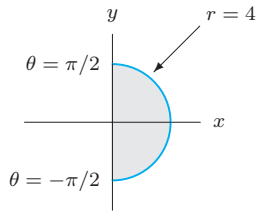
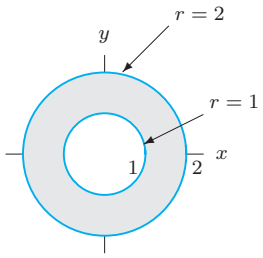
5 $\int_1^5 \int_2^4 f(x,y)\,dy\,dx$

7 $\int_\pi^{2\pi} \int_2^4 f(r\cos\theta, r\sin\theta)\,r\,dr\,d\theta$

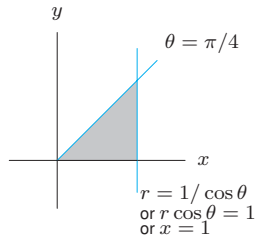
9



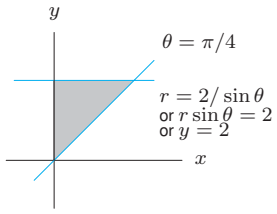
11



13



15



17 $\pi(1-\cos 4)$

19 $-2/3$

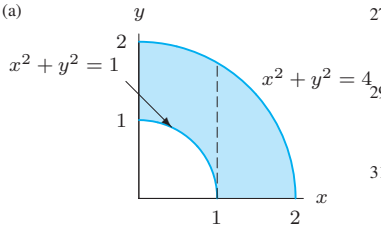
21 1.

23 (a) (i) $\int_0^{\pi/6}\int_0^{\pi}\int_0^5 \rho^2\sin\phi\,d\rho\,d\phi\,d\theta$; $125\pi/9$

(ii) $\int_0^{\pi/6}\int_0^5\int_{-\sqrt{25-r^2}}^{\sqrt{25-r^2}} r\,dz\,dr\,d\theta$; $2\int_0^{\pi/6}\int_0^5\int_0^{\sqrt{25-z^2}} r\,dr\,dz\,d\theta$; $125\pi/9$

(b) $1/12(4/3\pi 5^3)$

25 (a)



(b) $7/3$

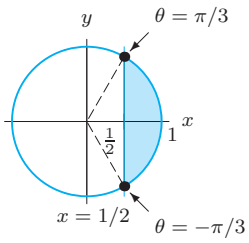
27 $32\pi(\sqrt{2}-1)/3$

29 (a) $\int_0^{2\pi}\int_0^3 r/(r^2+1)\,dr\,d\theta$

(b) $\pi \ln 10$

31 $250\pi/3$ grams

33 (a)



(b) $(4\pi - 3\sqrt{3})/12$

35 (a) $\int_{-\sqrt{3}/2}^{\sqrt{3}/2}\int_{1-\sqrt{1-y^2}}^{\sqrt{1-y^2}} dx\,dy$

(b) $\int_0^1 \int_{-\arccos(r/2)}^{\arccos(r/2)} r\,d\theta\,dr$

37 Upper limit for inner integral $1/\cos\theta$

39 Quarter disk $0 \le x \le 1, 0 \le y \le \sqrt{1-x^2}$

41 (a), (c), (e)

Section 16.5

1 (a) is (IV); (b) is (II); (c) is (VII); (d) is (VI); (e) is (III); (f) is (V)

3 $z = \sqrt{1-r^2}$

5 $\phi = \pi/4$

7 $\rho = 4/\cos\phi$

9 $200\pi/3$

11 25π

13 $\int_0^1\int_0^{2\pi}\int_0^4 f\cdot r\,dr\,d\theta\,dz$

15 $\int_0^{\pi}\int_0^{\pi}\int_2^3 f\cdot\rho^2\sin\phi\,d\rho\,d\phi\,d\theta$

17 $\int_0^5\int_0^2\int_0^{x/5} f\,dz\,dy\,dx$

19 $\int_0^{2\pi}\int_0^K\int_{-\sqrt{K^2-r^2}}^{\sqrt{K^2-r^2}} r\,dz\,dr\,d\theta$

21 $\int_0^{2\pi}\int_0^2\int_{2r}^4 f(r,\theta,z)\,r\,dz\,dr\,d\theta$

23 $\int_{-2}^2\int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}}\int_{2\sqrt{x^2+y^2}}^4 h(x,y,z)\,dz\,dy\,dx$

