Quiz 4: FTC1 and FTC2

Instructions: write your solutions to the following two questions on separate sheets of paper. Show all work to receive credit. You will have 25 minutes to complete the Quiz and 10 minutes to upload your solutions to the Crowdmark assessment "Quiz 4" located in the Assignments tab of the **Discussion** iLearn.

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(1) [3pts] Compute

$$\frac{d}{dx}\int_{2x}^{3x} \tan t dt.$$

(a) Using Theorem 5.2.1 explain why:

$$\int_{2x}^{3x} \tan t dt = \int_{0}^{3x} \tan t dt - \int_{0}^{2x} \tan t dt.$$

(b) Using FTC1 and the chain rule, compute

$$\frac{d}{dx}\int_{0}^{2x} \tan t dt \text{ and } \frac{d}{dx}\int_{0}^{3x} \tan t dt.$$

(c) Combining your answers to (a) and (b) compute

$$\frac{d}{dx}\int_{2x}^{3x} \tan t dt.$$

(2) [3pts] Evaluate $\displaystyle\int_{\pi}^{2\pi} \left(2\cos x - \frac{3}{x}\right) dx.$

(a) Using Theorem 5.1.2 evaluate $\displaystyle\int \left(2\cos x - \frac{3}{x}\right) dx.$

(b) Using FTC2 evaluate $\displaystyle\int_{\pi}^{2\pi} \left(2\cos x - \frac{3}{x}\right) dx.$

Theorem 5.2.1 Properties of the Definite Integral

Let f and g be defined on a closed interval I that contains the values a, b and c, and let k be a constant. The following hold:

1. $\displaystyle\int_a^a f(x)\,dx = 0$
2. $\displaystyle\int_a^b f(x)\,dx + \int_b^c f(x)\,dx = \int_a^c f(x)\,dx$
3. $\displaystyle\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$
4. $\displaystyle\int_a^b \big(f(x) \pm g(x)\big)\,dx = \int_a^b f(x)\,dx \pm \int_a^b g(x)\,dx$
5. $\displaystyle\int_a^b k\cdot f(x)\,dx = k\cdot\int_a^b f(x)\,dx$

Theorem 5.1.2 Derivatives and Antiderivatives

Common Differentiation Rules	Common Indefinite Integral Rules
1. $\frac{d}{dx}\big(cf(x)\big) = c \cdot f'(x)$	1. $\int c \cdot f(x)\,dx = c \cdot \int f(x)\,dx$
2. $\frac{d}{dx}\big(f(x) \pm g(x)\big) = f'(x) \pm g'(x)$	2. $\int \big(f(x) \pm g(x)\big)\,dx = \int f(x)\,dx \pm \int g(x)\,dx$
3. $\frac{d}{dx}\big(C\big) = 0$	3. $\int 0\,dx = C$
4. $\frac{d}{dx}\big(x\big) = 1$	4. $\int 1\,dx = \int dx = x + C$
5. $\frac{d}{dx}\big(x^n\big) = n \cdot x^{n-1}$	5. $\int x^n\,dx = \frac{1}{n+1}x^{n+1} + C \quad (n \neq -1)$
6. $\frac{d}{dx}\big(\sin x\big) = \cos x$	6. $\int \cos x\,dx = \sin x + C$
7. $\frac{d}{dx}\big(\cos x\big) = -\sin x$	7. $\int \sin x\,dx = -\cos x + C$
8. $\frac{d}{dx}\big(\tan x\big) = \sec^2 x$	8. $\int \sec^2 x\,dx = \tan x + C$
9. $\frac{d}{dx}\big(\csc x\big) = -\csc x \cot x$	9. $\int \csc x \cot x\,dx = -\csc x + C$
10. $\frac{d}{dx}\big(\sec x\big) = \sec x \tan x$	10. $\int \sec x \tan x\,dx = \sec x + C$
11. $\frac{d}{dx}\big(\cot x\big) = -\csc^2 x$	11. $\int \csc^2 x\,dx = -\cot x + C$
12. $\frac{d}{dx}\big(e^x\big) = e^x$	12. $\int e^x\,dx = e^x + C$
13. $\frac{d}{dx}\big(a^x\big) = \ln a \cdot a^x$	13. $\int a^x\,dx = \frac{1}{\ln a} \cdot a^x + C$
14. $\frac{d}{dx}\big(\ln x\big) = \frac{1}{x}$	14. $\int \frac{1}{x}\,dx = \ln\lvert x\rvert + C$