# STUDENT'S Solutions Manual 

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# College Algebra: Graphs and Models 

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$$
\begin{array}{lll}
x=-3-4 & \text { or } & x=-3+4 \\
x=-7 & \text { or } & x=1
\end{array}
$$

The solutions are -7 and 1 .
31. $\quad x^{2}=8 x-9$

$$
\begin{aligned}
& x^{2}-8 x=-9 \quad \text { Subtracting } 8 x \\
& x^{2}-8 x+16=-9+16 \text { Completing the square: } \\
& \frac{1}{2}(-8)=-4 \text { and }(-4)^{2}=16
\end{aligned}
$$

$$
\begin{aligned}
(x-4)^{2} & =7 & & \text { Factoring } \\
x-4 & = \pm \sqrt{7} & & \text { Using the principle } \\
x & =4 \pm \sqrt{7} & & \text { of square roots }
\end{aligned}
$$

The solutions are $4-\sqrt{7}$ and $4+\sqrt{7}$, or $4 \pm \sqrt{7}$.
33. $x^{2}+8 x+25=0$

$$
\begin{array}{rlrl}
x^{2}+8 x & =-25 & & \text { Subtracting } 25 \\
x^{2}+8 x+16 & =-25+16 & & \text { Completing the } \\
& & \text { square: } \\
(x+4)^{2} & =-9 & & \frac{1}{2} \cdot 8=4 \text { and } 4^{2}=16 \\
x+4 & = \pm 3 i & & \text { Factoring } \\
x & =-4 \pm 3 i & & \text { of square roots }
\end{array}
$$

The solutions are $-4-3 i$ and $-4+3 i$, or $-4 \pm 3 i$.
35. $3 x^{2}+5 x-2=0$

$$
\begin{aligned}
3 x^{2}+5 x & =2 \\
x^{2}+\frac{5}{3} x & =\frac{2}{3}
\end{aligned}
$$

Adding 2
Dividing by 3
$x^{2}+\frac{5}{3} x+\frac{25}{36}=\frac{2}{3}+\frac{25}{36} \quad$ Completing the
square:
$\frac{1}{2} \cdot \frac{5}{3}=\frac{5}{6}$ and $\left(\frac{5}{6}\right)^{2}=\frac{25}{36}$
$\left(x+\frac{5}{6}\right)^{2}=\frac{49}{36}$
Factoring and
simplifying
$x+\frac{5}{6}= \pm \frac{7}{6} \quad \begin{aligned} & \quad \begin{array}{l}\text { Using the principle } \\ \text { of square roots }\end{array}\end{aligned}$
$x=-\frac{5}{6} \pm \frac{7}{6}$
$x=-\frac{5}{6}-\frac{7}{6}$ or $x=-\frac{5}{6}+\frac{7}{6}$
$x=-\frac{12}{6} \quad$ or $\quad x=\frac{2}{6}$
$x=-2 \quad$ or $\quad x=\frac{1}{3}$
The solutions are -2 and $\frac{1}{3}$.
37. $x^{2}-2 x=15$
$x^{2}-2 x-15=0$
$(x-5)(x+3)=0 \quad$ Factoring
$x-5=0$ or $x+3=0$
$x=5$ or $\quad x=-3$
The solutions are 5 and -3 .
39. $\quad 5 m^{2}+3 m=2$

$$
\begin{array}{ccc}
5 m^{2}+3 m-2=0 & \\
(5 m-2)(m+1)=0 & \text { Factoring } \\
5 m-2=0 \quad \text { or } & m+1=0 \\
m=\frac{2}{5} & \text { or } & \\
5 m=-1
\end{array}
$$

The solutions are $\frac{2}{5}$ and -1 .
41. $3 x^{2}+6=10 x$

$$
3 x^{2}-10 x+6=0
$$

We use the quadratic formula. Here $a=3, b=-10$, and $c=6$.

$$
\begin{aligned}
x & =\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a} \\
& =\frac{-(-10) \pm \sqrt{(-10)^{2}-4 \cdot 3 \cdot 6}}{2 \cdot 3} \quad \text { Substituting } \\
& =\frac{10 \pm \sqrt{28}}{6}=\frac{10 \pm 2 \sqrt{7}}{6} \\
& =\frac{2(5 \pm \sqrt{7})}{2 \cdot 3}=\frac{5 \pm \sqrt{7}}{3}
\end{aligned}
$$

The solutions are $\frac{5-\sqrt{7}}{3}$ and $\frac{5+\sqrt{7}}{3}$, or $\frac{5 \pm \sqrt{7}}{3}$.
43. $x^{2}+x+2=0$

We use the quadratic formula. Here $a=1, b=1$, and $c=2$.

$$
\begin{aligned}
x & =\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a} \\
& =\frac{-1 \pm \sqrt{1^{2}-4 \cdot 1 \cdot 2}}{2 \cdot 1} \quad \text { Substituting } \\
& =\frac{-1 \pm \sqrt{-7}}{2} \\
& =\frac{-1 \pm \sqrt{7} i}{2}=-\frac{1}{2} \pm \frac{\sqrt{7}}{2} i
\end{aligned}
$$