25 (a) $\int_{-1/\sqrt{2}}^{1/\sqrt{2}}\int_{-\sqrt{(1/2)-x^2}}^{\sqrt{(1/2)-x^2}}\int_{\sqrt{x^2+y^2}}^{\sqrt{1-x^2-y^2}} dz\,dy\,dx$

(b) $\int_0^{2\pi}\int_0^{1/\sqrt{2}}\int_r^{\sqrt{1-r^2}} r\,dz\,dr\,d\theta$

(c) $\int_0^{2\pi}\int_0^{\pi/4}\int_0^1 \rho^2\sin\phi\,d\rho\,d\phi\,d\theta$

27 (a) $\int_0^{2\pi}\int_0^{\sqrt{2}}\int_r^{\sqrt{4-r^2}} r\,dz\,dr\,d\theta$

(b) $\int_0^{2\pi}\int_0^{\pi/4}\int_0^2 \rho^2\sin\phi\,d\rho\,d\phi\,d\theta$

29 $V = \int_0^{2\pi}\int_0^{\pi/3}\int_0^3 \rho^2\sin\phi\,d\rho\,d\phi\,d\theta$
Order of integration can be altered; other coordinates can be used

31 $V = \int_0^{\pi}\int_{\sqrt{2}}^{\sqrt{3}}\int_5^{10} r\,dz\,dr\,d\theta$;
Order of integration can be altered; other coordinates can be used

33 $V = \int_0^{2\pi}\int_0^3\int_1^{\sqrt{10-r^2}} r\,dz\,dr\,d\theta$ or $V = \int_0^{2\pi}\int_1^{\sqrt{10}}\int_0^{\sqrt{10-z^2}} r\,dr\,dz\,d\theta$ Order of integration can be altered; other coordinates can be used

35 (a) $\int_0^{2\pi}\int_0^{1/\sqrt{3}}\int_{\sqrt{3}r}^1 r\,dz\,dr\,d\theta$

(b) $\pi/9$

37 $16\pi(\sqrt{2}-1)/(3\sqrt{2})$

39 $28\pi/15$

41 $\int_0^{2\pi}\int_0^{5/\sqrt{2}}\int_r^{5/\sqrt{2}} r\,dz\,dr\,d\theta = 125\pi/(6\sqrt{2}) = 46.28\text{ cm}^3$

43 (a) Negative

(b) Zero

45 $pqr/6$

47 $\int_0^{2\pi}\int_0^{\pi/2}\int_a^b \rho^2\sin\phi\,d\rho\,d\phi\,d\theta = 2\pi(b^3-a^3)/3$

49 (a) $\int_0^{2\pi}\int_0^{\sqrt{2}}\int_0^{2-r^2}(2-z)r\,dz\,dr\,d\theta$

(b) $\left(\frac{16\sqrt{2}}{3} - \frac{4}{3}\right)\pi$

51 $\int_0^{2\pi}\int_0^{\pi}\int_0^3 2\rho^3\sin\phi\,d\rho\,d\phi\,d\theta$

53 $1/32$

55 (a) Mass $= \int_0^{2\pi}\int_0^a\int_{-\sqrt{a^2-r^2}}^{\sqrt{a^2-r^2}} k|z|r\,dz\,dr\,d\theta$

(b) $\pi k a^4/2$

57 $3/4$

61 $3I = \frac{6}{5}a^2$; $I = \frac{2}{5}a^2$

63 $(q^2/8\pi\epsilon)((1/a)-(1/b))$

65 Mass $= \int_{-2}^2\int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}}\int_0^{4-x^2-y^2} e^{-x-y}\,dz\,dy\,dx$ gm

67 $1/27$

69 $2\pi G\delta(H + R - \sqrt{R^2+H^2})$

71 Total charge $= 2\pi k R^2$

73 (c)

75 Limits of outer integral not constant

77 $\int_W \sqrt{x^2+y^2+z^2}\,dx\,dy\,dz$; W is unit ball $x^2+y^2+z^2 \le 1$

Section 16.6

1 Is a joint density function

3 Not a joint density function

5 Is joint density function

7 0

9 1

11 7/8

13 1/16

15 (a) 20/27

(b) 199/243

17 (a) $k = 3/8$

(b) 15/32

(c) 1/16

19 $\int_{65}^{100}\int_{0.8}^1 f(x,y)\,dx\,dy$

23 $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(p_1(x,y)+p_2(x,y))\,dx\,dy = 2$