

**Zill Differential Equations 9e Chapter 4 Form A**

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1. Is the set of functions  $\{f_1(x) = 1, f_2(x) = \sin^2 x, f_3(x) = \cos^2 x\}$  linearly dependent or linearly independent on  $(-\infty, \infty)$ ?
2. One solution of the differential equation  $y'' - y' = 0$  is  $y = e^x$ . Use the method of reduction of order to find a second linearly independent solution.
3. Solve the differential equation  $y'' + 3y' + 2y = 0$ .
4. Solve the differential equation  $y'' + 4y' + 4y = 0$ .
5. Solve the differential equation  $y'' + 4y' + 5y = 0$ .
6. Solve the differential equation  $y'' + 3y' + 2y = 3x + 1$ .
7. Solve the differential equation  $y'' + 4y' + 4y = \cos(2x)$ .
8. Solve the differential equation  $y'' + 4y' + 5y = 2xe^x$ .
9. Solve the differential equation  $y'' + 3y' = 4x - 3$ .
10. Solve the differential equation  $y'' + 3y' + 2y = 4e^{-x}$ .
11. Solve the differential equation  $y'' + 4y' + 4y = e^{-2x}$ .
12. Without solving for the undetermined coefficients, what is the correct form of the particular solution of the differential equation  $y'' + 4y' + 5y = e^{-2x} \cos x$ ?
13. Solve the differential equation  $x^2 y'' + xy' - y = 0$ .
14. Solve the differential equation  $x^2 y'' + 3xy' + y = 0$ .
15. Solve the differential equation  $x^2 y'' + 5xy' + 5y = 0$ .
16. Solve the system of differential equations
$$\begin{aligned}\frac{dx}{dt} &= 4x + 7y \\ \frac{dy}{dt} &= x - 2y.\end{aligned}$$
17. Solve the system of differential equations
$$\begin{aligned}\frac{dx}{dt} &= 4y + 3 \\ \frac{dy}{dt} &= -x + 2.\end{aligned}$$
18. Solve the initial value problem
$$\begin{aligned}\frac{dx}{dt} &= 4y + 3 \\ \frac{dy}{dt} &= -x + 2 \\ x(0) &= 0, y(0) = 1.\end{aligned}$$
19. Solve the differential equation  $x^2 y'' + (y')^2 = 0$ .
20. Solve the differential equation  $xy'' = y' + (y')^3$ .

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form A**

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1. linearly dependent
2.  $y = c$
3.  $y = c_1e^{-2x} + c_2e^{-x}$
4.  $y = c_1e^{-2x} + c_2xe^{-2x}$
5.  $y = c_1e^{-2x} \cos x + c_2e^{-2x} \sin x$
6.  $y = c_1e^{-2x} + c_2e^{-x} + 3x/2 - 7/4$
7.  $y = c_1e^{-2x} + c_2xe^{-2x} + \sin(2x)/8$
8.  $y = c_1e^{-2x} \cos x + c_2e^{-2x} \sin x + xe^x/5 - 3e^x/25$
9.  $y = c_1 + c_2e^{-3x} + 2x^2/3 - 13x/9$
10.  $y = c_1e^{-2x} + c_2e^{-x} + 4xe^{-x}$
11.  $y = c_1e^{-2x} + c_2xe^{-2x} + x^2e^{-2x}/2$
12.  $y_p = Axe^{-2x} \cos x + Bxe^{-x} \sin x$
13.  $y = c_1x + c_2x^{-1}$
14.  $y = c_1x^{-1} + c_2x^{-1} \ln x$
15.  $y = c_1x^{-2} \cos(\ln x) + c_2x^{-2} \sin(\ln x)$
16.  $x = 7c_1e^{5t} - c_2e^{-3t}, y = c_1e^{5t} + c_2e^{-3t}$
17.  $x = 2c_1 \sin(2t) - 2c_2 \cos(2t) + 2, y = c_1 \cos(2t) + c_2 \sin(2t) - 3/4$
18.  $x = 2 - 2 \cos(2t) + 7 \sin(2t)/2, y = 7 \cos(2t)/4 + \sin(2t) - 3/4$
19.  $y = c_1x + c_1^2 \ln(x - c_1) + c_2$
20.  $y = -\sqrt{c_1 - x^2} + c_2$

**Zill Differential Equations 9e Chapter 4 Form B**

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1. Is the set of functions  $\{f_1(x) = 1, f_2(x) = x + 1, f_3(x) = x^2\}$  linearly dependent or linearly independent on  $(-\infty, \infty)$ ?
2. One solution of the differential equation  $y'' - y = 0$  is  $y = e^x$ . Use the method of reduction of order to find a second linearly independent solution.
3. Solve the differential equation  $y'' - 4y' - 5y = 0$ .
4. Solve the differential equation  $y'' - 6y' + 9y = 0$ .
5. Solve the differential equation  $y'' + 6y' + 13y = 0$ .
6. Solve the differential equation  $y'' + 4y' + 3y = 5x - 2$ .
7. Solve the differential equation  $y'' + 6y' + 9y = \cos(3x)$ .
8. Solve the differential equation  $y'' + 2y' + 5y = 2xe^{-x}$ .
9. Solve the differential equation  $y'' - 4y' = 5x - 2$ .
10. Solve the differential equation  $y'' + 5y' + 4y = 2e^{-x}$ .
11. Solve the differential equation  $y'' - 4y' + 4y = e^{2x}$ .
12. Without solving for the undetermined coefficients, what is the correct form of the particular solution of the differential equation  $y'' + 4y' + 13y = e^{-2x} \cos(3x)$ ?
13. Solve the differential equation  $x^2y'' - xy' + y = 0$ .
14. Solve the differential equation  $x^2y'' + 3xy' + 10y = 0$ .
15. Solve the differential equation  $x^2y'' + 5xy' + 3y = 0$ .
16. Solve the system of differential equations
$$\begin{aligned}\frac{dx}{dt} &= 2x + 2y \\ \frac{dy}{dt} &= x + 3y.\end{aligned}$$
17. Solve the system of differential equations
$$\begin{aligned}\frac{dx}{dt} &= 2x + 3y + 1 \\ \frac{dy}{dt} &= -x - 2y + 4.\end{aligned}$$
18. Solve the initial value problem
$$\begin{aligned}\frac{dx}{dt} &= 3x - 3y \\ \frac{dy}{dt} &= 2x - 2y, \\ x(0) &= 0, y(0) = 1\end{aligned}$$
19. Solve the differential equation  $y^2y'' = y'$ .
20. Obtain the first four nonzero terms of a Taylor series solution, centered at  $x = 0$ , of the differential equation  $y'' + y^2 = 1$ ,  $y(0) = 1$ ,  $y'(0) = 2$ .

