1. $\int_1^2 x^{-3}\,dx = -\frac{1}{2x^2}\Big|_1^2 = -\frac{1}{8} + (+\frac{1}{2}) = \frac{3}{8}$ $\boxed{D}$

2. $\int_1^2 \frac{x^2-1}{x+1}\,dx = \int_1^2 \frac{\cancel{(x+1)}(x-1)}{\cancel{(x+1)}}dx = \int_1^2 (x-1)\,dx = \frac{x^2}{2} - x\Big|_1^2 = (2-2) - (\frac{1}{2}-1)$
$= \frac{1}{2}$

$\boxed{A}$

3. $\int_{-2}^2 (x^7 + k)\,dx = 16$

$\frac{x^8}{8} + kx\Big|_{-2}^2 = (32+2k) - (32-2k) = 16$

$4k = 16 \quad k = 4$ $\boxed{D}$

4. $\int_0^3 |x-1|\,dx = \int_0^1 (-x+1)\,dx + \int_1^3 (x-1)\,dx$

$= \left[-\frac{x^2}{2} + x\Big|_0^1\right] + \left[\frac{x^2}{2} - x\Big|_1^3\right]$

$= (-\frac{1}{2}+1) - (0) + (\frac{9}{2} - 3) - (\frac{1}{2} - 1)$

$= \frac{1}{2} + \frac{3}{2} + \frac{1}{2} = \frac{5}{2}$ $\boxed{D}$

5. $\int \tan(2x)\,dx = \begin{bmatrix} u = 2x \\ du = 2\,dx \end{bmatrix}$

$\frac{1}{2}\int \tan u\,du = \frac{1}{2}\ln|\sec(2x)| + C = -\frac{1}{2}\ln|\cos(2x)| + C$

$\boxed{B}$

6. $\int_0^{\pi/3} \sin(3x)\,dx = \begin{bmatrix} u = 3x \\ du = 3\,dx \end{bmatrix}$

$\frac{1}{3}\int_0^{\pi/3} \sin u\,du = \frac{1}{3}\left[-\cos(3x)\right|_0^{\pi/3} = \frac{1}{3}\left[-\cos(\pi) + (+\cos(0))\right. = \frac{1}{3}(1+1) = 2/3$

$\boxed{D}$

7. $\int \sec^2 x\,dx = \tan x + C$ $\boxed{A}$

8. $\int_0^1 (3x-2)^2\,dx = \int_0^1 (9x^2-12x+4)\,dx$

$= 3x^3 - 6x^2 + 4x \Big|_0^1 = 1$ $\boxed{D}$

9. $\int_0^K (2Kx - x^2)\,dx = 18$

$Kx^2 - \frac{x^3}{3} \Big|_0^K = 18 \quad 3\left(K^3 - \frac{K^3}{3}\right) = (18)3$ $\boxed{C}$

$3K^3 - K^3 = 54$

$K^3 = 27 \quad K = 3$

10. $\int_0^{\pi/2} \frac{\cos\theta}{\sqrt{1+\sin\theta}}\,d\theta$ $\left[\begin{array}{l} u = 1+\sin\theta \\ du = \cos\theta\,d\theta \end{array}\right.$

$= \int_0^{\pi/2} \frac{1}{\sqrt{u}}\,du = \int_0^{\pi/2} u^{-1/2}\,du = \underline{2u^{1/2}} = 2\left[\sqrt{1+\sin\theta}\right. \Big|_0^{\pi/2}$

$= 2\left[\sqrt{2} - 1\right]$ $\boxed{D}$

11. $\int \frac{x}{\sqrt{3x^2+5}}\,dx =$ $\left[\begin{array}{l} u = 3x^2+5 \\ du = 6x\,dx \end{array}\right.$

$\frac{1}{6}\int \frac{1}{\sqrt{u}}\,du = \frac{1}{6}\int u^{-1/2}\,du = \frac{1}{6}\left[\frac{u^{\frac{1}{2}}}{\frac{1}{2}}\right. = \frac{1}{3}(3x^2+5)^{1/2} + C$ $\boxed{D}$

12. $\int_2^3 \frac{x}{x^2+1}\,dx =$ $\left[\begin{array}{l} u = x^2+1 \\ du = 2x\,dx \end{array}\right.$

$\frac{1}{2}\int_2^3 \frac{1}{u}\,du = \frac{1}{2}\left[\ln|x^2+1|\right. \Big|_2^3 = \frac{1}{2}(\ln 10 - \ln 5)$ $\boxed{B}$

$= \frac{1}{2}\left(\ln\frac{10}{5}\right) = \frac{1}{2}\ln 2$

13. $\int_1^4 |x-3|\,dx = \int_1^3 (-x+3)\,dx + \int_3^4 (x-3)\,dx$

$= -\frac{x^2}{2} + 3x \Big|_1^3 + \frac{x^2}{2} - 3x \Big|_3^4$ $\boxed{C}$

$= \left(-\frac{9}{2}+9\right) - \left(-\frac{1}{2}+3\right) + (8-12) - \left(\frac{9}{2}-9\right)$

