Basic College Mathematics An Applied Approach (Canadian) 1st edition Aufmann Solutions Manual

SKU: 9780176562083-SOLUTIONS

Chapter 2: Fractions

Prep Test

1. 20

2. 120

3. 9

4. 10

5. 7

6.
$$\begin{array}{r} 2 \text{ r3} \\ 30\overline{)63} \\ \underline{-60} \\ 3 \end{array}$$

7. 1, 2, 3, 4, 6, 12

8. $8 \cdot 7 + 3 = 56 + 3 = 59$

9. 7

10. <

Section 2.1

Concept Check

1. 5, 10, 15, 20

2. 7, 14, 21, 28

3. 10, 20, 30, 40

4. 15, 30, 45, 60

5. Multiples of 6: 6, 12, 18, 24, 30, 36, 42, 48, 54, 60

Multiples of 8: 8, 16, 24, 32, 40, 48, 56, 64, 72, 80

Common multiples: 24, 48

Least common multiple: 24

6. 1, 2, 3, 4, 6, 12

7. 1, 2, 4, 5, 10, 20

8. 1, 23

9. 1, 2, 4, 7, 14, 28

10. Factors of 18: 1, 2, 3, 6, 9, 18

Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24

Common factors: 1, 2, 3, 6

Greatest common factor: 6

Objective A Exercises

11.

	2	5
5 =		(5)
8 =	(2 · 2 · 2)	

LCM $= 2 \cdot 2 \cdot 2 \cdot 5 = 40$

12.

	2	3
3 =		3
6 =	(2)	(3)

LCM $= 2 \cdot 3 = 6$

13.

	2	3
3 =		(3)
8 =	(2 · 2 · 2)	

LCM $= 2 \cdot 2 \cdot 2 \cdot 3 = 24$

14.

	2	5
2 =	(2)	
5 =		(5)

LCM $= 2 \cdot 5 = 10$

15.

	2	3
4 =	(2 · 2)	
6 =	2	(3)

LCM $= 2 \cdot 2 \cdot 3 = 12$

16.

	2	3
6 =	2	(3)
8 =	(2 · 2 · 2)	

LCM $= 2 \cdot 2 \cdot 2 \cdot 3 = 24$

17.

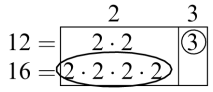
	2	3
8 =	(2 · 2 · 2)	
12 =	2 · 2	(3)

LCM $= 2 \cdot 2 \cdot 2 \cdot 3 = 24$

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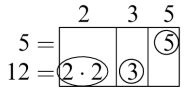
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18.



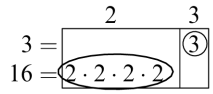
LCM $= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$

19.



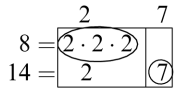
LCM $= 2 \cdot 2 \cdot 3 \cdot 5 = 60$

20.



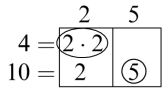
LCM $= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$

21.



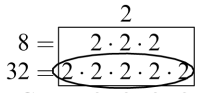
LCM $= 2 \cdot 2 \cdot 2 \cdot 7 = 56$

22.



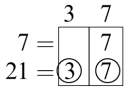
LCM $= 2 \cdot 2 \cdot 5 = 20$

23.



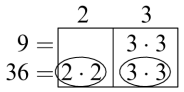
LCM $= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

24.



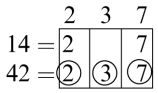
LCM $= 3 \cdot 7 = 21$

25.



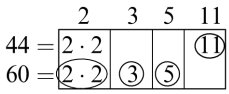
LCM $= 2 \cdot 2 \cdot 3 \cdot 3 = 36$

26.



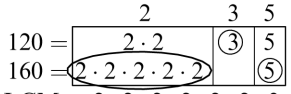
LCM $= 2 \cdot 3 \cdot 7 = 42$

27.



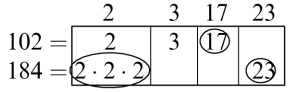
LCM $= 2 \cdot 3 \cdot 5 \cdot 11 = 660$

28.



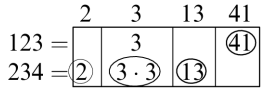
LCM $= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 = 480$

29.



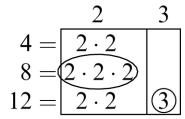
LCM $= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 17 \cdot 23 = 9384$

30.



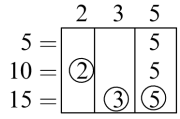
LCM $= 2 \cdot 3 \cdot 3 \cdot 13 \cdot 41 = 9594$

31.



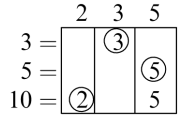
LCM $= 2 \cdot 2 \cdot 2 \cdot 3 = 24$

32.