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form B**

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1. linearly independent
2.  $y = e^{-x}$
3.  $y = c_1 e^{5x} + c_2 e^{-x}$
4.  $y = c_1 e^{3x} + c_2 x e^{3x}$
5.  $y = c_1 e^{-3x} \cos(2x) + c_2 e^{-3x} \sin(2x)$
6.  $y = c_1 e^{-3x} + c_2 e^{-x} + 5x/3 - 26/9$
7.  $y = c_1 e^{-3x} + c_2 x e^{-3x} + \sin(3x)/18$
8.  $y = c_1 e^{-x} \cos(2x) + c_2 e^{-x} \sin(2x) + x e^{-x}/2$
9.  $y = c_1 + c_2 e^{4x} - 5x^2/8 + 3x/16$
10.  $y = c_1 e^{-4x} + c_2 e^{-x} + 2x e^{-x}/3$
11.  $y = c_1 e^{2x} + c_2 x e^{2x} + x^2 e^{2x}/2$
12.  $y_p = A x e^{-2x} \cos(3x) + B x e^{-2x} \sin(3x)$
13.  $y = c_1 x + c_2 x \ln x$
14.  $y = c_1 x^{-1} \cos(3 \ln x) + c_2 x^{-1} \sin(3 \ln x)$
15.  $y = c_1 x^{-1} + c_2 x^{-3}$
16.  $x = -2c_1 e^t + c_2 e^{4t}, y = c_1 e^t + c_2 e^{4t}$
17.  $x = -3c_1 e^t - c_2 e^{-t} - 14, y = c_1 e^t + c_2 e^{-t} + 9$
18.  $x = 3 - 3e^t, y = 3 - 2e^t$
19.  $c_1 y - \ln(1 + c_1 y) = -c_1^2(x + c_2)$
20.  $y = 1 + 2x - 2x^3/3 - x^4/3$

1. Which of the following sets of functions are linearly independent on  $(0, \infty)$ ?

Select all that apply.

- (a)  $\{1, \sin^2 x, \cos^2 x\}$
- (b)  $\{1, x + 3, 2x\}$
- (c)  $\{\sqrt{x}, x, x^2\}$
- (d)  $\{1, \tan^2 x, \sec^2 x\}$
- (e)  $\{1/x, x, \ln x\}$

2. One solution of the differential equation  $y'' + y' = 0$  is  $y = e^{-x}$ . A second linearly independent solution is

Select the correct answer.

- (a)  $y = c$
- (b)  $y = e^x$
- (c)  $y = xe^x$
- (d)  $y = xe^{-x}$
- (e)  $y = e^{-x}$

3. Two linearly independent solutions of the differential equation  $y'' - 4y' + 4y = 0$  are

Select the correct answer.

- (a)  $y_1 = e^{2x}, y_2 = e^{2x}$
- (b)  $y_1 = e^{2x}, y_2 = xe^{2x}$
- (c)  $y_1 = e^{2x}, y_2 = e^{-2x}$
- (d)  $y_1 = e^{-2x}, y_2 = xe^{-2x}$
- (e)  $y_1 = e^{-2x}, y_2 = xe^{2x}$

4. Two linearly independent solutions of the differential equation  $y'' - 5y' - 6y = 0$  are

Select the correct answer.

- (a)  $y_1 = e^{6x}, y_2 = e^x$
- (b)  $y_1 = e^{6x}, y_2 = xe^{-x}$
- (c)  $y_1 = e^{6x}, y_2 = e^{-x}$
- (d)  $y_1 = e^{-6x}, y_2 = xe^{-x}$
- (e)  $y_1 = e^{-6x}, y_2 = e^x$

5. Two linearly independent solutions of the differential equation  $y'' - 6y' + 25y = 0$  are  
Select the correct answer.

- (a)  $y_1 = e^{3x}, y_2 = e^{4x}$
- (b)  $y_1 = e^{-3x}, y_2 = e^{-4x}$
- (c)  $y_1 = e^{-3x} \cos(4x), y_2 = e^{-3x} \sin(4x)$
- (d)  $y_1 = e^{3x} \cos(4x), y_2 = e^{3x} \sin(4x)$
- (e)  $y_1 = e^{4x} \cos(3x), y_2 = e^{4x} \sin(3x)$

6. A particular solution of the differential equation  $y'' + 3y' + 2y = 4x + 3$  is  
Select the correct answer.

- (a)  $y_p = 4x + 3$
- (b)  $y_p = 2x + 3/2$
- (c)  $y_p = 2x - 3/2$
- (d)  $y_p = 4x^2 + 3x$
- (e)  $y_p = 2x - 3$

7. A particular solution of the differential equation  $y'' + 2y' + y = e^x$  is  
Select the correct answer.

- (a)  $y_p = 4xe^x$
- (b)  $y_p = x^2e^x/2$
- (c)  $y_p = 2x^2e^x$
- (d)  $y_p = e^x/4$
- (e)  $y_p = e^x$

8. A particular solution of the differential equation  $y'' - 2y' + y = \cos x$  is  
Select the correct answer.

- (a)  $y_p = \cos x$
- (b)  $y_p = \sin x$
- (c)  $y_p = \sin x/2$
- (d)  $y_p = \cos x/2$
- (e)  $y_p = -\sin x/2$

9. A particular solution of the differential equation  $y'' - 2y' + y = e^x$  is  
Select the correct answer.

- (a)  $y_p = x^2 e^x / 2$
- (b)  $y_p = x e^x / 2$
- (c)  $y_p = x e^x$
- (d)  $y_p = e^x$
- (e)  $y_p = e^{-x} / 4$

10. A particular solution of the differential equation  $y'' + 3y' - 4y = e^x$  is  
Select the correct answer.

- (a)  $y_p = x^2 e^x$
- (b)  $y_p = x e^x / 5$
- (c)  $y_p = x e^x$
- (d)  $y_p = e^x$
- (e)  $y_p = e^{-x} / 5$

11. Without solving for the undetermined coefficients, the correct form of a particular solution of the differential equation  $y'' + 4y = \cos(2x)$  is  
Select the correct answer.

- (a)  $y_p = A \cos(2x)$
- (b)  $y_p = A \cos(2x) + B \sin(2x)$
- (c)  $y_p = Ax \cos(2x)$
- (d)  $y_p = Ax \cos(2x) + B \sin(2x)$
- (e)  $y_p = Ax \cos(2x) + Bx \sin(2x)$

12. Without solving for the undetermined coefficients, the correct form of a particular solution of the differential equation  $y'' + 4y' + 5y = e^{-2x} \cos x$  is  
Select the correct answer.

- (a)  $y_p = A e^{-2x} \cos x$
- (b)  $y_p = A e^{-2x} \cos x + B e^{-2x} \sin x$
- (c)  $y_p = A e^{-2x} \sin x$
- (d)  $y_p = A x e^{-2x} \cos x + B x e^{-2x} \sin x$
- (e)  $y_p = A x e^{-2x} \cos x + B e^{-2x} \sin x$

13. The auxiliary equation for the differential equation  $x^2y'' + 3xy' + y = 6$  is

Select the correct answer.

