

Math 104 Fall 2009
Section 18.4 Practice Problems

1. Use power series to solve:

$$y'' + xy' + 2y = 0$$

2. Use power series to solve.

$$y'' - y' = 0$$

3. Use power series to solve the differential equation.

$$y' = 4x^2y$$

Select the correct answer.

a. $y(x) = ce^{\frac{4x^3}{3}}$

b. $y(x) = ce^{4x}$

c. $y(x) = ce^{-\frac{4x^3}{3}}$

d. $y(x) = 4e^{\frac{x^3}{3}}$

e. $y(x) = e^{-\frac{x^3}{3}}$

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4. Use power series to solve the differential equation.

$$(x - 6)y' + 2y = 0$$

Select the correct answer.

a. $y(x) = c_0 \sum_{n=0}^{\infty} \frac{n+1}{6^n} x^n$

b. $y(x) = c_0 \sum_{n=0}^{\infty} \frac{x^n}{6^n}$

c. $y(x) = c_0 \sum_{n=0}^{\infty} \frac{nx^n}{6^n}$

d. $y(x) = c_0 \sum_{n=0}^{\infty} (n+1)x^n$

e. $y(x) = c_0 \sum_{n=0}^{\infty} \frac{(n+1)}{x^n}$

5. Use power series to solve the differential equation.

$$y'' - xy' - y = 0, \quad y(0) = 5, \quad y'(0) = 0$$

Select the correct answer.

a. $y(x) = e^{5x}$ b. $y(x) = 5e^{\frac{x^2}{2}}$ c. $y(x) = 5e^x$ d. $y(x) = ce^{\frac{x^2}{2}}$ e. $y(x) = 5e^{-\frac{x^2}{2}}$

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6. Use power series to solve the differential equation.

$$y'' + x^2y = 0, \quad y(0) = 6, \quad y'(0) = 0$$

Select the correct answer.

a. $y(x) = 6 - \sum_{n=1}^{\infty} (-1)^n \frac{x^{4n}}{4n(4n-1)\dots 4 \cdot 3}$

b. $y(x) = \sum_{n=1}^{\infty} (-1)^n \frac{6x^{4n}}{4n(4n-1)\dots 4 \cdot 3}$

c. $y(x) = 6 + \sum_{n=1}^{\infty} (-1)^n \frac{6x^{4n}}{4n(4n-1)\dots 4 \cdot 3}$

d. $y(x) = -6 + \sum_{n=1}^{\infty} (-1)^n \frac{x^{4n}}{4n(4n-1)\dots 4 \cdot 3}$

e. $y(x) = \sum_{n=1}^{\infty} (-1)^n \frac{x^{4n}}{4n(4n-1)\dots 4 \cdot 3}$

7. The solution of the initial-value problem $x^2y'' + xy' + x^2y = 0$, $y(0) = 1$, $y'(0) = 0$ is called a Bessel function of order 0. Solve the initial - value problem to find a power series expansion for the Bessel function.

Select the correct answer.

a. $y(x) = x + \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{2^{2n}(n!)^2}$

b. $y(x) = \sum_{n=0}^{\infty} (-1)^{n+1} \frac{nx^{2n-1}}{2^{2n-1}(n!)^2}$

c. $y(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{2^{2n}(n!)^2}$

d. $y(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^n}{2^n(2n!)}$

e. $y(x) = 2^x + \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(n!)^2}$

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8. Solve the differential equation.

$$y'' - 8y' + 25y = 0$$

Select the correct answer.

a. $y(x) = e^{4x}(c_1 \cos(3x) + c_2 \sin(3x))$

b. $y(x) = e^{4x}(c_1 \cos(3x) + c_2 x \sin(3x))$

c. $y(x) = ce^{4x} \cos(3x)$

d. $y(x) = c_1 \cos(3x) + c_2 x \sin(3x)$

e. $y(x) = e^{4x}(c_1 \cos(4x) + c_2 x \sin(4x))$

9. Use power series to solve the differential equation.

$$(x^2 + 1)y'' + xy' - y = 0$$

Select the correct answer.

a. $y(x) = c_0 + c_1 x + c_0 \frac{x^2}{2} + c_0 \sum_{n=2}^{\infty} \frac{(-1)^{n-1} (2n-3)!}{2^{2n-2} n!(n-2)!} x^{2n+1}$

b. $y(x) = c_0 \sum_{n=2}^{\infty} \frac{(-1)^{n-1} (2n-3)!}{2^{2n-2} n!(n-2)!} x^{2n}$

c. $y(x) = c_0 + c_1 x + c_0 \frac{x^2}{2} + c_0 \sum_{n=2}^{\infty} \frac{(-1)^{n-1} (2n-3)!}{2^{2n-2} (n-2)!} x^{2n}$

d. $y(x) = c_0 + c_1 x + c_0 \frac{x^2}{2} + c_0 \sum_{n=2}^{\infty} \frac{(-1)^{n-1} (2n-3)!}{2^{2n-2} n!(n-2)!} x^{2n}$

e. $y(x) = c_0 + c_1 x + c_0 \frac{x^2}{2} + c_0 \sum_{n=2}^{\infty} \frac{(-1)^{n+1} (2n)!}{2^{2n+2} n!(n-2)!} x^{2n+1}$

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Answers:

1.
$$a_0 \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k}}{1 \cdot 3 \cdot 5 \cdots (2k-1)} + a_1 \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{2^k k!}$$

2.
$$a_0 \sum_{k=0}^{\infty} \frac{x^{2k}}{(2k)!} + a_1 \sum_{k=0}^{\infty} \frac{x^{2k+1}}{(2k+1)!}$$

3. a

4. a

5. b

6. c

7. c

8. a

9. d