Student Solutions Manual

Kevin Bodden
Randy Gallaher

Elementary & Intermediate Algebra

Michael Sullivan, III
Katherine R. Struve
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Preface

This Student Solutions Manual (SSM) supplements *Elementary & Intermediate Algebra* by Michael Sullivan, III, Katherine Struve, and Janet Mazzarella. We hope it will be a valuable resource as you study algebra. This manual consists of two parts. The first portion provides detailed solutions to the Quick Check exercises that are embedded within each section of the textbook. The second portion contains solutions to the odd-numbered exercises from the Exercise Sets, and to both odd- and even-numbered exercises from the Preparing for Sections, Putting the Concepts Together, Chapter Reviews, Chapter Tests, and Cumulative Reviews. For exercises requiring calculators, screenshots from TI-84 Plus graphing calculators have been used. We have made a concerted effort to make this manual easy to read and follow. For each section, problems have been worked using the same methods as the textbook examples. We have also tried to make this manual as error free as possible. If you have suggestions or corrections, please feel free to email us at the addresses below.

We offer special thanks to Ann Heath at Prentice Hall for all her prompt help, often under hectic circumstances. Your organization skills are inspiring! Thanks to Abigail Rethore for all her assistance and to Paul Murphy for allowing us to work with such talented individuals. Thanks also to Cindy Trimble and Ondine Parker for their contributions to the manual.

Most importantly, we would like to thank our wives (Angie Bodden and Karen Gallaher) and our children (Shawn, Payton and Logan Bodden, and Ethan, Ben and Annie Gallaher) for their patience and support. Thanks for putting up with us when work had to come first and for enduring the many late hours of typing.

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Chapter 1 – Quick Checks

1.2 Quick Checks

1. The first 4 positive odd numbers are 1, 3, 5, and 7. If we let O represent this set, then $O = \{1, 3, 5, 7\}$.

2. The states whose names begin with the letter A are Alabama, Alaska, Arizona, and Arkansas. If we let A represent this set, then $A = \{\text{Alabama, Alaska, Arizona, Arkansas}\}$.

3. There are no states whose names begin with the letter Z. If we let Z represent this set, then $Z = \{\ \}$ or $\varnothing$.

4. 12 is the only natural number.

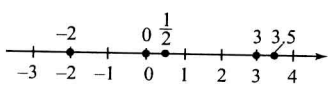
5. 0 and 12 are the whole numbers.

6. -5, 12, and 0 are the integers.

7. $\frac{11}{5}$, -5, 12, $2.\overline{76}$, 0, and $\frac{18}{4}$ are the rational numbers.

8. π is the only irrational number.

9. All the numbers listed are real numbers.

10. 

11. $2 < 9$ because 2 lies to the left of 9 on the real number line.

12. $-5 < -3$ because -5 lies to the left of -3 on the real number line.

13. $\frac{4}{5} > \frac{1}{2}$ because $\frac{4}{5} = \frac{8}{10}$ and $\frac{1}{2} = \frac{5}{10}$. Having 8 parts out of 10 is more than having 5 parts out of 10. Also, $\frac{4}{5} = 0.8$ and $\frac{1}{2} = 0.5$ and 0.8 lies to the right of 0.5 on the real number line.

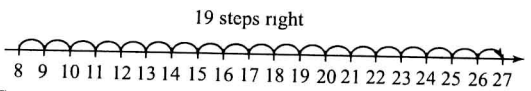
14. $\frac{4}{7} > 0.5$ because $\frac{4}{7} = 0.\overline{571428}$ and $0.\overline{571428}$ lies to the right of 0.5 on the real number line.

15. $\frac{4}{3} = \frac{20}{15}$

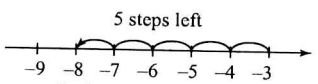
16. $|-15| = 15$ because the distance from 0 to -15 on the real number line is 15.

17. $\left|-\frac{3}{4}\right| = \frac{3}{4}$ because the distance from 0 to $-\frac{3}{4}$ on the real number line is $\frac{3}{4}$.

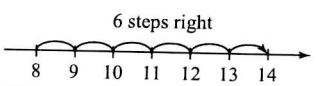
1.3 Quick Checks

1. 

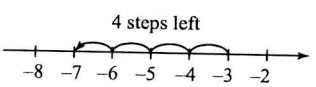
$8 + 19 = 27$

2. 

