

1. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{e^t\}$.
2. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{\sin t\}$.
3. Let $f(t) = \begin{cases} 1 & \text{if } 0 \leq t \leq 2 \\ 3 & \text{if } t > 2 \end{cases}$. Find $\mathcal{L}\{f(t)\}$.
4. Find $\mathcal{L}\{t \sin t\}$.
5. Find $\mathcal{L}\{te^{2t}\}$.
6. How do you know that $F(s) = 1$ is not the Laplace transform of a piecewise continuous, exponential order function?
7. Find $\mathcal{L}^{-1}\{1/(s - 2)\}$.
8. Find $\mathcal{L}^{-1}\{1/s^3\}$.
9. Find $\mathcal{L}^{-1}\{1/(s^2 + 16)\}$.
10. Find $\mathcal{L}^{-1}\{(4s + 3)/(s^2 + 4)\}$.
11. Find $\mathcal{L}\{t \sinh(2t)\}$.
12. Find $\mathcal{L}\{t^2 \sin(2t)\}$.
13. Use the method of Laplace transforms to solve the initial value problem $y' + 4y = e^{2t}$, $y(0) = 1$.
14. Use the method of Laplace transforms to solve the initial value problem $y'' + 4y' + 4y = \cos t$, $y(0) = -1$, $y'(0) = 2$.
15. Use the method of Laplace transforms to solve the initial value problem $y'' + 2y' + 2y = t$, $y(0) = 1$, $y'(0) = -1$.
16. Solve the equation $f(t) + \int_0^t f(\tau)d\tau = 1$.
17. Find $\mathcal{L}\{\delta(t - 3)\}$
18. Solve the problem $y' + y = \delta(t - 1)$, $y(0) = 3$.
19. Use the Laplace transform method to solve the system
$$\begin{aligned} \frac{dx}{dt} &= -x + y \\ \frac{dy}{dt} &= 2x \\ x(0) &= 1, y(0) = 0. \end{aligned}$$
20. Use the Laplace transform method to solve the system
$$\begin{aligned} \frac{dx}{dt} &= 4x - 2y + e^t \\ \frac{dy}{dt} &= 3x - y \\ x(0) &= 1, y(0) = 0. \end{aligned}$$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form A**

1. $\mathcal{L}\{e^t\} = \int_0^\infty e^t e^{-st} dt = \int_0^\infty e^{t(1-s)} dt = e^{t(1-s)} / (1-s) \Big|_0^\infty = 1/(s-1)$ if $s > 1$
2. $1/(s^2 + 1)$
3. $(1 + 2e^{-2s})/s$
4. $2s/(s^2 + 1)^2$
5. $1/(s-2)^2$
6. $F(s)$ does not approach 0 as $s \rightarrow \infty$
7. e^{2t}
8. $t^2/2$
9. $\sin(4t)/4$
10. $4 \cos(2t) + 3 \sin(2t)/2$
11. $4s/(s^2 - 4)^2$
12. $(12s^2 - 16)/(s^2 + 4)^3$
13. $y = (e^{2t} + 5e^{-4t})/6$
14. $y = (-28e^{-2t} - 10te^{-2t} + 3 \cos t + 4 \sin t)/25$
15. $y = t/2 - 1/2 + 3 \cos t e^{-t}/2$
16. $f(t) = e^{-t}$
17. e^{-3s}
18. $y = 3e^{-t} + e^{-(t-1)}\mathcal{U}(t-1)$
19. $x = (e^t + 2e^{-2t})/3, y = 2(e^t - e^{-2t})/3$
20. $x = -5e^t - 2te^t + 6e^{2t}, y = -6e^t - 3te^t + 6e^{2t}$

1. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{e^{2t}\}$.
2. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{\cos t\}$.
3. Let $f(t) = \begin{cases} 2+t & \text{if } 0 \leq t \leq 1 \\ 4-t & \text{if } t > 1 \end{cases}$. Find $\mathcal{L}\{f(t)\}$.
4. Find $\mathcal{L}\{t \cos(3t)\}$.
5. Find $\mathcal{L}\{t^5\}$.
6. The gamma function is defined by $\Gamma(\alpha) = \int_0^\infty t^{\alpha-1} e^{-t} dt$ for $\alpha > 0$. Show that $\Gamma(\alpha + 1) = \alpha\Gamma(\alpha)$.
7. Use the previous problem to show that $\mathcal{L}\{t^\alpha\} = \Gamma(\alpha + 1)/s^{\alpha+1}$ for $\alpha > -1$.
8. Find $\mathcal{L}^{-1}\{1/(s + 5)\}$.
9. Find $\mathcal{L}^{-1}\{1/(s^2 + 2)\}$.
10. Find $\mathcal{L}^{-1}\{s/(s^2 - 9)\}$.
11. Find $\mathcal{L}\{t^2 e^{3t}\}$.
12. Find $\mathcal{L}\{t\mathcal{U}(t - 3)\}$.
13. Use the method of Laplace transforms to solve the initial value problem $y' - 2y = e^{2t}$, $y(0) = 6$.
14. Use the method of Laplace transforms to solve the initial value problem $y'' + 6y' + 9y = 1$, $y(0) = 2$, $y'(0) = -12$.
15. Use the method of Laplace transforms to solve the initial value problem $y'' + 8y' + 20y = e^t$, $y(0) = 0$, $y'(0) = -3$.
16. Solve the equation $f(t) = 2t + 5 \int_0^t \sin \tau f(t - \tau) d\tau$.
17. Find $\mathcal{L}\{\delta(t - 3)\}$
18. Solve the problem $y' - 2y = \delta(t - 4)$, $y(0) = 1$.
19. Use the Laplace transform method to solve the system
$$\begin{aligned} \frac{dx}{dt} &= -x + 2y \\ \frac{dy}{dt} &= x \\ x(0) &= 0, y(0) = 3. \end{aligned}$$
20. Use the Laplace transform method to solve the system
$$\begin{aligned} \frac{dx}{dt} + 3x + \frac{dy}{dt} &= 1 \\ \frac{dx}{dt} - x + \frac{dy}{dt} &= e^t \\ x(0) &= 0, y(0) = 0. \end{aligned}$$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form B**