The solutions are $-\frac{1}{2}-\frac{\sqrt{7}}{2} i$ and $-\frac{1}{2}+\frac{\sqrt{7}}{2} i$, or $-\frac{1}{2} \pm \frac{\sqrt{7}}{2} i$.
45. $5 t^{2}-8 t=3$
$5 t^{2}-8 t-3=0$
We use the quadratic formula. Here $a=5, b=-8$, and $c=-3$.

$$
\begin{aligned}
t & =\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a} \\
& =\frac{-(-8) \pm \sqrt{(-8)^{2}-4 \cdot 5(-3)}}{2 \cdot 5} \\
& =\frac{8 \pm \sqrt{124}}{10}=\frac{8 \pm 2 \sqrt{31}}{10} \\
& =\frac{2(4 \pm \sqrt{31})}{2 \cdot 5}=\frac{4 \pm \sqrt{31}}{5}
\end{aligned}
$$

The solutions are $\frac{4-\sqrt{31}}{5}$ and $\frac{4+\sqrt{31}}{5}$, or

Solve the second equation for $l$ : $l=9-w$
Substitute $9-w$ for $l$ in the first equation and solve for $w$.

$$
\begin{aligned}
(9-w) w & =20 \\
9 w-w^{2} & =20 \\
0 & =w^{2}-9 w+20 \\
0 & =(w-5)(w-4) \\
w=5 \text { or } w & =4
\end{aligned}
$$

If $w=5$, then $l=9-w$, or 4 . If $w=4$, then $l=9-4$, or 5 . Since length is usually considered to be longer than width, we have the solution $l=5$ and $w=4$, or (5,4).
Check. If $l=5$ and $w=4$, the area is $5 \cdot 4$, or 20 . The perimeter is $2 \cdot 5+2 \cdot 4$, or 18 . The numbers check.
State. The length of the brochure is 5 in . and the width is 4 in .
63. Familiarize. We make a drawing of the $\operatorname{dog}$ run. Let $l=$ the length and $w=$ the width.


Since it takes 210 yd of fencing to enclose the run, we know that the perimeter is 210 yd .

## Translate.

Perimeter: $2 l+2 w=210$, or $l+w=105$
Area: $l w=2250$
Carry out. We solve the system:
Solve the first equation for $l$ : $l=105-w$
Substitute $105-w$ for $l$ in the second equation and solve for $w$.

$$
\begin{aligned}
(105-w) w & =2250 \\
105 w-w^{2} & =2250 \\
0 & =w^{2}-105 w+2250 \\
0 & =(w-30)(w-75) \\
w=30 \text { or } w & =75
\end{aligned}
$$

If $w=30$, then $l=105-30$, or 75 . If $w=75$, then $l=105-75$, or 30 . Since length is usually considered to be longer than width, we have the solution $l=75$ and $w=30$, or $(75,30)$.
Check. If $l=75$ and $w=30$, the perimeter is $2 \cdot 75+2 \cdot 30$, or 210 . The area is $75(30)$, or 2250 . The numbers check.
State. The length is 75 yd and the width is 30 yd .
65. Familiarize. We first make a drawing. Let $l=$ the length and $w=$ the width.


## Translate.

Area: $l w=\sqrt{3}$
From the Pythagorean theorem: $l^{2}+w^{2}=2^{2}$
Carry out. We solve the system of equations.
We first solve equation (1) for $w$.

$$
\begin{aligned}
l w & =\sqrt{3} \\
w & =\frac{\sqrt{3}}{l}
\end{aligned}
$$

Then we substitute $\frac{\sqrt{3}}{l}$ for $w$ in equation 2 and solve for $l$.

$$
\begin{aligned}
& l^{2}+\left(\frac{\sqrt{3}}{l}\right)^{2}=4 \\
& l^{2}+\frac{3}{l^{2}}=4 \\
& l^{4}+3=4 l^{2} \\
& l^{4}-4 l^{2}+3=0 \\
& u^{2}-4 u+3=0 \quad \text { Letting } u=l^{2} \\
&(u-3)(u-1)=0 \\
& u=3 \text { or } u=1
\end{aligned}
$$

We now substitute $l^{2}$ for $u$ and solve for $l$.

$$
\begin{array}{rlrlrl}
l^{2} & =3 & & \text { or } & l^{2} & =1 \\
l & = \pm \sqrt{3} & \text { or } & l & = \pm 1
\end{array}
$$

Measurements cannot be negative, so we only need to consider $l=\sqrt{3}$ and $l=1$. Since $w=\sqrt{3} / l$, if $l=\sqrt{3}, w=1$ and if $l=1, w=\sqrt{3}$. Length is usually considered to be longer than width, so we have the solution $l=\sqrt{3}$ and $w=1$, or $(\sqrt{3}, 1)$.
Check. If $l=\sqrt{3}$ and $w=1$, the area is $\sqrt{3} \cdot 1=\sqrt{3}$. Also $(\sqrt{3})^{2}+1^{2}=3+1=4=2^{2}$. The numbers check.
State. The length is $\sqrt{3} \mathrm{~m}$, and the width is 1 m .
67. Familiarize. We let $x=$ the length of a side of one test plot and $y=$ the length of a side of the other plot. Make a drawing.


## Translate.

The sum of the areas is $832 \mathrm{ft}^{2}$


The difference of the areas is $320 \mathrm{ft}^{2}$.


Carry out. We solve the system of equations.