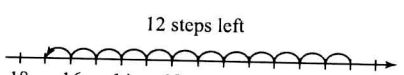
$-3 + (-5) = -8$

3. 

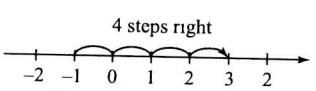
$8 + 6 = 14$

4. 

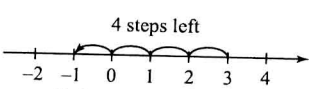
$-3 + (-4) = -7$

5. 

$-5 + (-12) = -17$

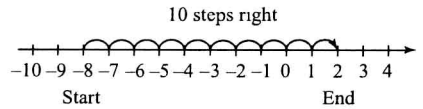
6. 

$-1 + 4 = 3$

7. 

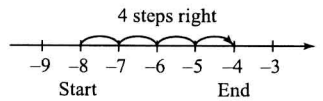
$3 + (-4) = -1$

8.



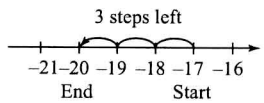
$-8 + 10 = 2$

9.



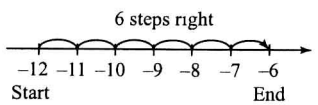
$-8 + 4 = -4$

10.



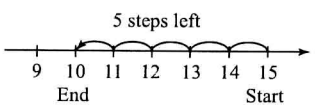
$-17 + (-3) = -20$

11.



$-12 + 6 = -6$

12.



$15 + (-5) = 10$

13. $|-11| = 11$
$|7| = 7$
The signs of −11 and 7 are different, so we subtract the absolute values: $11 - 7 = 4$.
The larger absolute value, 11, corresponds to a negative number in the original problem, so the sum is negative.
$-11 + 7 = -4$

14. $|5| = 5$
$|-8| = 8$
The signs of 5 and −8 are different, so we subtract the absolute values: $8 - 5 = 3$.
The larger absolute value, 8, corresponds to a negative number in the original problem, so the sum is negative.
$5 + (-8) = -3$

15. $|-8| = 8$
$|-16| = 16$
The signs of −8 and −16 are the same, so we add the absolute values: $8 + 16 = 24$.
Both numbers in the original problem are negative, so the sum is negative.
$-8 + (-16) = -24$

16. $|-94| = 94$
$|38| = 38$
The signs of −94 and 38 are different, so we subtract the absolute values: $94 - 38 = 56$.
The larger absolute value, 94, corresponds to a negative number in the original problem, so the sum is negative.
$-94 + 38 = -56$

17. The additive inverse of 7 is −7 because $7 + (-7) = 0$.

18. The additive inverse of $\frac{3}{7}$ is $-\frac{3}{7}$ because $\frac{3}{7} + \left(-\frac{3}{7}\right) = 0$.

19. The additive inverse of −21 is $-(-21) = 21$ because $-21 + 21 = 0$.

20. The additive inverse of $-\frac{8}{5}$ is $-\left(-\frac{8}{5}\right) = \frac{8}{5}$ because $-\frac{8}{5} + \frac{8}{5} = 0$.

21. The additive inverse of −5.75 is $-(-5.75) = 5.75$ because $-5.75 + 5.75 = 0$.

22. $59 - (-21) = 59 + 21 = 80$

23. $-32 - 146 = -32 + (-146) = -178$

24. 17 minus 35 is $17 - 35$.
$17 - 35 = 17 + (-35) = -18$

25. −382 subtracted from −2954 is $-2954 - (-382)$.
$-2954 - (-382) = -2954 + 382 = -2572$

26.
$$\begin{aligned} 8-13+5-21 &= 8+(-13)+5+(-21) \\ &= -5+5+(-21) \\ &= 0+(-21) \\ &= -21 \end{aligned}$$

27.
$$\begin{aligned} -27-49+18 &= -27+(-49)+18 \\ &= -76+18 \\ &= -58 \end{aligned}$$

28.
$$\begin{aligned} 3-(-14)-8+3 &= 3+14+(-8)+3 \\ &= 17+(-8)+3 \\ &= 9+3 \\ &= 12 \end{aligned}$$

29. $-825 + 375 - (-735) + 265$
$= -825 + 375 + 735 + 265$
$= -450 + 735 + 265$
$= 285 + 265$
$= 550$

