1. (30 points) Evaluate the following integrals.

(a) $\displaystyle\int \frac{\sqrt{x^9} + 4x^3 \tan x - 6x^2 + 5}{2x^3}\,dx$

(b) $\displaystyle\int_0^{\pi} x^2 \sin(3x)\,dx$

(c) $\displaystyle\int_{-2}^{4} |6 - 2x|\,dx$

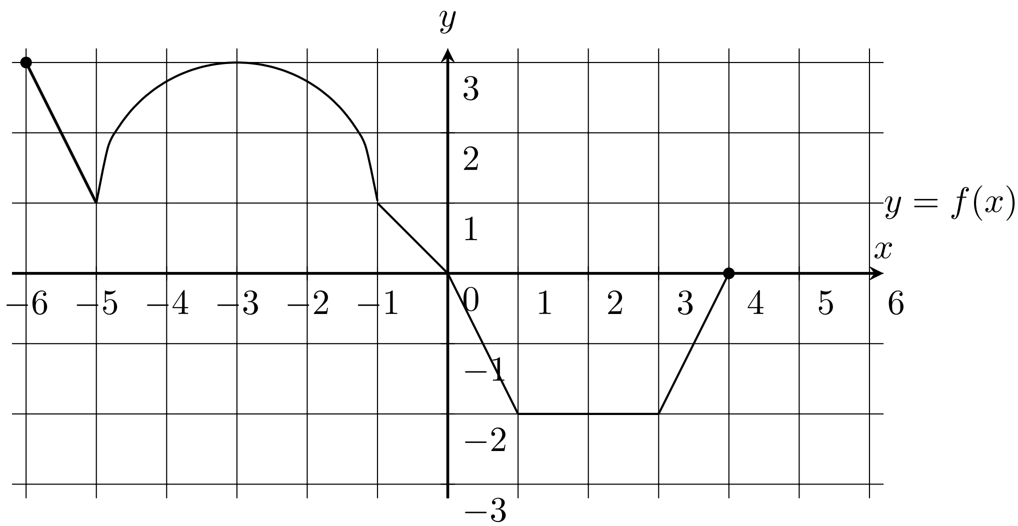
(d) $\displaystyle\int \frac{-3x^2 + 4x + 5}{(2x+1)(x+2)^2}\,dx$

(e) $\displaystyle\int \frac{\csc^2(3x)}{\sqrt{\cot(3x)+1}}\,dx$

(f) $\displaystyle\int \frac{\cos(\ln(3x))}{x}\,dx$

2. (4 points) Approximate $\displaystyle\int_1^3 \sqrt[4]{x^2 + 3x}\,dx$ using a Riemann sum with right endpoints and $n = 3$ rectangles. Round your answer to 4 decimals.

3. (3 points) Given the graph of function f below, find the following



(a) $\displaystyle\int_{-6}^{-1} f(x)\,dx$

(b) $\displaystyle\int_{-1}^{4} f(x)\,dx$

(c) $\displaystyle\int_{4}^{-1} 3f(x)\,dx$

4. (6 points) Find the area of the region enclosed by the curves $f(x) = -x^2 - 2x + 5$ and $g(x) = x^2 - 7$.

5. (6 points) The weekly demand function of a product is $p = \dfrac{49}{\sqrt{2x+3}}$, and the supply function is $p = \sqrt{2x+3}$.

(a) Find the equilibrium point.

(b) Evaluate the consumers' surplus.

6. (5 points) Solve the differential equation for y given $2x\dfrac{dy}{dx} = 2x^2y^2 + 4y^2$, with initial condition $y(1) = 2$.

7. (6 points) The rate at which a social media post gains likes is proportional to the square root of the current number of likes of the post. If a post starts with 100 likes and gains 50 likes in the first hour, find the equation for the like accumulation function $L(t)$ and determine the time it takes for the post to reach 500 likes.

8. (6 points) Evaluate the following limits. Justify your work.

(a) $\displaystyle\lim_{x\to\pi/4} \frac{\tan^2 x - 1}{2x - \pi/2}$

(b) $\displaystyle\lim_{x\to\infty} \frac{\ln(x^2+1)}{x^2}$

9. (10 points) Determine whether the following improper integrals converge or diverge. If the integral converges, find its value.

(a) $\displaystyle\int_{-\infty}^{0} \frac{e^{2x}}{e^{2x}+1}\,dx$

(b) $\displaystyle\int_{\pi/2}^{3\pi/2} \frac{\cos x}{(\sin x + 1)^3}\,dx$

10. (2 points) Give the n^{th} term of the sequence $\left\{\dfrac{13}{1}, -\dfrac{11}{2}, \dfrac{9}{4}, -\dfrac{7}{8}, \dfrac{5}{16}, \dots\right\}$

11. (4 points) Does the sequence converge or diverge? If it converges, find the limit.

(a) $a_n = \left(-\dfrac{3}{4}\right)^n$

(b) $a_n = \dfrac{\sqrt{4n^2+1}}{3n-1}$

12. (15 points) Determine the convergence or divergence of the following series. Mention the test you used. In the case of a convergent geometric or telescoping series, find the sum.

(a) $\displaystyle\sum_{n=1}^{\infty} \ln\left(\frac{n+1}{n+2}\right)$

(b) $\displaystyle\sum_{n=1}^{\infty} \frac{n^e + n^\pi}{n^5}$

(c) $\displaystyle\sum_{n=2}^{\infty} \frac{2^{n-1}}{3^{2n+1}}$

(d) $\displaystyle\sum_{n=1}^{\infty} \frac{2n^3+1}{n^2(2n+1)}$

(e) $\displaystyle\sum_{n=2}^{\infty} \frac{n^2}{2^n(n+1)!}$

13. (3 points) A deposit of \$120 is made at the beginning of each week for 4 years in an account that pays an annual rate of 3% interest compounded weekly. Find the total balance in this account at the end of 4 years.

Question 13 continues on the next page.

Answers. **1.** (a) $\frac{x^{5/2}}{5} - 2\ln|\cos x| - 3\ln|x| - \frac{5}{4x^2} + c$

(b) $\frac{\pi^2}{3} - \frac{4}{27}$

(c) 26

(d) $\frac{1}{2}\ln|2x+1| - 2\ln|x+2| - \frac{5}{x+2} + c$

(e) $-\frac{2}{3}\sqrt{\cot(3x)+1} + c$

(f) $\sin(\ln(3x)) + c$

2. 3.7386

3. (a) $6 + 2\pi$

(b) $-\frac{11}{2}$

(c) $\frac{33}{2}$

4. $\frac{125}{3}$

5. (a) (23, 7)

(b) 97.1295

6. $y = -\frac{1}{\frac{x^2}{2}+2\ln|x|-1}$

7. 5.5 hours

8. (a) 2

(b) 0

9. (a) $\frac{\ln 2}{2}$, C

(b) $-\infty$, D

10. $a_n = (-1)^{n+1} \cdot \frac{-2n+15}{2^{n-1}}$

11. (a) 0, C

(b) $\dfrac{2}{3}$, C

12. (a) $-\infty$, D

(b) PS, C

(c) GS, C, $S = \frac{2}{189}$

(d) nTT, D

(e) RT, C