Math 252: Quiz 1 **Spring 2026**

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24 points possible; each part is worth 2 points. No aids (book, notes, calculator, phone, etc.) are permitted. Show all work and use proper notation for full credit.

1. [12 points] Compute the derivatives of the following functions.

a. $f(x) = x^2 e^{x^2+1} + x + 1$

$$f'(x) = \left(2x e^{x^2+1} + x^2 \cdot 2x \cdot e^{x^2+1}\right) + 1$$

$$= (2x + 2x^3) e^{x^2+1} + 1$$

b. $f(x) = \tan(2x) + \sin^2(x)\cos(x)$

$$f'(x) = 2\sec^2(2x) + 2\sin(x)\cos(x) \cdot \cos(x) + \sin^2(x)(-\sin(x))$$

$$= 2\sec^2(2x) + 2\sin(x)\cos^2(x) - \sin^3(x)$$

c. $f(x) = \dfrac{3x^2 - 1}{\ln(x^2+1)}$

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

d. $f(x) = \sqrt{x + \sin^2(x^2)}$

$$f'(x) = \frac{1}{2}\left(x + \sin^2(x^2)\right)^{-1/2}\left(1 + 2\sin(x^2)\cos(x^2)\cdot 2x\right)$$

e. $f(x) = e^{1/x} - \frac{x^2}{2} + \frac{2}{\sqrt{x}}$

$$f'(x) = \left(-\frac{1}{x^2}\right)e^{1/x} - x + 2\cdot\left(-\frac{1}{2}\right)x^{-3/2}$$

$$= -\frac{e^{1/x}}{x^2} - x - \frac{1}{x^{3/2}}$$

f. $f(x) = \ln(a + b^{2x})$ where a and b are constants

$$f'(x) = \frac{1}{a + b^{2x}}\cdot(\ln b)\, b^{2x}\cdot 2$$

2. [12 points] Compute the following antiderivatives (indefinite integrals) and definite integrals. Remember that antiderivatives need a "$+C$".

a. $\int_0^\pi 4e^x + \cos(x)\,dx$ $= \left[4e^x + \sin x\right]_0^\pi$

$= \left(4e^\pi + \sin \pi\right) - \left(4e^0 + \sin 0\right)$

$= 4e^\pi - 4$

b. $\int_0^3 (x+2)(x-3)\,dx$ $= \int_0^3 x^2 - x - 6\;dx$

$= \left[\frac{1}{3}x^3 - \frac{1}{2}x - 6x\right]_0^3$

$= 9 - \frac{9}{2} - 18 \quad = -\frac{27}{2}$

c. $\int 2x^3\sqrt{x^2+1}\,dx$ $u = x^2+1$, $du = 2x\,dx$, $x^2 = u-1$

$= \int (u-1)\sqrt{u}\,du$

$= \int u^{3/2} - u^{1/2}\;du$

$= \frac{2}{5}u^{5/2} - \frac{2}{3}u^{3/2} + C \quad = \frac{2}{5}\left(x^2+1\right)^{5/2} - \frac{2}{3}(x^2+1)^{3/2} + C$

d. $\int_0^{\pi/3} \sec^2(x)\tan(x)\,dx$

$u = \sec(x)$, $du = \sec(x)\tan(x)\,dx$

$\sec(0) = \frac{1}{\cos 0} = 1$

$\sec(\pi/3) = \frac{1}{\cos \pi/3} = \frac{1}{1/2} = 2$

$= \int_1^2 u\,du$

$= \left[\frac{1}{2}u^2\right]_1^2$

$= \frac{1}{2}\cdot 2^2 - \frac{1}{2}\cdot 1^2 = 2 - \frac{1}{2} = \frac{3}{2}$

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e. $\int \frac{e^x}{1+e^{(2x)}}\,dx$

$u = e^x$, $du = e^x du$

$= \int \frac{1}{1+u^2}\,du$

$= \arctan(u) + C = \arctan(e^x) + C$

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f. $\int \tan(2x)\,dx$

$= \int \frac{\sin(2x)}{\cos(2x)}\,dx$

$u = \cos(2x)$, $du = -2\sin(2x)\,dx$

$= \int -\frac{1}{2u}\,du$

$= -\frac{1}{2}\ln|u| + C = -\frac{1}{2}\ln|\cos(2x)| + C$

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