ANSWERS TO TRY THESE

1.1 Constants, Variables, and Expressions
(page 5)

1.

a) The variable quantity is the download cost.

b) The constant is the fixed service cost.

c) Annual cost = 50 + 2x, where x represents the number of downloaded photographs.

d) Annual cost = 50 + 2·20 = 50 + 40 = 90

The annual cost of downloading 20 photos is $90.

3.

a) There are 2 variable quantities in this problem.

b) There are no constants in this problem.

2.1 Vectors
(page 9)

1. $\vec{v} = \langle -3, 2 \rangle$ and $\vec{u} = \langle 13, 3 \rangle$
2. Two vectors are equal because they have the same direction and magnitude.

2.2 Addition, Subtraction, and Scalar Multiplication of Vectors
(page 13)

1. $\vec{u} + \vec{v} = \langle -5, 1 \rangle$
2. $\vec{v} - \vec{u} = \langle 15, -3 \rangle$

2.3 Magnitude, Direction, and Components of a Vector
(page 18)

1. $\|\vec{v}\| = 5$
2. $\|\vec{v}\| = 3\sqrt{2}$
3. $\vec{v}_x = 3\sqrt{3}$ and $\vec{v}_y = 3$
4. $\theta \approx 73.3008°$

2.4 The Dot Product of Two Vectors, the Length of a Vector, and the Angle Between Two Vectors
(page 23)

1. $\vec{u} \cdot \vec{v} = -13$
2. $\vec{u} \cdot \vec{v} = 0$
3. $\sqrt{65}$
4. 5
5. $135°$
6. $90°$

2.5 Parallel and Perpendicular Vectors, The Unit Vector
(page 27)

1. Parallel
2. Perpendicular
3. Neither parallel nor perpendicular
4. $\hat{v} = \left\langle \frac{2}{\sqrt{5}}, \frac{-1}{\sqrt{5}} \right\rangle$

2.6 The Vector Projection of One Vector onto Another
(page 32)

1. $\left\langle \frac{21}{5}, \frac{7}{5} \right\rangle$
2. $\left\langle \frac{-222}{61}, \frac{185}{61} \right\rangle$

3.1 Three Dimensional Vectors
(page 36)

1. $\sqrt{29} \approx 5.4$ units
2. $7\sqrt{5} \approx 15.6$ units
3. $(x-2)^2 + (y-9)^2 = 1$
4. $(x+2)^2 + (y-5)^2 + (z+7)^2 = 16$

3.2 Magnitude and Direction Cosines of a Vector
(page 41)

1. $\|\vec{v}\| = \sqrt{29}$
2. $\|\vec{v}\| = \sqrt{2}$
3. {0.802, -0.267, 0.535}
4. $< -18, -6, 21 >$

3.3 Arithmetic on Vectors in 3-Dimensional Space
(page 45)

1. $\vec{u} + \vec{v} = \langle 5, 11, 1 \rangle$
2. $\vec{u} - \vec{v} = \langle -11, -3, 11 \rangle$
3. $2\vec{u} + 3\vec{v} - 4\vec{w} = \langle -5, 16, -42 \rangle$
4. $4\vec{u} - 4\vec{v} - \vec{w} = \langle 16, -13, -26 \rangle$

3.4 The Unit Vector in 3-Dimensions and Vectors in Standard Position
(page 49)

1. $\frac{2}{\sqrt{29}}\hat{\imath} - \frac{3}{\sqrt{29}}\hat{\jmath} + \frac{4}{\sqrt{29}}\hat{k}$
2. $\frac{1}{\sqrt{3}}\hat{\imath} - \frac{1}{\sqrt{3}}\hat{\jmath} + \frac{1}{\sqrt{3}}\hat{k}$
3. $\frac{1}{\sqrt{2}}\hat{\imath} - \frac{1}{\sqrt{2}}\hat{k}$
4. $\frac{4}{\sqrt{29}}\hat{\imath} + \frac{3}{\sqrt{29}}\hat{\jmath} + \frac{2}{\sqrt{29}}\hat{k}$

3.5 The Dot Product, Length of a Vector, and the Angle between Two Vectors in Three Dimensions
(page 54)

1. $\vec{u} \cdot \vec{v} = -31$
2. $\vec{u} \cdot \vec{v} = 0$
3. $\sqrt{101}$
4. 5
5. $63.6°$
6. $90°$

3.6 The Cross Product: Algebra
(page 59)

1. $\vec{u} \times \vec{v} = \langle -5, -7, 6 \rangle$
2. $\vec{u} \times \vec{v} = \vec{0}$
3. 144

