# Custom Calculus Test Solutions

## Solution to Problem 1

Find the derivative of: $\sin(\pi x)$

$$\pi \cos(\pi x)$$

## Solution to Problem 2

Find the derivative of: $\cot(x)$

$$-\frac{1}{\sin^2(x)}$$

## Solution to Problem 3

Find the derivative of: $\frac{1}{x^2}$

$$-\frac{2}{x^3}$$

## Solution to Problem 4

Find the derivative of: $\frac{1}{x^2}$

$$-\frac{2}{x^3}$$

## Solution to Problem 5

Find the integral of: $\frac{1}{x^2+1}$

$$\operatorname{atan}(x) + C$$

## Solution to Problem 6

Find the integral of: $\frac{1}{x}$

$$\log(x) + C$$

## Solution to Problem 7

Use U-substitution to find the integral of: $(2x+1)^3$

$$x\left(2x^3 + 4x^2 + 3x + 1\right) + C$$

## Solution to Problem 8

Use U-substitution to find the integral of: $(2x+1)^3$

$$x\left(2x^3+4x^2+3x+1\right)+C$$

## Solution to Problem 9

Use U-substitution to find the integral of: $e^{2x}$

$$\frac{e^{2x}}{2}+C$$

## Solution to Problem 10

Use U-substitution to find the integral of: $\sin(2x)$

$$-\frac{\cos(2x)}{2}+C$$

## Solution to Problem 11

Use integration by parts to find the integral of: $xe^x$

$$(x-1)\,e^x+C$$

## Solution to Problem 12

Find the integral of the trigonometric function: $\sin(x)\cos(x)$

$$\frac{\sin^2(x)}{2}+C$$

## Solution to Problem 13

Use trigonometric substitution to find the integral of: $\sqrt{x^2-1}$

$$\frac{x\sqrt{x^2-1}}{2}-\frac{\operatorname{acosh}(x)}{2}+C$$

## Solution to Problem 14

Use partial fractions to find the integral of: $\frac{1}{x^2+1}$

$$\operatorname{atan}(x)+C$$

## Solution to Problem 15

Find the improper integral of: $\frac{1}{x^2+1}$ from 1 to $\infty$

$$\frac{\pi}{4}$$

## Solution to Problem 16

Find the limit of: $\frac{1}{x+1}$ as $x$ approaches 1

$$\frac{1}{2}$$