Question 1

Let A be $\lim\limits_{x\to 2}\dfrac{x^3-5x^2+2x-4}{x^2-3x+3}$

Let B be $\lim\limits_{x\to 0}\dfrac{x}{\sqrt{x+2}-\sqrt{2}}$

Let C be $\lim\limits_{x\to -\infty}\dfrac{4x+5}{\sqrt{x^2+5}}$

Let D be $\lim\limits_{x\to 2}\dfrac{\sqrt{x^2+5}-3}{x^2+x-6}$

Find $A+B\sqrt{2}+C+30D$.

Question 2

Let $A = f'(-3)$ where $f(x) = \dfrac{x^2 - 3}{x + 4}$

Let $B = f'(-2)$ where $f(x) = \dfrac{x^3 + 2}{(x + 3)^2}$

Let $C = f'(-2)$ where $f(x) = (x^4 + 3x^3 + 2x^2 + x + 1)^3$

Let $D = f'(\frac{\pi}{6})$ where$f(x) = 12\cos(x)$

Find $A + B + C + D$.

Question 3

Let A be the 2012th derivative of $\cos(x)$ with respect to x

Let B be the 2010th derivative of $\sin(x)$ with respect to x

Let C be the 2011th derivative of $\cos(x)$ with respect to x

Let D be the 4th derivative of $e^x \sin(x)$ with respect to x

Find $A + B + C + D$.

Question 4

Let A be the area of the region in the coordinate plane bounded by the graphs of $y = x^2$ and $y = 2x$.

Let B be the arc length of $y = \frac{2}{3}(1 + x^2)^{3/2}$ for $0 \leq x \leq 4$

Let C be the area of the region in the coordinate plane bounded by the graphs of $y = x^2 - 4x$ and $x + y = 0$

Let D be the arc length of $y = \ln(\sec x)$ for $0 \leq x \leq \frac{\pi}{3}$

Find $3B - 6A - 2C + D$.

Question 5

Evaluate

$$\lim_{n\to\infty}\left[\int_0^1 |\cos(nt)|\,dt\right]$$

using the substitution $u = nt$.

Question 6

Farmer Daniel wishes to fence in a rectangular field of $10,000$ ft^2. The fences have to be oriented in the cardinal directions. The north-south fences cost \$3.00 per foot, while the east-west fences cost \$12.00 per foot. Find the dimensions of the field that will minimize the cost. Let A feet be the length of the east-west dimension and let B feet be the length of the north-south dimension.

Farmer Tarun also owns a rectangular field of $10,000$ ft^2. He wants to fence an area for his pet cow Moo-Moo. However, farmer Tarun only has 30 feet of wire to form a rectangular fence for his Moo-Moo. What dimensions should the rectangle have to maximize the area? Let C by D be the dimensions of the fence in any order.

Find $A + B + C + D$.

Question 7

Let $A = \int_1^3 (x + x^2)dx$

Let $B = \int_1^5 \frac{x+3}{x^2+6x+5}dx$

Find $6(A + B)$.

Question 8

Consider the functions $f(x) = 4x^3 - 16x^2 + 3$ and $g(x) = 4x^2 - 7x + 3$.

Let A be the absolute minimum of the function $f(x)$ in the interval $[-1, 0]$

Let B be the absolute maximum of the function $f(x)$ in the interval $[-1, 0]$

Let C be the absolute minimum of the function $g(x)$ in the interval $[-2, 3]$

Let D be the absolute maximum of the function $g(x)$ in the interval $[-2, 3]$

Evaluate $A + B + 32C + D$

Question 9

Mr. Harrington decides to compete in the annual Sopchoppy Punkin' Chunkin' contest. His task is to hurl a pumpkin as far as he can. He uses his pumpkin cannon to launch his pumpkin in the following manner:

- At an initial speed of 100 meters/second
- At a 45-degree angle to the ground
- From an initial height of 0 meters

In addition, the wind is blowing at a constant rate from in front of the pumpkin, such that the pumpkin's horizontal position is decelerating at a rate of 4 m/s^2.

Assuming the acceleration due to gravity is 10 m/s^2 downward, and that the wind and gravity are the only forces acting on the pumpkin, how far, in meters, (horizontal distance) will the pumpkin travel before it hits the ground?

Question 10

Exactly how many of the following are true?

a. If a function f is continuous on $[a, b]$, $f(a) < 0$, and $f(b) > 0$, then f has a root in $[a, b]$.

b. If a function f is differentiable at a certain point, then f is continuous at that point.

c. If a function f is continuous on an open interval (a, b), then f is bounded on (a, b).

d. If a function f has domain $[a, b]$, then there exists a point in (a, b) at which f is continuous.

Question 11

Using a 4th-degree Taylor polynomial centered at 0 to approximate the integrand, approximate the value of

$$\int_0^2 e^{-x^2}\,dx.$$

Question 12

If the series converges, let the value of the corresponding letter equal -3. If the series diverges, let the value of the corresponding letter equal 5.

$A: \quad \sum_{n=1}^{\infty} \frac{1}{n^p}$ when $0 < p \leq 1$

$B: \quad \sum_{n=1}^{\infty} \frac{1}{\sqrt{n^3+3}}$

$C: \quad \sum_{n=2}^{\infty} \frac{1}{n(\ln n)^2}$

$D: \quad \sum_{n=1}^{\infty} \frac{n^2}{e^n}$

Find the value of $A + B + C + D$.

Question 13

Find the derivative of the function $f(x) = x^2 + 2x + 1$ with respect to x.

Question 14

Find $f''(x)$ if $f(x) = x^3 + 2x$.