(a)  $m^2 + 3m + 1$

(b)  $m^2 + 3m + 1 = 0$

(c)  $m^2 + 2m + 1 = 0$

(d)  $m^2 + 3m + 1 = 6$

(e)  $m^2 + 2m + 1 = 6$

14. The solution of the differential equation  $x^2y'' + 3xy' + y = 0$  is

Select the correct answer.

(a)  $y = c_1x^{-1} + c_2x^{-1} \ln x$

(b)  $y = c_1x^{-1} + c_2x^{-2}$

(c)  $y = c_1x^{(-3+\sqrt{5})/2} + c_2x^{(-3-\sqrt{5})/2}$

(d)  $y = c_1x + c_2x \ln x$

(e)  $y = c_1x + c_2x^2$

15. The solution of the differential equation  $x^2y'' - 2xy' + 2y = 0$  is

Select the correct answer.

(a)  $y = c_1x \cos(\ln x) + c_2x \sin(\ln x)$

(b)  $y = c_1x^{1/2} \cos(\sqrt{3} \ln x/2) + c_2x^{1/2} \sin(\sqrt{3} \ln x/2)$

(c)  $y = c_1x^{(1+\sqrt{3})/2} + c_2x^{(1-\sqrt{3})/2}$

(d)  $y = c_1x + c_2x \ln x$

(e)  $y = c_1x + c_2x^2$

16. A solution of the differential equation  $y'' = 2x(y')^2$  is

Select the correct answer.

(a)  $y = \ln(c_1 - x^2) + c_2$

(b)  $y = \ln((c_1 - x)/(c_1 + x)) + c_2$

(c)  $y = \ln((c_1 + x)/(c_1 - x)) + c_2$

(d)  $y = \ln(((c_1 + x)/(c_1 - x))^2) + c_2$

(e)  $y = \ln(((c_1 - x)/(c_1 + x))^2) + c_2$



17. The solution of the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= x + 2y \\ \frac{dy}{dt} &= 4x + 3y\end{aligned}$$

is

Select the correct answer.

- (a)  $x = c_1e^{5t}/2 + c_2e^{-t}$ ,  $y = c_1e^{5t} + c_2e^{-t}$
- (b)  $x = c_1e^{5t}/2 - c_2e^{-t}$ ,  $y = c_1e^{5t} - c_2e^{-t}$
- (c)  $x = c_1e^{5t} - c_2e^{-t}$ ,  $y = c_1e^{5t} + c_2e^{-t}$
- (d)  $x = c_1e^{5t} + c_2e^{-t}$ ,  $y = c_1e^{5t} + c_2e^{-t}$
- (e)  $x = c_1e^{5t}/2 - c_2e^{-t}$ ,  $y = c_1e^{5t} + c_2e^{-t}$

18. The solution of the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 3x - y \\ \frac{dy}{dt} &= 9x - 3y\end{aligned}$$

is

Select the correct answer.

- (a)  $x = (c_1 + 3c_1t + 3c_2)/9$ ,  $y = c_1t + c_2$
- (b)  $x = (3c_1t + 3c_2)/9$ ,  $y = c_1t + c_2$
- (c)  $x = (c_1 + 3c_1t)/9$ ,  $y = c_1t + c_2$
- (d)  $x = (c_1 + 3c_1t + 3c_2)$ ,  $y = c_1t + c_2$
- (e)  $x = (c_1 - 3c_1t + 3c_2)/9$ ,  $y = c_1t + c_2$

19. The solution of the initial value problem

$$\begin{aligned}\frac{dx}{dt} &= 10x - 5y \\ \frac{dy}{dt} &= 8x - 12y, \\ x(0) &= 2, y(0) = 1\end{aligned}$$

is

Select the correct answer.

- (a)  $x = (35e^{8t} - e^{-10t})/18$ ,  $y = (7e^{8t} + 2e^{-10t})/9$
- (b)  $x = (35e^{8t} + e^{-10t})/18$ ,  $y = (7e^{8t} + 2e^{-10t})/9$
- (c)  $x = (35e^{8t} + e^{-10t})/9$ ,  $y = (7e^{8t} + 2e^{-10t})/9$
- (d)  $x = (35e^{8t} - e^{-10t})/9$ ,  $y = (7e^{8t} - 2e^{-10t})/9$
- (e)  $x = (35e^{8t} + e^{-10t})/18$ ,  $y = (7e^{8t} - 2e^{-10t})/9$

20. The solution of the differential equation  $y'y'' = 4$  is

Select the correct answer.

(a)  $y = (8x + c_1)^{3/2}/24 + c_2$

(b)  $y = (4x + c_1)^{3/2}/12 + c_2$

(c)  $y = (4x + c_1)^{3/2}/24 + c_2$

(d)  $y = (8x + c_1)^{1/2}/12 + c_2$

(e)  $y = (8x + c_1)^{3/2}/12 + c_2$

**ANSWER KEY**

***Zill Differential Equations 9e Chapter 4 Form C***

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1. c, e
2. a
3. b
4. c
5. d
6. c
7. d
8. e
9. a
10. b
11. e
12. d
13. c
14. a
15. e
16. e
17. a
18. b
19. b
20. e

1. The Wronskian of the functions  $e^x$  and  $e^{3x}$  is

Select the correct answer.

- (a)  $2e^{4x}$
- (b)  $-2e^{4x}$
- (c)  $2e^{2x}$
- (d)  $4e^{4x}$
- (e)  $4e^{2x}$

2. One solution of the differential equation  $y'' + y = 0$  is  $y = \cos x$ . A second linearly independent solution is

Select the correct answer.

- (a)  $y = \cos x$
- (b)  $y = \sin x$
- (c)  $y = e^x$
- (d)  $y = e^{-x}$
- (e)  $y = x \cos x$

3. Two linearly independent solutions of the differential equation  $y'' - 4y' + 5y = 0$  are

Select the correct answer.

- (a)  $y_1 = e^x, y_2 = e^{5x}$
- (b)  $y_1 = e^{-x}, y_2 = e^{-5x}$
- (c)  $y_1 = e^{2x} \cos x, y_2 = e^{2x} \sin x$
- (d)  $y_1 = e^x \cos(2x), y_2 = e^x \sin(2x)$
- (e)  $y_1 = e^{-x} \cos(2x), y_2 = e^{-2x} \sin(2x)$

4. Two linearly independent solutions of the differential equation  $y'' - 5y' + 6y = 0$  are

Select the correct answer.

- (a)  $y_1 = e^{2x}, y_2 = e^{3x}$
- (b)  $y_1 = e^{-2x}, y_2 = e^{-3x}$
- (c)  $y_1 = e^{6x}, y_2 = e^{-x}$
- (d)  $y_1 = e^{-6x}, y_2 = e^x$
- (e)  $y_1 = e^{-6x}, y_2 = e^{-x}$

5. Two linearly independent solutions of the differential equation  $y'' + 6y' + 9y = 0$  are  
Select the correct answer.

