3. $(-\frac{17}{7}+\frac{6}{7}t, 3-t, -\frac{18}{7}+\frac{1}{7}t, t)$ 4. $(2t, 1-t, 1+t, t)$ 5. No solution

6. $(2.5810-0.0406t, 3.2462-3.8226t, 1.6619-2.1548t, 0.2942+0.3531t, t)$

2.4 CONCEPT QUESTIONS, page 107

1. a. A matrix is an ordered rectangular array of real numbers.
   b. A matrix has size (or dimension) $m\times n$ if it has m rows and n columns.
   c. A row matrix is one of size $1\times n$.
   d. A column matrix is one of size $m\times 1$.
   e. A square matrix is one of size $n\times n$.

2. Two matrices are equal if they have the same size and the corresponding entries are equal. For example,

$$\begin{bmatrix} 1 & 3 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & (4-1) \\ (1-2) & (1+1) \end{bmatrix}$$

3.

$$A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & -2 & 1 \\ 4 & 1 & 3 \end{bmatrix}$$

The entries satisfy $a_{ij} = a_{ji}$, that is A is symmetric with respect to the main diagonal.

EXERCISES 2.4, page 107

1. The size of A is 4×4; the size of B is 4×3; the size of C is 1×5, and the size of D is 4×1.

2. $a_{14} = -4$; $a_{21} = -11$; $a_{31} = 6$; $a_{43} = 5$.

3. These are entries of the matrix B. The entry b_{13} refers to the entry in the first row and third column and is equal to 2. Similarly, $b_{31} = 3$, and $b_{43} = 8$.

4. The row matrix is the matrix C. The transpose of the matrix C is

$$C^T = \begin{bmatrix} 1 \\ 0 \\ 3 \\ 4 \\ 5 \end{bmatrix}.$$

5. The column matrix is the matrix D. The transpose of the matrix D is

$$D^T = [1 \;\; 3 \;\; -2 \;\; 0].$$

6. The square matrix is A. The transpose is

$$A^T = \begin{bmatrix} 2 & -11 & 6 & 5 \\ -3 & 2 & 0 & 1 \\ 9 & 6 & 2 & 5 \\ -4 & 7 & 9 & -8 \end{bmatrix}.$$

7. A is of size 3×2; B is of size 3×2; C and D are of size 3×3.

8. A is of size 3×2 and C is of size 3×3; therefore, their sum does not exist.

9. $$A + B = \begin{bmatrix} -1 & 2 \\ 3 & -2 \\ 4 & 0 \end{bmatrix} + \begin{bmatrix} 2 & 4 \\ 3 & 1 \\ -2 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 6 \\ 6 & -1 \\ 2 & 2 \end{bmatrix}.$$

10. $$2A - 3B = \begin{bmatrix} -2 & 4 \\ 6 & -4 \\ 8 & 0 \end{bmatrix} - \begin{bmatrix} 6 & 12 \\ 9 & 3 \\ -6 & 6 \end{bmatrix} = \begin{bmatrix} -8 & -8 \\ -3 & -7 \\ 14 & -6 \end{bmatrix}.$$

11. $$C - D = \begin{bmatrix} 3 & -1 & 0 \\ 2 & -2 & 3 \\ 4 & 6 & 2 \end{bmatrix} - \begin{bmatrix} 2 & -2 & 4 \\ 3 & 6 & 2 \\ -2 & 3 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -4 \\ -1 & -8 & 1 \\ 6 & 3 & 1 \end{bmatrix}.$$

12. $$4D - 2C = \begin{bmatrix} 8 & -8 & 16 \\ 12 & 24 & 8 \\ -8 & 12 & 4 \end{bmatrix} + \begin{bmatrix} -6 & 2 & 0 \\ -4 & 4 & -6 \\ -8 & -12 & -4 \end{bmatrix} = \begin{bmatrix} 2 & -6 & 16 \\ 8 & 28 & 2 \\ -16 & 0 & 0 \end{bmatrix}.$$

13. $\begin{bmatrix} 6 & 3 & 8 \\ 4 & 5 & 6 \end{bmatrix} - \begin{bmatrix} 3 & -2 & -1 \\ 0 & -5 & -7 \end{bmatrix} = \begin{bmatrix} 3 & 5 & 9 \\ 4 & 10 & 13 \end{bmatrix}.$