1. $\mathcal{L}\{e^{2t}\} = \int_0^\infty e^{2t}e^{-st}dt = \int_0^\infty e^{t(2-s)}dt = e^{t(2-s)}/(2-s)|_0^\infty = 1/(s-2)$ if $s > 2$
2. $s/(s^2 + 1)$
3. $(2s + 1 - 2e^{-s})/s^2$
4. $(s^2 - 9)/(s^2 + 9)^2$
5. $120/s^6$
6. $\Gamma(\alpha + 1) = \int_0^\infty t^\alpha e^{-t}dt = -t^\alpha e^{-t}|_0^\infty + \alpha \int_0^\infty t^{\alpha-1}e^{-t}dt = \alpha\Gamma(\alpha)$ if $Re(\alpha) > 0$
7. $\mathcal{L}\{t^\alpha\} = \int_0^\infty t^\alpha e^{-st}dt$. Let $u = st$. Then $\mathcal{L}\{t^\alpha\} = \int_0^\infty (u/s)^\alpha e^{-u}du/s = \Gamma(\alpha + 1)/s^{\alpha+1}$
8. e^{-5t}
9. $\sin(\sqrt{2}t)/\sqrt{2}$
10. $\cosh(3t)$
11. $2/(s-3)^3$
12. $(1 + 3s)e^{-3s}/s^2$
13. $y = (6 + t)e^{2t}$
14. $y = (1 + 17e^{-3t} - 57te^{-3t})/9$
15. $y = (e^t - \cos(2t)e^{-4t} - 46\sin(2t)e^{-4t})/29$
16. $f(t) = -t/2 + 5(e^{2t} - e^{-2t})/8$
17. e^{-3s}
18. $y = e^{2t} + e^{2(t-4)}\mathcal{U}(t-4)$
19. $x = 2(e^t - e^{-2t}), y = 2e^t + e^{-2t}$
20. $x = (1 - e^t)/4, y = t/4 - 1 + e^t$

1. The Laplace transform of $\cos t$ is

Select the correct answer

- (a) $1/(s - 1)$
- (b) $s/(s^2 - 1)$
- (c) $s/(s^2 + 1)$
- (d) $1/(s^2 - 1)$
- (e) $1/(s^2 + 1)$

2. The Laplace transform of e^{-t} is

Select the correct answer

- (a) $1/(s - 1)$
- (b) $1/(s + 1)$
- (c) $1/(s - 1)^2$
- (d) $1/(s + 1)^2$
- (e) $1/(s^2 - 1)$

3. Let $f(t) = \left\{ \begin{array}{ll} 3 & \text{if } 0 \leq t \leq 2 \\ 5 - t & \text{if } t > 2 \end{array} \right\}$. Then $\mathcal{L}\{f(t)\}$ is

Select the correct answer

- (a) $3/s^2 - e^{-2s}/s^2$
- (b) $3/s - e^{-2s}/s^2$
- (c) $3/s^2 + e^{-2s}/s^2$
- (d) $3/s + e^{-2s}/s$
- (e) $3/s^2 + e^{2s}/s^2$

4. The Laplace transform of te^{-t} is

Select the correct answer

- (a) $1/(s - 1)$
- (b) $1/(s - 1)^2$
- (c) $1/(s + 1)$
- (d) $1/(s + 1)^2$
- (e) $1/(s^2 - 1)$

5. The Laplace transform of $t^2 \sin(3t)$ is

Select the correct answer

- (a) $(18s^2 - 54)/(s^2 + 9)^3$
- (b) $(18s^2 - 54)/(s^2 + 9)^2$
- (c) $(30s^2 - 54)/(s^2 + 9)^2$
- (d) $(30s^2 - 54)/(s^2 + 9)^3$
- (e) $(12s^2 - 54)/(s^2 + 9)^3$

6. The inverse Laplace transform of $F(s) = 3/s^2$ is

Select the correct answer

- (a) $t^2/2$
- (b) $t^2/3$
- (c) $t^3/3$
- (d) $t/3$
- (e) $3t$

7. The inverse Laplace transform of $F(s) = 3/(s^2 + 1)$ is

Select the correct answer

- (a) $\cos(3t)$
- (b) $\sin(3t)$
- (c) $3 \sin(3t)$
- (d) $3 \sin t$
- (e) $3 \cos t$

8. The inverse Laplace transform of $F(s) = e^{-2s}/s^2$ is

Select the correct answer

- (a) $(t - 2)\mathcal{U}(t - 2)$
- (b) $t\mathcal{U}(t - 2)$
- (c) $(t - 2)\mathcal{U}(t)$
- (d) $t^2\mathcal{U}(t - 2)$
- (e) $(t - 2)^2\mathcal{U}(t - 2)$

9. The inverse Laplace transform of $F(s) = (5s + 2)/(s^2 \cdot (s^2 - 1))$ is

Select the correct answer

- (a) $-5 - 2t + 7e^t/2 + 3e^{-t}/2$
- (b) $5 - 2t - 7e^t/2 + 3e^{-t}/2$
- (c) $5 - 2t + 7e^t/2 + 3e^{-t}/2$
- (d) $-5 + 2t - 7e^t/2 + 3e^{-t}/2$
- (e) $-5 + 2t + 7e^t/2 + 3e^{-t}/2$

10. The Laplace transform of $t^2 \cos(4t)$ is

Select the correct answer

- (a) $(2/s^3)s/(s^2 + 16)$
- (b) $(2/s^2)s/(s^2 + 16)$
- (c) $8/(s^3)(s^2 + 16)$
- (d) $(2s^3 - 32s)/(s^2 + 16)^3$
- (e) $(2s^3 - 96s)/(s^2 + 16)^3$

11. The Laplace transform of $\int_0^t e^\tau \sin(t - \tau) d\tau$ is

Select the correct answer

- (a) $1/((s - 1)(s^2 + 1))$
- (b) $1/((s + 1)(s^2 + 1))$
- (c) $s/((s - 1)(s^2 + 1))$
- (d) $s/((s + 1)(s^2 + 1))$
- (e) $1/((s - 1)(s^2 - 1))$

12. $\mathcal{L}\{\sin t \mathcal{U}(t - \pi)\} =$

Select the correct answer

- (a) $-se^{-\pi s}/(s^2 + 1)$
- (b) $se^{-\pi s}/(s^2 + 1)$
- (c) $-e^{-\pi s}/(s^2 + 1)$
- (d) $e^{\pi s}/(s^2 + 1)$
- (e) $-e^{\pi s}/(s^2 + 1)$

