Name: ________________________________

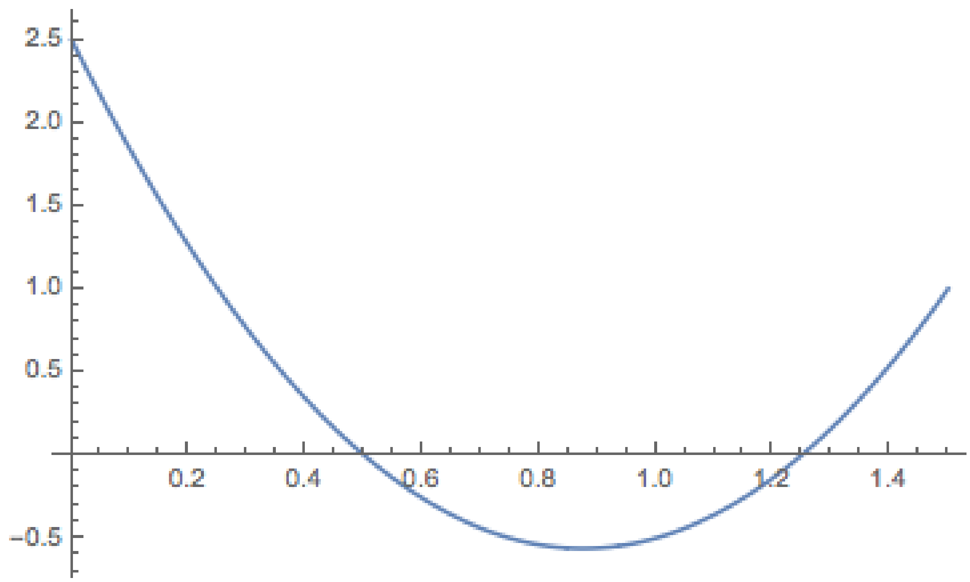
1. (1A,1B) Simplify $f(x) = \dfrac{x^2+2x-3}{2x^2-3x+1}$, and evaluate $\lim_{x\to 0} f(x)$.

2. (1C) Find the linearization of $f(x) = \dfrac{x^2+2x-3}{2x^2-3x+1}$ at $x=1$.

3. (1D) Convert the following limerick to an equation, and check its veracity.

   Integral zee squared dee zee
   From one to the cube root of three
   Times the cosine
   of three pi over nine
   Is the log of the cube root of e.

4. (2A) The function $g(x)$ is shown below. Sketch the graph of $G(x) = \int_0^x g(t)\,dt$.



5. (2B) How much area is in the region enclosed between $y = x^2 - 2x + 4$ and $y = 2x + 1$.

6. (2C) Let R be the region below $y = (x-1)(x-4)$, above $y = 0$, and between $x = 1$ and $x = 4$. Rotate the region R around the y-axis. What is the volume of the resulting solid?

7. (2D) What is the average value of $y = x(x-1)$ on the interval $[0,1]$?

8. (2E) Write an integral for the arc length of $y = x(x-1)$ between $(0,0)$ and $(1,0)$.

9. (2F) Use the integral test for sums to decide if $\sum_{n=1}^{\infty} \frac{\log n}{n}$ converges.

10. (3A) Evaluate $\int_1^e \frac{\log x}{x}\,dx$, and simplify your answer.

11. (3B) Use integration by parts to evaluate $\int (x+1)\log(x)\,dx$.

12. (3C) Evaluate $\int \sin^2 t \cos^2 t \, dt$.

13. (3D) Use trigonometric substitution to evaluate $\int_{1/4}^{1/3} \sqrt{1+9x^2}\, dx$.

14. (3E) Compute the partial fraction decomposition of $f(x) = \dfrac{x^2-3}{2x^2-3x+1}$.

15. (3F) Evaluate $\int_{-1}^{1} \frac{2dx}{(x-1)^2}$.

16. (4A) Use L'Hôpital's Rule to evaluate $\lim_{x\to\infty} \frac{e^{-x^2}}{1/\log(x)}$.

17. (4A) Consider the sequence $3, \frac{5}{4}, \frac{7}{9}, \frac{9}{16}, \frac{11}{25}, \frac{13}{36}, \frac{15}{49}, \ldots$. Write an expression for the n-th term.

18. (4B) Let $S = \sum_{n=3}^{\infty} \frac{\log\log n}{\log n}$. Write out the first 3 terms, and the first 3 partial sums.

19. (4C) Describe each of the following sequences.
    (a) $\sum_{n=1}^{\infty} \frac{1}{n}$
    (b) $\sum_{n=0}^{\infty} \frac{6}{3^n}$
    (c) $\sum_{n=1}^{\infty} \frac{1}{n^\pi}$
    (d) $\sum_{n=1}^{\infty} \left(\frac{2}{17}n + 12\right)$

20. (4D) Use the Direct Comparison Test to show that $\sum_{n=1}^{\infty} \frac{n-1}{n^3+3n+1}$ converges.

21. (4E) Use the Limit Comparison Test to show that $\sum_{n=1}^{\infty} \frac{n-1}{n^3+3n+1}$ converges.

22. (4F) Does the sequence $\sum_{n=1}^{\infty} \sum_{n=1}^{\infty} (-1)^n \frac{1}{n}$ converge conditionally, converge absolutely, or diverge?

23. (4G) Does the sequence $\sum_{r=2}^{\infty} \frac{4^r r^4}{r!}$ converge?

24. (4H) Does the sequence $\sum_{x=3}^{\infty} \left(\frac{x^2+2x-3}{2x^2-3x+1}\right)^x$ converge?

25. (4I) Let $S = \sum_{n=0}^{\infty} a_n$. Define the partial sum of S. Define S. Explain the difference between "S *converges conditionally*" and "S *converges absolutely*."

26. (5A) Find the degree 3 Taylor Polynomial approximation to $f(x) = \log(x)$ at $x = e$.

27. (5B) Find the power series of $f(x) = \exp(x-1)$ with center 0.

28. (5C) What is the radius of convergence of $R(x) = \sum_{n=0}^{\infty} \frac{n!^2}{(2n)!} x^n$.

29. (5D) Use power series to estimate $\int_0^{\pi} \frac{\sin x}{x}\, dx$.

30. (5E) Find the power series (up to degree 4) of the function $f(x)$ that satisfies $f'(x) - \frac{1}{2} f(x) = 1 + x$ and $f(0) = 2017$.

31. (6A) Give a parametric equation for the circle with radius 3 and center $(1, 2)$.

32. (6B) Let $r = \cos\theta + \sin\theta$. Make a table of values of r and plot the curve.