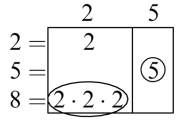
LCM $= 2 \cdot 3 \cdot 5 = 30$

33.



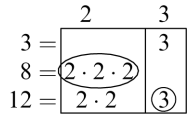
LCM $= 2 \cdot 3 \cdot 5 = 30$

34.



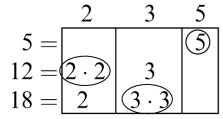
LCM $= 2 \cdot 2 \cdot 2 \cdot 5 = 40$

35.



LCM $= 2 \cdot 2 \cdot 2 \cdot 3 = 24$

36.

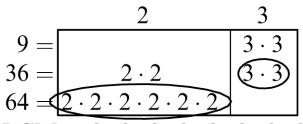


LCM $= 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$

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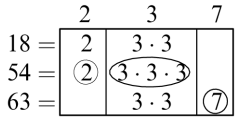
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37.



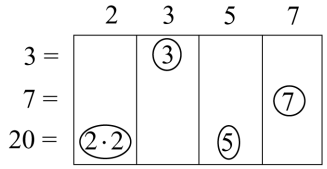
LCM $= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 = 576$

38.



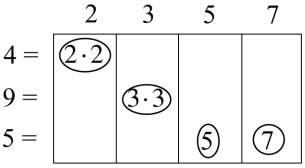
LCM $= 2 \cdot 3 \cdot 3 \cdot 3 \cdot 7 = 378$

39.



LCM $= 2 \cdot 2 \cdot 3 \cdot 5 \cdot 7 = 420$

40.



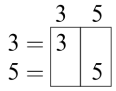
LCM $= 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \cdot 7 = 1260$

41. True

42. False

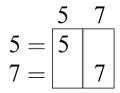
Objective B Exercises

43.



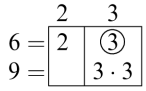
GCF $= 1$

44.



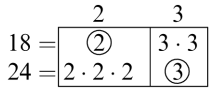
GCF $= 1$

45.



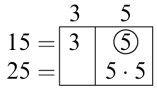
GCF $= 3$

46.



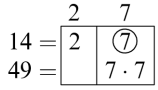
GCF $= 2 \cdot 3 = 6$

47.



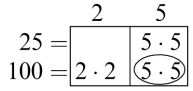
GCF $= 5$

48.



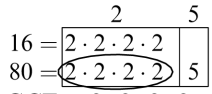
GCF $= 7$

49.



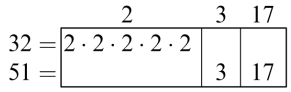
GCF $= 5 \cdot 5 = 25$

50.



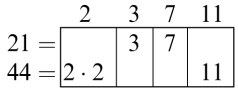
GCF $= 2 \cdot 2 \cdot 2 \cdot 2 = 16$

51.



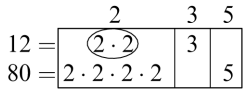
GCF $= 1$

52.



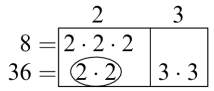
GCF $= 1$

53.



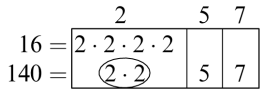
GCF $= 2 \cdot 2 = 4$

54.



GCF $= 2 \cdot 2 = 4$

55.



GCF $= 2 \cdot 2 = 4$

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56.

	2	3
$48 =$	$2 \cdot 2 \cdot 2 \cdot 2$	(3)
$144 =$	$2 \cdot 2 \cdot 2 \cdot 2$	$3 \cdot 3$

$\text{GCF} = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$

57.

	2	3	11
$44 =$	$2 \cdot 2$		11
$96 =$	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	3	

$\text{GCF} = 2 \cdot 2 = 4$

58.

	2	3
$18 =$	(2)	$3 \cdot 3$
$32 =$	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	

$\text{GCF} = 2$

59.

	3	5	11
$3 =$	3		
$5 =$		5	
$11 =$			11

$\text{GCF} = 1$

60.

	2	3	5
$6 =$	2	3	
$8 =$	$2 \cdot 2 \cdot 2$		
$10 =$	(2)		5

$\text{GCF} = 2$

61.

	2	7
$7 =$		7
$14 =$	2	(7)
$49 =$		$7 \cdot 7$

$\text{GCF} = 7$

62.

	2	3	5
$6 =$	2	3	
$15 =$		(3)	5
$36 =$	$2 \cdot 2$	$3 \cdot 3$	

$\text{GCF} = 3$

63.

	2	3	5
$10 =$	2		5
$15 =$		3	5
$20 =$	$2 \cdot 2$		(5)

$\text{GCF} = 5$

64.

	2	3	5
$12 =$	$2 \cdot 2$	3	
$18 =$	(2)	$3 \cdot 3$	
$20 =$	$2 \cdot 2$		5

$\text{GCF} = 2$

65.

