$C(x) = 2.5x + 3000.$

Since the break-even point is when $R(x) = C(x)$, we solve the equation $4.5x = 2.5x + 3000$.

$$\begin{aligned} 4.5x &= 2.5x + 3000 \\ 2x &= 3000 \\ x &= 1500 \end{aligned}$$

The company must sell 1500 packages to break even.

6. Let x = measure of smallest angle
y = measure of largest angle
z = measure of third angle
The sum of the measures is 180°:
$x + y + z = 180.$

The measure of the largest angle is 40° more than the measure of the smallest angle:
$y = x + 40.$

The measure of the remaining angle is 20° more than the measure of the smallest angle:
$y = x + 20.$

We solve the following system.

$$\begin{cases} x + y + z = 1180 \\ y = x + 40 \\ z = x + 20 \end{cases}$$

We substitute $x + 40$ for y and $x + 20$ for z in the first equation.

$$\begin{aligned} x + (x + 40) + (x + 20) &= 180 \\ 3x + 60 &= 180 \\ 3x &= 120 \\ x &= 40 \end{aligned}$$

Then $y = x + 40 = 40 + 40 = 80$ and $z = x + 20 = 40 + 20 = 60$.
The angle measures are 40°, 60°, and 80°.

Vocabulary, Readiness & Video Check 4.3

1. Up to now we've been choosing one variable/unknown and translating to one equation. To solve by a system of equations, we'll choose two variables to represent two unknowns and translate to two equations.

2. The break-even point occurs when revenue equals cost—money has not been lost or made; set the revenue function equal to the cost function and solve for the variable.

3. The ordered triple still needs to be interpreted in the context of the application. Each value actually represents the angle measure of a triangle, in degrees.

Exercise Set 4.3

1. Let x = the first number, y = the second number.

$$\begin{cases} x = y + 2 \\ 2x = 3y - 4 \end{cases}$$

Substitute $x = y + 2$ in the second equation.

$$\begin{aligned} 2(y + 2) &= 3y - 4 \\ 2y + 4 &= 3y - 4 \\ y &= 8 \end{aligned}$$

Replace y with 8 in the first equation.
$x = 8 + 2 = 10$
The numbers are 10 and 8.

3. a. Let e = length of the Enterprise class,
n = length of the Nimitz class.

$$\begin{cases} e + n = 2193 \\ e - n = 9 \end{cases}$$

Add the equations.

$$\begin{aligned} 2e &= 2202 \\ e &= 1101 \end{aligned}$$

Replace e with 1101 in the first equation.

$$\begin{aligned} 1101 + n &= 2193 \\ n &= 1092 \end{aligned}$$

The Enterprise class is 1101 feet and the Nimitz class is 1092 feet.

b. There are 3 feet in each yard, so there are 300 feet in 100 yards.

$$\frac{1101}{300} = 3.67$$

The length of the Enterprise class carrier is 3.67 football fields.

5. With the wind, the plane was moving at $\frac{2520}{4.5} = 560$ mph. Against the wind, the plane was moving at $\frac{2160}{4.5} = 480$ mph.

Let p = speed of the plane in still air,
w = speed of the wind.

$$\begin{cases} p + w = 560 \\ p - w = 480 \end{cases}$$

Add the equations.

$$\begin{aligned} 2p &= 1040 \\ p &= 520 \end{aligned}$$

Replace p with 520 in the first equation.

$$\begin{aligned} 520 + w &= 560 \\ w &= 40 \end{aligned}$$

The speed of the plane is 520 mph and the speed of the wind is 40 mph.

7. Let x = amount of 4% butterfat milk, and y = amount of 1% butterfat milk.

qt	strength	amount of butterfat
x	4%	$0.04x$
y	1%	$0.01y$
60	2%	0.02(60) = 1.2

$$\begin{cases} x + y = 60 \\ 0.04x + 0.01y = 1.2 \end{cases}$$

Multiply the second equation by −100 and add the result to the first equation.

$$\begin{array}{r} x + y = 60 \\ -4x - y = -120 \\ \hline -3x = -60 \\ x = 20 \end{array}$$

Replace x with 20 in the first equation.

$$\begin{aligned} 20 + y &= 60 \\ y &= 40 \end{aligned}$$

Thus, mix 20 quarts of 4% butterfat milk with 40 quarts of 1% butterfat milk.

9. Let x be the number of students studying in the United Kingdom, and y be the number studying in Italy.

$$\begin{cases} x + y = 58,704 \\ x = y + 3980 \end{cases}$$

Replace x with $y + 3980$ in the first equation.

$$\begin{aligned} x + y &= 58,704 \\ y + 3980 + y &= 58,704 \\ 2y + 3980 &= 58,704 \\ 2y &= 54,724 \\ y &= 27,362 \end{aligned}$$

Replace y with 27,362 in the second equation.
$x = y + 3980 = 27{,}362 + 3980 = 31{,}342$
31,342 students studied in the United Kingdom, and 27,362 studied in Italy.

11. Let l be the number of large frames and s be the number of small frames.

$$\begin{cases} l + s = 22 \\ 15l + 8s = 239 \end{cases}$$

Solve the first equation for l.
$l = 22 - s$
Replace l with $22 - s$ in the second equation.

$$\begin{aligned} 15(22 - s) + 8s &= 239 \\ 330 - 15s + 8s &= 239 \\ -7s &= -91 \\ s &= 13 \end{aligned}$$

Replace s with 13 in the first equation.

$$\begin{aligned} l + 13 &= 22 \\ l &= 9 \end{aligned}$$

She bought 9 large frames and 13 small frames.