- (a)  $y_1 = e^{3x}, y_2 = xe^{3x}$
- (b)  $y_1 = e^{-3x}, y_2 = xe^{-3x}$
- (c)  $y_1 = e^{3x}, y_2 = e^{-3x}$
- (d)  $y_1 = e^{3x} \cos(x), y_2 = e^{3x} \sin(x)$
- (e)  $y_1 = e^{-3x} \cos(3x), y_2 = e^{-3x} \sin(x)$

6. A particular solution of the differential equation  $y'' + 3y' + 4y = 8x + 2$  is  
Select the correct answer.

- (a)  $y_p = 2x + 1$
- (b)  $y_p = 8x + 2$
- (c)  $y_p = 2x - 1$
- (d)  $y_p = x^2 + 3x$
- (e)  $y_p = 2x - 3$

7. A particular solution of the differential equation  $y'' + 4y' + 4y = e^{2x}$  is  
Select the correct answer.

- (a)  $y_p = e^{2x}$
- (b)  $y_p = x^2 e^{2x} / 2$
- (c)  $y_p = 2x e^{2x}$
- (d)  $y_p = e^{2x} / 4$
- (e)  $y_p = e^{2x} / 16$

8. A particular solution of the differential equation  $y'' - 2y' + y = \sin x$  is  
Select the correct answer.

- (a)  $y_p = \cos x$
- (b)  $y_p = \sin x$
- (c)  $y_p = \sin x / 2$
- (d)  $y_p = \cos x / 2$
- (e)  $y_p = -\cos x / 2$

9. A particular solution of the differential equation  $y'' + 2y' + y = e^{-x}$  is  
Select the correct answer.

- (a)  $y_p = x^2 e^{-x} / 2$
- (b)  $y_p = x e^{-x} / 2$
- (c)  $y_p = x e^{-x}$
- (d)  $y_p = e^{-x}$
- (e)  $y_p = e^{-x} / 4$

10. A particular solution of the differential equation  $y'' - 3y' - 4y = e^{4x}$  is  
Select the correct answer.

- (a)  $y_p = x^2 e^{4x}$
- (b)  $y_p = x e^{4x} / 7$
- (c)  $y_p = x e^{4x} / 5$
- (d)  $y_p = e^{4x}$
- (e)  $y_p = e^{4x} / 9$

11. Without solving for the undetermined coefficients, the correct form of a particular solution of the differential equation  $y'' + 9y = \sin(3x)$  is  
Select the correct answer.

- (a)  $y_p = A \cos(3x)$
- (b)  $y_p = Ax \cos(3x) + Bx \sin(3x)$
- (c)  $y_p = A \sin(3x)$
- (d)  $y_p = Ax \cos(3x) + B \sin(3x)$
- (e)  $y_p = A \cos(3x) + B \sin(3x)$

12. Without solving for the undetermined coefficients, the correct form of a particular solution of the differential equation  $y'' + 6y' + 13y = e^{-3x} \cos(2x)$  is  
Select the correct answer.

- (a)  $y_p = A e^{-3x} \cos(2x)$
- (b)  $y_p = A e^{-3x} \cos(2x) + B e^{-3x} \sin(2x)$
- (c)  $y_p = A e^{-3x} \cos(2x)$
- (d)  $y_p = A x e^{-3x} \cos(2x) + B x e^{-3x} \sin(2x)$
- (e)  $y_p = A x e^{-3x} \cos(2x) + B e^{-3x} \sin(2x)$

13. The auxiliary equation for the differential equation  $x^2y'' + 5y' + 4y = 6$  is  
Select the correct answer.

- (a)  $m^2 + 5m + 4$
- (b)  $m^2 + 4m + 4 = 0$
- (c)  $m^2 + 5m + 4 = 0$
- (d)  $m^2 + 5m + 4 = 6$
- (e)  $m^2 + 4m + 4 = 6$

14. The solution of the differential equation  $x^2y'' - 3xy' + 4y = 0$  is  
Select the correct answer.

- (a)  $y = c_1x + c_2x^2$
- (b)  $y = c_1x + c_2x^3$
- (c)  $y = c_1x^{(3+\sqrt{7})/2} + c_2x^{(3-\sqrt{7})/2}$
- (d)  $y = c_1x^2 + c_2x^2 \ln x$
- (e)  $y = c_1x + c_2x \ln x$

15. The solution of the differential equation  $x^2y'' - 5xy' + 5y = 0$  is  
Select the correct answer.

- (a)  $y = c_1x + c_2x^5$
- (b)  $y = c_1x^2 \cos(\ln x) + c_2x^2 \sin(\ln x)$
- (c)  $y = c_1x \cos(2 \ln x) + c_2x \sin(2 \ln x)$
- (d)  $y = c_1x^{(5+\sqrt{5})/2} + c_2x^{(5-\sqrt{5})/2}$
- (e)  $y = c_1e^{2x} \cos x + c_2e^{2x} \sin x$

16. The solution of the differential equation  $y'' = 2x(y')^2$  is  
Select the correct answer.

- (a)  $y = -\tan^{-1}(x/c_1)/c_1 + c_2$
- (b)  $y = c_1 \int e^{x^2} dx + c_2$
- (c)  $y = c_1e^x + c_2$
- (d)  $y = c_1x^3 + c_2$
- (e)  $y = c_1x^3 + c_2x$

17. The solution of the system of differential equations

$$\frac{dx}{dt} = -6x + 5y$$

$$\frac{dy}{dt} = -5x + 4y$$

is

Select the correct answer.

(a)  $x = (c_1 - c_2/5)e^t + c_2te^t, y = c_1e^t + c_2te^t$

(b)  $x = (c_1 - c_2)e^{-t} + c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$

(c)  $x = (c_1 + c_2)e^{-t} + c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$

(d)  $x = (c_1 + c_2/5)e^{-t} + c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$

(e)  $x = (c_1 - c_2/5)e^{-t} + c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$

18. The solution of the initial value problem

$$\frac{dx}{dt} = -6x + 5y$$

$$\frac{dy}{dt} = -5x + 4y,$$

$$x(0) = 1/3, y(0) = 0$$

is

Select the correct answer.

(a)  $x = (e^t - 5te^t)/3, y = -5te^t/3$

(b)  $x = (e^{-t} - te^{-t})/3, y = -te^{-t}/3$

(c)  $x = (e^{-t} + te^{-t})/3, y = te^{-t}/3$

(d)  $x = (e^{-t} + 5te^{-t})/3, y = 5te^{-t}/3$

(e)  $x = (e^{-t} - 5te^{-t})/3, y = -5te^{-t}/3$

19. The solution of the system of differential equations

$$\frac{dx}{dt} = -6x + 5y + t$$

$$\frac{dy}{dt} = -5x + 4y + 1$$

is

Select the correct answer.