30. $-3(7) = -21$

31. $13(-4) = -52$

32. $5 \cdot 16 = 80$

33. $-9(-12) = 108$

34. $(-13)(-25) = 325$

35. $-3 \cdot 9 \cdot (-4) = -27 \cdot (-4) = 108$

36. $(-3)\cdot(-4)\cdot(-5)\cdot(-6) = 12\cdot(-5)\cdot(-6)$
$= -60\cdot(-6)$
$= 360$

37. The reciprocal of 6 is $\frac{1}{6}$.

38. The reciprocal of -2 is $-\frac{1}{2}$.

39. $\frac{20}{-4} = \frac{5\cdot 4}{-1\cdot 4} = \frac{5\cdot \cancel{4}}{-1\cdot \cancel{4}} = \frac{5}{-1} = -5$

40. $\frac{707}{-101} = \frac{7\cdot 101}{-1\cdot 101} = \frac{7\cdot \cancel{101}}{-1\cdot \cancel{101}} = \frac{7}{-1} = -7$

41. $-63 \div (-7) = \frac{-63}{-7} = \frac{9\cdot(-7)}{1\cdot(-7)} = \frac{9\cdot \cancel{(-7)}}{1\cdot \cancel{(-7)}} = 9$

42. $\frac{-54}{4} = \frac{-27\cdot 2}{2\cdot 2} = \frac{-27\cdot \cancel{2}}{2\cdot \cancel{2}} = \frac{-27}{2} = -\frac{27}{2}$

1.4 Quick Checks

1. $\frac{-4}{14} = \frac{-2\cdot 2}{7\cdot 2} = \frac{-2\cdot \cancel{2}}{7\cdot \cancel{2}} = -\frac{2}{7}$

2. $-\frac{18}{30} = -\frac{3\cdot 6}{5\cdot 6} = -\frac{3\cdot \cancel{6}}{5\cdot \cancel{6}} = -\frac{3}{5}$

3. $\frac{24}{-4} = \frac{6\cdot 4}{-1\cdot 4} = \frac{6\cdot \cancel{4}}{-1\cdot \cancel{4}} = \frac{6}{-1} = -6$

4. $\frac{3}{4}\cdot\frac{9}{8} = \frac{3\cdot 9}{4\cdot 8} = \frac{27}{32}$

5. $\frac{-5}{7}\cdot\frac{56}{15} = \frac{-5\cdot 56}{7\cdot 15} = \frac{-1\cdot 5\cdot 7\cdot 8}{7\cdot 3\cdot 5} = \frac{-1\cdot \cancel{5}\cdot \cancel{7}\cdot 8}{\cancel{7}\cdot 3\cdot \cancel{5}} = -\frac{8}{3}$

6. $\frac{12}{45}\cdot\left(-\frac{18}{20}\right) = \frac{12}{45}\cdot\frac{-18}{20}$
$= \frac{12\cdot(-18)}{45\cdot 20}$
$= \frac{2\cdot 2\cdot 3\cdot 2\cdot 3\cdot(-3)}{3\cdot 3\cdot 5\cdot 2\cdot 2\cdot 5}$
$= \frac{\cancel{2}\cdot\cancel{2}\cdot\cancel{3}\cdot 2\cdot\cancel{3}\cdot(-3)}{\cancel{3}\cdot\cancel{3}\cdot 5\cdot\cancel{2}\cdot\cancel{2}\cdot 5}$
$= \frac{2\cdot(-3)}{5\cdot 5}$
$= -\frac{6}{25}$

7. $-\frac{25}{75}\cdot\left(-\frac{9}{4}\right) = \frac{-25}{75}\cdot\frac{-9}{4}$
$= \frac{-25\cdot(-9)}{75\cdot 4}$
$= \frac{-1\cdot 5\cdot 5\cdot(-1)\cdot 3\cdot 3}{3\cdot 5\cdot 5\cdot 2\cdot 2}$
$= \frac{\cancel{3}\cdot\cancel{5}\cdot\cancel{3}\cdot 3}{\cancel{3}\cdot\cancel{5}\cdot\cancel{3}\cdot 2\cdot 2}$
$= \frac{3}{2\cdot 2}$
$= \frac{3}{4}$