	2	3	5
$24 =$	$2 \cdot 2 \cdot 2$	3	
$40 =$	$2 \cdot 2 \cdot 2$		5
$72 =$	$2 \cdot 2 \cdot 2$	$3 \cdot 3$	

$\text{GCF} = 2 \cdot 2 \cdot 2 = 8$

66.

	3	17
$3 =$	3	
$17 =$		17
$51 =$	3	17

$\text{GCF} = 1$

67.

	3	17	31
$17 =$		17	
$31 =$			31
$81 =$	$3 \cdot 3 \cdot 3 \cdot 3$		

$\text{GCF} = 1$

68.

	2	3	7
$14 =$	2		7
$42 =$	(2)	3	7
$84 =$	$2 \cdot 2$	3	(7)

$\text{GCF} = 2 \cdot 7 = 14$

69.

	5
$25 =$	$5 \cdot 5$
$125 =$	$5 \cdot 5 \cdot 5$
$625 =$	$5 \cdot 5 \cdot 5 \cdot 5$

$\text{GCF} = 25$

70.

	2	3	17	23
$12 =$	$2 \cdot 2$	3		
$68 =$	$2 \cdot 2$		17	
$92 =$	$2 \cdot 2$			23

$\text{GCF} = 2 \cdot 2 = 4$

71.

	2	3	7
$32 =$	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$		
$56 =$	$2 \cdot 2 \cdot 2$		7
$72 =$	$2 \cdot 2 \cdot 2$	$3 \cdot 3$	

$\text{GCF} = 2 \cdot 2 \cdot 2 = 8$

72.

	2	3
$24 =$	$2 \cdot 2 \cdot 2$	3
$36 =$	$2 \cdot 2$	$3 \cdot 3$
$48 =$	$2 \cdot 2 \cdot 2 \cdot 2$	(3)

$\text{GCF} = 2 \cdot 2 \cdot 3 = 12$

73. True

74. True

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Critical Thinking

75. Joe has a 4-day cycle (3 workdays + 1 day off). Raya has a 6-day cycle (5 workdays + 1 day off). The least common multiple of 4 and 6 is 12. After Joe and Raya have a day off together, they will have another day off together in 12 days.

76. The LCM of 2 and 3 is 6. The LCM of 5 and 7 is 35. The LCM of 11 and 19 is 209. The LCM of two prime numbers is the product of the two numbers. The LCM of three prime numbers is the product of the three numbers.

77. The GCF of 3 and 5 is 1. The GCF of 7 and 11 is 1. The GCF of 29 and 43 is 1. Because two prime numbers do not have a common factor other than 1, the GCF of two prime numbers is 1. Because three prime numbers do not have a common factor other than 1, the GCF of three prime numbers is 1.

Projects or Group Activities

78. 4, the GCF of 20, 36, and 60

79a. No; the GCF of 48 and 50 is 4. 48 and 50 are not coprime.

b. Yes; $25 = 5 \cdot 5$ and $36 = 2 \cdot 2 \cdot 3 \cdot 3$, so their GCF is 1.

c. Yes; $22 = 2 \cdot 11$ and $27 = 3 \cdot 3 \cdot 3$, so their GCF is 1.

d. Yes; 71 and 73 are both prime numbers, so their GCF is 1.

Section 2.2

Concept Check

1. Improper fraction; greater than 1

2. Mixed number; greater than 1

3. Proper fraction; less than 1

4. Improper fraction; equal to 1

Objective A Exercises

5. $\frac{3}{4}$

6. $\frac{4}{7}$

7. $\frac{7}{8}$

8. $\frac{3}{5}$

9. $1\frac{1}{2}$

10. $2\frac{2}{3}$

11. $2\frac{5}{8}$

12. $2\frac{3}{4}$

13. $3\frac{3}{5}$

14. $3\frac{5}{6}$

15. $\frac{5}{4}$

16. $\frac{7}{6}$

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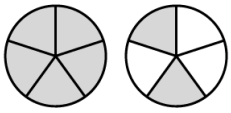
17. $\frac{8}{3}$

18. $\frac{9}{4}$

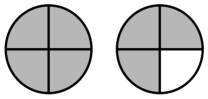
19. $\frac{27}{8}$

20. $\frac{18}{5}$

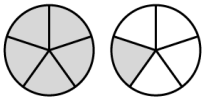
21.



22.



23.



24.