13. $\mathcal{L}\{t^2 e^{3t}\} =$

Select the correct answer

- (a) $2/(s - 3)^2$
- (b) $2/(s - 3)^3$
- (c) $1/(s - 3)^2$
- (d) $1/(s - 3)^3$
- (e) $2/(s - 3)^4$

14. $\mathcal{L}^{-1}\{1/(s^2 + 9)^2\} =$

Select the correct answer

- (a) $(\cos(3t) - 3t \cos(3t))/54$
- (b) $(\sin(3t) - 3t \cos(3t))/54$
- (c) $(\sin(3t) - 3t \cos(3t))/18$
- (d) $(\cos(3t) - 3t \cos(3t))/18$
- (e) $(\cos(3t) - 3t \sin(3t))/18$

15. $\mathcal{L}^{-1}\{1/(s^2 + 16)\} =$

Select the correct answer

- (a) $(1 + \sin(4t))/4$
- (b) $(1 - \cos(4t))/4$
- (c) $(1 - \cos(4t))/16$
- (d) $(1 + \cos(4t))/16$
- (e) $(1 - \sin(4t))/16$

16. The solution of $y' + 6y + 9 \int_0^t y(\tau) d\tau = 1$, $y(0) = 1$ is

Select the correct answer

- (a) $e^{3t} - 2te^{3t}$
- (b) $e^{3t} + 2te^{3t}$
- (c) $-e^{-3t} - 2te^{-3t}$
- (d) $e^{-3t} - 2te^{-3t}$
- (e) $e^{-3t} + 2te^{-3t}$

17. $\mathcal{L}\{\delta(t - 3)\} =$

Select the correct answer

- (a) $1/(s - 3)$
- (b) $-e^{3s}$
- (c) e^{3s}
- (d) e^{-3s}
- (e) none of the above

18. When the Laplace transform is applied to the system

$$\begin{aligned} \frac{dx}{dt} &= 4x - y \\ \frac{dy}{dt} &= 2x + y \\ x(0) &= 1, y(0) = 0, \end{aligned}$$

the resulting transformed system is

Select the correct answer

- (a) $sX = 4X - Y, sY - 1 = 2X + Y$
- (b) $sX = 4X - Y - 1, sY = 2X + Y$
- (c) $sX = 4X - Y, sY = 2X + Y - 1$
- (d) $sX = 4X - Y, sY = 2X + Y$
- (e) $sX - 1 = 4X - Y, sY = 2X + Y$

19. The solution of the system in the previous problem is

Select the correct answer

- (a) $x = 2e^{-3t} - e^{2t}, y = 2e^{-3t} - 2e^{2t}$
- (b) $x = 2e^{3t} - e^{-2t}, y = 2e^{3t} - 2e^{-2t}$
- (c) $x = 2e^{3t} - e^{2t}, y = 2e^{3t} - 2e^{2t}$
- (d) $x = 2e^{-3t} - e^{-2t}, y = 2e^{-3t} - 2e^{-2t}$
- (e) $x = 2e^{3t} + e^{2t}, y = 2e^{3t} + 2e^{2t}$

20. A uniform beam of length L has a concentrated load, w_0 , at $x = L/2$. It is embedded at the left end and free at the right end. The correct initial value problem for the vertical deflection, $y(x)$, at a distance x from the embedded end is

Select the correct answer

- (a) $EIy'''' = w_0\delta(x - L/2), y(0) = 0, y'(0) = 0, y''(L) = 0, y'''(L) = 0$
- (b) $y'''' = EIw_0\delta(x - L/2), y(0) = 0, y'(0) = 0, y''(L) = 0, y'''(L) = 0$
- (c) $EIy'' = w_0\delta(x - L/2), y(0) = 0, y'(0) = 0, y''(L) = 0, y'''(L) = 0$
- (d) $y'' = EIw_0\delta(x - L/2), y(0) = 0, y'(0) = 0, y''(L) = 0, y'''(L) = 0$
- (e) $EIy'''' = w_0\delta(x + L/2), y(0) = 0, y'(0) = 0, y''(L) = 0, y'''(L) = 0$

ANSWER KEY

Zill Differential Equations 9e Chapter 7 Form C

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

1. The Laplace transform of $\sin(2t)$ is

Select the correct answer

- (a) $1/(s - 2)$
- (b) $s/(s^2 - 4)$
- (c) $s/(s^2 + 4)$
- (d) $2/(s^2 - 4)$
- (e) $2/(s^2 + 4)$

2. The Laplace transform of e^{3t} is

Select the correct answer

- (a) $1/(s - 3)$
- (b) $1/(s + 3)$
- (c) $1/(s - 3)^2$
- (d) $1/(s + 3)^2$
- (e) $1/(s^2 - 9)$

3. Let $f(t) = \left\{ \begin{array}{ll} 1 & \text{if } 0 \leq t \leq 3 \\ t - 2 & \text{if } t > 3 \end{array} \right\}$. Then $\mathcal{L}\{f(t)\}$ is

Select the correct answer

- (a) $1/s - e^{-3s}/s^2$
- (b) $1/s + e^{3s}/s$
- (c) $1/s + e^{-3s}/s$
- (d) $1/s + e^{3s}/s^2$
- (e) $1/s + e^{-3s}/s^2$

4. The Laplace transform of te^t is

Select the correct answer

- (a) $1/(s - 1)$
- (b) $1/(s - 1)^2$
- (c) $1/(s + 1)$
- (d) $1/(s + 1)^2$
- (e) $1/(s^2 - 1)$

5. The Laplace transform of $e^t t^3 + \sin(3t)$ is

Select the correct answer

- (a) $3/(s-1)^3 + 1/(s^2+9)$
- (b) $3/(s-1)^4 + 1/(s^2+9)$
- (c) $6/(s-1)^3 + 3/(s^2+9)$
- (d) $6/(s-1)^4 + 3/(s^2+9)$
- (e) $6/(s-1)^4 + 9/(s^2+9)$

