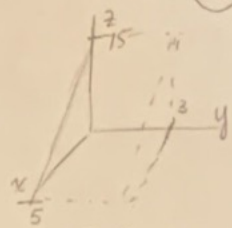


15.1 9) $\int_0^3 \int_0^5 (15-3x) dx dy$
 $= \int_0^3 (15x - \frac{3}{2}x^2) dy$
 $= \int_0^3 (75 - \frac{3}{2} \cdot 25) dy$
 $= \int_0^3 \frac{150}{2} - \frac{75}{2} dy = \int_0^3 \frac{75}{2} dy$
 $= \frac{75y}{2} \Big|_0^3 = \frac{225}{2}$



15) $\int_0^5 \int_{-4}^4 x^3 dx dy$
 $= \int_0^5 0 dy = 0$

21) $\int_4^9 \int_{-3}^3 dx dy$
 $= \int_4^9 (x)_{-3}^3 dy$
 $= \int_4^9 11 dy = 11y \Big|_4^9 = 55$

23) $\int_{-1}^1 \int_0^\pi x^2 \sin y dy dx$
 $= \int_{-1}^1 x^2 (\cos y) \Big|_0^\pi dx$
 $= \int_{-1}^1 -2x^2 dx = -\frac{2}{3}x^3 \Big|_{-1}^1$
 $= -\frac{2}{3}(1) - \frac{2}{3}(-1) = 0$

25) $\int_2^6 \int_1^4 x^2 dx dy$
 $= \int_2^6 (\frac{1}{3}x^3) \Big|_1^4 dy$
 $= \int_2^6 21 dy = 21y \Big|_2^6 = 84$

31) $\int_1^2 \int_0^4 \frac{dy dx}{x+y}$
 $= \int_1^2 (\ln(x+y)) \Big|_0^4 dx$
 $= \int_1^2 \ln(x+4) - \ln x dx$
 $= \int_1^2 \ln(\frac{x+4}{x}) dx$
 $= 4 \ln(x+4) + x \ln(\frac{x+4}{x}) \Big|_1^2$
 $= 4 \ln 6 + 2 \ln 3 - 4 \ln 5 - \ln 5$
 $= 4 \ln 6 - 5 \ln 5 + 2 \ln 3$

33) $\int_0^4 \int_0^5 (x+y)^{1/2} dy dx$
 $= \int_0^4 2\sqrt{x+y} \Big|_0^5 dx$
 $= \int_0^4 2(\sqrt{x+5} - \sqrt{x}) dx$
 $= \frac{4}{3} ((x+5)^{3/2} - x^{3/2}) \Big|_0^4$
 $= \frac{4}{3} [(27-8) - (\sqrt{125})]$
 $= \frac{4}{3} (19 - 5\sqrt{5})$

35) $\int_1^2 \int_1^3 \frac{\ln(xy) dy dx}{y}$
 $u = \ln(xy), du = \frac{y}{y} dy$
 $= \int_1^2 (\frac{1}{2} \ln^2(xy)) \Big|_1^3 dx$
 $= \frac{1}{2} \int_1^2 \ln^2 3x - \ln^2 x dx$
 $= \frac{1}{2} x \ln^2 3x - x \ln 3x - \frac{1}{2} \ln^2 x + x \ln x \Big|_1^2$
 $= \ln^2 6 - 2 \ln 6 - \frac{1}{2} \ln^2 2 + 2 \ln 2$
 $- \frac{1}{2} \ln^2 3 - \ln 3$

37) $\int_1^3 \int_{-2}^4 \frac{x}{y} dx dy = \int_1^3 \frac{x^2}{2y} \Big|_{-2}^4 dy$
 $\int_1^3 \frac{6}{y} dy = 6 \ln y \Big|_1^3 = 6 \ln 3$

41) $\int_1^2 \int_0^{\pi/4} e^x \sin y dy dx$
 $= \int_1^2 e^x \cos y \Big|_0^{\pi/4} dx$
 $= \int_1^2 \frac{\sqrt{2}}{2} e^x - e^x dx$
 $= \frac{\sqrt{2}}{2} e^x - e^x \Big|_1^2 = \frac{\sqrt{2}}{2} e^2 - e^2 - \frac{\sqrt{2}}{2} + 1$

15.2 3) vertical: $0 \leq x \leq 1$
 $0 \leq y \leq 1-x^2$
 horizontal: $0 \leq y \leq 1$
 $0 \leq x \leq \sqrt{1-y}$

