Integration Exercises

A. Compute the following definite integrals using basic geometry.

1. $\int_{-4}^{10} 6x + 4 \, dx$
2. $\int_{1}^{6} 2 + \sqrt{6x - x^2} \, dx$
3. $\int_{-2}^{4} |x| \, dx$

B. Compute the following definite integrals using Reimann Sums.

1. $\int_{-4}^{10} 6x + 4 \, dx$
2. $\int_{0}^{3} x^2 + 3x - 4 \, dx$
3. $\int_{-1}^{7} \pi \, dx$

C. Express the following limits as definite integrals, and then compute them.

1. $\lim_{n\to\infty} \sum_{i=1}^{n} \left(2 + \frac{3i}{n}\right)^2 \frac{6}{n}$
2. $\lim_{n\to\infty} \sum_{i=1}^{n} \cos\left(-2 + \frac{2i}{n}\right)^2 \frac{8i^2}{n^3}$

D. Compute the following derivatives.

1. $\frac{d}{dx} \int_{0}^{x^2} e^{t^2} \, dt$
2. $\frac{d}{dx} \int_{0}^{1} \cos(3t + 4) \, dt$
3. $\frac{d}{dx} \int_{\sin(x)}^{2^x} t^3 \ln(4t^2 - 5) \, dt$

E. Compute the following indefinite integrals

1. $\int 3x^2 \ln(x^2) \, dx$
2. $\int x\sqrt{x+1} \, dx$
3. $\int \frac{e^{2x}}{1 + e^{2x}} \, dx$
4. $\int \cos^2(x) \sin^2(x) \, dx$
5. $\int \cos^3(x) \sin^2(x) \, dx$
6. $\int x^3 \ln(x) \, dx$
7. $\int \frac{1}{x^2 - 3x} \, dx$
8. $\int \sec^2(2x) \, dx$
9. $\int \frac{1}{1 + 4x^2} \, dx$
10. $\int \frac{\ln(x)}{x} \, dx$
11. $\int \ln(x) \, dx$
12. $\int \frac{1}{x\sqrt{\ln(x)}} \, dx$
13. $\int \frac{\sin(\sqrt{x})}{\sqrt{x}} \, dx$
14. $\int \frac{1}{x^2 + 5x + 6} \, dx$
15. $\int \sin(x) e^x \, dx$
16. $\int \sin(x)\cos(x) \, dx$
17. $\int \arcsin(x)^2 \, dx$
18. $\int \sqrt{3 + 4x^2} \, dx$
19. $\int x^3\sqrt{5 - x^2} \, dx$
20. $\int \frac{x^2 + 2x + 3}{(x-1)(x+1)^2} \, dx$
21. $\int x^2 \sin(2x) \, dx$
22. $\int \frac{2x^2 - 1}{(4x-1)(x^2+1)} \, dx$
23. $\int \frac{1}{x^2 - 4x + 11} \, dx$
24. $\int \frac{2x + 4}{x^3 - 2x^2} \, dx$
25. $\int \arctan\left(\frac{1}{x}\right) \, dx$
26. $\int \frac{1}{x^2 - 7x + 99} \, dx$
27. $\int \left(\frac{1}{x+2} + e^{-x}\right) \, dx$
28. $\int \cos^2(x) \, dx$
29. $\int \frac{x^2}{(x^3+1)^2} dx$
30. $\int \frac{2x - 8}{(x^2+4)(x+1)} dx$

F. Determine if the following integrals are convergent or divergent. If convergent, find the value; if divergent state why.

1. $\int_{0}^{\infty} \frac{3}{x^2 + 3x + 2} \, dx.$
2. $\int_{0}^{2} \frac{dx}{\sqrt{4 - x^2}}$
3. $\int_{-\infty}^{\infty} \frac{dx}{4 + x^2}$
4. $\int_{0}^{2} \frac{dx}{(x-1)^2}$
5. $\int_{0}^{\pi^2} \frac{\sin(\sqrt{x})}{\sqrt{x}} \, dx$
6. $\int_{0}^{\infty} \frac{1}{1 + x^2} \, dx$
7. $\int_{0}^{\infty} e^{-3x} \, dx$
8. $\int_{0}^{3} \frac{e^x}{e^x - 1} \, dx$