1. Find \( \int \sin^3(x) \sqrt{\cos(x)} \ dx \).

2. Find \( \int \cot^5(x) \sin^2(x) \ dx \).

3. Find \( \int \tan(x) \sec^3(x) \ dx \).

4. Find \( \int \tan^6(x) \ dx \).

5. Find \( \int \cot^4(x) \csc^4(x) \ dx \).

6. Find \( \int \tan^3(x) \sec^4(x) \ dx \).

7. Find \( \int \frac{1 - \tan^2(x)}{\sec^2(x)} \ dx \).

8. Find \( \int \frac{\cos(x) + \sin(x)}{\sin(2x)} \ dx \).

9. Find \( \int \sin(3x) \sin(6x) \ dx \).

10. Find \( \int_{\pi/4}^{\pi/2} x \csc^2(x) \ dx \).

11. Find \( \int x^3 \ln(x) \ dx \).

12. Find \( \int_1^4 \ln(\sqrt{x}) \ dx \).

13. Find \( \int \sqrt{x} \ln(x) \ dx \).

14. Find \( \int \left( \frac{\ln(x)}{x} \right)^2 \ dx \).

15. Find \( \int \frac{x^3 e^{x^2}}{(x^2 + 1)^2} \ dx \).

16. A tank, shown below, is full of water. Find the work required to pump the water out of the outlet. (Use the fact that water weighs 62.5 \( \text{lb/ft}^3 \)).
17. A container full of water has the form of a frustrum of a right circular cone with height $h$, lower base radius $R$, and top radius $r$. Find the work needed to pump all the water out over the side.

18. A semicylindrical tank 8 ft long has a diameter of 4 ft, it is full of water. Find the work needed to pump all the water out over the side.

19. A tank full of water has the form of a frustrum of a pyramid of square base of side $b$, square top of side $a$, and height $h$. Find the work needed to pump all the water out over the side.

20. A tank full of water has the form of a paraboloid of revolution, that is, its shape is obtained by rotating a parabola about a vertical axis. If its height is 4 ft and the radius at the top is 4 ft, find the work required to pump the water out of the tank.

21. Find $\int (1 - x)\sqrt{2x - x^2} \, dx$.

22. Find $\int \frac{x}{\sqrt{1 - x^4}} \, dx$.

23. Find $\int \frac{1}{\sqrt{x}(1 + x)} \, dx$.

24. Find $\int_0^8 |x^2 - 6x + 8| \, dx$.

25. Find the derivative of the function $F(x) = \int_1^x \sqrt{1 + t^4} \, dt$.

26. Find the derivative of the function $F(x) = \int_0^{x^5} \frac{t}{\sqrt{1 + t^3}} \, dt$.

27. Find the derivative of the function $F(x) = \int_0^x \frac{\cos t}{t} \, dt$.

28. Find the area of the region bounded by $x - 2y + 7 = 0$, $y^2 - 6y - x = 0$.

29. Find the area of the region bounded by $y = x^3$, $y = x^2 - 4x + 4$, $x = a$, $x = b$, $x = 2$.

30. Find the volume of the solid of revolution obtained by rotating the region bounded by the curves $y = x^2$ and $y = x^3$ about $y = 2$.

31. Find the volume of the solid of revolution obtained by rotating the region bounded by the curves $y = x^3$ and $y = 2x - x^2$ about the $y$-axis.

32. Find the volume of the solid of revolution obtained by rotating the region bounded by the curves $x^2 + (y - 1)^2 = 1$ about the $x$-axis.