25. False

Objective B Exercises

26. $4\overline{)11}$ $\quad -8$ $\quad 3$ $\qquad \frac{11}{4} = 2\frac{3}{4}$

27. $3\overline{)16}$ $\quad -15$ $\quad 1$ $\qquad \frac{16}{3} = 5\frac{1}{3}$

28. $4\overline{)20}$ $\quad -20$ $\quad 0$ $\qquad \frac{20}{4} = 5$

29. $9\overline{)18}$ $\quad -18$ $\quad 0$ $\qquad \frac{18}{9} = 2$

30. $8\overline{)9}$ $\quad -8$ $\quad 1$ $\qquad \frac{9}{8} = 1\frac{1}{8}$

31. $4\overline{)13}$ $\quad -12$ $\quad 1$ $\qquad \frac{13}{4} = 3\frac{1}{4}$

32. $10\overline{)23}$ $\quad -20$ $\quad 3$ $\qquad \frac{23}{10} = 2\frac{3}{10}$

33. $2\overline{)29}$ $\quad -2$ $\quad 09$ $\quad -8$ $\quad 1$ $\qquad \frac{29}{2} = 14\frac{1}{2}$

34. $16\overline{)48}$ $\quad -48$ $\quad 0$ $\qquad \frac{48}{16} = 3$

35. $3\overline{)51}$ $\quad -3$ $\quad 21$ $\quad -21$ $\quad 0$ $\qquad \frac{51}{3} = 17$

36. $7\overline{)8}$ $\quad -7$ $\quad 1$ $\qquad \frac{8}{7} = 1\frac{1}{7}$

37. $9\overline{)16}$ $\quad -9$ $\quad 7$ $\qquad \frac{16}{9} = 1\frac{7}{9}$

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38. $3\overline{)7}$ $\frac{2}{}$, -6, 1 $\quad \frac{7}{3} = 2\frac{1}{3}$

39. $5\overline{)9}$ $\frac{1}{}$, -5, 4 $\quad \frac{9}{5} = 1\frac{4}{5}$

40. $1\overline{)16}$ $\frac{16}{}$, -1, 06, -6, 0 $\quad \frac{16}{1} = 16$

41. $1\overline{)23}$ $\frac{23}{}$, -2, 03, -3, 0 $\quad \frac{23}{1} = 23$

42. $8\overline{)17}$ $\frac{2}{}$, -16, 1 $\quad \frac{17}{8} = 2\frac{1}{8}$

43. $16\overline{)31}$ $\frac{1}{}$, -16, 15 $\quad \frac{31}{16} = 1\frac{15}{16}$

44. $5\overline{)12}$ $\frac{2}{}$, -10, 2 $\quad \frac{12}{5} = 2\frac{2}{5}$

45. $3\overline{)19}$ $\frac{6}{}$, -18, 1 $\quad \frac{19}{3} = 6\frac{1}{3}$

46. $9\overline{)9}$ $\frac{1}{}$, -9, 0 $\quad \frac{9}{9} = 1$

47. $8\overline{)40}$ $\frac{5}{}$, -40, 0 $\quad \frac{40}{8} = 5$

48. $8\overline{)72}$ $\frac{9}{}$, -72, 0 $\quad \frac{72}{8} = 9$

49. $3\overline{)3}$ $\frac{1}{}$, -3, 0 $\quad \frac{3}{3} = 1$

50. $2\frac{1}{3} = \frac{6+1}{3} = \frac{7}{3}$

51. $4\frac{2}{3} = \frac{12+2}{3} = \frac{14}{3}$

52. $6\frac{1}{2} = \frac{12+1}{2} = \frac{13}{2}$

53. $8\frac{2}{3} = \frac{24+2}{3} = \frac{26}{3}$

54. $6\frac{5}{6} = \frac{36+5}{6} = \frac{41}{6}$

55. $7\frac{3}{8} = \frac{56+3}{8} = \frac{59}{8}$

56. $9\frac{1}{4} = \frac{36+1}{4} = \frac{37}{4}$

57. $6\frac{1}{4} = \frac{24+1}{4} = \frac{25}{4}$

58. $10\frac{1}{2} = \frac{20+1}{2} = \frac{21}{2}$

59. $15\frac{1}{8} = \frac{120+1}{8} = \frac{121}{8}$

60. $8\frac{1}{9} = \frac{72+1}{9} = \frac{73}{9}$

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61. $3\frac{5}{12} = \frac{36+5}{12} = \frac{41}{12}$

