1. Compute $\int_0^1 \cos(\pi x) dx$.

2. Compute $\int_1^2 \frac{3x}{\sqrt[4]{2x^2+7}} dx$.

3. Compute $\int_4^{16} \frac{1-\sqrt{u}}{\sqrt{u}} du$ two different ways.

4. Compute $\int_0^1 t\sqrt[3]{t^2+2} dt$.

5. Compute $\int \frac{1}{\sqrt{x}\sqrt{\sqrt{x}+1}} dx$.

6. Compute $D_x \int_x^{x^2} 3t \cos\sqrt{t} dt$.

7. Compute $\frac{d}{dt} \int_{-t}^{2t} x^2 \frac{x-3}{x^2+1} dx$.

8. Let $F(x) = \int_0^{\tan x} \frac{1}{1+t^2} dt$ for $0 \le x < \frac{\pi}{2}$.

   a) Compute $F'(x)$ and simplify your answer as far as possible.

   b) Based on your answer to part a), find a simple formula for $F(x)$.

   c) Based on part b), find a formula for $\int \frac{1}{1+t^2} dt$.

   d) Convert the formula in part c) to a formula involving a derivative instead of an integral.

9. Let $F(x) = \int_0^{\sin x} \frac{1}{\sqrt{1-t^2}} dt$ for $0 \le x \le \frac{\pi}{2}$.

   a) Compute $F'(x)$ and simplify your answer as far as possible.

   b) Based on your answer to part a), find a simple formula for $F(x)$.

   c) Based on part b), find a formula for $\int \frac{1}{\sqrt{1+t^2}} dt$.

   d) Convert the formula in part c) to a formula involving a derivative instead of an integral.

10. Let $F(x) = \int_1^x \frac{1}{t} dt$ for any positive real number x. Show that

    a) $F(1/a) = -F(a)$ for any positive real number a.

    b) $F(ab) = F(a) + F(b)$ for all positive real numbers a and b.

    c) $F(a^n) = nF(a)$ for all positive integers n.

    d) $F(a^n) = nF(a^n)$ for all integers.

    e) Based on parts a)-d), what function does $F(x)$ seem to be?

11. Find the area bounded between the x-axis and the function $f(x) = x^3 - 6x^2 + 8x$.

12. Find the area bounded between the function $f(x) = 2(x^3 - x)$ and the function $f(x) = x^3$.

13. Find the area bounded between the graphs of $y = 2\sin x$ and $y = \sin(2x)$ where $0 \le x \le \pi$.

14. Write Simpson's rule for $\int_0^\pi \sin x^2 dx$ using $n = 6$. Find an n that according to the error estimate on Simpson's rule gives you an error of at most 0.000005 for this integral.

15. Write the trapezoid rule for $\int_0^\pi \sin x^2 dx$ using $n = 6$. Find an n that according to the error estimate on the trapezoid rule gives you an error of at most 0.000005 for this integral.

16. How large does n have to be in order to compute $\int_1^2 \frac{1}{x} dx$ within an accuracy of 0.0001 using the Trapezoid method? Using Simpson's method?

17. Explain how the error estimate shows that Simpson's rule gives the exact answer for the integral of any polynomial of degree at most three. Use Simpson's rule with $n = 2$ on the integral $\int_0^{10} x^3 - 3x^2 - 5dx$ and compute the integral as an example.

18. Find the volume obtained by revolving the region in the first quadrant bounded by $y = x$ and $y = x^4$ about the x-axis using

    a) the washer or disk method.

    b) the cylindrical shell method.

19. Derive the formula for the volume of a sphere.

20. Derive the formula for the volume of a cone.

21. Find the volume obtained by revolving the region in the plane bounded by $y = \sin x$ and the x-axis, for $0 \leq x \leq \pi$ about the x-axis.

22. Find the volume obtained by rotating the region bounded by $y = 2x - 1$, $y = \sqrt{x}$, and $x = 0$ about the y-axis.

23. Find the volume obtained by rotating the region bounded by $y = 2x^2 + 2x + 13$, and $y = x^2 - 4x + 5$ about the $x-$axis. Then compute the volume if rotated about the $y-$axis

24. Two solid cylinders each have radius one and their axes meet at right angles. Find the volume that is contained in the intersection of the solid cylinders.

25. The triangle whose vertices are $(2, 1)$, $(2, 3)$, and $(4, 2)$ is rotated about the y-axis. Find the volume.

26. Find the length of the curve $x = t^3$, $y = \frac{3t^2}{2}$, $0 \leq t \leq \sqrt{3}$

27. Find the length of the curve $x = \frac{y^3}{6} + \frac{1}{2y}$ from $y = 1$ to $y = 2$.

28. Find the value of c in the Mean Value Theorem for Integrals for $\int_0^3 x^2\, dx$.

29. Give the proof of the first version of the Fundamental Theorem of Calculus.

30. Give a proof of the second version of the Fundamental Theorem of Calculus. You may use the first version.

31. Derive the formula for the surface area of a cone.

32. Derive the formula for the surface area of a sphere.

33. Find the surface area if the curve in the plane $y = \sqrt{x}$ for $\frac{3}{4} \leq x \leq \frac{15}{4}$ is rotated about the $x-$axis.

34. Find the surface area obtained by rotating the curve in the plane $x = y^3/3$ for $0 \leq y \leq 1$ about the $y-$axis.