int_{\pi/4}^{\pi/2} e^{\cot x}(\csc^2 x)\,dx$$

$u = \cot x$

$du = -\csc^2 x\,dx$

$-du = \csc^2 x\,dx$

$$-\int_1^0 e^u\,du = \int_0^1 e^u\,du = e^u\Big|_0^1$$

$$= e - e^0 = e - 1$$