62. $5\frac{3}{11} = \frac{55+3}{11} = \frac{58}{11}$

63. $3\frac{7}{9} = \frac{27+7}{9} = \frac{34}{9}$

64. $2\frac{5}{8} = \frac{16+5}{8} = \frac{21}{8}$

65. $12\frac{2}{3} = \frac{36+2}{3} = \frac{38}{3}$

66. $1\frac{5}{8} = \frac{8+5}{8} = \frac{13}{8}$

67. $5\frac{3}{7} = \frac{35+3}{7} = \frac{38}{7}$

68. $11\frac{1}{9} = \frac{99+1}{9} = \frac{100}{9}$

69. $12\frac{3}{5} = \frac{60+3}{5} = \frac{63}{5}$

70. $3\frac{3}{8} = \frac{24+3}{8} = \frac{27}{8}$

71. $4\frac{5}{9} = \frac{36+5}{9} = \frac{41}{9}$

72. $6\frac{7}{13} = \frac{78+7}{13} = \frac{85}{13}$

73. $8\frac{5}{14} = \frac{112+5}{14} = \frac{117}{14}$

74. True

Critical Thinking

75. Students might mention any of the following: fractional parts of an hour, as in three-quarters of an hour; lengths of nails, as in $\frac{3}{4}$-inch nail; lengths of fabric, as in $1\frac{5}{8}$ yards of material; lengths of lumber, as in $2\frac{1}{2}$ feet of pine; ingredients in a recipe, as in $1\frac{1}{2}$ cups sugar; or innings pitched, as in four and two-thirds innings.

Projects or Group Activities

76. To write improper fractions that represent the numbers 1, 2, 3, and 4, write the first four multiples of 5 in the numerators:

$$\frac{5}{5}, \frac{10}{5}, \frac{15}{5}, \frac{20}{5}$$

77. Answers will vary. For example, $\frac{17}{8}$.

Section 2.3

Concept Check

1. No. 5 does not divide into 7 evenly.

2. 1

Objective A Exercises

3. $10 \div 2 = 5; \frac{1 \cdot 5}{2 \cdot 5} = \frac{5}{10}$

4. $16 \div 4 = 4; \frac{1 \cdot 4}{4 \cdot 4} = \frac{4}{16}$

5. $48 \div 16 = 3; \frac{3 \cdot 3}{16 \cdot 3} = \frac{9}{48}$

6. $81 \div 9 = 9; \frac{5 \cdot 9}{9 \cdot 9} = \frac{45}{81}$

7. $32 \div 8 = 4; \frac{3 \cdot 4}{8 \cdot 4} = \frac{12}{32}$

8. $33 \div 11 = 3; \frac{7 \cdot 3}{11 \cdot 3} = \frac{21}{33}$

9. $51 \div 17 = 3; \frac{3 \cdot 3}{17 \cdot 3} = \frac{9}{51}$

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10. $90 \div 10 = 9;\ \dfrac{7 \cdot 9}{10 \cdot 9} = \dfrac{63}{90}$