6. The inverse Laplace transform of $F(s) = 4/s^3$ is

Select the correct answer

- (a) $t^3/4$
- (b) $t^2/4$
- (c) $t^2/2$
- (d) $2t^2$
- (e) $3t^3/2$

7. The inverse Laplace transform of $F(s) = (2s-3)/(s^2+1)$ is

Select the correct answer

- (a) $2 \cos t + 3 \sin t$
- (b) $-2 \cos t - 3 \sin t$
- (c) $2 \cos t - 3 \sin t$
- (d) $\cos(2t) - \sin(3t)$
- (e) $-\cos(2t) + \sin(3t)$

8. The inverse Laplace transform of $F(s) = e^{-s}/(s(s+1))$ is

Select the correct answer

- (a) $(1 - e^t)\mathcal{U}(t-1)$
- (b) $(1 + e^{1-t})\mathcal{U}(t-1)$
- (c) $(1 - e^{1-t})\mathcal{U}(t-1)$
- (d) $(1 - e^{t-1})\mathcal{U}(t-1)$
- (e) $(1 + e^{t-1})\mathcal{U}(t-1)$

9. The inverse Laplace transform of $F(s) = (3s^2 + 1)/(s^2 \cdot (s^2 + 1))$ is

Select the correct answer

- (a) $2 \cos t + t^2$
- (b) $2 \sin t + t^2$
- (c) $2 \cos t + t$
- (d) $2 \sin t + t$
- (e) $\sin t + 2t$

10. The Laplace transform of $t^3 e^{-t}$ is

Select the correct answer

- (a) $1/(s + 1)$
- (b) $-1/(s + 1)^2$
- (c) $2/(s + 1)^3$
- (d) $-6/(s + 1)^4$
- (e) $6/(s + 1)^4$

11. The Laplace transform of $\int_0^t \tau^2 \cos(t - \tau) d\tau$ is

Select the correct answer

- (a) $2/(s^2(s^2 + 1))$
- (b) $1/(s^2(s^2 + 1))$
- (c) $2/(s^3(s^2 + 1))$
- (d) $6/(s^2(s^2 + 1))$
- (e) $6/(s^3(s^2 + 1))$

12. $\mathcal{L}\{t^3 e^t\} =$

Select the correct answer

- (a) $-6/(s - 1)^4$
- (b) $6/(s - 1)^4$
- (c) $-3/(s - 1)^4$
- (d) $-6/(s - 1)^3$
- (e) $-2/(s - 1)^3$

13. $\mathcal{L}\{\cos t \mathcal{U}(t - \pi/2)\} =$

Select the correct answer

- (a) $-e^{\pi s/2}/(s^2 + 1)$
- (b) $e^{\pi s/2}/(s^2 + 1)$
- (c) $-se^{-\pi s/2}/(s^2 - 1)$
- (d) $-e^{-\pi s/2}/(s^2 + 1)$
- (e) $-se^{-\pi s/2}/(s^2 + 1)$

14. When the Laplace transform is applied to the problem $y'' + 2y' + y = e^{3t}$, $y(0) = 1$, $y'(0) = 2$, the resulting transformed equation is

Select the correct answer

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

15. The solution of the initial value problem in the previous problem is

Select the correct answer

- (a) $y = (15e^t + 44te^t + e^{3t})/16$
- (b) $y = (15e^t - 44te^t + e^{3t})/16$
- (c) $y = (15e^{-t} + 44te^{-t} + e^{3t})/16$
- (d) $y = (15e^{-t} - 44te^{-t} + e^{3t})/8$
- (e) $y = (15e^{-t} + 44te^{-t} + e^{3t})/8$

16. The solution of $f(t) = \cos t + \int_0^t e^{-\tau} f(t - \tau) d\tau$ is

Select the correct answer

- (a) $f(t) = -\cos t + \sin t$
- (b) $f(t) = \cos t - \sin t$
- (c) $f(t) = \cos t + \sin t$
- (d) $f(t) = -\cos t - \sin t$
- (e) $f(t) = \cos t - 2\sin t$

17. $\mathcal{L}\{\delta(t - 8)\} =$

Select the correct answer

- (a) $1/(s - 8)$
- (b) $-e^{8s}$
- (c) e^{8s}
- (d) e^{-8s}
- (e) none of the above

18. When the Laplace transform is applied to the system

$$\begin{aligned}\frac{dx}{dt} &= 3x - y \\ \frac{dy}{dt} &= x + y \\ x(0) &= 2, y(0) = 1,\end{aligned}$$

the resulting transformed system is

Select the correct answer

- (a) $sX = 3X - Y - 2, sY - 1 = X + Y$
- (b) $sX - 2 = 3X - Y, sY = X + Y - 1$
- (c) $sX = 3X - Y - 2, sY = X + Y - 1$
- (d) $sX - 2 = 3X - Y, sY - 1 = X + Y$
- (e) $sX + 2 = 3X - Y, sY + 1 = X + Y$

19. The solution of the system in the previous problem is

Select the correct answer

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

20. A uniform beam of length L has a concentrated load, w_0 , at $x = L/2$. It is embedded at the left end and simply supported at the right end. If $y(x)$ is the vertical deflection, then the correct differential equation for y , is

Select the correct answer

- (a) $EIy'''' = w_0\delta(x - L/2)$
- (b) $y'''' = EIw_0\delta(x - L/2)$
- (c) $EIy'' = w_0\delta(x - L/2)$
- (d) $y'' = EIw_0\delta(x - L/2)$
- (e) $EIy'''' = w_0\delta(x + L/2)$

ANSWER KEY

Zill Differential Equations 9e Chapter 7 Form D

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

1. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{e^{-t}\}$.
2. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{\cos(2t)\}$.
3. Why doesn't the function $f(x) = e^{x^2}$ satisfy the hypotheses of Theorem 7.2 (Sufficient Condition for Existence)?

