1. Integration:

$$\int_0^1 x^2 e^x \, dx$$

2. Find the general solution for this differential equation:

$$\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = 0$$

3. If the area of the region bounded by the line $y = mx$ and the curve $x^2 = y$ is $\frac{32}{3}$ sq. units, then find the positive value of m using integration.

4. Find:

$$\int \frac{1}{e^x + 1} \, dx$$

5. Evaluate:

$$\int_1^4 \{|x| + |3 - x|\} \, dx$$

6. Evaluate:

$$\int_{-3}^3 \frac{x^4}{1 + e^x} \, dx$$

7. Find the particular solution of the differential equation:

$$x\frac{dy}{dx} + y + \frac{1}{1 + x^2} = 0$$

given that $y(1) = 0$.

8. Find the general solution of the differential equation:

$$x(y^3 + x^3) \, dy = (2y^4 + 5x^3 y) \, dx$$

9. Find:

$$\int \frac{dx}{\sqrt{4x - x^2}}$$

10. Find the general solution of the following equation:

$$\frac{dy}{dx} = e^x - yx^2 e^{-y}$$

11. Find:

$$\int e^x \sin(2x)\, dx$$

12. Find:

$$\int \frac{2x}{(x^2+1)(x^2+2)}\, dx$$

13. Evaluate:

$$\int_1^3 \frac{\sqrt{x}}{\sqrt{x}+\sqrt{4-x}}\, dx$$

14. Solve the following differential equations:

$$(y - \sin^2 x)\, dx + \tan(x)\, dy = 0$$

15. Find the general solution of the differential equation:

$$(x^3 + y^3)\, dy = x^2 y\, dx$$

16. Find:

$$\int \frac{1}{\sqrt{12 + 4x - x^2}}\, dx$$

17. Find:

$$\int \frac{xe^x}{(x+4)^5}\, dx$$

18. Find the general solution of the following differential equation:

$$(4 + y^2)(3 + \log x)\, dx + x\, dy = 0$$

19. Evaluate:

$$\int_0^{\frac{\pi}{3}} \left|\cos(3x)\right|, dx$$

20. Find the general solution of the following differential equation:

$$2xe^{\frac{y}{x}}\, dy + (x - 2ye^{\frac{y}{x}})\, dx = 0$$

21. Find the particular solution of the differential equation:

$$(2x^2 + y)\frac{dx}{dy} = x$$

given that $y = 2$ when $x = 1$.

22. Find:

$$\int \frac{x^2 + x + 1}{(x + 1)(x^2 + 4)}\, dx$$

23. Find the area bounded by the ellipse $x^2 + 4y^2 = 16$ and the ordinates $x = 0$ and $x = 2$, using integration.

24. Find the area of the region $\{(x, y) : x^2 \leq y \leq x\}$, using integration.

25. Find:

$$\int_0^{\frac{\pi}{2}} \frac{1}{1 + \sqrt{\cot x}}\, dx$$

is equal to:

(a) $\frac{\pi}{3}$

(b) $\frac{\pi}{6}$

(c) $\frac{\pi}{4}$

(d) $\frac{\pi}{2}$

26. Find:

$$\int \frac{(x + 2)(x + 2\log x)^3}{x}\, dx$$

27. Find:

$$\int_0^{\frac{\pi}{2}} \log(\tan x)\, dx$$

28. Find:

$$\int_{-1}^{2} |x|\ dx$$

29. Find:

$$\int x^2 \log x . dx$$

30. Find the general solution of the following differential equation :

$$\frac{dy}{dx} = (1 + x)(1 + y)$$

31. Find the integrating factor for the following differential equation:

$$\frac{dy}{dx} + y \cot x = 2x + x^2 \cot x (x \neq 0)$$

32. Find:

$$\int \frac{x}{(x-1)^2(x+2)} dx$$

33. Find the following differential equation :

$$x \cos\left(\frac{y}{x}\right) \frac{dy}{dx} = y \cos\left(\frac{y}{x}\right) + x$$