10. $x^n J_{n-1}(x)$ **11.** $\frac{1}{2}(3x^2-1)$ **12.** zero

13. True **14.** $P_n(x) = \frac{1}{n!2^n}\frac{d^n}{dx^n}(x^2-1)^n$ ■ **15.** $\alpha \neq \beta$

16. $2P_3 + 4P_1$ **17.** $(1-2xt+t^2)^{-1/2} = \sum_{n=0}^{\infty} t^n P_n(x)$

18. $-J_1(x)$ **19.** False **20.** True **21.** True **22.** True **23.** True
24. False **25.** (*b*) **26.** (*c*) **27.** (*iv*) **28.** (*iii*) **29.** (*iii*)
30. (*iv*) **31.** (*iii*) **32.** (*iii*) **33.** (*iii*) **34.** (*iii*) **35.** (*iv*)
36. 0, 1.

Problems 17.1, page 579

1. $z = px + qy + p^2 + q^2$ **2.** $z^2(p^2+q^2+1) = c^2$ **3.** $p^2 + q^2 = \tan^2\alpha$
4. $p + q = px + qy$ **5.** $z^2(p^2+q^2+1) = 9$ **6.** $py - qx = 0$
7. $py + qx = 0$ **8.** $qx - py = x + y$ **9.** $xys = px + py - z$

10. $xyr = 2\,(px + qy - 2z)$ **11.** $\frac{\partial^2 z}{\partial y^2} = \frac{\partial z}{\partial y}$ **12.** $x(y-z)p + y(z-x)q = z(x-y)$

13. $z\frac{\partial^2 z}{\partial x \partial y} = \frac{\partial z}{\partial x}\cdot\frac{\partial z}{\partial y}$ **14.** $p + q = mz$ **15.** $px^2 + qy = 2y^2$

16. $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6\frac{\partial^2 z}{\partial y^2} = 0$ **17.** $\frac{\partial^2 v}{\partial t^2} = \frac{a^2}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial v}{\partial r}\right)$ **18.** $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial t} + \frac{\partial^2 z}{\partial t^2} = 0$

19. $p(x-2z) + q(2z-y) = y - x$ **20.** $(y-z)p + (z-x)q = x - y$.

Problems 17.2, page 581

1. $z = \frac{x^2}{2}\log x + axy + \phi(x) + \psi(y)$ **2.** $z = \frac{1}{6}x^3y + xf(y) + \phi(y)$

3. $u = -e^{-t}\sin x + \phi(x) + \psi(t)$ **4.** $z = f(x) + x\phi(y) + \psi(y) - \frac{1}{12}\sin(2x+3y)$

5. $z = e^x \cosh y + e^{-x}\sinh x$ **6.** $z = \sin x + e^y \cos x$.

Problems 17.3, page 584

1. $x = z^3 f(x/y)$ **2.** $\sqrt{x} - \sqrt{y} = f(\sqrt{x} - \sqrt{z})$ **3.** $x^2 + y^2 + z^2 = f(x+y+z)$

4. $[\cos(x+y) + \sin(x+y)]e^{y-x} = \phi\left[z^{\sqrt{2}}\tan\left(\frac{x+y}{2} + \frac{\pi}{8}\right)\right]$ **5.** $x^2 - y^2 = f(y^2 - z^2)$

6. $\phi\left(\frac{\sin x}{\sin y}, \frac{\sin y}{\sin z}\right) = 0$ **7.** $x\log(x+y) - z = f(x+y)$ **8.** $x^2 + y^2 + 2z = [\log(xy)]$

9. $x^2 + y^2 - z^2 = f(x+y+z)$ **10.** $x + y + z = f(xyz)$ **11.** $\phi(x^2+y^2+z^2, xyz) = 0$
12. $x^2 + y^2 = f(y^2 - yz)$ **13.** $\phi(y/z, x^2+y^2+z^2) = 0$ **14.** $x^2 + y^2 + z^2 = f(y^2 - 2yz - z^2)$

15. $f\left(\frac{y}{z}, \frac{z}{x} - \frac{y}{x} + x^2\right) = 0.$

Problems 17.4, page 587

1. $z = ax - ay/(1 + a) + b$ **2.** $z = ax + \sqrt{(1 - a^2)}y + c$ **3.** $4z(1 + a^2) = (x + ay + b)^2$