$= 5/2$

14. $\int \frac{1}{x}\left(\int_1^x \frac{1}{u}\,du\right)dx =$

$\int \frac{1}{x}\left[\ln(x)-\ln 1\right]dx =$

$\int \frac{1}{x}\ln x\,dx \qquad \begin{bmatrix} u=\ln x \\ du=\frac{1}{x}dx \end{bmatrix} = \int u\,du = \frac{u^2}{2}+C$

$= \frac{(\ln x)^2}{2}+C$ $\boxed{E}$

15. $\int_0^1 x(x^2+2)^2\,dx \quad \begin{bmatrix} u=x^2+2 \to 0:2 \\ du=2x\,dx \quad 1:3 \end{bmatrix}$

$\frac{1}{2}\int_2^3 u^2\,du = \frac{1}{2}\left[\frac{u^3}{3}\right]_2^3 = \frac{1}{2}\left[9-\frac{8}{3}\right] = \frac{1}{2}\left[\frac{19}{3}\right] = \frac{19}{6}$ $\boxed{D}$

Calc ☆

16. $\int_1^{500}(13^x-11^x)\,dx = \frac{13^x}{\ln 13}-\frac{11^x}{\ln 11}\Big|_1^{500} = \cancel{\frac{13^{500}}{\ln 13}} - \cancel{\frac{11^{500}}{\ln 11}} + \left(\frac{13}{\ln 13}+\frac{11}{\ln 11}\right)$

$+$

$\int_2^{500}(11^x-13^x)\,dx = \frac{11^x}{\ln 11}-\frac{13^x}{\ln 13}\Big|_2^{500} = \cancel{\frac{11^{500}}{\ln 11}} - \cancel{\frac{13^{500}}{\ln 13}} + \left(\frac{11^2}{\ln 11}+\frac{13^2}{\ln 13}\right)$ $\boxed{B}$

Gross!

$= \frac{13^2-13}{\ln 13} - \frac{(11^2-11)}{\ln 11} = 14.946$

17. $\int \frac{3x^2}{\sqrt{x^3+1}}\,dx \quad \begin{bmatrix} u=x^3+1 \\ du=3x^2dx \end{bmatrix}$

$\int \frac{1}{\sqrt{u}}\,du = \int u^{-1/2}\,du = 2u^{1/2}+C = 2\sqrt{x^3+1}+C$ $\boxed{A}$

18. $\int (x^2+1)^2\,dx = \int (x^4+2x^2+1)\,dx = \frac{x^5}{5}+\frac{2}{3}x^3+x+C$ $\boxed{E}$

19. II only $\boxed{B}$

20. $\int_0^{\sqrt{3}} \frac{1}{\sqrt{4-x^2}}\,dx \quad \begin{matrix} u=x \\ a=2 \end{matrix} \quad \arcsin\left(\frac{x}{2}\right)\Big|_0^{\sqrt{3}} = \arcsin\frac{\sqrt{3}}{2} - \arcsin 0$

$= \pi/3$ $\boxed{A}$

21. $f' = \int(2x-\cos x)\,dx = x^2-\sin x+C$

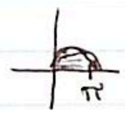
$f = \int f' = \int(x^2-\sin x+C)\,dx = \frac{x^3}{3}+\cos x+Cx+C$ $\boxed{A}$

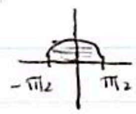
22. $\int_0^1 x^3 e^{x^4}dx \quad \left[\begin{array}{l} u = x^4 \\ du = 4x^3 dx \end{array}\right.$

$= \frac{1}{4}\int_0^1 e^u du = \frac{1}{4}\left[e^{x^4}\Big|_0^1 = \frac{1}{4}\left[e^1 - e^0\right] = \frac{1}{4}(e-1) \quad \boxed{A}$

23. II only $\quad \boxed{B}$

24. $\int_0^{\pi} \sin(x)dx \qquad \int_{-\pi/2}^{\pi/2} \cos(x)dx \qquad \boxed{A}$





25. $f(x) = \begin{cases} x & x \le 1 \\ \frac{1}{x} & x > 1 \end{cases}$

$\int_0^e f(x)dx = \int_0^1 x\,dx + \int_1^e \frac{1}{x}dx$

$= \frac{x^2}{2}\Big|_0^1 + \ln x\Big|_1^e = \frac{1}{2} + (\ln e - \ln 1) = \frac{1}{2} + 1 = \frac{3}{2} \quad \boxed{B}$

