# 2010 TCU Calculus Bee 

Friday, April 23, 2010
Winners:

| First Place | Yajing Yang |
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| Second Place | Brian Preskitt |
| Third Place | Wenting Yu |

1. Evaluate $\frac{d}{d x}\left(e^{2010 \cdot T \cdot C \cdot U \cdot x}\right)$, where $T, C$, and $U$ are positive constants.
2. Evaluate $\int_{0}^{2 \pi} \sin ^{2}(2010 x) d x$.
3. Find and simplify $\frac{d}{d x}(\sin x \cdot \cos x \cdot \tan x \cdot \cot x \cdot \sec x \cdot \csc x)$ for $0<x<\pi / 2$.
4. Find $\int_{e^{3}}^{e^{5}} \frac{5}{x} d x$, and simplify your answer.
5. Find $\frac{d^{2010}}{d x^{2010}}\left(\left(x^{2}+1\right)^{1004}\right)$.
6. Suppose $\sum_{n=2}^{\infty}\left(c \cdot 3^{-n}\right)=2$. Find $c$.
7. Evaluate $\int\left(\frac{x^{2}+1}{x}\right)^{-1} d x$.
8. Let $G(x)=(x-1)(x-2) \cdots(x-2009)(x-2010)$. Find $G^{\prime}(2010)$.
9. Find the maximum area of a rectangle in the first quadrant with one corner being the origin and the opposite corner on the curve $y=\frac{1}{1+2 x^{2}}$.
10. Find the $x$-value of the point on $y=x^{2}$ where its tangent line is perpendicular to the tangent line at the point $(3,9)$.
11. Evaluate $\int 2^{\ln x} d x$.
12. Evaluate $\lim _{n \rightarrow \infty}\left(\sin \frac{\pi}{n}+\cos \frac{\pi}{n}\right)^{n}$.
13. Find the value of $p$ that maximizes $p^{2003}(1-p)^{2010}$ on the interval $0 \leq p \leq 1$.