(a)  $x = (c_1 + c_2/5)e^{-t} + c_2te^{-t} - 4t + 69/5, y = c_1e^{-t} + c_2te^{-t} - 5t - 16$

(b)  $x = (c_1 + c_2/5)e^{-t} + c_2te^{-t} + 4t + 69/5, y = c_1e^{-t} + c_2te^{-t} - 5t + 16$

(c)  $x = (c_1 + c_2/5)e^t + c_2te^t - 4t + 69/5, y = c_1e^t + c_2te^t - 5t + 16$

(d)  $x = (c_1 - c_2/5)e^{-t} + c_2te^{-t} - 4t + 69/5, y = c_1e^{-t} + c_2te^{-t} - 5t + 16$

(e)  $x = (c_1 + c_2/5)e^{-t} + c_2te^{-t} - 4t + 69/5, y = c_1e^{-t} + c_2te^{-t} - 5t + 16$



20. The solution of the initial value problem  $2y'' = 3y^2$ ,  $y(0) = 1$ ,  $y'(0) = 1$  is

Select the correct answer.

(a)  $y = 2/(x + 2)^2$

(b)  $y = 4/(x + 2)^3$

(c)  $y = 1/(x + 1)^3$

(d)  $y = 1/(x + 1)^2$

(e)  $y = 4/(x + 2)^2$

**ANSWER KEY**

***Zill Differential Equations 9e Chapter 4 Form D***

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1. a
2. b
3. c
4. a
5. b
6. c
7. e
8. d
9. a
10. c
11. b
12. d
13. b
14. d
15. a
16. a
17. a
18. e
19. a
20. e

1. The Wronskian of the functions  $x$ ,  $x^2$  and  $e^x$  is

Select the correct answer.

- (a)  $x^2e^x$
- (b)  $-x^2e^x$
- (c)  $(x^2 - 2x + 2)e^x$
- (d)  $-(x^2 - 2x + 2)e^x$
- (e)  $2x^2e^x - 2xe^x$

2. One solution of the differential equation  $y'' - 4y = 0$  is  $y = e^{2x}$ . A second linearly independent solution is

Select the correct answer.

- (a)  $e^{2x}$
- (b)  $xe^{-2x}$
- (c)  $xe^{2x}$
- (d)  $e^{-2x}$
- (e)  $\cos(2x)$

3. Solve the differential equation  $y'' - 2y' + y = 0$ .

4. Solve the differential equation  $y'' - 3y' + 2y = 0$ .

5. Solve the differential equation  $y'' - 2y' + 5y = 0$ .

6. A particular solution of the differential equation  $y'' + y' - 2y = 8x + 2$  is

Select the correct answer.

- (a)  $y_p = 4x - 6$
- (b)  $y_p = 8x + 2$
- (c)  $y_p = 4x - 1$
- (d)  $y_p = x^2 + 3x$
- (e)  $y_p = -4x - 3$

7. Solve the differential equation  $y'' + 2y' + 5y = xe^{-x}$ .

8. Solve the differential equation  $y'' + 2y' = 2x - 3$ .

9. A particular solution of the differential equation  $y'' + 2y' - 8y = -\sin(2x)$  is

Select the correct answer.

- (a)  $y_p = \sin(2x)$
- (b)  $y_p = \cos(2x) + \sin(2x)$
- (c)  $y_p = (\cos(2x) - 3\sin(2x))/4$
- (d)  $y_p = (\cos(2x) + 3\sin(2x))/40$
- (e)  $y_p = (3\cos(2x) + \sin(2x))/40$

10. A particular solution of the differential equation  $y'' + 2y' - 8y = e^{2x}$  is

Select the correct answer.

- (a)  $y_p = xe^{2x}/6$
- (b)  $y_p = xe^{2x}/2$
- (c)  $y_p = x^2e^{2x}/6$
- (d)  $y_p = xe^{2x}$
- (e)  $y_p = e^{2x}$

11. A particular solution of the differential equation  $y'' + 4y = \sin(2x)$  is

Select the correct answer.

- (a)  $y_p = \sin(2x)$
- (b)  $y_p = x\cos(2x) + \sin(2x)$
- (c)  $y_p = -x\cos(2x)/4$
- (d)  $y_p = \sin(2x)/4$
- (e)  $y_p = \cos(2x)$

12. Without solving for the undetermined coefficients, what is the correct form of a particular solution of the differential equation  $y'' + 2y' + 5y = e^{-x}\cos(2x)$ ?

13. The auxiliary equation for the differential equation  $x^2y'' + 4y' + 2y = 6$  is

Select the correct answer.

- (a)  $m^2 + 3m + 2$
- (b)  $m^2 + 4m + 2 = 6$
- (c)  $m^2 + 3m + 2 = 6$
- (d)  $m^2 + 4m + 2 = 0$
- (e)  $m^2 + 3m + 2 = 0$

14. Solve the differential equation  $x^2y'' - 2xy' + 2y = x$ .

15. Solve the differential equation  $x^3y''' - 3x^2y'' + 6xy' - 6y = 0$ .

16. Consider the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 2x - y \\ \frac{dy}{dt} &= x\end{aligned}$$

After eliminating one variable, the auxiliary equation for the other is

Select the correct answer.

- (a)  $m^2 + 2m + 1 = 0$
- (b)  $m^2 - 2m + 1 = 0$
- (c)  $m^2 - 2m - 1 = 0$
- (d)  $m^2 + 2m - 1 = 0$
- (e)  $m^2 - 2m = 0$

17. The solution of the system of differential equations in the previous problem is

Select the correct answer.

- (a)  $x = c_1e^t + c_2e^t + c_2te^t, y = c_1e^t + c_2te^t$
- (b)  $x = -c_1e^{-t} + c_2e^{-t} - c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$
- (c)  $x = c_1e^t - c_2e^t + c_2te^t, y = c_1e^t + c_2te^t$
- (d)  $x = -c_1e^{-t} - c_2e^{-t} - c_2te^{-t}, y = c_1e^{-t} + c_2te^{-t}$
- (e)  $x = c_1e^t + 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$

18. Solve the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 6x - y \\ \frac{dy}{dt} &= 5x + 2y\end{aligned}$$

19. The solution of the differential equation  $y'' + (y')^2 + 1 = 0$  is

Select the correct answer.

- (a)  $y = -\ln(\cos(c_1 - x)) + c_2$
- (b)  $y = -\ln(\sin(c_1 - x)) + c_2$
- (c)  $y = \ln(\cos(c_1 - x)) + c_2$
- (d)  $y = \ln(\sin(c_1 - x)) + c_2$
- (e)  $y = \tan^{-1}(c_1 - x) + c_2$

20. Write down the first four nonzero terms in the Taylor expansion about  $x = 0$  of the solution of the initial value problem  $y'' + y^2 = 1, y(0) = 2, y'(0) = 1$ .