4. $(1 - a + az) = (x + ay + b)^2$ **5.** $2z = ay^2 - [a/(a + 1)]x^2 + b$ **6.** $z = a(x - y) - (\cos x + \cos y) + b$

7. $\frac{8}{9}z = (x + a)^{3/2} + (y + a)^{3/2} + b$ **8.** $3z = (x + a)^3 + (y - a)^3 + b$

9. $z = \dfrac{a^2}{2}\sinh^{-1}\dfrac{x}{a} + \dfrac{x_1\sqrt{(x^2+a^2)}}{2} + \dfrac{y\sqrt{(y^2-a^2)}}{2} - \dfrac{a^2}{2}\cosh^{-1}\dfrac{y}{a} + b$

10. $z = ax + by + \sin(a + b)$ **11.** $z = \dfrac{1}{6}(zx + a)^3 + a^2y + b$ **12.** $z = ax + by - 2\sqrt{(ab)}$

13. $z = axy + a^2(x + y) + b.$

Problems 17.5, page 590

1. $z = \{\sqrt{(ax)} + \sqrt{(b + y)}\}^2/(1 + a)$ **2.** $z = ax^by^{1/b}$

3. $\dfrac{z^2}{2} \pm \left\{\dfrac{z}{2}\sqrt{z^2 - 4a^2} - 2a^2\log\left(z + \sqrt{z^2 - 4a^2}\right)\right\} = 2ax + 2y + b$

4. $\log(z - ax) = y - a\log(a + y) + b$ **5.** $2\sqrt{(z - a - b)} = \sqrt{ax} + \dfrac{1}{\sqrt{a}}y + c$

6. $z = axe^{-y} - \frac{1}{2}a^2e^{-2y} + b.$

Problems 17.6, page 595

1. $z = f_1(y) + f_2(y + 2x) + xf_3(y + 2x)$ **2.** $z = f_1(y - x) + f_2(y + 2x) + xf_3(y + 2x) + \dfrac{e^{x+2y}}{27}$

3. $z = f_1(x + y) + xf_2(x + y) + \dfrac{x^2}{2} \times e^{x+y}$ **4.** $z = f_1(y + x) + zf_2(y + x) + f_3(y + 2x) - e^{2x+y}$

5. $z = f_1(y + x) + xf_2(y + x) - \sin x$ **6.** $y = f_1(x - at) + f_2(x + at) - \dfrac{E}{p^2}\sin pt$

7. $z = f_1(y) + f_2(y + 2x) + xf_3(y + 2x) + 3x\cos(3x + 2y)$

8. $f_1(y\,x) + f_2(y - 2x) + f_3(y + 3x) + \dfrac{1}{75}\sin(x + 2y) + \dfrac{2}{3}x^3.$

9. $z = f_1(y + x) + f_2(y + 2x) + \dfrac{1}{12}e^{2x-y} - xe^{x+y} - \dfrac{1}{3}\cos(x + 2y)$

10. $z = f_1(y) + f_2(y + x) + \frac{1}{3}(\sin x\cos 2y + 2\cos x\sin 2y)$

11. $z = f_1(y) + f_2(y + x) + \dfrac{1}{2}[\sin(x + 2y) + \cos(x + 2y)] - \dfrac{1}{6}[\sin(x - 2y) + \cos(x - 2y)]$

12. $z = f_1(y + x) + f_2(y - x) + \dfrac{3}{28}e^{x-y}[\sin(x + 2y) - 2\cos(x + 2y)]$

13. $z = f_1(y - x) + f_2(y - 2x) + 4x^3y - 3x^4$ **14.** $z = f_1(y - x) + xf_2(y - x) + \dfrac{1}{4}(x^4 - 2x^3y + 2x^2y^2)$

15. $z = f_1(y - x) + f_2(y + 2x) + ye^x$ **16.** $z = f_1(y - x) + xf_2(y - x) + f_3(y + x) + \dfrac{e^x}{25}(\cos 2y + 2\sin 2y)$

17. $z = f_1(y - x) + xf_2(y - x) + x\sin y.$