3.7 The Cross Product: Geometry
(page 65)

1. $\vec{u} \times \vec{v} = \langle 11, 33, -11 \rangle$
2. $\vec{u} \times \vec{v} = \langle 0, 0, 0 \rangle = \vec{0}$
3. $5\sqrt{6}$ = 12.2 units

4.

$$\theta = \cos^{-1}\frac{\vec{u}\cdot\vec{v}}{\|\vec{u}\|\cdot\|\vec{v}\|}$$

$$\theta = \cos^{-1}\frac{\langle 4,-7,6\rangle\cdot\langle 5,-1,2\rangle}{\sqrt{4^2+(-7)^2+6^2}\cdot\sqrt{5^2+(-1)^2+2^2}}$$

$$\theta = \cos^{-1}\frac{4\cdot 5+(-7)\cdot(-1)+6\cdot 2}{\sqrt{91}\cdot\sqrt{30}}$$

$$\theta = \cos^{-1}\frac{25}{\sqrt{101}\cdot\sqrt{30}}$$

$$\theta = 74.19°$$

5. Perpendicular since $\vec{u}\cdot\vec{v}=0$

6. Parallelogram is 26.94 square units. Triangle is (½ of 26.94) = 13.47 square units.

4.1 Matrices

(page 70)

1.
   a) 4×3
   b) 2×3
   c) 1×3

2. True

3.
   a) 5
   b) 2
   c) 1
   d) 4

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

5. $I_{4\times 4}=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}$

6. $I_{3\times 3}^T = I_{3\times 3}$

7. <4,3,2>

8. $\begin{bmatrix}5 & 0\\ 2 & 6\end{bmatrix}$ or $\begin{bmatrix}5 & 2\\ 0 & 6\end{bmatrix}$

4.2 Addition, Subtraction, Scalar Multiplication, and Products of Row and Column Matrices
(page 75)

1. $\begin{bmatrix} 4 & 4 \\ 0 & 3 \\ -1 & 2 \end{bmatrix}$
2. $\begin{bmatrix} -2 & 0 \\ 2 & -3 \\ -1 & -6 \end{bmatrix}$
3. Not possible
4. $[38]$
5. $[38]$
6. $\begin{bmatrix} 12 & 0 \\ -6 & 3 \end{bmatrix}$
7. Not defined
8. $[114]$
9. $[-76]$
10. $[4]$

4.3 Matrix Multiplication
(page 79)

1. $\begin{bmatrix} 10 & 5 & 5 \\ 10 & 5 & 0 \\ 16 & 8 & 4 \end{bmatrix}$
2. $\begin{bmatrix} 1 & 19 \\ 2 & 18 \end{bmatrix}$
3. Is not commutative
4. $\begin{bmatrix} 20 & 10 & 0 \\ 12 & 6 & 13 \end{bmatrix}$
5. $\begin{bmatrix} 20 \\ 15 \end{bmatrix}$
6. $\begin{bmatrix} 9 \\ 1 \\ 8 \end{bmatrix}$
7. $\begin{bmatrix} 28 & -6 \\ -4 & 25 \end{bmatrix}$
8. D
9. $\begin{bmatrix} 2 & 20 \\ -2 & 6 \\ -6 & -8 \end{bmatrix}$
10. $\begin{bmatrix} 84 & 42 & 26 \\ 20 & 10 & 0 \\ -44 & -22 & -26 \end{bmatrix}$
11. Not defined

4.4 Rotation Matrices in 2-Dimensions
(page 83)

1. $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$
2. $\begin{bmatrix} -1 \\ -1 \end{bmatrix}$
3. $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$
4. $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$
5. $\begin{bmatrix} 0 \\ \sqrt{2} \end{bmatrix}$
6. $\begin{bmatrix} -\sqrt{2} \\ 0 \end{bmatrix}$
7. $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$
8. $\begin{bmatrix} -3 \\ 3 \end{bmatrix}$
9. $\begin{bmatrix} -1.36603 \\ 0.36603 \end{bmatrix}$

4.5 Finding the Angle of Rotation Between Two Rotated Vectors in 2-Dimensions
(page 87)

1. $\theta = \frac{\pi}{4} = 45°$
2. $\theta = \frac{\pi}{3} = 60°$
3. $\theta = \frac{3\pi}{2} = 270°$
4. $\theta = \frac{\pi}{3} = 60°$
5. $\theta = \frac{7\pi}{4} = 315° = -45°$

4.6 Rotation Matrices in 3-Dimensions
(page 92)

1. $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$
2. $\begin{bmatrix} \sqrt{2} \\ 0 \\ 1 \end{bmatrix}$
3. $\begin{bmatrix} 3 \\ -5 \\ 4 \end{bmatrix}$