14. $\begin{bmatrix} 2 & -3 & 4 & -1 \\ 3 & 1 & 0 & 0 \end{bmatrix} + \begin{bmatrix} 4 & 3 & -2 & -4 \\ 6 & 2 & 0 & -3 \end{bmatrix} = \begin{bmatrix} 6 & 0 & 2 & -5 \\ 9 & 3 & 0 & -3 \end{bmatrix}.$

15. $\begin{bmatrix} 1 & 4 & -5 \\ 3 & -8 & 6 \end{bmatrix} + \begin{bmatrix} 4 & 0 & -2 \\ 3 & 6 & 5 \end{bmatrix} - \begin{bmatrix} 2 & 8 & 9 \\ -11 & 2 & -5 \end{bmatrix} = \begin{bmatrix} 3 & -4 & -16 \\ 17 & -4 & 16 \end{bmatrix}.$

16. $3\begin{bmatrix} 1 & 1 & -3 \\ 3 & 2 & 3 \\ 7 & -1 & 6 \end{bmatrix} + 4\begin{bmatrix} -2 & -1 & 8 \\ 4 & 2 & 2 \\ 3 & 6 & 3 \end{bmatrix} = \begin{bmatrix} 3 & 3 & -9 \\ 9 & 6 & 9 \\ 21 & -3 & 18 \end{bmatrix} + \begin{bmatrix} -8 & -4 & 32 \\ 16 & 8 & 8 \\ 12 & 24 & 12 \end{bmatrix}$

$= \begin{bmatrix} -5 & -1 & 23 \\ 25 & 14 & 17 \\ 33 & 21 & 30 \end{bmatrix}.$

17. $\begin{bmatrix} 1.2 & 4.5 & -4.2 \\ 8.2 & 6.3 & -3.2 \end{bmatrix} - \begin{bmatrix} 3.1 & 1.5 & -3.6 \\ 2.2 & -3.3 & -4.4 \end{bmatrix} = \begin{bmatrix} -1.9 & 3.0 & -0.6 \\ 6.0 & 9.6 & 1.2 \end{bmatrix}.$

18. $\begin{bmatrix} 0.06 & 0.12 \\ 0.43 & 1.11 \\ 1.55 & -0.43 \end{bmatrix} - \begin{bmatrix} 0.77 & -0.75 \\ 0.22 & -0.65 \\ 1.09 & -0.57 \end{bmatrix} = \begin{bmatrix} -0.71 & 0.87 \\ 0.21 & 1.76 \\ 0.46 & 0.14 \end{bmatrix}.$

19. $\frac{1}{2}\begin{bmatrix} 1 & 0 & 0 & -4 \\ 3 & 0 & -1 & 6 \\ -2 & 1 & -4 & 2 \end{bmatrix} + \frac{4}{3}\begin{bmatrix} 3 & 0 & -1 & 4 \\ -2 & 1 & -6 & 2 \\ 8 & 2 & 0 & -2 \end{bmatrix} - \frac{1}{3}\begin{bmatrix} 3 & -9 & -1 & 0 \\ 6 & 2 & 0 & -6 \\ 0 & 1 & -3 & 1 \end{bmatrix}$

$= \begin{bmatrix} \frac{7}{2} & 3 & -1 & \frac{10}{3} \\ -\frac{19}{6} & \frac{2}{3} & -\frac{17}{2} & \frac{23}{3} \\ \frac{29}{3} & \frac{17}{6} & -1 & -2 \end{bmatrix}.$

20. $0.5\begin{bmatrix} 1 & 3 & 5 \\ 5 & 2 & -1 \\ -2 & 0 & 1 \end{bmatrix} - 0.2\begin{bmatrix} 2 & 3 & 4 \\ -1 & 1 & -4 \\ 3 & 5 & -5 \end{bmatrix} + 0.6\begin{bmatrix} 3 & 4 & -1 \\ 4 & 5 & 1 \\ 1 & 0 & 0 \end{bmatrix}$

$$= \begin{bmatrix} 1.9 & 3.3 & 1.1 \\ 5.1 & 3.8 & 0.9 \\ -1 & -1 & 1.5 \end{bmatrix}.$$

21. $\begin{bmatrix} 2x-2 & 3 & 2 \\ 2 & 4 & y-2 \\ 2z & -3 & 2 \end{bmatrix} = \begin{bmatrix} 3 & u & 2 \\ 2 & 4 & 5 \\ 4 & -3 & 2 \end{bmatrix}.$

Now, by the definition of equality of matrices,

$u = 3$

$2x - 2 = 3$ and $2x = 5$, or $x = 5/2$,

$y - 2 = 5$, and $y = 7$,

$2z = 4$, and $z = 2$.