11. $16 \div 4 = 4;\ \dfrac{3 \cdot 4}{4 \cdot 4} = \dfrac{12}{16}$

12. $32 \div 8 = 4;\ \dfrac{5 \cdot 4}{8 \cdot 4} = \dfrac{20}{32}$

13. $9 \div 1 = 9;\ \dfrac{3 \cdot 9}{1 \cdot 9} = \dfrac{27}{9}$

14. $25 \div 1 = 25;\ \dfrac{5 \cdot 25}{1 \cdot 25} = \dfrac{125}{25}$

15. $60 \div 3 = 20;\ \dfrac{1 \cdot 20}{3 \cdot 20} = \dfrac{20}{60}$

16. $48 \div 16 = 3;\ \dfrac{1 \cdot 3}{16 \cdot 3} = \dfrac{3}{48}$

17. $60 \div 15 = 4;\ \dfrac{11 \cdot 4}{15 \cdot 4} = \dfrac{44}{60}$

18. $300 \div 50 = 6;\ \dfrac{3 \cdot 6}{50 \cdot 6} = \dfrac{18}{300}$

19. $18 \div 3 = 6;\ \dfrac{2 \cdot 6}{3 \cdot 6} = \dfrac{12}{18}$

20. $36 \div 9 = 4;\ \dfrac{5 \cdot 4}{9 \cdot 4} = \dfrac{20}{36}$

21. $49 \div 7 = 7;\ \dfrac{5 \cdot 7}{7 \cdot 7} = \dfrac{35}{49}$

22. $32 \div 8 = 4;\ \dfrac{7 \cdot 4}{8 \cdot 4} = \dfrac{28}{32}$

23. $18 \div 9 = 2;\ \dfrac{5 \cdot 2}{9 \cdot 2} = \dfrac{10}{18}$

24. $36 \div 12 = 3;\ \dfrac{11 \cdot 3}{12 \cdot 3} = \dfrac{33}{36}$

25. $3 \div 1 = 3;\ \dfrac{7 \cdot 3}{1 \cdot 3} = \dfrac{21}{3}$

26. $4 \div 1 = 4;\ \dfrac{9 \cdot 4}{1 \cdot 4} = \dfrac{36}{4}$

27. $45 \div 9 = 5;\ \dfrac{7 \cdot 5}{9 \cdot 5} = \dfrac{35}{45}$

28. $42 \div 6 = 7;\ \dfrac{5 \cdot 7}{6 \cdot 7} = \dfrac{35}{42}$

29. $64 \div 16 = 4;\ \dfrac{15 \cdot 4}{16 \cdot 4} = \dfrac{60}{64}$

30. $54 \div 18 = 3;\ \dfrac{11 \cdot 3}{18 \cdot 3} = \dfrac{33}{54}$

31. $98 \div 14 = 7;\ \dfrac{3 \cdot 7}{14 \cdot 7} = \dfrac{21}{98}$

32. $144 \div 6 = 24;\ \dfrac{5 \cdot 24}{6 \cdot 24} = \dfrac{120}{144}$

33. $48 \div 8 = 6;\ \dfrac{5 \cdot 6}{8 \cdot 6} = \dfrac{30}{48}$

34. $96 \div 12 = 8;\ \dfrac{7 \cdot 8}{12 \cdot 8} = \dfrac{56}{96}$

35. $42 \div 14 = 3;\ \dfrac{5 \cdot 3}{14 \cdot 3} = \dfrac{15}{42}$

36. $42 \div 3 = 14;\ \dfrac{2 \cdot 14}{3 \cdot 14} = \dfrac{28}{42}$

37. $144 \div 24 = 6;\ \dfrac{17 \cdot 6}{24 \cdot 6} = \dfrac{102}{144}$

38. 1

Objective B Exercises

39. $\dfrac{4}{12} = \dfrac{\overset{1}{2} \cdot \overset{1}{2}}{\underset{1}{2} \cdot \underset{1}{2} \cdot 3} = \dfrac{1}{3}$

40. $\dfrac{8}{22} = \dfrac{\overset{1}{2} \cdot 2 \cdot 2}{\underset{1}{2} \cdot 11} = \dfrac{4}{11}$

41. $\dfrac{22}{44} = \dfrac{\overset{1}{2} \cdot \overset{1}{11}}{\underset{1}{2} \cdot 2 \cdot \underset{1}{11}} = \dfrac{1}{2}$

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42. $\frac{2}{14} = \frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 7} = \frac{1}{7}$

43. $\frac{2}{12} = \frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 3} = \frac{1}{6}$

44. $\frac{50}{75} = \frac{2 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}}}{3 \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}}} = \frac{2}{3}$

45. $\frac{40}{36} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 5}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 3} = \frac{10}{9} = 1\frac{1}{9}$

46. $\frac{12}{8} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2} = \frac{3}{2} = 1\frac{1}{2}$

47. $\frac{0}{30} = 0$

48. $\frac{10}{10} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{5}}} = \frac{1}{1} = 1$

49. $\frac{9}{22} = \frac{3 \cdot 3}{2 \cdot 11} = \frac{9}{22}$

50. $\frac{14}{35} = \frac{2 \cdot \overset{1}{\cancel{7}}}{5 \cdot \underset{1}{\cancel{7}}} = \frac{2}{5}$

51. $\frac{75}{25} = \frac{3 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}}} = 3$

52. $\frac{8}{60} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 5} = \frac{2}{15}$

53. $\frac{16}{84} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 7} = \frac{4}{21}$

54. $\frac{20}{44} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 5}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 11} = \frac{5}{11}$

55. $\frac{12}{35} = \frac{2 \cdot 2 \cdot 3}{5 \cdot 7} = \frac{12}{35}$

56. $\frac{8}{36} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 3} = \frac{2}{9}$

57. $\frac{28}{44} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 7}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 11} = \frac{7}{11}$

58. $\frac{12}{16} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2} = \frac{3}{4}$

59. $\frac{16}{12} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3} = \frac{4}{3} = 1\frac{1}{3}$

60. $\frac{24}{18} = \frac{\overset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{3}} \cdot 3} = \frac{4}{3} = 1\frac{1}{3}$

61. $\frac{24}{40} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 5} = \frac{3}{5}$

62. $\frac{44}{60} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 11}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 5} = \frac{11}{15}$

63. $\frac{8}{88} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 11} = \frac{1}{11}$

64. $\frac{9}{90} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{2 \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 5} = \frac{1}{10}$

65. $\frac{144}{36} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}}} = 4$

66. $\frac{140}{297} = \frac{2 \cdot 2 \cdot 5 \cdot 7}{3 \cdot 3 \cdot 3 \cdot 11} = \frac{140}{297}$

67. $\frac{48}{144} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{3}} \cdot 3} = \frac{1}{3}$

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68. $\frac{32}{120} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 5} = \frac{4}{15}$

69. $\frac{60}{100} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 5 \cdot \underset{1}{\cancel{5}}} = \frac{3}{5}$

70. $\frac{33}{110} = \frac{3 \cdot \overset{1}{\cancel{11}}}{2 \cdot 5 \cdot \underset{11}{\cancel{11}}} = \frac{3}{10}$

71. $\frac{36}{16} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3 \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2} = \frac{9}{4} = 2\frac{1}{4}$

72. $\frac{80}{45} = \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{5}}}{3 \cdot 3 \cdot \underset{1}{\cancel{5}}} = \frac{16}{9} = 1\frac{7}{9}$

73. $\frac{32}{160} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 5} = \frac{1}{5}$

74. 1

Critical Thinking

75. Answers will vary. For example, $\frac{4}{6}, \frac{6}{9}, \frac{8}{12}, \frac{10}{15}$, and $\frac{12}{18}$ are fractions that are equal to $\frac{2}{3}$.