4. Let $f(t) = \begin{cases} t & \text{if } 0 \leq t \leq 3 \\ 6 - t & \text{if } t > 3 \end{cases}$. Then $\mathcal{L}\{f(t)\}$ is

Select the correct answer

- (a) $1/s^2 - 2e^{-3s}/s^2$
- (b) $1/s - 2e^{-3s}/s$
- (c) $1/s^2 + 2e^{-3s}/s^2$
- (d) $1/s + 2e^{-3s}/s$
- (e) $1/s^2 + 2e^{3s}/s^2$

5. The Laplace transform of te^{-t} is

Select the correct answer

- (a) $1/(s - 1)$
- (b) $1/(s - 1)^2$
- (c) $1/(s + 1)$
- (d) $1/(s + 1)^2$
- (e) $1/(s^2 - 1)$

6. The Laplace transform of $t^2 + t \cos(2t)$ is

Select the correct answer

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

7. Find $\mathcal{L}^{-1}\{1/s^2\}$.
8. Find $\mathcal{L}^{-1}\{3/(s^2 + 25)\}$.
9. Find $\mathcal{L}^{-1}\{1/(s^2(s + 5))\}$.
10. Find $\mathcal{L}^{-1}\{e^{-4s}/(s - 1)\}$.

11. The Laplace transform of $t^2 \cos(2t)$ is

Select the correct answer

- (a) $(2s^3 + 24s)/(s^2 + 4)^3$
- (b) $(2s^2 - 24s)/(s^2 + 4)^3$
- (c) $(2s^2 + 24s)/(s^2 + 4)^3$
- (d) $(2s^3 - 24s)/(s^2 + 4)^3$
- (e) $(s^3 - 12s)/(s^2 + 4)^3$

12. The Laplace transform of $\int_0^t \tau^2 e^{t-\tau} d\tau$ is

Select the correct answer

- (a) $2/(s^3(s + 1))$
- (b) $2/(s^3(s - 1))$
- (c) $1/(s^3(s + 1))$
- (d) $1/(s^3(s - 1))$
- (e) $6/(s^3(s + 1))$

13. Use the method of Laplace transforms to solve the initial value problem $y' + 8y = t + 1$, $y(0) = 1$.

14. Use the method of Laplace transforms to solve the initial value problem $y'' + 2y' + y = te^t$, $y(0) = -2$, $y'(0) = 4$.

15. Use the method of Laplace transforms to solve the initial value problem $y'' - 4y' + 13y = e^{3t}$, $y(0) = 0$, $y'(0) = 1$.

16. When the Laplace transform is applied to the problem $y'' - 3y' + 2y = \sin(2t)$, $y(0) = -1$, $y'(0) = 4$, the resulting transformed equation is

Select the correct answer

- (a) $(s^2 - 3s + 2)Y = -s - 7 + 1/(s^2 + 4)$
- (b) $(s^2 - 3s + 2)Y = -s + 7 + s/(s^2 + 4)$
- (c) $(s^2 - 3s + 2)Y = -s - 7 + s/(s^2 + 4)$
- (d) $(s^2 - 3s + 2)Y = -s + 7 + 2/(s^2 + 4)$
- (e) $(s^2 - 3s + 2)Y = -s - 7 + 2/(s^2 + 4)$

17. The solution of the initial value problem in the previous problem is

Select the correct answer

(a) $y = -32e^t/5 + 21e^{2t}/4 + 3 \cos(2t)/20 - \sin(2t)/20$

(b) $y = -32e^t/5 + 21e^{2t}/4 + 3 \cos(2t)/20 + \sin(2t)/20$

(c) $y = -32e^t/5 + 21e^{2t}/4 - 3 \cos(2t)/20 - \sin(2t)/20$

(d) $y = -32e^{-t}/5 + 21e^{-2t}/4 + 3 \cos(2t)/20 + \sin(2t)/20$

(e) $y = -32e^{-t}/5 + 21e^{-2t}/4 + 3 \cos(2t)/20 - \sin(2t)/20$

18. Use the convolution theorem to find $\mathcal{L}^{-1}\{1/(s^2(s^2 + 4))\}$.

19. Use the Laplace transform method to solve the system

$$\frac{dx}{dt} = x + y$$

$$\frac{dy}{dt} = 2x$$

$$x(0) = 3, y(0) = -1.$$

20. Use the Laplace transform method to solve the system

$$\frac{dx}{dt} = 5x - 3y + 1$$

$$\frac{dy}{dt} = 3x - y + t$$

$$x(0) = 1, y(0) = 0.$$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form E**

1. $\mathcal{L}\{e^{-t}\} = \int_0^{\infty} e^{-t}e^{-st}dt = \int_0^{\infty} e^{-t(s+1)}dt = -e^{-t(s+1)}/(s+1) \Big|_0^{\infty} = 1/(s+1)$ if $s > -1$
2. $s/(s^2 + 4)$
3. It is not of exponential order as $t \rightarrow \infty$.
4. a
5. d
6. e
7. t
8. $3\sin(5t)/5$
9. $(-1 + 5t + e^{-5t})/25$
10. $e^{t-4}\mathcal{U}(t-4)$
11. d
12. b
13. $y = (7 + 8t + 57e^{-8t})/64$
14. $y = (-e^t + te^t - 7e^{-t} + 9te^{-t})/4$
15. $y = (e^{3t} - \cos(3t)e^{2t} + 3\sin(3t)e^{2t})/10$
16. d
17. a
18. $t/4 - \sin(2t)/8$
19. $x = (5e^{2t} + 4e^{-t})/3, y = (5e^{2t} - 8e^{-t})/3$
20. $x = (-2 - 3t + 6e^{2t} + 15te^{2t})/4, y = (-1 - 5t + e^{2t} + 15te^{2t})/4$

1. Why doesn't the function $f(x) = \ln x$ satisfy the hypotheses of Theorem 7.2 (Sufficient Condition for Existence)?

2. The Laplace transform of 10 is

Select the correct answer

- (a) $1/(s - 10)$
- (b) $s/(s - 10)$
- (c) $s/(s^2 + 10)^2$
- (d) $10/s^2$
- (e) $10/s$

3. The Laplace transform of e^{-4t} is

Select the correct answer

- (a) $1/(s - 4)$
- (b) $1/(s + 4)$
- (c) $1/(s - 4)^2$
- (d) $1/(s + 4)^2$
- (e) $1/(s^2 - 16)$

4. Let $f(t) = \begin{cases} t & \text{if } 0 \leq t \leq 3 \\ 3 & \text{if } t > 3 \end{cases}$. Find $\mathcal{L}\{f(t)\}$.