22. $\begin{bmatrix} x & -2 \\ 3 & y \end{bmatrix} + \begin{bmatrix} -2 & z \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 4 & -2 \\ 2u & 4 \end{bmatrix}; \quad \begin{bmatrix} x-2 & -2+z \\ 2 & y+2 \end{bmatrix} = \begin{bmatrix} 4 & -2 \\ 2u & 4 \end{bmatrix}.$

Now, by the definition of equality of matrices,

$x - 2 = 4$, so $x = 6$

$-2 + z = -2$, so $z = 0$

$2 = 2u$, so $u = 1$

$y + 2 = 4$, so $y = 2$.

23. $\begin{bmatrix} 1 & x \\ 2y & -3 \end{bmatrix} - 4\begin{bmatrix} 2 & -2 \\ 0 & 3 \end{bmatrix} = \begin{bmatrix} 3z & 10 \\ 4 & -u \end{bmatrix}; \begin{bmatrix} -7 & x+8 \\ 2y & -15 \end{bmatrix} = \begin{bmatrix} 3z & 10 \\ 4 & -u \end{bmatrix}.$

Now, by the definition of equality of matrices,

$-u = -15$, so $u = 15$

$x + 8 = 10$, so $x = 2$

$2y = 4$, so $y = 2$

$3z = -7$, so $z = -7/3$.

24. $\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ x & -1 \end{bmatrix} - 3\begin{bmatrix} y-1 & 2 \\ 1 & 2 \\ 4 & 2z+1 \end{bmatrix} = 2\begin{bmatrix} -4 & -u \\ 0 & -1 \\ 4 & 4 \end{bmatrix}$; $\begin{bmatrix} -3y+4 & -4 \\ 0 & -2 \\ x-12 & -6z-4 \end{bmatrix} = \begin{bmatrix} -8 & -2u \\ 0 & -2 \\ 8 & 8 \end{bmatrix}$.

Now, by the definition of equality of matrices,

$-2u = -4$, so $u = 2$

$x - 12 = 8$, so $x = 20$

$-3y + 4 = -8$, so $-3y = -12$, $y = 4$

$-6z - 4 = 8$, so $-6z = 12$, and $z = -2$.

25. To verify the Commutative Law for matrix addition, let us show that $A + B = B + A$.

Now, $A + B = \begin{bmatrix} 2 & -4 & 3 \\ 4 & 2 & 1 \end{bmatrix} + \begin{bmatrix} 4 & -3 & 2 \\ 1 & 0 & 4 \end{bmatrix} = \begin{bmatrix} 6 & -7 & 5 \\ 5 & 2 & 5 \end{bmatrix}$

$= \begin{bmatrix} 4 & -3 & 2 \\ 1 & 0 & 4 \end{bmatrix} + \begin{bmatrix} 2 & -4 & 3 \\ 4 & 2 & 1 \end{bmatrix} = B + A$.

26. To verify the Associative Law for matrix addition, let us show that $A + (B + C) = (A + B) + C$. Now,

$B + C = \begin{bmatrix} 4 & -3 & 2 \\ 1 & 0 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 2 \\ 3 & -2 & 1 \end{bmatrix} = \begin{bmatrix} 5 & -3 & 4 \\ 4 & -2 & 5 \end{bmatrix}$

and $A + (B + C) = \begin{bmatrix} 2 & -4 & 3 \\ 4 & 2 & 1 \end{bmatrix} + \begin{bmatrix} 5 & -3 & 4 \\ 4 & -2 & 5 \end{bmatrix} = \begin{bmatrix} 7 & -7 & 7 \\ 8 & 0 & 6 \end{bmatrix}$.

