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 $0 \leq x < \frac{\pi}{2}$.

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

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

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

12. 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.

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

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

15. 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.

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

17. 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

18. Two solid cylinders each have radius of 5 cm and their axes meet at right angles. Find the volume that is contained in the intersection of the solid cylinders.

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

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

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

22. Solve the initial value problem by first writing your answer as a definite integral and then evaluating: $\dfrac{dy}{dx} = \left(x + \dfrac{1}{x}\right)^2$, $y(1) = 1$.

23. Explicitly compute a limit of Riemann sums to evaluate $\displaystyle\int_1^3 x^2\,dx$.

24. Explicitly compute a limit of Riemann sums to evaluate $\displaystyle\int_{-1}^2 (2x - x^2)\,dx$.

25. True of False. There is a function whose derivative is $\sin(x^2)$. Either give a formula for the function, explain how you know there is such a function, or explain how you know there isn't.

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

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

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

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

30. An object moving along a straight line is at position $x(t)$ at time t. Its acceleration is given by $a(t) = \sin(2t)$ and at time $t = 0$, it is not moving at the origin. Find its position at time t.

31. An object moving along a straight line is at position $x(t)$ at time t. Its acceleration is given by $a(t) = -3.8$ and at time $t = 4$, it is at the point $x = 2$ moving with velocity $v = -3$. Find its position at time t.

32. An object is moving with velocity function given by $v(t) = 3.5 + 2\cos(1.8t)$. Find the acceleration and position functions for the object assuming that its position at time $t = 0$ is $x = 2$.