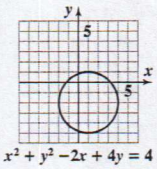
81. a. -3 and 3 **b.** -2 and 2 **82.** $\frac{x^2}{16} + \frac{y^2}{25} = 1$ **83.** $(x-1)^2 + (y+2)^2 = 9$; center: $(1, -2)$; radius: 3;



Chapter 9 Review Exercises

1. $\left[\begin{array}{ccc|c} 1 & 2 & 2 & 2 \\ 0 & 1 & -1 & 2 \\ 0 & 0 & 9 & -9 \end{array}\right]$ **2.** $\left[\begin{array}{ccc|c} 1 & -1 & \frac{1}{2} & -\frac{1}{2} \\ 1 & 2 & -1 & 2 \\ 6 & 4 & 3 & 5 \end{array}\right]$ **3.** $\{(1, 3, -4)\}$ **4.** $\{(-2, -1, 0)\}$ **5.** $\{(2, -2, 3, 4)\}$

6. a. $a = -2$; $b = 32$; $c = 42$ **b.** 2:00 p.m.; 170 parts per million **7.** capitalist: 1%; upper middle: 15%; lower middle: 34%; working: 30%
8. $\varnothing$ **9.** $\{(2t + 4, t + 1, t)\}$ **10.** $\{(-37t + 2, 16t, -7t + 1, t)\}$ **11.** $\{(7t + 18, -3t - 7, t)\}$

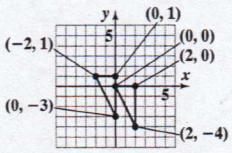
12. a. $x + z = 750$
$y - z = -250$
$x + y = 500$
b. $\{(-t + 750, t - 250, t)\}$ **c.** $x = 350$; $y = 150$ **13.** $x = -5$; $y = 6$; $z = 6$ **14.** $\begin{bmatrix} 0 & 2 & 3 \\ 8 & 1 & 3 \end{bmatrix}$ **15.** $\begin{bmatrix} 0 & -4 \\ 6 & 4 \\ 2 & -10 \end{bmatrix}$

16. $\begin{bmatrix} -4 & 4 & -1 \\ -2 & -5 & 5 \end{bmatrix}$ **17.** Not possible since B is 3×2 and C is 3×3. **18.** $\begin{bmatrix} 2 & 3 & 8 \\ 21 & 5 & 5 \end{bmatrix}$ **19.** $\begin{bmatrix} -12 & 14 & 0 \\ 2 & -14 & 18 \end{bmatrix}$ **20.** $\begin{bmatrix} 0 & -10 & -15 \\ -40 & -5 & -15 \end{bmatrix}$

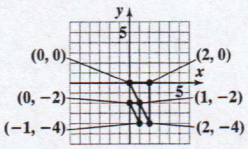
21. $\begin{bmatrix} -1 & -16 \\ 8 & 1 \end{bmatrix}$ **22.** $\begin{bmatrix} -10 & -6 & 2 \\ 16 & 3 & 4 \\ -23 & -16 & 7 \end{bmatrix}$ **23.** $\begin{bmatrix} -6 & 4 & -8 \\ 0 & 5 & 11 \\ -17 & 13 & -19 \end{bmatrix}$ **24.** $\begin{bmatrix} 10 & 5 \\ -2 & -30 \end{bmatrix}$ **25.** Not possible since AB is 2×2 and BA is 3×3.

26. $\begin{bmatrix} 7 & 6 & 5 \\ 2 & -1 & 11 \end{bmatrix}$ **27.** $\begin{bmatrix} -6 & -22 & -40 \\ 9 & 43 & 58 \\ -14 & -48 & -94 \end{bmatrix}$ **28.** $\begin{bmatrix} -2 & -6 \\ 3 & \frac{1}{3} \end{bmatrix}$ **29.** $\begin{bmatrix} 2 & 2 & 2 \\ 1 & 2 & 1 \\ 1 & 2 & 1 \end{bmatrix}$ **30.** $\begin{bmatrix} 1 & 1 & 1 \\ -1 & 1 & -1 \\ -1 & 1 & -1 \end{bmatrix}$