Next, $A + B = \begin{bmatrix} 2 & -4 & 3 \\ 4 & 2 & 1 \end{bmatrix} + \begin{bmatrix} 4 & -3 & 2 \\ 1 & 0 & 4 \end{bmatrix} = \begin{bmatrix} 6 & -7 & 5 \\ 5 & 2 & 5 \end{bmatrix}$

and $(A + B) + C = \begin{bmatrix} 6 & -7 & 5 \\ 5 & 2 & 5 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 2 \\ 3 & -2 & 1 \end{bmatrix} = \begin{bmatrix} 7 & -7 & 7 \\ 8 & 0 & 6 \end{bmatrix}$.

27. $(3+5)A = 8A = 8\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} = \begin{bmatrix} 24 & 8 \\ 16 & 32 \\ -32 & 0 \end{bmatrix} = 3\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} + 5\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix}$

$= 3A + 5A$.

28. $2(4A) = 2(4)\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} = 2\begin{bmatrix} 12 & 4 \\ 8 & 16 \\ -16 & 0 \end{bmatrix} = \begin{bmatrix} 24 & 8 \\ 16 & 32 \\ -32 & 0 \end{bmatrix} \quad = (2\cdot 4)\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} = 8\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix}.$

29. $4(A+B) = 4\left[\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 2 \\ -1 & 0 \\ 3 & 2 \end{bmatrix}\right] = 4\begin{bmatrix} 4 & 3 \\ 1 & 4 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 16 & 12 \\ 4 & 16 \\ -4 & 8 \end{bmatrix}$

$$4A + 4B = 4\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} + 4\begin{bmatrix} 1 & 2 \\ -1 & 0 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 16 & 12 \\ 4 & 16 \\ -4 & 8 \end{bmatrix}.$$

30. $2(A-3B) = 2\left[\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} - 3\begin{bmatrix} 1 & 2 \\ -1 & 0 \\ 3 & 2 \end{bmatrix}\right] = 2\begin{bmatrix} 0 & -5 \\ 5 & 4 \\ -13 & -6 \end{bmatrix} = \begin{bmatrix} 0 & -10 \\ 10 & 8 \\ -26 & -12 \end{bmatrix}.$

$$2A - 6B = 2\begin{bmatrix} 3 & 1 \\ 2 & 4 \\ -4 & 0 \end{bmatrix} - 6\begin{bmatrix} 1 & 2 \\ -1 & 0 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 0 & -10 \\ 10 & 8 \\ -26 & -12 \end{bmatrix}.$$

31. $\begin{bmatrix} 3 & 2 & -1 & 5 \end{bmatrix}^T = \begin{bmatrix} 3 \\ 2 \\ -1 \\ 5 \end{bmatrix}.$

32. $\begin{bmatrix} 4 & 2 & 0 & -1 \\ 3 & 4 & -1 & 5 \end{bmatrix}^T = \begin{bmatrix} 4 & 3 \\ 2 & 4 \\ 0 & -1 \\ -1 & 5 \end{bmatrix}.$

33. $\begin{bmatrix} 1 & -1 & 2 \\ 3 & 4 & 2 \\ 0 & 1 & 0 \end{bmatrix}^T = \begin{bmatrix} 1 & 3 & 0 \\ -1 & 4 & 1 \\ 2 & 2 & 0 \end{bmatrix}.$

34. $\begin{bmatrix} 1 & 2 & 6 & 4 \\ 2 & 3 & 2 & 5 \\ 6 & 2 & 3 & 0 \\ 4 & 5 & 0 & 2 \end{bmatrix}^T = \begin{bmatrix} 1 & 2 & 6 & 4 \\ 2 & 3 & 2 & 5 \\ 6 & 2 & 3 & 0 \\ 4 & 5 & 0 & 2 \end{bmatrix}.$

35.

$$\begin{array}{r} \\ Mr.\ Cross \\ Mr.\ Jones \\ Mr.\ Smith \end{array}\begin{array}{c} \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \\ \begin{bmatrix} 220 & 215 & 210 & 205 \\ 220 & 210 & 200 & 195 \\ 215 & 205 & 195 & 190 \end{bmatrix} \end{array}$$