5. Find $\mathcal{L}\{t^2 + e^{5t}\}$.

6. Find $\mathcal{L}\{\sinh(2t)\}$.

7. Find $\mathcal{L}\{t^3 e^t\}$.

8. Find $\mathcal{L}\{t \cosh t\}$.

9. The inverse Laplace transform of $F(s) = 1/s^4$ is

Select the correct answer

- (a) $t^3/2$
- (b) $t^3/3$
- (c) $t^4/6$
- (d) $t^4/24$
- (e) $t^3/6$

10. The inverse Laplace transform of $F(s) = 5/(s^2 - 1)$ is

Select the correct answer

- (a) $5 \cos t$
- (b) $5 \sin t$
- (c) $5 \sinh t$
- (d) $5 \cosh t$
- (e) $\sinh(5t)$

11. The inverse Laplace transform of $F(s) = e^{-2s}/s^2$ is

Select the correct answer

- (a) $(t - 2)\mathcal{U}(t - 2)$
- (b) $t\mathcal{U}(t - 2)$
- (c) $(t - 2)^2\mathcal{U}(t - 2)$
- (d) $t^2\mathcal{U}(t - 2)$
- (e) $(t - 2)\mathcal{U}(t)$

12. The inverse Laplace transform of $F(s) = (2s - 3)/(s^3 - s)$ is

Select the correct answer

- (a) $-3 - e^t/2 + 5e^{-t}/2$
- (b) $-3 + e^t/2 - 5e^{-t}/2$
- (c) $3 - e^t/2 - 5e^{-t}/2$
- (d) $3 + e^t/2 - 5e^{-t}/2$
- (e) $3 - e^t/2 + 5e^{-t}/2$

13. Solve the equation $f(t) + \int_0^t e^{-\tau} f(t - \tau) d\tau = 1$.

14. Find $\mathcal{L}\{\sin t \delta(t - 5)\}$

15. $\mathcal{L}\{\sin(2t)\mathcal{U}(t - \pi)\} =$

Select the correct answer

- (a) $-se^{-\pi s}/(s^2 + 4)$
- (b) $se^{-\pi s}/(s^2 + 4)$
- (c) $2e^{\pi s}/(s^2 + 4)$
- (d) $2e^{-\pi s}/(s^2 + 4)$
- (e) $-e^{\pi s}/(s^2 + 4)$

16. $\mathcal{L}\{t \cos(2t)\} =$

Select the correct answer

- (a) $(4 - s^2)/(s^2 + 4)^2$
- (b) $(s^2 - 4)/(s^2 + 4)^2$
- (c) $(s^2 + 4)/(s^2 - 4)^2$
- (d) $(3s^2 - 4)/(s^2 + 4)^2$
- (e) $(4 - 3s^2)/(s^2 + 4)^2$

17. Use the convolution theorem to find $\mathcal{L}^{-1}\{1/(s^2 + 1)^2\}$

18. Solve the problem $y'' + y = \delta(t - 2)$, $y(0) = 1$, $y'(0) = 0$.

19. When the Laplace transform is applied to the system

$$\begin{aligned}\frac{dx}{dt} &= 3x - y \\ \frac{dy}{dt} &= 2x + y \\ x(0) &= 2, y(0) = 1,\end{aligned}$$

the resulting transformed system is

Select the correct answer

- (a) $sX - 2 = 3X - Y$, $sY - 1 = 2X + Y$
- (b) $sX + 2 = 3X - Y$, $sY + 1 = 2X + Y$
- (c) $sX = 3X - Y - 2$, $sY - 1 = 2X + Y$
- (d) $sX - 2 = 3X - Y$, $sY = 2X + Y - 1$
- (e) $sX = 3X - Y - 2$, $sY = 2X + Y - 2$

20. The solution of the system in the previous problem is

Select the correct answer

- (a) $x = (2 \cos t + \sin t)e^{-2t}/2$, $y = (\cos t + 3 \sin t)e^{-2t}$
- (b) $x = (2 \cos t - \sin t)e^{-2t}/2$, $y = (\cos t - 3 \sin t)e^{-2t}$
- (c) $x = (2 \cos t + \sin t)e^{2t}$, $y = (\cos t + 3 \sin t)e^{2t}$
- (d) $x = (2 \cos t - \sin t)e^{2t}/2$, $y = (\cos t - 3 \sin t)e^{2t}$
- (e) $x = (2 \cos t + \sin t)e^{2t}/2$, $y = (\cos t - 3 \sin t)e^{2t}$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form F**

1. It is not piecewise continuous on $[0, \infty)$.

2. e

3. b

4. $(1 - e^{-3s})/s^2$

5. $2/s^3 + 1/(s - 5)$

6. $2/(s^2 - 4)$

7. $6/(s - 1)^4$

8. $(s^2 + 1)/(s^2 - 1)^2$

9. e

10. c

11. a

12. c

13. $f(t) = (1 + e^{-2t})/2$

14. $\sin 5e^{-5s}$

15. d

16. b

17. $(\sin t - t \cos t)/2$

18. $y = \cos t + \sin(t - 2)\mathcal{U}(t - 2)$

19. a

20. c

1. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{e^{-2t}\}$.
2. Use the definition of Laplace transform and integrate to find $\mathcal{L}\{\sin(3t)\}$.
3. Let $f(t) = \begin{cases} 1+t & \text{if } 0 \leq t \leq 4 \\ 5 & \text{if } t > 4 \end{cases}$. Then $\mathcal{L}\{f(t)\}$ is

Select the correct answer

- (a) $1/s + 1/s^2 - e^{-4s}/s$
- (b) $1/s + 1/s^2 - e^{-4s}/s^2$
- (c) $1/s + 1/s^2 + e^{-4s}/s^2$
- (d) $1/s + 1/s^2 + e^{4s}/s$
- (e) $1/s + 1/s^2 + e^{4s}/s^2$

4. The Laplace transform of $t \sin t$ is

Select the correct answer

- (a) $2/(s^2 + 1)$
- (b) $2/(s + 1)$
- (c) $2s/(s^2 + 1)^2$
- (d) $2s/(s^2 - 1)^2$
- (e) $2/(s^2 - 1)$

5. The Laplace transform of $t^2 e^t$ is

Select the correct answer

- (a) $-2/(s - 1)^2$
- (b) $-2/(s - 1)^3$
- (c) $2/(s - 1)$
- (d) $2/(s - 1)^2$
- (e) $2/(s - 1)^3$

6. Find $\mathcal{L}^{-1}\{5/s^5\}$.
7. Find $\mathcal{L}^{-1}\{(s - 2)/(s^2 + 25)\}$.
8. Find $\mathcal{L}^{-1}\{1/(s(s + 2)^3)\}$.
9. Find $\mathcal{L}^{-1}\{e^{-2s}/s^3\}$.