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form E**

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1. c

2. d

3.  $y = c_1e^x + c_2xe^x$

4.  $y = c_1e^x + c_2e^{2x}$

5.  $y = c_1e^x \cos(2x) + c_2e^x \sin(2x)$

6. e

7.  $y = c_1e^{-x} \cos(2x) + c_2e^{-x} \sin(2x) + xe^{-x}/4$

8.  $y = c_1 + c_2e^{-2x} + x^2/2 - 2x$

9. d

10. a

11. c

12.  $y_p = Axe^{-x} \cos(2x) + Bxe^{-x} \sin(2x)$

13. e

14.  $y = c_1x + c_2x^2 - x \ln x - x$

15.  $y = c_1x + c_2x^2 + c_3x^3$

16. b

17. a

18.  $x = e^{4t}(c_1 \cos t + c_2 \sin t), y = e^{4t}(c_1(2 \cos t + \sin t) + c_2(2 \sin t - \cos t))$

19. c

20.  $y = 2 + x - 3x^2/2 - 2x^3/3$

1. Evaluate the Wronskian of  $1, x, e^x, e^{2x}$ .
2. One solution of the differential equation  $xy'' - 3y' = 0$  is  $y = x^4$ . A second linearly independent solution is

Select the correct answer.

- (a)  $y = x^3$
- (b)  $y = x^{-3}$
- (c)  $y = x^4 \ln x$
- (d)  $y = x^3 \ln x$
- (e)  $y = c$

3. Solve the differential equation  $y'' - 4y' + 4y = 0$ .
4. Solve the differential equation  $y'' - 5y' - 6y = 0$ .
5. Solve the differential equation  $y'' - 4y' + 5y = 0$ .
6. A particular solution of the differential equation  $y'' - y' - 2y = 4x - 1$  is

Select the correct answer.

- (a)  $y_p = -2x + 3/2$
- (b)  $y_p = 2x - 3$
- (c)  $y_p = 4x - 1$
- (d)  $y_p = x^2 + 2x$
- (e)  $y_p = -4x - 3$

7. A particular solution of the differential equation  $y'' - y' - 6y = \sin(2x)$  is
- Select the correct answer.

- (a)  $y_p = \sin(2x)$
- (b)  $y_p = (\cos(2x) + \sin(2x))/52$
- (c)  $y_p = (\cos(2x) - 3\sin(2x))/52$
- (d)  $y_p = (\cos(2x) - 5\sin(2x))/52$
- (e)  $y_p = (3\cos(2x) + \sin(2x))/52$

8. Solve the differential equation  $y'' - 4y' + 5y = xe^x$ .
9. Solve the differential equation  $y'' - 3y' = 6x - 2$ .

10. A particular solution of the differential equation  $y'' + y' - 2y = e^x$  is  
Select the correct answer.

- (a)  $y_p = xe^x/2$
- (b)  $y_p = xe^x/3$
- (c)  $y_p = x^2e^x/2$
- (d)  $y_p = xe^x$
- (e)  $y_p = e^x$

11. A particular solution of the differential equation  $y'' + 9y = \sin(3x)$  is  
Select the correct answer.

- (a)  $y_p = \sin(3x)$
- (b)  $y_p = x \cos(3x) + \sin(3x)$
- (c)  $y_p = -x \cos(3x)/6$
- (d)  $y_p = x \sin(3x)/4$
- (e)  $y_p = \cos(3x)$

12. Without solving for the undetermined coefficients, what is the correct form of a particular solution of the differential equation  $y'' - 4y' + 5y = e^{2x} \sin x$ ?

13. The auxiliary equation for the differential equation  $x^2y'' - 4y' + 4y = 6$  is  
Select the correct answer.

- (a)  $m^2 - 4m + 4$
- (b)  $m^2 - 4m + 4 = 0$
- (c)  $m^2 - 5m + 4 = 6$
- (d)  $m^2 - 3m + 4 = 6$
- (e)  $m^2 - 5m + 4 = 0$

14. Solve the differential equation  $x^2y'' - 4xy' + 4y = 0$ .

15. Solve the differential equation  $x^3y''' - 3x^2y'' + 6xy' - 6y = 0$ .



16. Consider the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 3x - 2y \\ \frac{dy}{dt} &= x\end{aligned}$$

After eliminating one variable, the auxiliary equation for the other is

Select the correct answer.

- (a)  $m^2 + 3m - 2 = 0$
- (b)  $m^2 - 3m - 2 = 0$
- (c)  $m^2 + 3m + 2 = 0$
- (d)  $m^2 - 3m + 2 = 0$
- (e)  $m^2 - 3m = 0$

17. The solution of the system of differential equations in the previous problem is

Select the correct answer.

- (a)  $x = c_1e^{-t} - c_2e^{-2t}, y = c_1e^{-t} + c_2e^{-2t}$
- (b)  $x = c_1e^t - 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$
- (c)  $x = c_1e^t + c_2e^{2t}, y = c_1e^t + c_2e^{2t}$
- (d)  $x = c_1e^{-t} - 2c_2e^{-2t}, y = c_1e^{-t} + c_2e^{-2t}$
- (e)  $x = c_1e^t + 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$

18. The solution of the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 5x - 4y \\ \frac{dy}{dt} &= x\end{aligned}$$

is

Select the correct answer.

- (a)  $x = c_1e^{-t} + 4c_2e^{-4t}, y = c_1e^{-t} + c_2e^{-4t}$
- (b)  $x = c_1e^t - 4c_2e^{4t}, y = c_1e^t + c_2e^{4t}$
- (c)  $x = c_1e^t + 4c_2e^{4t}, y = c_1e^t + c_2e^{4t}$
- (d)  $x = c_1e^{-t} - 4c_2e^{-4t}, y = c_1e^{-t} + c_2e^{-4t}$
- (e)  $x = c_1e^t + c_2e^{4t}, y = c_1e^t + c_2e^{4t}$

19. Find the first four nonzero terms in the Taylor expansion about  $x = 0$  of the solution of the initial value problem  $y'' = e^y, y(0) = 1, y'(0) = -1$ .

20. The solution of the differential equation  $y^2y'' = y'$  is

Select the correct answer.

- (a)  $c_1y + \ln(c_1y - 1) = c_1^2x + c_2$
- (b)  $c_1y + \ln(c_1y + 1) = c_1^2x + c_2$
- (c)  $c_1y + \ln(c_1y - 1) = c_1^2x^2 + c_2$
- (d)  $c_1y + \ln(c_1y + 1) = c_1^2x^2 + c_2$
- (e)  $c_1y + \ln(c_1y - 1) = c_1^2x^2 + c_2x$

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form F**

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1.  $4e^{3x}$
2. e
3.  $y = c_1e^{2x} + c_2xe^{2x}$
4.  $y = c_1e^{6x} + c_2e^{-x}$
5.  $y = c_1e^{2x} \cos x + c_2e^{2x} \sin x$
6. a
7. d
8.  $y = c_1e^{2x} \cos x + c_2e^{2x} \sin x + (x/2 + 1/2)e^x$
9.  $y = c_1 + c_2e^{3x} - x^2$
10. b
11. c
12.  $y_p = Axe^{2x} \cos x + Be^{2x} \sin x$
13. e
14.  $y = c_1x + c_2x^4$
15.  $y = c_1x + c_2x^2 + c_3x^3$
16. d
17. e
18. c
19.  $y = 1 - x + ex^2/2 - ex^3/6$
20. a

**Zill Differential Equations 9e Chapter 4 Form G**

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1. The functions  $y_1 = e^x$ ,  $y_2 = e^{2x}$ ,  $y_3 = e^{3x}$  are solutions of the differential equation  $y''' - 6y'' + 11y' - 6y = 0$ . Write the general solution.