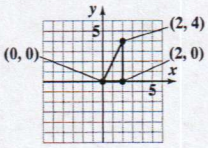
31. $\begin{bmatrix} -2 & 0 & 0 \\ 1 & 1 & -3 \end{bmatrix}$



32. $\begin{bmatrix} 0 & 1 & 1 \\ -2 & -2 & -4 \end{bmatrix}$

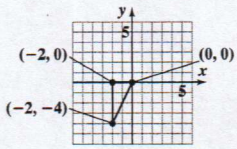


33. $\begin{bmatrix} 0 & 2 & 2 \\ 0 & 0 & 4 \end{bmatrix}$



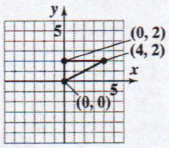
The effect is a reflection over the x-axis

34. $\begin{bmatrix} 0 & -2 & -2 \\ 0 & 0 & -4 \end{bmatrix}$



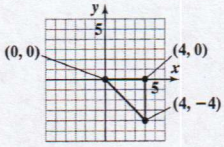
The effect is a reflection over the y-axis

35. $\begin{bmatrix} 0 & 0 & 4 \\ 0 & 2 & 2 \end{bmatrix}$



The effect is a 90° counterclockwise rotation about the origin

36. $\begin{bmatrix} 0 & 4 & 4 \\ 0 & 0 & -4 \end{bmatrix}$



The effect is a horizontal stretch by a factor of 2.

37. $AB = \begin{bmatrix} 1 & 7 \\ 0 & 5 \end{bmatrix}$; $BA = \begin{bmatrix} 1 & 0 \\ 1 & 5 \end{bmatrix}$; $B \neq A^{-1}$ **38.** $AB = I_3$; $BA = I_3$; $B = A^{-1}$ **39.** $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ **40.** $\begin{bmatrix} -\frac{3}{5} & \frac{1}{5} \\ 1 & 0 \end{bmatrix}$ **41.** $\begin{bmatrix} 3 & 0 & -2 \\ -6 & 1 & 4 \\ 1 & 0 & -1 \end{bmatrix}$

42. $\begin{bmatrix} 8 & -8 & 5 \\ -3 & 2 & -1 \\ -1 & -1 & 1 \end{bmatrix}$ **43. a.** $\begin{bmatrix} 1 & 1 & 2 \\ 0 & 1 & 3 \\ 3 & 0 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ -2 \\ 0 \end{bmatrix}$ **b.** $\{(-18, 79, -27)\}$ **44. a.** $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & -1 \\ 1 & 0 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 12 \\ -5 \\ 10 \end{bmatrix}$

b. $\{(4, -2, 3)\}$ **45.** The encoded message is 96, 135, 46, 63; The decoded message is 18, 21, 12, 5 or RULE. **46.** 17 **47.** 4

48. -86 **49.** -236 **50.** 4 **51.** 16 **52.** $\left\{\left(\frac{7}{4}, -\frac{25}{8}\right)\right\}$ **53.** $\{(2, -7)\}$ **54.** $\{(23, -12, 3)\}$ **55.** $\{(-3, 2, 1)\}$

56. $a = \frac{5}{8}$; $b = -50$; $c = 1150$; 30- and 50-year-olds are involved in an average of 212.5 automobile accidents per day.

Chapter 9 Test

1. $\left\{\left(-3, \frac{1}{2}, 1\right)\right\}$ **2.** $\{(t, t - 1, t)\}$ **3.** $\begin{bmatrix} 5 & 4 \\ 1 & 11 \end{bmatrix}$ **4.** $\begin{bmatrix} 5 & -2 \\ 1 & -1 \\ 4 & -1 \end{bmatrix}$ **5.** $\begin{bmatrix} \frac{3}{5} & -\frac{2}{5} \\ \frac{1}{5} & \frac{1}{5} \end{bmatrix}$ **6.** $\begin{bmatrix} -1 & 2 \\ -5 & 4 \end{bmatrix}$ **7.** $AB = I_3$; $BA = I_3$