10. The Laplace transform of $t \sin(3t)$ is

Select the correct answer

- (a) $3s^2/(s^2 + 9)^2$
- (b) $s^2/(s^2 + 9)^2$
- (c) $3s^2/(s^2 + 9)$
- (d) $-6s^2/(s^2 + 9)^2$
- (e) $6s/(s^2 + 9)^2$

11. The Laplace transform of $\int_0^t \tau^2 \sin(2t - 2\tau) d\tau$ is

Select the correct answer

- (a) $2/(s^3(s^2 + 4))$
- (b) $2/(s^2(s^2 + 4))$
- (c) $4/(s^2(s^2 + 4))$
- (d) $4/(s^3(s^2 + 4))$
- (e) $4/(s(s^2 + 2))$

12. Solve the initial value problem $y' + 3y = te^{2t}$, $y(0) = 1$.

13. Let $f(t) = \begin{cases} 3 + t & \text{if } 0 \leq t \leq 1 \\ 5 - t & \text{if } t > 1 \end{cases}$. Use the method of Laplace transforms to solve the initial value problem $y'' + 4y' + 3y = f(t)$, $y(0) = 0$, $y'(0) = 0$.

14. Use the method of Laplace transforms to solve the initial value problem $y'' + 6y' + 10y = \sin t$, $y(0) = 0$, $y'(0) = 0$.

15. Use the Laplace transform to solve the integral equation $f(t) = 4t - \int_0^t (t - \tau) f(\tau) d\tau$.

16. When the Laplace transform is applied to the system

$$\frac{dx}{dt} = 3x$$

$$\frac{dy}{dt} = 2x + 2y$$

$$x(0) = -1, y(0) = 1,$$

the resulting transformed system is

Select the correct answer

- (a) $sX - 1 = 3X$, $sY - 1 = 2X + 2Y$
- (b) $sX + 1 = 3X$, $sY + 1 = 2X + 2Y$
- (c) $sX = 3X - 1$, $sY - 1 = 2X + 2Y$
- (d) $sX - 1 = 3X$, $sY = 2X + 2Y - 1$
- (e) $sX = 3X - 1$, $sY = 2X + 2Y - 2$

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

Select the correct answer

- (a) $x = -e^{3t}, y = 3e^{-2t} + 2e^{3t}$
- (b) $x = -e^{-3t}, y = 3e^{-2t} - 2e^{-3t}$
- (c) $x = e^{-3t}, y = 3e^{2t} - 2e^{-3t}$
- (d) $x = -e^{3t}, y = 3e^{2t} - 2e^{3t}$
- (e) $x = e^{3t}, y = 3e^{2t} + 2e^{3t}$

18. A uniform beam of length L has a concentrated load, w_0 , at $x = L/2$. It is simply supported at the left end and embedded at the other end. The correct differential equation for the vertical deflection, $y(x)$, at a distance x from the embedded end is

Select the correct answer

- (a) $y'''' = EIw_0\delta(x - L/2)$
- (b) $EIy'''' = w_0\delta(x + L/2)$
- (c) $EIy'''' = w_0\delta(x - L/2)$
- (d) $EIy'' = w_0\delta(x - L/2)$
- (e) $y'' = EIw_0\delta(x - L/2)$

19. When the Laplace transform is applied to the problem $y'' - 5y' + 4y = e^t, y(0) = 1, y'(0) = 2$, the resulting transformed equation is

Select the correct answer

- (a) $(s^2 - 5s + 4)Y = -s + 7 + 1/(s - 1)$
- (b) $(s^2 - 5s + 4)Y = s + 7 + 1/(s - 1)$
- (c) $(s^2 - 5s + 4)Y = -s + 3 + 1/(s - 1)$
- (d) $(s^2 - 5s + 4)Y = s - 3 + 1/(s - 1)$
- (e) $(s^2 - 5s + 4)Y = -s - 3 + 1/(s - 1)$

20. The solution of the initial value problem in the previous problem is

Select the correct answer

- (a) $y = (5e^{4t} + 4e^t - 3te^t)/3$
- (b) $y = (4e^{4t} + 5e^t - 3te^t)/3$
- (c) $y = (4e^{4t} + 5e^t + 3te^t)/3$
- (d) $y = (4e^{4t} + 5e^t + 3te^t)/9$
- (e) $y = (4e^{4t} + 5e^t - 3te^t)/9$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form G**

1. $\mathcal{L}\{e^{-2t}\} = \int_0^{\infty} e^{-2t} e^{-st} dt = \int_0^{\infty} e^{-t(s+2)} dt = -e^{-t(s+2)}/(s+2) \Big|_0^{\infty} = 1/(s+2)$ if $s > -2$
2. $3/(s^2 + 9)$
3. b
4. c
5. e
6. $5t^4/24$
7. $\cos(5t) - 2\sin(5t)/5$
8. $(1 - e^{-2t} - 2te^{-2t} - 2t^2e^{-2t})/8$
9. $(t - 2)^2\mathcal{U}(t - 2)/2$
10. e
11. d
12. $y = (-e^{2t} + 5te^{2t} + 26e^{-3t})/25$
13. $y = (5 + 3t - 9e^{-t} + 4e^{-3t})/9 + \mathcal{U}(t - 1)(8 - 6(t - 1) - 9e^{-(t-1)} + e^{-3(t-1)})/9$
14. $y = (-2\cos t + 3\sin t + 2\cos t e^{-3t} + 3\sin t e^{-3t})/39$
15. $f(t) = 4\sin t$
16. c
17. d
18. c
19. d
20. e

1. Name two functions that have the same Laplace transform.

2. The Laplace transform of t^2 is

Select the correct answer

- (a) $2/s$
- (b) $2/s^2$
- (c) $2/s^3$
- (d) $1/s^2$
- (e) $1/s^3$

3. The Laplace transform of $\cosh(2t)$ is

Select the correct answer

- (a) $2/(s^2 + 4)$
- (b) $2/(s^2 - 4)$
- (c) $2/(s^2 - 2)^2$
- (d) $s/(s^2 - 4)$
- (e) $s/(s^2 - 2)$

4. Let $f(t) = \left\{ \begin{array}{ll} 1 + t & \text{if } 0 \leq t \leq 1 \\ 3 - t & \text{if } t > 1 \end{array} \right\}$. Find $\mathcal{L}\{f(t)\}$.