13. Let m = the first number, n = the second number.

$$\begin{cases} m = n - 2 \\ 2m = 3n + 4 \end{cases}$$

Substitute $m = n - 2$ in the second equation.

$$\begin{aligned} 2(n - 2) &= 3n + 4 \\ 2n - 4 &= 3n + 4 \\ -8 &= n \end{aligned}$$

Replace n with −8 in the first equation.
$m = -8 - 2 = -10$
The numbers are −10 and −8.

15. a.

$$\begin{cases} y = -4.5x + 24 \\ y = 2x + 7 \end{cases}$$

Replace y with $-4.5x + 24$ in the second equation.

$$\begin{aligned} y &= 2x + 7 \\ -4.5x + 24 &= 2x + 7 \\ -6.5x + 24 &= 7 \\ -6.5x &= -17 \\ x &\approx 3 \end{aligned}$$

2007 + 3 = 2010
The predicted year is 2010 where the percent of adults under 30 and the percent of adults over 30 will blog at the same rate.

b. answers may vary

17. Let p be the price of a pen and w be the price of a writing tablet.

$$\begin{cases} 7w + 4p = 6.40 \\ 2w + 19p = 5.40 \end{cases}$$

Multiply the first equation by −2 and the second equation by 7 and add the resulting equations.

$$\begin{array}{r} -14w - 8p = -12.8 \\ 14w + 133p = 37.8 \\ \hline 125p = 25 \\ p = 0.2 \end{array}$$

Replace p with 0.2 in the first equation.

$$\begin{aligned} 7w + 4p &= 6.40 \\ 7w + 4(0.2) &= 6.40 \\ 7w + 0.8 &= 6.4 \\ 7w &= 5.6 \\ w &= 0.8 \end{aligned}$$

The price of a writing tablet is \$0.80 and the price of a pen is \$0.20.

19. Let p be the speed of the plane and w be the speed of the wind.

$$\begin{cases} 3p+3w=2160 \\ 4p-4w=2160 \end{cases}$$

Multiply the first equation by $\frac{1}{3}$ and the second equation by $\frac{1}{4}$, and add the results.

$$\begin{array}{r} p+w=720 \\ p-w=540 \\ \hline 2p \quad =1260 \\ p=630 \end{array}$$

Replace p with 630 in the first equation.

$$\begin{aligned} 3(630)+3w&=2160 \\ 1890+3w&=2160 \\ 3w&=270 \\ w&=90 \end{aligned}$$

The plane's speed is 630 mph and the wind's speed is 90 mph.

21. a. answers may vary

b. $\begin{cases} y=0.06x+9.7 \\ y=0.21x+9.3 \end{cases}$

Replace y with $0.21x + 9.3$ in the first equation.

$$\begin{aligned} y&=0.06x+9.7 \\ 0.21x+9.3&=0.06x+9.7 \\ 0.15x+9.3&=9.7 \\ 0.15x&=0.4 \\ x&\approx 2.7 \end{aligned}$$

The pounds of each cheese consumed were the same 3 years after 2000, or in 2003.

23. Let x be the length of each of the equal sides and y be the length of the third side.

$$\begin{cases} 2x+y=93 \\ y=x+9 \end{cases}$$

Replace y with $x + 9$ in the first equation.

$$\begin{aligned} 2x+y&=93 \\ 2x+x+9&=93 \\ 3x&=84 \\ x&=28 \end{aligned}$$

Replace x with 28 in the second equation.

$y = x + 9 = 28 + 9 = 37$

The lengths of the sides are 28 cm, 28 cm, and 37 cm.

25. Let m be the number of miles.

Hertz = $25 + 0.10m$

Budget = $20 + 0.25m$

Using Budget = 2 · Hertz gives

$$\begin{aligned} 20+0.25m&=2(25+0.10m) \\ 20+0.25m&=50+0.20m \\ 0.25m&=30+0.20m \\ 0.05m&=30 \\ m&=\frac{30}{0.05}=600 \end{aligned}$$

The Budget charge is twice the Hertz charge for a daily mileage of 600 miles.

27. $\begin{cases} x=y-30 \\ x+y=180 \end{cases}$

Replace x with $y - 30$ in the second equation.

$$\begin{aligned} x+y&=180 \\ y-30+y&=180 \\ 2y&=210 \\ y&=105 \end{aligned}$$

Replace y with 105 in the first equation.

$x = y - 30 = 105 - 30 = 75$

The values are $x = 75$ and $y = 105$.

29. The break-even point is where $C(x) = R(x)$.

$$\begin{aligned} 30x+10,000&=46x \\ 10,000&=16x \\ 625&=x \end{aligned}$$

625 units must be sold to break even.

31. The break-even point is where $C(x) = R(x)$.

$$\begin{aligned} 1.2x+1500&=1.7x \\ 1500&=0.5x \\ 3000&=x \end{aligned}$$

3000 units must be sold to break even.

33. The break-even point is where $C(x) = R(x)$.

$$\begin{aligned} 75x+160,000&=200x \\ 160,000&=125x \\ 1280&=x \end{aligned}$$

1280 units must be sold to break even.

35. a. Let x be the number of desks. The revenue from each desk is \$450, so $R(x) = 450x$.

b. The cost is \$6000 plus \$200 for each desk, so $C(x) = 200x + 6000$.

c.

$$\begin{aligned} R(x)&=C(x) \\ 450x&=200x+6000 \\ 250x&=6000 \\ x&=24 \end{aligned}$$

The break-even point is 24 desks.