2. One solution of the differential equation  $xy'' - y' = 0$  is  $y = x^2$ . A second linearly independent solution is

Select the correct answer.

(a)  $y = x^4$

(b)  $y = x^3$

(c)  $y = c$

(d)  $y = x^{-2}$

(e)  $y = x^2 \ln x$

3. The solution of the differential equation  $y'' - 6y' + 8y = 0$  is

Select the correct answer.

(a)  $y = c_1 e^{-6x} + c_2 e^{2x}$

(b)  $y = c_1 e^{-4x} + c_2 e^{2x}$

(c)  $y = c_1 e^{6x} + c_2 e^{2x}$

(d)  $y = c_1 e^{-4x} + c_2 e^{-2x}$

(e)  $y = c_1 e^{4x} + c_2 e^{2x}$

4. Solve the differential equation  $y'' - 6y' + 25y = 0$ .

5. The solution of the differential equation  $y'' - 6y' + 9y = 0$  is

Select the correct answer.

(a)  $y = c_1 e^{-6x} + c_2 e^{3x}$

(b)  $y = c_1 e^{6x} + c_2 e^{3x}$

(c)  $y = c_1 e^{3x} + c_2 e^{-3x}$

(d)  $y = c_1 e^{3x} + c_2 x e^{3x}$

(e)  $y = c_1 e^{-3x} + c_2 x e^{-3x}$

6. Solve the differential equation  $y'' - 4y' = x e^x$ .

7. Solve the differential equation  $y'' + 4y' = 2x - 3$ .

8. A particular solution of the differential equation  $y'' - 2y' + y = x^2 - 1$  is

Select the correct answer.

(a)  $y_p = x^2 - 4x + 1$

(b)  $y_p = x^2 + 4x + 5$

(c)  $y_p = x^2 + 4x - 5$

(d)  $y_p = x^2 - 1$

(e)  $y_p = x^2 - 4x + 5$

9. A particular solution of the differential equation  $y'' - 4y = \sin(2x)$  is

Select the correct answer.

(a)  $y_p = -\sin(2x)/8$

(b)  $y_p = -\cos(2x)/8$

(c)  $y_p = -x \sin(2x)/4$

(d)  $y_p = -x \cos(2x)/4$

(e)  $y_p = \sin(2x)$

10. A particular solution of the differential equation  $y'' + 2y' - 3y = e^x$  is

Select the correct answer.

(a)  $y_p = xe^x$

(b)  $y_p = xe^x/3$

(c)  $y_p = x^2e^x/2$

(d)  $y_p = xe^x/4$

(e)  $y_p = e^x$

11. A particular solution of the differential equation  $y'' + y = \sin x$  is

Select the correct answer.

(a)  $y_p = \sin x$

(b)  $y_p = x \cos x + x \sin x$

(c)  $y_p = -x \cos x/2$

(d)  $y_p = x \sin x/4$

(e)  $y_p = \cos x$

12. Without solving for the undetermined coefficients, what is the correct form of a particular solution of the differential equation  $y'' - 4y' + 8y = e^{2x} \sin(2x)$ ?

13. Solve the differential equation  $x^2y'' - 3xy' + 3y = 0$ .

14. Solve the differential equation  $x^2y'' - 3xy' + 13y = 0$ .

15. The solution of  $x^2y'' + 4xy' + 2y = 0$  is  $y = c_1x^{-1} + c_2x^{-2}$ . Find a particular solution of  $x^2y'' + 4xy' + 2y = x$ .

16. Consider the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 3x + 2y \\ \frac{dy}{dt} &= -x\end{aligned}$$

After eliminating one variable, the auxiliary equation for the other is

Select the correct answer.

(a)  $m^2 + 3m - 2 = 0$

(b)  $m^2 - 3m + 2 = 0$

(c)  $m^2 + 3m + 2 = 0$

(d)  $m^2 - 3m - 2 = 0$

(e)  $m^2 - 3m = 0$

17. The solution of the system of differential equations in the previous problem is

Select the correct answer.

(a)  $x = c_1e^t - 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$

(b)  $x = -c_1e^{-t} + 2c_2e^{-2t}, y = c_1e^{-t} + c_2e^{-2t}$

(c)  $x = c_1e^{-t} + 2c_2e^{-2t}, y = c_1e^{-t} + c_2e^{-2t}$

(d)  $x = -c_1e^t - 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$

(e)  $x = c_1e^t + 2c_2e^{2t}, y = c_1e^t + c_2e^{2t}$

18. The solution of the initial value problem  $y'' + yy' = 0, y(0) = 2, y'(0) = -2$  is

Select the correct answer.

(a)  $\int e^{y^2/2} dy = c_1x + c_2$

(b)  $\int e^{-y^2/2} dy = c_1x + c_2$

(c)  $\int e^{y^2/2} dy = c_1x^2 + c_2x$

(d)  $y = -2/(x - 1)$

(e)  $y = 2/(x + 1)$

19. Solve the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 2x + y \\ \frac{dy}{dt} &= 3x + 4y\end{aligned}$$

20. Solve the differential equation  $x^2y'' + (y')^2 = 0$

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form G**

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1.  $y = c_1e^x + c_2e^{2x} + c_3e^{3x}$

2. c

3. e

4.  $y = c_1e^{3x}\cos(4x) + c_2e^{3x}\sin(4x)$

5. d

6.  $y = c_1e^{4x} + c_2 + (-x/3 - 2/9)e^x$

7.  $y = c_1 + c_2e^{-4x} + x^2/4 - 7x/8$

8. b

9. a

10. d

11. c

12.  $y_p = Axe^{2x}\cos(2x) + Bxe^{2x}\sin(2x)$

13.  $y = c_1x + c_2x^3$

14.  $y = c_1x^2\cos(3\ln x) + c_2x^2\sin(3\ln x)$

15.  $y_p = x/6$

16. b

17. d

18. e

19.  $x = c_1e^t + c_2e^{5t}, y = -c_1e^t + 3c_2e^{5t}$

20.  $y = c_1x + c_1^2\ln(x - c_1) + c_2$

1. The functions  $y_1 = e^x$ ,  $y_2 = e^{2x}$ ,  $y_3 = e^{3x}$  are solutions of the differential equation  $y''' - 6y'' + 11y' - 6y = 0$ . The function  $y_p = -2x - 4$  is a solution of  $y''' - 6y'' + 11y' - 6y = 12x + 2$ . Write the general solution of  $y''' - 6y'' + 11y' - 6y = 12x + 2$ .