5. Find $\mathcal{L}\{t \sin(2t)\}$.

6. Find $\mathcal{L}\{t^3 e^t\}$.

7. Find $\mathcal{L}\{t^2 e^{3t}\}$.

8. Find $\mathcal{L}\{t^2 \sinh(2t)\}$.

9. The inverse Laplace transform of $F(s) = 1/s^{1/2}$ is

Select the correct answer

- (a) $t^{-1/2}/\sqrt{\pi}$
- (b) $t^{3/2}/\sqrt{\pi}$
- (c) $t^{1/2}/\sqrt{\pi}$
- (d) $t^{-1/2}/\pi$
- (e) $t^{1/2}/\pi$

10. The inverse Laplace transform of $F(s) = (3s + 1)/(s^2 + 16)$ is

Select the correct answer

- (a) $3 \cos(16t) + \sin(16t)/16$
- (b) $3 \cos(16t) + \sin(16t)/4$
- (c) $3 \cos(4t) - 4 \sin(4t)$
- (d) $3 \cos(4t) + 4 \sin(4t)$
- (e) $3 \cos(4t) + \sin(4t)/4$

11. The inverse Laplace transform of $F(s) = e^{-5s}/s^5$ is

Select the correct answer

- (a) $t^4/24\mathcal{U}(t - 5)$
- (b) $(t - 5)^4/24\mathcal{U}(t - 5)$
- (c) $(t - 5)^4/120\mathcal{U}(t - 5)$
- (d) $(t - 5)^5/24\mathcal{U}(t - 5)$
- (e) $(t - 5)^5/120\mathcal{U}(t - 5)$

12. The inverse Laplace transform of $F(s) = (2s^2 - 8s - 8)/((s - 2)s(s^2 + 4))$ is

Select the correct answer

- (a) $1/4 - e^{2t}/4 + \cos(2t)/2$
- (b) $1/4 + e^{2t}/4 + \sin(2t)/2$
- (c) $1 - e^{2t} + 2 \cos(2t)$
- (d) $1 - e^{2t} + 2 \sin(2t)$
- (e) $1/4 - e^{2t}/4 + \sin(2t)/2$

13. Solve the equation $f(t) + \int_0^t \sin(\tau)f(t - \tau)d\tau = 1$.

14. Find $\mathcal{L}\{(2t + 1)\delta(t - 2)\}$

15. $\mathcal{L}\{\sin(2t)\mathcal{U}(t - \pi)\} =$

Select the correct answer

- (a) $-se^{-\pi s}/(s^2 + 4)$
- (b) $se^{-\pi s}/(s^2 + 4)$
- (c) $2e^{-\pi s}/(s^2 + 4)$
- (d) $2e^{\pi s}/(s^2 + 4)$
- (e) $-e^{\pi s}/(s^2 + 4)$

16. $\mathcal{L}\{t^2 \sin(2t)\} =$

Select the correct answer

(a) $(20s^2 + 16)/(s^2 + 4)^3$

(b) $(20s^2 - 16)/(s^2 + 4)^3$

(c) $(12s^2 - 16)/(s^2 + 4)^2$

(d) $(12s^2 - 16)/(s^2 + 4)^3$

(e) $(12s^2 + 16)/(s^2 + 4)^3$

17. Use the convolution theorem to find $\mathcal{L}^{-1}\{1/(s^2 + 1)(s^2 + 4)\}$

18. Solve the problem $y'' - y = \delta(t - 4)$, $y(0) = 0$, $y'(0) = 1$.

19. When the Laplace transform is applied to the system

$$\frac{dx}{dt} = 3x + y$$

$$\frac{dy}{dt} = 2x + 2y$$

$$x(0) = -1, y(0) = -2,$$

the resulting transformed system is

Select the correct answer

(a) $sX - 1 = 3X + Y$, $sY - 2 = 2X + 2Y$

(b) $sX + 1 = 3X + Y$, $sY + 2 = 2X + 2Y$

(c) $sX = 3X + Y - 1$, $sY - 2 = 2X + 2Y$

(d) $sX - 1 = 3X + Y$, $sY = 2X + 2Y - 2$

(e) $sX = 3X + Y - 1$, $sY = 2X + 2Y - 1$

20. The solution of the system in the previous problem is

Select the correct answer

(a) $x = (-4e^{4t} + e^{-t})/3$, $y = (-4e^{4t} - 2e^{-t})/3$

(b) $x = (-4e^{4t} + e^t)/3$, $y = (-4e^{4t} - 2e^t)/3$

(c) $x = (-4e^{4t} + e^t)/3$, $y = (4e^{4t} - 2e^t)/3$

(d) $x = (-4e^{-4t} + e^t)/3$, $y = (4e^{-4t} - 2e^t)/3$

(e) $x = (-4e^{-4t} + e^t)/3$, $y = (-4e^{-4t} - 2e^t)/3$

ANSWER KEY**Zill Differential Equations 9e Chapter 7 Form H**

1. $f(t) = t, g(t) = \begin{cases} t & \text{if } t \neq 4 \\ 18 & \text{if } t = 4 \end{cases}$. Many other examples.
2. c
3. d
4. $(s + 1 - 2e^{-s})/s^2$
5. $4s/(s^2 + 4)^2$
6. $6/(s - 1)^4$
7. $2/(s - 3)^3$
8. $(12s^2 + 16)/(s^2 - 4)^3$
9. a
10. e
11. b
12. d
13. $f(t) = (1 + \cos(\sqrt{2}t))/2$
14. $5e^{-2s}$
15. c
16. d
17. $(2 \sin t - \sin(2t))/6$
18. $y = (e^t - e^{-t})/2 + (e^{(t-4)} - e^{-(t-4)})\mathcal{U}(t - 4)/2$
19. b
20. b