8. $\frac{7}{3}\cdot\frac{1}{14}\cdot\left(-\frac{9}{11}\right) = \frac{7}{3}\cdot\frac{1}{14}\cdot\frac{-9}{11}$
$= \frac{7\cdot 1\cdot(-9)}{3\cdot 14\cdot 11}$
$= \frac{7\cdot 3\cdot(-3)}{3\cdot 2\cdot 7\cdot 11}$
$= \frac{\cancel{7}\cdot\cancel{3}\cdot(-3)}{\cancel{3}\cdot 2\cdot\cancel{7}\cdot 11}$
$= \frac{-3}{2\cdot 11}$
$= -\frac{3}{22}$

9. The reciprocal of 12 is $\frac{1}{12}$ because $12 \cdot \frac{1}{12} = 1$.

10. The reciprocal of $\frac{7}{5}$ is $\frac{5}{7}$ because $\frac{7}{5} \cdot \frac{5}{7} = 1$.

11. The reciprocal of $-\frac{1}{4}$ is -4 because $-\frac{1}{4} \cdot (-4) = 1$.

12. The reciprocal of $-\frac{31}{20}$ is $-\frac{20}{31}$ because $-\frac{31}{20} \cdot \left(-\frac{20}{31}\right) = 1$.

13. $\frac{5}{7} \div \frac{7}{10} = \frac{5}{7} \cdot \frac{10}{7} = \frac{5 \cdot 10}{7 \cdot 7} = \frac{50}{49}$

14.
$$\begin{aligned} -\frac{9}{12} \div \frac{14}{7} &= -\frac{9}{12} \cdot \frac{7}{14} \\ &= -\frac{3 \cdot 3 \cdot 7}{2 \cdot 2 \cdot 3 \cdot 2 \cdot 7} \\ &= -\frac{\cancel{3} \cdot 3 \cdot \cancel{7}}{2 \cdot 2 \cdot \cancel{3} \cdot 2 \cdot \cancel{7}} \\ &= -\frac{3}{2 \cdot 2 \cdot 2} \\ &= -\frac{3}{8} \end{aligned}$$

15.
$$\begin{aligned} \frac{8}{35} \div \left(\frac{-1}{10}\right) &= \frac{8}{35} \cdot \left(\frac{10}{-1}\right) \\ &= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5}{5 \cdot 7 \cdot (-1)} \\ &= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot \cancel{5}}{\cancel{5} \cdot 7 \cdot (-1)} \\ &= \frac{2 \cdot 2 \cdot 2 \cdot 2}{7 \cdot (-1)} \\ &= -\frac{16}{7} \end{aligned}$$

16.
$$\begin{aligned} -\frac{18}{63} \div \left(-\frac{54}{35}\right) &= \frac{-18}{63} \cdot \left(\frac{-35}{54}\right) \\ &= \frac{-1 \cdot 2 \cdot 3 \cdot 3 \cdot (-1) \cdot 5 \cdot 7}{3 \cdot 3 \cdot 7 \cdot 2 \cdot 3 \cdot 3 \cdot 3} \\ &= \frac{\cancel{2} \cdot \cancel{3} \cdot \cancel{3} \cdot 5 \cdot \cancel{7}}{\cancel{3} \cdot \cancel{3} \cdot \cancel{7} \cdot \cancel{2} \cdot 3 \cdot 3 \cdot 3} \\ &= \frac{5}{3 \cdot 3 \cdot 3} \\ &= \frac{5}{27} \end{aligned}$$

17.
$$\begin{aligned} -\frac{9}{10} - \frac{3}{10} &= \frac{-9}{10} - \frac{3}{10} \\ &= \frac{-9-3}{10} \\ &= \frac{-12}{10} \\ &= \frac{2 \cdot (-6)}{2 \cdot 5} \\ &= \frac{\cancel{2} \cdot (-6)}{\cancel{2} \cdot 5} \\ &= -\frac{6}{5} \end{aligned}$$

18. $\frac{8}{11} + \frac{2}{11} = \frac{8+2}{11} = \frac{10}{11}$

19.
$$\begin{aligned} -\frac{18}{35} + \frac{3}{35} &= \frac{-18}{35} + \frac{3}{35} \\ &= \frac{-18+3}{35} \\ &= \frac{-15}{35} \\ &= \frac{-3 \cdot 5}{5 \cdot 7} \\ &= \frac{-3 \cdot \cancel{5}}{\cancel{5} \cdot 7} \\ &= -\frac{3}{7} \end{aligned}$$

20. $\frac{19}{63} - \frac{10}{63} = \frac{19-10}{63} = \frac{9}{63} = \frac{1 \cdot 9}{7 \cdot 9} = \frac{1 \cdot \cancel{9}}{7 \cdot \cancel{9}} = \frac{1}{7}$