76. $\frac{15}{24} = \frac{5}{8}$

$\overbrace{}^{\frac{15}{24}}$

1	2	3	4	5			
6	7	8	9	10			
11	12	13	14	15			

$\underbrace{}_{\frac{5}{8}}$

Projects or Group Activities

77a. Five provinces and territories begin with the letter N: Northwest Territories, Nunavut, Newfoundland and Labrador, Nova Scotia, New Brunswick. The fraction of provinces and territories that begin with the letter N is $\frac{5}{13}$.

b. Five provinces and territories end with a vowel: British Columbia, Alberta, Manitoba, Ontario, Nova Scotia. The fraction of provinces and territories that end with a vowel is $\frac{5}{13}$.

Section 2.4

Concept Check

1. $\frac{2}{9} + \frac{5}{9} = \frac{2+5}{9} = \frac{7}{9}$

2. $\frac{1}{8} + \frac{3}{8} = \frac{1+3}{8} + \frac{4}{8} = \frac{1}{2}$

3. 8

4. 12

5. 18

6. 70

Objective A Exercises

7.
$$\begin{array}{r} \frac{2}{7} \\ +\frac{1}{7} \\ \hline \frac{3}{7} \end{array}$$

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8.
$$\begin{array}{r} \frac{3}{11} \\ +\frac{5}{11} \\ \hline \frac{8}{11} \end{array}$$

9.
$$\begin{array}{r} \frac{2}{9} \\ +\frac{4}{9} \\ \hline \frac{6}{9}=\frac{2}{3} \end{array}$$

10.
$$\begin{array}{r} \frac{5}{8} \\ +\frac{1}{8} \\ \hline \frac{6}{8}=\frac{3}{4} \end{array}$$

11.
$$\begin{array}{r} \frac{3}{14} \\ +\frac{5}{14} \\ \hline \frac{8}{14}=\frac{4}{7} \end{array}$$

12.
$$\begin{array}{r} \frac{3}{20} \\ +\frac{9}{20} \\ \hline \frac{12}{20}=\frac{3}{5} \end{array}$$

13.
$$\begin{array}{r} \frac{1}{2} \\ +\frac{1}{2} \\ \hline \frac{2}{2}=1 \end{array}$$

14.
$$\begin{array}{r} \frac{1}{3} \\ +\frac{2}{3} \\ \hline \frac{3}{3}=1 \end{array}$$

15.
$$\begin{array}{r} \frac{8}{11} \\ +\frac{7}{11} \\ \hline \frac{15}{11}=1\frac{4}{11} \end{array}$$

16.
$$\begin{array}{r} \frac{9}{13} \\ +\frac{7}{13} \\ \hline \frac{16}{13}=1\frac{3}{13} \end{array}$$

17.
$$\begin{array}{r} \frac{8}{5} \\ +\frac{9}{5} \\ \hline \frac{17}{5}=3\frac{2}{5} \end{array}$$

18.
$$\begin{array}{r} \frac{5}{3} \\ +\frac{7}{3} \\ \hline \frac{12}{3}=4 \end{array}$$

19.
$$\begin{array}{r} \frac{3}{8} \\ \frac{7}{8} \\ +\frac{1}{8} \\ \hline \frac{11}{8}=1\frac{3}{8} \end{array}$$

20.
$$\begin{array}{r} \frac{5}{12} \\ \frac{7}{12} \\ +\frac{1}{12} \\ \hline \frac{13}{12}=1\frac{1}{12} \end{array}$$

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21.
$$\begin{array}{r} \frac{4}{15} \\ \frac{7}{15} \\ +\frac{11}{15} \\ \hline \frac{22}{15} = 1\frac{7}{15} \end{array}$$

22.
$$\begin{array}{r} \frac{5}{7} \\ \frac{4}{7} \\ +\frac{5}{7} \\ \hline \frac{14}{7} = 2 \end{array}$$

23. $\frac{5}{12} + \frac{1}{12} + \frac{11}{12} = \frac{17}{12} = 1\frac{5}{12}$

24. $\frac{5}{8} + \frac{3}{8} + \frac{7}{8} = \frac{15}{8} = 1\frac{7}{8}$

25. A whole number other than 1

26. A mixed number

27. The number 1

28. A proper fraction

Objective B Exercises

29.
$$\begin{array}{r} \frac{1}{2} = \frac{3}{6} \\ +\frac{2}{3} = \frac{4}{6} \\ \hline \frac{7}{6} = 1\frac{1}{6} \end{array}$$