36. a. The required matrices are

$$A = \begin{array}{r} {\scriptstyle Lesley} \\ {\scriptstyle Tom} \end{array}\begin{bmatrix} 500 & 350 & 200 & 400 \\ 400 & 450 & 300 & 200 \end{bmatrix}, \quad B = \begin{array}{r} {\scriptstyle Lesley} \\ {\scriptstyle Tom} \end{array}\begin{bmatrix} 50 & 50 & 0 & 100 \\ 0 & 80 & 100 & 50 \end{bmatrix}$$

b. Their holdings at the end of the year are

$$C = A + B = \begin{array}{r} {\scriptstyle Lesley} \\ {\scriptstyle Tom} \end{array}\begin{bmatrix} 550 & 400 & 200 & 500 \\ 400 & 530 & 400 & 250 \end{bmatrix}$$

37. $$B = (1.03)A = 1.03\begin{bmatrix} 340 & 360 & 380 \\ 410 & 430 & 440 \\ 620 & 660 & 700 \end{bmatrix} = \begin{array}{r} \\ I \\ II \\ III \end{array}\begin{array}{c} \begin{matrix} M_1 & M_2 & M_3 \end{matrix} \\ \begin{bmatrix} 350.2 & 370.8 & 391.4 \\ 422.3 & 442.9 & 453.2 \\ 638.6 & 679.8 & 721 \end{bmatrix} \end{array}$$

38. We want to find r so that

$$(1.01r)A = B$$

By the definition of scalar multiplication, we just need to consider the corresponding

entries in the first row and first column. Thus,

$$(1 + 0.01r)(340) = 357$$

$$0.01r = \frac{357}{340} - 1$$

and $r = 5$. So the percentage increase is 5%.

39. a. $D = A + B - C$

$$= \begin{bmatrix} 2820 & 1470 & 1120 \\ 1030 & 520 & 480 \\ 1170 & 540 & 460 \end{bmatrix} + \begin{bmatrix} 260 & 120 & 110 \\ 140 & 60 & 50 \\ 120 & 70 & 50 \end{bmatrix} - \begin{bmatrix} 120 & 80 & 80 \\ 70 & 30 & 40 \\ 60 & 20 & 40 \end{bmatrix}$$

$$= \begin{bmatrix} 2960 & 1510 & 1150 \\ 1100 & 550 & 490 \\ 1230 & 590 & 470 \end{bmatrix}.$$

b. $$E = 1.1D = 1.1\begin{bmatrix} 2960 & 1510 & 1150 \\ 1100 & 550 & 490 \\ 1230 & 590 & 470 \end{bmatrix} = \begin{bmatrix} 3256 & 1661 & 1265 \\ 1210 & 605 & 539 \\ 1353 & 649 & 517 \end{bmatrix}.$$

40. a. $$\begin{array}{cc} & \begin{array}{cccc} Text. & Fict. & \begin{array}{c} Non- \\ Fict. \end{array} & Ref. \end{array} \\ A = \begin{array}{r} Hard \\ Paper \end{array} & \begin{bmatrix} 5280 & 1680 & 2320 & 1890 \\ 1940 & 2810 & 1490 & 2070 \end{bmatrix} \end{array}$$

b. $$\begin{array}{cc} & \begin{array}{cccc} Text. & Fict. & \begin{array}{c} Non- \\ Fict. \end{array} & Ref. \end{array} \\ B = \begin{array}{r} Hard \\ Paper \end{array} & \begin{bmatrix} 6340 & 2220 & 1790 & 1980 \\ 2050 & 3100 & 1720 & 2710 \end{bmatrix} \end{array}$$

c. $$\begin{array}{cc} & \begin{array}{cccc} Text. & Fict. & \begin{array}{c} Non- \\ Fict. \end{array} & Ref. \end{array} \\ C = \begin{array}{r} Hard \\ Paper \end{array} & \begin{bmatrix} 11620 & 3900 & 4110 & 3870 \\ 3990 & 5910 & 3210 & 4780 \end{bmatrix} \end{array}$$

41.

$$A = \begin{array}{r} \text{MA} \\ \text{U.S.} \end{array} \begin{bmatrix} 6.88 & 7.05 & 7.18 \\ 4.13 & 4.09 & 4.06 \end{bmatrix}$$

42. $$A = \begin{array}{r} M \\ W \end{array} \begin{bmatrix} 1 & 2.6 & 7 & 18.8 & 36.3 \\ 0.8 & 1.8 & 4.4 & 12.2 & 27.6 \end{bmatrix}$$

43.