21. $12 = 2 \cdot 2 \cdot 3$
$18 = 2 \cdot 3 \cdot 3$
$\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 3 = 36$
$\frac{5}{12} - \frac{5}{18} = \frac{5}{12} \cdot \frac{3}{3} - \frac{5}{18} \cdot \frac{2}{2} = \frac{15}{36} - \frac{10}{36} = \frac{15-10}{36} = \frac{5}{36}$

22. $14 = 2 \cdot 7$
$21 = 3 \cdot 7$
$\text{LCD} = 2 \cdot 3 \cdot 7 = 42$
$\frac{3}{14} + \frac{10}{21} = \frac{3}{14} \cdot \frac{3}{3} + \frac{10}{21} \cdot \frac{2}{2} = \frac{9}{42} + \frac{20}{42} = \frac{9+20}{42} = \frac{29}{42}$

23. $6 = 2 \cdot 3$
$12 = 2 \cdot 2 \cdot 3$
$\text{LCD} = 2 \cdot 2 \cdot 3 = 12$

$$-\frac{23}{6}+\frac{7}{12}=\frac{-23}{6}\cdot\frac{2}{2}+\frac{7}{12}$$
$$=\frac{-46}{12}+\frac{7}{12}$$
$$=\frac{-46+7}{12}$$
$$=\frac{-39}{12}$$
$$=\frac{-1\cdot 3\cdot 13}{2\cdot 2\cdot 3}$$
$$=\frac{-1\cdot \cancel{3}\cdot 13}{2\cdot 2\cdot \cancel{3}}$$
$$=\frac{-13}{2\cdot 2}$$
$$=-\frac{13}{4}$$

24. $5 = 5$
$11 = 11$
$\text{LCD} = 5 \cdot 11 = 55$

$$\frac{3}{5}+\left(-\frac{4}{11}\right)=\frac{3}{5}\cdot\frac{11}{11}+\frac{-4}{11}\cdot\frac{5}{5}$$
$$=\frac{33}{55}+\frac{-20}{55}$$
$$=\frac{33+(-20)}{55}$$
$$=\frac{13}{55}$$

25.
$$-2+\frac{7}{16}=\frac{-2}{1}+\frac{7}{16}$$
$$=\frac{-2}{1}\cdot\frac{16}{16}+\frac{7}{16}$$
$$=\frac{-32}{16}+\frac{7}{16}$$
$$=\frac{-32+7}{16}$$
$$=\frac{-25}{16}$$
$$=-\frac{25}{16}$$

26.
$$6+\left(\frac{-9}{4}\right)=\frac{6}{1}+\left(\frac{-9}{4}\right)$$
$$=\frac{6}{1}\cdot\frac{4}{4}+\left(\frac{-9}{4}\right)$$
$$=\frac{24}{4}+\left(\frac{-9}{4}\right)$$
$$=\frac{24+(-9)}{4}$$
$$=\frac{15}{4}$$

27.
$$\begin{array}{r} 9.670 \\ +\ 11.344 \\ \hline 21.014 \end{array}$$
So $9.67 + 11.344 = 21.014$.

28.
$$\begin{array}{r} 81.96 \\ -\ 17.39 \\ \hline 64.57 \end{array}$$
So $81.96 - 17.39 = 64.57$.

29.
$$\begin{array}{r} 14.950 \\ 7.118 \\ +\ 0.300 \\ \hline 22.368 \end{array}$$
So $14.95 + 7.118 + 0.3 = 22.368$.

30.
$$\begin{array}{r} 345.6700 \\ -\ 8.0912 \\ \hline 337.5788 \end{array}$$
So $345.67 - 8.0912 = 337.5788$.

31.
$$\begin{array}{r} 180.782 \\ -\ 100.300 \\ \hline 80.482 \end{array}$$
$-180.782 + 100.3 + 9.07 = -80.482 + 9.07$
$$\begin{array}{r} 80.482 \\ -\ 9.070 \\ \hline 71.412 \end{array}$$
So $-180.782 + 100.3 + 9.07 = -71.412$.

32.
$$\begin{array}{r} 74.280 \\ +\ 14.832 \\ \hline 89.112 \end{array}$$
So $-74.28 - 14.832 = -74.28 + (-14.832)$
$= -89.112$.