2. One solution of the differential equation  $y'' + 4y = 0$  is  $y = \cos(2x)$ . A second linearly independent solution is

Select the correct answer.

- (a)  $y = x \cos(2x)$
- (b)  $y = \sin(2x)$
- (c)  $y = -x \cos(2x)$
- (d)  $y = e^{2x}$
- (e)  $y = e^{-2x}$

3. The solution of the differential equation  $y'' - 6y' + 10y = 0$  is

Select the correct answer.

- (a)  $y = c_1 e^{3x} + c_2 e^x$
- (b)  $y = c_1 e^{3x} \cos x + c_2 e^{3x} \sin x$
- (c)  $y = c_1 e^{-3x} \cos x + c_2 e^{-3x} \sin x$
- (d)  $y = c_1 e^{-3x} + c_2 e^x$
- (e)  $y = c_1 e^{4x} + c_2 e^{2x}$

4. Solve the differential equation  $y'' + 4y' - 5y = 0$ .

5. The solution of the differential equation  $y'' + 6y' + 9y = 0$  is

Select the correct answer.

- (a)  $y = c_1 e^{-6x} + c_2 e^{3x}$
- (b)  $y = c_1 e^{6x} + c_2 e^{3x}$
- (c)  $y = c_1 e^{3x} + c_2 e^{-3x}$
- (d)  $y = c_1 e^{3x} + c_2 x e^{3x}$
- (e)  $y = c_1 e^{-3x} + c_2 x e^{-3x}$

6. Solve the differential equation  $y'' - 4y' + 5y = x e^{2x}$ .

7. Solve the differential equation  $y'' - 5y' = 6x - 2$ .

8. A particular solution of the differential equation  $y'' - y' - 2y = 4x - 1$  is

Select the correct answer.

(a)  $y_p = -4x - 3$

(b)  $y_p = 2x - 3$

(c)  $y_p = 4x - 1$

(d)  $y_p = x^2 + 2x$

(e)  $y_p = -2x + 3/2$

9. A particular solution of the differential equation  $y'' - y' - 6y = \cos(2x)$  is

Select the correct answer.

(a)  $y_p = \cos(2x)$

(b)  $y_p = (-5 \cos(2x) - \sin(2x))/52$

(c)  $y_p = (5 \cos(2x) - \sin(2x))/52$

(d)  $y_p = (5 \cos(2x) + \sin(2x))/52$

(e)  $y_p = (-5 \cos(2x) + \sin(2x))/52$

10. A particular solution of the differential equation  $y'' + y' - 2y = e^{-2x}$  is

Select the correct answer.

(a)  $y_p = -xe^{-2x}/2$

(b)  $y_p = x^2e^{-2x}/2$

(c)  $y_p = -xe^{-2x}/3$

(d)  $y_p = xe^{-2x}$

(e)  $y_p = e^{-2x}$

11. A particular solution of the differential equation  $y'' + 4y = \cos(2x)$  is

Select the correct answer.

(a)  $y_p = \sin(2x)$

(b)  $y_p = x \cos(2x) + \sin(2x)$

(c)  $y_p = -x \cos(2x)/6$

(d)  $y_p = x \sin(2x)/4$

(e)  $y_p = \cos(2x)$

12. Without solving for the undetermined coefficients, what is the correct form of a particular solution of the differential equation  $y'' - 2y' + 10y = e^x \sin(3x)$ ?

13. Solve the differential equation  $x^2y'' - 4xy' + 6y = 0$ .

14. Solve the differential equation  $x^2y'' - 3xy' + 4y = 0$ .



15. The solution of  $x^2y'' - 2xy' + 2y = 0$  is  $y = c_1x + c_2x^2$ . Find a particular solution of  $x^2y'' - 2xy' + 2y = x$ .

16. Consider the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= -3x + 2y \\ \frac{dy}{dt} &= -x\end{aligned}$$

After eliminating the variable  $x$ , the differential equation for the variable  $y$  is

Select the correct answer.

- (a)  $\frac{d^2y}{dt^2} - 3\frac{dy}{dt} + 2y = 0$
- (b)  $\frac{d^2y}{dt^2} + 3\frac{dy}{dt} - 2y = 0$
- (c)  $\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = 0$
- (d)  $\frac{d^2y}{dt^2} - 2\frac{dy}{dt} - 3y = 0$
- (e)  $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 3y = 0$

17. The solution of the system of differential equations in the previous problem is

Select the correct answer.

- (a)  $x = c_1e^{-t} + 2c_2e^{-2t}$ ,  $y = c_1e^{-t} + c_2e^{-2t}$
- (b)  $x = c_1e^{-t} - 2c_2e^{-2t}$ ,  $y = c_1e^{-t} + c_2e^{-2t}$
- (c)  $x = -c_1e^{-t} - 2c_2e^{-2t}$ ,  $y = c_1e^{-t} + c_2e^{-2t}$
- (d)  $x = -c_1e^t - 2c_2e^{2t}$ ,  $y = c_1e^t + c_2e^{2t}$
- (e)  $x = c_1e^t + 2c_2e^{2t}$ ,  $y = c_1e^t + c_2e^{2t}$

18. Solve the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= -6x + 5y \\ \frac{dy}{dt} &= -x\end{aligned}$$

19. Solve the initial value problem  $yy'' = (y')^2/2$ ,  $y(1) = 1$ ,  $y'(1) = -1$

20. The solution of the differential equation  $yy'' = (y')^2/2$

Select the correct answer.

- (a)  $y = c_1x + c_2$
- (b)  $y = c_1x^2 + c_2$
- (c)  $y = c_1/x^2 + c_2$
- (d)  $y = c_1/x + c_2$
- (e)  $y = (c_1x + c_2)^2$

**ANSWER KEY****Zill Differential Equations 9e Chapter 4 Form H**

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1.  $y = c_1e^x + c_2e^{2x} + c_3e^{3x} - 2x - 4$

2. b

3. b

4.  $y = c_1e^{-5x} + c_2e^x$

5. e

6.  $y = c_1e^{2x} \cos x + c_2e^{2x} \sin x + xe^{2x}$

7.  $y = c_1 + c_2e^{5x} - 3x^2/5 + 4x/25$

8. e

9. b

10. c

11. d

12.  $y_p = Axe^x \cos(3x) + Bxe^x \sin(3x)$

13.  $y = c_1x^2 + c_2x^3$

14.  $y = c_1x^2 + c_2x^2 \ln x$

15.  $y_p = -x \ln x - x$

16. c

17. a

18.  $x = c_1e^{-t} + c_2e^{-5t}, y = c_1e^{-t} + c_2e^{-5t}/5$

19. e

20.  $y = (3/2 - x^2/2)^2$