26. $\int_1^2 (4x^3 - 6x)dx = x^4 - 3x^2\Big|_1^2 = (16-12) - (1-3)$
$= 4 + 2 = 6 \quad \boxed{C}$

27. $\frac{1}{2}\int e^{\frac{1}{2}t}dt \quad \left[\begin{array}{l} u = \frac{1}{2}t \\ du = \frac{1}{2}dt \end{array}\right]$

$= \int e^u du = e^{t/2} + C \qquad \boxed{C}$

28. $\int_0^{\pi/4} \frac{e^{\tan x}}{\cos^2 x}dx \quad \left[\begin{array}{l} u = \tan x \\ du = \sec^2 x\,dx \\ du = \frac{1}{\cos^2 x}dx \end{array}\right.$

$\int_0^{\pi/4} e^u du = e^{\tan x}\Big|_0^{\pi/4} = e^{\tan \pi/4} - e^{\tan 0}$
$= e^1 - e^0 = e - 1 \quad \boxed{C}$

29. $\int_0^1 x^{1/2}(x+1)dx = \int_0^1 (x^{3/2} + x^{1/2})dx$

$= \frac{2}{5}x^{5/2} + \frac{2}{3}x^{3/2}\Big|_0^1 = \frac{2}{5} + \frac{2}{3} = \frac{16}{15} \quad \boxed{C}$

Calc ★ 30. $\int_0^x (t^2-2t)dt = \frac{t^3}{3} - t^2 \Big|_0^x = \frac{1}{3}x^3 - x^2$

$\int_2^x (t)dt = \frac{1}{2}t^2 \Big|_2^x = \frac{1}{2}x^2 - 2$ $\quad \frac{1}{3}x^3 - x^2 \geq \frac{1}{2}x^2 - 2$

$\frac{1}{3}x^3 - \frac{3}{2}x^2 + 2 \geq 0$

$x = 1.388$ $\boxed{B}$

Calc ★ 31. $\int \sin x \cos x \, dx$ $\quad u = \sin x$, $du = \cos x \, dx$ $\quad \int \sin x \cos x \, dx$ $\quad u = \cos x$, $du = -\sin x \, dx$

$\int u \, du = \frac{\sin^2 x}{2}$ I $\quad - \int u \, du = -\frac{\cos^2 x}{2}$

Manipulate original w/ trig identity $\sin(2x) = 2\sin x \cos x$

$\int \sin x \cos x \, dx = \frac{1}{2}\int 2\sin x \cos x \, dx = \frac{1}{2}\int \sin(2x)$ $\quad u = 2x$, $du = 2dx$

$= \frac{1}{4}\int \sin u \, du$

$= \frac{1}{4}(-\cos(2x)) =$

$-\frac{1}{4}\cos(2x)$ III

$\therefore$ I & III $\boxed{D}$

32. $\int_1^2 x^{-2} dx = -\frac{1}{x} \Big|_1^2 = -\frac{1}{2} - (-1) = \frac{1}{2}$

$\boxed{C}$

33. $\int_0^x \sin t \, dt = -\cos t \Big|_0^x = -\cos x - (-\cos 0)$ $\boxed{E}$

$= -\cos x + 1 = 1 - \cos x$

34. $\int_1^e \frac{x^2-1}{x} dx$

$= \int_1^e (x - \frac{1}{x}) dx = \frac{x^2}{2} - \ln x \Big|_1^e = \left(\frac{e^2}{2} - \ln e\right) - \left(\frac{1}{2} - \ln 1\right)$ $\boxed{E}$

$= \frac{e^2}{2} - 1 - \frac{1}{2} = \frac{e^2}{2} - \frac{3}{2}$

35. $\int_{-3}^{K} x^2\,dx = 0 \qquad \left.\frac{x^3}{3}\right|_{-3}^{K} = 0$

$$\frac{K^3}{3} - (-9) = 0$$
$$\frac{K^3}{3} + 9 = 0$$
$$K^3 = -27$$
$$K = -3 \text{ only} \qquad \boxed{A}$$

Calc ☆ 36. $F(x) = \int_{1}^{9} \frac{(\ln x)^3}{x}\,dx = F(9) - F(1)$

$$= 5.827 - 0 \qquad \boxed{C}$$

37. $f(x) = g(x) + 7$ $\quad \int_{3}^{5} [f(x) + g(x)]\,dx$

$3 \le x \le 5$

$$= \int_{3}^{5} [g(x) + 7 + g(x)]\,dx$$
$$= \int_{3}^{5} (2g(x) + 7)\,dx$$
$$= 2\int_{3}^{5} g(x)\,dx + \int_{3}^{5} 7\,dx \qquad = \left. 7x \right|_{3}^{5} = 35 - 21 = 14$$
$$= 2\int_{3}^{5} g(x)\,dx + 14 \qquad \boxed{B}$$