$$A = \begin{array}{c} \\ W \\ M \end{array}\begin{array}{c} \begin{matrix} W & B & H \end{matrix} \\ \begin{bmatrix} 81 & 76.1 & 82.2 \\ 76 & 69.9 & 75.9 \end{bmatrix} \end{array} \quad ; \quad B = \begin{array}{c} \\ W \\ B \\ H \end{array}\begin{array}{c} \begin{matrix} W & M \end{matrix} \\ \begin{bmatrix} 81 & 76 \\ 76.1 & 69.9 \\ 82.2 & 75.9 \end{bmatrix} \end{array}$$

44.

$$A = \begin{array}{c} \\ 2001 \\ 2001 \end{array}\begin{array}{c} \begin{matrix} H & H\text{-}D & Y & S & K & O \end{matrix} \\ \begin{bmatrix} 27.9 & 21.9 & 19.2 & 11 & 9.1 & 10.9 \\ 27.6 & 23.3 & 18.2 & 10.5 & 8.8 & 11.6 \end{bmatrix} \end{array}$$

The sum of all elements in the first row is 100%. The sum of all elements in the second row is 100%. Harley-Davidson gained the most: 23.3-21.9 or 1.4%.

45. True. Each element in $A + B$ is obtained by adding together the corresponding elements in A and B. Therefore, the matrix $c(A+B)$ is obtained by multiplying each element in $A + B$ by c. On the other hand, cA is obtained by multiplying each element in A by c and cB is obtained by multiplying each element in B by c and $cA + cB$ is obtained by adding the corresponding elements in cA and cB. Thus $c(A+B) = cA + cB$.

46. True. $(-1)B$ is the matrix whose elements are the negatives of the respective elements of B. The result now follows by the definition of matrix addition.

47. False. Take $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $c = 2$. Then

$$cA = 2\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} \text{ and } (cA)^T = \begin{bmatrix} 2 & 6 \\ 4 & 8 \end{bmatrix}.$$

On the other hand, $\frac{1}{c}A^T = \frac{1}{2}\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} \frac{1}{2} & \frac{3}{2} \\ 1 & 2 \end{bmatrix} \neq (cA)^T$

48. True. A^T is obtained from A by interchanging the rows and columns of A. $(A^T)^T$ is obtained by interchanging the rows and columns of A^T. This leads to the original matrix A. Thus, $(A^T)^T = A$.

USING TECHNOLOGY EXERCISES 2.4, page 113

1. $\begin{bmatrix} 15 & 38.75 & -67.5 & 33.75 \\ 51.25 & 40 & 52.5 & -38.75 \\ 21.25 & 35 & -65 & 105 \end{bmatrix}$

2. $\begin{bmatrix} -52.08 & 26.88 & -11.76 & 10.08 \\ -26.04 & -22.68 & 10.08 & -14.28 \\ -10.08 & 11.76 & 14.28 & -23.52 \end{bmatrix}$

3. $\begin{bmatrix} -5 & 6.3 & -6.8 & 3.9 \\ 1 & 0.5 & 5.4 & -4.8 \\ 0.5 & 4.2 & -3.5 & 5.6 \end{bmatrix}$

4. $\begin{bmatrix} 5 & -6.3 & 6.8 & -3.9 \\ -1 & -0.5 & -5.4 & 4.8 \\ -0.5 & -4.2 & 3.5 & -5.6 \end{bmatrix}$

5. $\begin{bmatrix} 16.44 & -3.65 & -3.66 & 0.63 \\ 12.77 & 10.64 & 2.58 & 0.05 \\ 5.09 & 0.28 & -10.84 & 17.64 \end{bmatrix}$

6. $\begin{bmatrix} -8.02 & 11.95 & -13.72 & 7.71 \\ 3.34 & 2.13 & 10.86 & -9.4 \\ 1.53 & 8.26 & -8.03 & 12.88 \end{bmatrix}$

7. $\begin{bmatrix} 22.2 & -0.3 & -12 & 4.5 \\ 21.6 & 17.7 & 9 & -4.2 \\ 8.7 & 4.2 & -20.7 & 33.6 \end{bmatrix}$

8. $\begin{bmatrix} -12.142 & 26.091 & -32.968 & 17.979 \\ 12.584 & 8.983 & 25.974 & -21.606 \\ 5.473 & 19.11 & -22.633 & 36.4 \end{bmatrix}$