33.
$$\begin{array}{r} 23.9 \\ \times\ 0.2 \\ \hline 4.78 \end{array}$$
one digit to the right of the decimal point
one digit to the right of the decimal point
two digits to the right of the decimal point

34.
$$\begin{array}{rl} 9.1 & \text{one digit to the right of the decimal point} \\ \times\, 7.24 & \text{two digits to the right of the decimal point} \\ \hline 364 & \\ 182 & \\ 637 & \\ \hline 65.884 & \text{three digits to the right of the decimal point} \end{array}$$

35.
$$\begin{array}{rl} -3.45 & \text{two digits to the right of the decimal point} \\ \times\ 0.03 & \text{two digits to the right of the decimal point} \\ \hline -0.1035 & \text{four digits to the right of the decimal point} \end{array}$$

36.
$$\begin{array}{rl} 257 & \text{no digits to the right of the decimal point} \\ \times -3.5 & \text{one digit to the right of the decimal point} \\ \hline 1285 & \\ 771 & \\ \hline -899.5 & \text{one digit to the right of the decimal point} \end{array}$$

37.
$$\begin{array}{rl} -0.03 & \text{two digits to the right of the decimal point} \\ \times\ -0.45 & \text{two digits to the right of the decimal point} \\ \hline 0.0135 & \text{four digits to the right of the decimal point} \end{array}$$

38.
$$\begin{array}{rl} 9.9 & \text{one digit to the right of the decimal point} \\ \times\ 0.002 & \text{three digits to the right of the decimal point} \\ \hline 0.0198 & \text{four digits to the right of the decimal point} \end{array}$$

39.
$$\begin{array}{r} 0.25 \\ 73\overline{)18.25} \\ 146 \\ \hline 3\,65 \\ 3\,65 \\ \hline 0 \end{array}$$

So, $\dfrac{18.25}{73} = 0.25$.

40. $\dfrac{1.0032}{0.12} = \dfrac{1.0032}{0.12} \cdot \dfrac{100}{100} = \dfrac{100.32}{12}$

$$\begin{array}{r} 8.36 \\ 12\overline{)100.32} \\ 96 \\ \hline 4\,3 \\ 3\,6 \\ \hline 72 \\ 72 \\ \hline 0 \end{array}$$

So $\dfrac{1.0032}{0.12} = 8.36$.

41. $\dfrac{-4.2958}{45.7} = \dfrac{-4.2958}{45.7} \cdot \dfrac{10}{10} = \dfrac{-42.958}{457}$

$$\begin{array}{r} 0.094 \\ 457\overline{)42.958} \\ 41\,13 \\ \hline 1\,828 \\ 1\,828 \\ \hline 0 \end{array}$$

So $\dfrac{-4.2958}{45.7} = -0.094$.

42. $\dfrac{0.1515}{-5.05} = \dfrac{0.1515}{-5.05} \cdot \dfrac{100}{100} = \dfrac{15.15}{-505}$

$$\begin{array}{r} 0.03 \\ 505\overline{)15.15} \\ 15\,15 \\ \hline 0 \end{array}$$

So $\dfrac{0.1515}{-5.05} = -0.03$.

1.5 Quick Checks

1. $96 \text{ inches} = 96 \text{ inches} \cdot \dfrac{1 \text{ foot}}{12 \text{ inches}}$

$$= \frac{96}{12} \text{ feet}$$
$$= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3}{2 \cdot 2 \cdot 3} \text{ feet}$$
$$= \frac{\cancel{2} \cdot \cancel{2} \cdot 2 \cdot 2 \cdot 2 \cdot \cancel{3}}{\cancel{2} \cdot \cancel{2} \cdot \cancel{3}} \text{ feet}$$
$$= 8 \text{ feet}$$

2. $500 \text{ minutes} = 500 \text{ minutes} \cdot \dfrac{1 \text{ hour}}{60 \text{ minutes}}$

$$= \frac{500}{60} \text{ hours}$$
$$= \frac{2 \cdot 2 \cdot 5 \cdot 5 \cdot 5}{2 \cdot 2 \cdot 3 \cdot 5} \text{ hours}$$
$$= \frac{\cancel{2} \cdot \cancel{2} \cdot \cancel{3} \cdot 5 \cdot 5}{\cancel{2} \cdot \cancel{2} \cdot 3 \cdot \cancel{5}} \text{ hours}$$
$$= \frac{25}{3} \text{ hours}$$
$$= 8 \text{ hours, } 20 \text{ minutes}$$