5) $y = -\frac{1}{2}x + 2$
 $0 \leq x \leq 4, \frac{1}{2}x \leq y \leq 2$
 $\int_0^4 \int_{\frac{1}{2}x}^2 x^2 y dy dx$
 $= \int_0^4 x^2 (\frac{1}{2}y^2) \Big|_{\frac{1}{2}x}^2 dx$
 $= \int_0^4 x^2 (2 - (2-x + \frac{1}{8}x^2)) dx$
 $= \frac{1}{4}x^4 - \frac{1}{40}x^5 \Big|_0^4$
 $= \frac{256}{4} - \frac{128}{5} = 38.4$

6) $y = \frac{1}{2}x, x=2y$
 $0 \leq y \leq 2, 0 \leq x \leq 2y$
 $\int_0^2 \int_0^{2y} x^2 y dx dy$
 $= \int_0^2 y (\frac{1}{3}x^3) \Big|_0^{2y} dy = \int_0^2 \frac{8}{3} y^4 dy$
 $= \frac{8}{15} y^5 \Big|_0^2 = \frac{256}{15}$

7) $y=x, 0 \leq y \leq 2, 0 \leq x \leq y$
 $\int_0^2 \int_0^y x^2 y dx dy$
 $= \int_0^2 \frac{1}{3} x^3 y \Big|_0^y dy = \int_0^2 \frac{1}{3} y^4 dy$
 $= \frac{1}{15} y^5 \Big|_0^2 = \frac{32}{15}$

11) $x^2 + y^2 = 4, y = \sqrt{4-x^2}$
 $1 \leq x \leq 2, 0 \leq y \leq \sqrt{4-x^2}$
 $\int_1^2 \int_0^{\sqrt{4-x^2}} \frac{y}{x} dy dx = \int_1^2 \frac{y^2}{2x} \Big|_0^{\sqrt{4-x^2}} dx = \int_1^2 \frac{4-x^2}{2x} dx$
 $\int_1^2 \frac{2}{x} - \frac{x}{2} dx = 2 \ln x - \frac{x^2}{4} \Big|_1^2$
 $2 \ln 2 - \frac{4}{4} - 0 + \frac{1}{4} = 2 \ln 2 - \frac{3}{4}$

19) $\int_0^1 \int_1^{e^{2x}} x dy dx = \int_0^1 xy \Big|_1^{e^{2x}} dx$
 $= \int_0^1 xe^{2x} - x dx \quad u=x^2, du=2x dx$
 $= \frac{1}{2} \int_0^1 e^u - 1 du = \frac{1}{2} (e^u - u) \Big|_0^1 = \frac{1}{2} (e^2 - 2)$

21) $y \leq x \leq y^2, 0 \leq y \leq 1$
 $\int_0^1 \int_y^{y^2} 2xy dx dy = \int_0^1 x^2 y \Big|_y^{y^2} dy = \int_0^1 y^4 - y^3 dy$
 $= \frac{1}{5} y^5 - \frac{1}{4} y^4 \Big|_0^1 = \frac{1}{5} - \frac{1}{4} = -\frac{1}{20}$

25) $\int_0^4 \int_0^x f(x,y) dx dy$

31) $\int_1^e \int_{\ln y}^{\ln x} \frac{1}{\ln y} dx dy = \int_1^e \frac{x}{\ln y} dy = \int_1^e \ln y - 1 dy$
 $= y \ln y - 2y \Big|_1^e = e - 2e + 2 = -e + 2$

33) $\int_0^1 \int_0^x \frac{\sin y}{x} dy dx = \int_0^1 \sin x dx = \cos 1 - 1$

35) $\int_0^1 \int_0^y x e^{y^3} dx dy = \int_0^1 \frac{1}{2} y^2 e^{y^3} dy$
 $= \frac{1}{6} \int_0^1 e^u du = \frac{1}{6} e^y \Big|_0^1 = \frac{1}{6} (e - 1)$

37) $\int_0^2 \int_0^y e^{x+y} dy dx = \int_0^2 e^{x+2} + e^x dx = e^2 - e$

43) $\int_1^2 \int_y^{2y} \frac{\sin y}{y} dy dx = \int_1^2 \sin y dy = \cos 2 - \cos 1$

49) $\int_{-2}^2 \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} (8-2x^2) dy dx$