1. Evaluate $\int_0^3 f(x)dx$ if $f(x) = \begin{cases} x-4 & \text{if } -2 \leq x \leq 2 \\ 2-x^2 & \text{if } x > 2 \end{cases}$

2. Determine $\int \frac{e^{4x}}{\sqrt{1+e^{4x}}} dx$

3. Test for relative extrema and saddle points the function $f(x, y) = \dfrac{x^3}{3} + \dfrac{y^3}{3} - 4x + y^2 - 3y$

4. Find y subject to the conditions: $y''' = e^x - 24x$; $y''(0) = 2$, $y'(0) = 1$, $y(0) = 0$

5. Determine $\int \cot(2x+1)dx$

6. Find the area of the region bounded by the curves $y = 3x^2$ and $y = x^2 + 8$

7. The demand equation for a product is $p = 100 - \sqrt{q^2 + 20}$ (where p is the price per unit when q units are demanded). Find

(i) The relative rate of change of p with respect to q
(ii) The rate of change of q with respect to p

8. The cost function c of producing x units of a product is $c(x) = x^3 - 9x^2 + 15x + 75$. Use the second derivative test to determine all values of x at which relative maxima and relative minima occur.

15. If $f(x, y, z) = z(x^2 + xy)^3 + \ln(x^2 + y^2)$ then $f_{xyz}(1, 0, 2) =$

(A) 35

(B) 30

(C) 25

(D) 20

(E) 15

16. The number of critical points of $f(x, y) = x^2 + y^2 + xy^2 - 2x + 2$ is

(A) 0

(B) 1

(C) 2

(D) 3

(E) 4

9. $\int_0^1 \frac{2x^3 + x}{x^2 + x^4 + 1} dx =$

(A) $\frac{\ln 2}{3}$

(B) $\frac{\ln 3}{3}$

(C) $\frac{\ln 3}{2}$

(D) $\frac{\ln 5}{2}$

(E) $\frac{\ln 7}{2}$

10. If $f(x) = \frac{e^{\cos x}}{\sin x}$ then $f'(\pi/2) =$

(A) -1

(B) 1

(C) 0

(D) -2

(E) 2

11. $\int_0^1 (1-\sqrt{x})(x+\sqrt{x})dx =$

(A) $\frac{2}{15}$

(B) $\frac{4}{15}$

(C) $\frac{8}{15}$

(D) $\frac{3}{5}$

(E) $\frac{1}{5}$

12. $\int_1^e \frac{2^{\ln x}}{x} dx =$

(A) $2\ln 2$

(B) $3\ln 2$

(C) $\frac{1}{\ln 2}$

(D) $\frac{2}{\ln 2}$

(E) $\frac{3}{\ln 2}$

17. The equation of the oblique asymptote to the graph of $y = \dfrac{3x^4 - x^3 + x + 1}{x^3 + 2x - 3}$ is

(A) $y = 3x + 1$

(B) $y = 3x - 1$

(C) $y = 3x + 2$

(D) $y = 3x - 2$

(E) $y = x + 3$

18. If $f(x, y) = \dfrac{3xy^2 - xy}{x^2y^3 + 1}$ then $f_y(2, -1) =$

(A) -6

(B) 6

(C) -3

(D) 3

(E) 2

13. The area of the region (in the second quadrant) bounded by the curve $y = \sqrt{4+x}$, the x-axis, and the y-axis is equal to

(A) $\frac{8}{3}$

(B) $\frac{10}{3}$

(C) $\frac{14}{3}$

(D) $\frac{16}{3}$

(E) $\frac{20}{3}$

14. Using integration by parts, we find that $\int_1^e \frac{4\ln x}{x^3} dx =$

(A) $3 - \frac{2}{e^2}$

(B) $2 + \frac{3}{e^2}$

(C) $2 - \frac{3}{e^2}$

(D) $1 + \frac{3}{e^2}$

(E) $1 - \frac{3}{e^2}$