

**2010 TCU Calculus Bee**  
**Friday, April 23, 2010**

**Winners:**

<i>First Place</i>	<i>Yajing Yang</i>
<i>Second Place</i>	<i>Brian Preskitt</i>
<i>Third Place</i>	<i>Wenting Yu</i>

1. Evaluate  $\frac{d}{dx}(e^{2010 \cdot T \cdot C \cdot U \cdot x})$ , where  $T$ ,  $C$ , and  $U$  are positive constants.
2. Evaluate  $\int_0^{2\pi} \sin^2(2010x) dx$ .
3. Find and simplify  $\frac{d}{dx}(\sin x \cdot \cos x \cdot \tan x \cdot \cot x \cdot \sec x \cdot \csc x)$  for  $0 < x < \pi/2$ .
4. Find  $\int_{e^3}^{e^5} \frac{5}{x} dx$ , and simplify your answer.
5. Find  $\frac{d^{2010}}{dx^{2010}}((x^2 + 1)^{1004})$ .
6. Suppose  $\sum_{n=2}^{\infty} (c \cdot 3^{-n}) = 2$ . Find  $c$ .
7. Evaluate  $\int \left( \frac{x^2 + 1}{x} \right)^{-1} dx$ .
8. Let  $G(x) = (x - 1)(x - 2) \cdots (x - 2009)(x - 2010)$ . Find  $G'(2010)$ .
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  $y = \frac{1}{1+2x^2}$ .
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  $\int 2^{\ln x} dx$ .
12. Evaluate  $\lim_{n \rightarrow \infty} (\sin \frac{\pi}{n} + \cos \frac{\pi}{n})^n$ .
13. Find the value of  $p$  that maximizes  $p^{2003}(1 - p)^{2010}$  on the interval  $0 \leq p \leq 1$ .