5.1 The Basic Trigonometric Functions

(page 97)

1.
   a) $\sin 45° = \frac{1}{\sqrt{2}} = 0.7071, \cos 45° = \frac{1}{\sqrt{2}} = 0.7071, \tan 45° = 1$
   b) $\sin \theta = \frac{4}{5} = 0.8, \cos \theta = \frac{3}{5} = 0.6, \tan \theta = \frac{4}{3} = 1.3333$
   c) $\sin \theta = \frac{\sqrt{5}}{3} = 0.7454, \cos \theta = \frac{2}{3} = 0.6666, \tan \theta = \frac{\sqrt{5}}{2} = 1.1180$
   d) $\sin \theta = \frac{2}{\sqrt{5}} = 0.8944, \cos \theta = \frac{1}{\sqrt{5}} = 0.4472, \tan \theta = \frac{2}{1} = 2$
   e) $\sin \theta = \frac{15}{17} = 0.8834, \cos \theta = \frac{8}{17} = 0.4705, \tan \theta = \frac{15}{8} = 1.875$
2.
   a) $\sin 30° = 0.5, \cos 30° = 0.8661, \tan 30° = 0.5774$
   b) $\sin 90° = 1, \cos 90° = 0$
   c) $\sin 0° = 0, \cos 0° = 1, \tan 0° = 0$
   d) $\sin 180° = 0, \cos 180° = -1$
   e) $\sin 120° = 0.8660, \cos 120° = -0.5$

5.2 Circular Trigonometry

(page 102)

1. (0.7071, 0.7071)
2. (0.9962, 0.0872)
3. (6.4705, 4.8396)
4. (-7.0711, 7.0711)
5. 34.31 ft
6. 6 units

5.3 Graphs of the Sine Function

(page 107)

1.
   a) -0.7071
   b) -1
   c) -0.7071
   d) 0
2.
   a) 0.5
   b) 0.7071
   c) 0.8660
   d) 1

3.

a) True, since 0.9986 > 0.9781

b) False, since 0.4226 < 0.5736

c) True, since 0.5 = 0.5

d) True, since $1 \geq -1$

4.

a) True, since $\sin(87°) = 0.9986 > \cos(87°) = 0.0523$

b) False, since $\sin(155°) = 0.4226 < \cos(55°) = 0.5736$

c) True, since $\sin(20°) = 0.3420 < \cos(20°) = 0.9396$

d) True, since $\sin(135°) = 0.7071 = \cos(315°) = 0.7071$

5.4 Graphs of the Cosine Function

(page 110)

1.

a) -0.7071

b) 0

c) 0.7071

d) 1

2.

a) 0.8660

b) 0.7071

c) 0.5

d) 0

3.

a) False, since 0.0523 < 0.2079

b) False, since 0.7071 < 0.9063 (Be careful here: 0.7071 > –0.9063, but the negative sign tells us the object is the left of the observer. Think absolute value. At 45°, the object is 0.7071 to the right of the observer. At 145°, the object is 0.9063 units to the left of the observer, and, therefore, farther from the observer.)

c) False, since is |0.8660| =|-0.8660|

d) True, since 0 = 0

5.5 Amplitude and Period of the Sine and Cosine Functions

(page 116)

1.

a) $y = 3\sin(2x)$

b) $y = 2\cos(3x)$

c) $y = 7\cos(x)$

2. 3 complete cycles. Period is $\frac{360^\circ}{3} = 120^\circ$. Amplitude is 4.

3. $\frac{4}{5}$ of a complete cycle. Period is $\frac{360^\circ}{4/5} = 360^\circ \times \frac{5}{4} = 450^\circ$. Amplitude is 5.

4. $y = 15\sin(7.2\theta)$, where $\frac{360^\circ}{B} = 50^\circ \rightarrow B = \frac{360^\circ}{50^\circ} = 7.2$

5. $y = 100\cos(30\theta)$, where $\frac{360^\circ}{B} = 12^\circ \rightarrow B = \frac{360^\circ}{12^\circ} = 30$

6. $y = 3\cos(4\theta)$

We need to specify both A and B in $y = A\cos(B\theta)$. Since the amplitude is 3, $A = 3$. Since the curve makes two complete cycles from 0° to 180°, it must make 4 complete cycles from 0° to 360°. So, $B = 4$.

7. $y = 4\sin(12\theta)$

We need to specify both A and B in $y = A\cos(B\theta)$. Since the amplitude is 4, $A = 4$. Since the curve makes three complete cycles from 0° to 90°, it must make 12 complete cycles from 0° to 360°. So, $B = 12$.