

Section 8.9

1. Determine whether the following improper integrals converge or diverge. If it converges, find the value of the integral. If it diverges, explain why.

a.) $\int_2^{\infty} \frac{x}{x^2 + 1} dx$

b.) $\int_e^\infty \frac{1}{x(\ln x)^4} dx$

c.) $\int_{-\infty}^0 x e^x dx$

d.) $\int_{-\infty}^{\infty} \frac{dx}{x^2 + 9}$

$$\text{e.) } \int_{-3}^0 \frac{dx}{(x+3)^2}$$

$$\text{f.) } \int_{-1}^{32} \frac{1}{\sqrt[5]{x}} dx$$

2. Determine whether the following integrals converge or diverge using the comparison theorem:

a.) $\int_0^{\infty} \frac{1}{x^{10} + e^{5x}} dx$

$$\text{b.) } \int_2^{\infty} \frac{x}{x^{3/2} - x} dx$$

$$\mathbf{c.)} \int_1^\infty \frac{\cos^2 x}{x^4} dx$$

d.) $\int_1^{\infty} \frac{\arctan x + 5}{x^2} dx$

3. For what value(s) of p does $\int_1^\infty \frac{dx}{x^p}$ converge?

Section 9.1

4. Solve the equation $\frac{dy}{dx} = \frac{x - e^{3x}}{3y^2}$

5. Solve $\frac{dy}{dx} = \frac{xy}{2 \ln y}$

6. Solve $y' = e^{3x-y}$, $y(0) = 2$.

7. Solve $y' = 1 + y^2 - 2x - 2xy^2$, $y(0) = 0$

8. A tank contains 200 liters of water with 5 kg of dissolved salt. Pure water enters the tank at a rate of 10 liters per minute. The solution is kept mixed and drains from the tank at the same rate. How much salt is in the tank after 8 minutes?

Section 9.2

9. Solve $\frac{dy}{dx} + 3y = x$.

10. Solve $y' - \frac{y}{x} = 2$, $y(8) = 2$

11. Solve $x \frac{dy}{dx} + 2y = \sin(x^2)$, $y(\sqrt{\pi}) = 1$

12. A tank contains 1000 liters of pure water. Brine that contains 0.1 kg of salt per liter enters the tank at a rate of 5 liters per minute. The solution is kept mixed and drains from the tank at the same rate. How much salt is in the tank at time t minutes?