30.
$$\begin{array}{r} \frac{2}{3} = \frac{8}{12} \\ +\frac{1}{4} = \frac{3}{12} \\ \hline \frac{11}{12} \end{array}$$

31.
$$\begin{array}{r} \frac{3}{14} = \frac{3}{14} \\ +\frac{5}{7} = \frac{10}{14} \\ \hline \frac{13}{14} \end{array}$$

32.
$$\begin{array}{r} \frac{3}{5} = \frac{6}{10} \\ +\frac{7}{10} = \frac{7}{10} \\ \hline \frac{13}{10} = 1\frac{3}{10} \end{array}$$

33.
$$\begin{array}{r} \frac{8}{15} = \frac{32}{60} \\ +\frac{7}{20} = \frac{21}{60} \\ \hline \frac{53}{60} \end{array}$$

34.
$$\begin{array}{r} \frac{1}{6} = \frac{3}{18} \\ +\frac{7}{9} = \frac{14}{18} \\ \hline \frac{17}{18} \end{array}$$

35.
$$\begin{array}{r} \frac{3}{8} = \frac{21}{56} \\ +\frac{9}{14} = \frac{36}{56} \\ \hline \frac{57}{56} = 1\frac{1}{56} \end{array}$$

36.
$$\begin{array}{r} \frac{5}{12} = \frac{20}{48} \\ +\frac{5}{16} = \frac{15}{48} \\ \hline \frac{35}{48} \end{array}$$

37.
$$\begin{array}{r} \frac{3}{20} = \frac{9}{60} \\ +\frac{7}{30} = \frac{14}{60} \\ \hline \frac{23}{60} \end{array}$$

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38.
$$\begin{array}{r} \frac{5}{12}=\frac{25}{60} \\ +\ \frac{7}{30}=\frac{14}{60} \\ \hline \frac{39}{60}=\frac{13}{20} \end{array}$$

39.
$$\begin{array}{r} \frac{1}{3}=\frac{6}{18} \\ \frac{5}{6}=\frac{15}{18} \\ +\frac{7}{9}=\frac{14}{18} \\ \hline \frac{35}{18}=1\frac{17}{18} \end{array}$$

40.
$$\begin{array}{r} \frac{2}{3}=\frac{8}{12} \\ \frac{5}{6}=\frac{10}{12} \\ +\ \frac{7}{12}=\frac{7}{12} \\ \hline \frac{25}{12}=2\frac{1}{12} \end{array}$$

41.
$$\begin{array}{r} \frac{5}{6}=\frac{40}{48} \\ \frac{1}{12}=\frac{4}{48} \\ +\frac{5}{16}=\frac{15}{48} \\ \hline \frac{59}{48}=1\frac{11}{48} \end{array}$$

42.
$$\begin{array}{r} \frac{2}{9}=\frac{70}{315} \\ \frac{7}{15}=\frac{147}{315} \\ +\ \frac{4}{21}=\frac{60}{315} \\ \hline \frac{277}{315} \end{array}$$

43.
$$\begin{array}{r} \frac{2}{3}=\frac{40}{60} \\ \frac{1}{5}=\frac{12}{60} \\ +\frac{7}{12}=\frac{35}{60} \\ \hline \frac{87}{60}=1\frac{27}{60}=1\frac{9}{20} \end{array}$$

44.
$$\begin{array}{r} \frac{3}{4}=\frac{45}{60} \\ \frac{4}{5}=\frac{48}{60} \\ +\ \frac{7}{12}=\frac{35}{60} \\ \hline \frac{128}{60}=2\frac{8}{60}=2\frac{2}{15} \end{array}$$

45.
$$\begin{array}{r} \frac{2}{3}=\frac{80}{120} \\ \frac{3}{5}=\frac{72}{120} \\ +\ \frac{7}{8}=\frac{105}{120} \\ \hline \frac{257}{120}=2\frac{17}{120} \end{array}$$

46.
$$\begin{array}{r} \frac{3}{10}=\frac{45}{150} \\ \frac{14}{15}=\frac{140}{150} \\ +\ \frac{9}{25}=\frac{54}{150} \\ \hline \frac{239}{150}=1\frac{89}{150} \end{array}$$

47.
$$\begin{array}{r} \frac{2}{3}=\frac{48}{72} \\ \frac{5}{8}=\frac{45}{72} \\ +\frac{7}{9}=\frac{56}{72} \\ \hline \frac{149}{72}=2\frac{5}{72} \end{array}$$

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48.
$$\begin{array}{r} \frac{1}{3}=\frac{24}{72} \\ \frac{2}{9}=\frac{16}{72} \\ +\ \frac{7}{8}=\frac{63}{72} \\ \hline \frac{103}{72}=1\frac{31}{72} \end{array}$$

49.
$$\begin{array}{r} \frac{3}{8}=\frac{15}{40} \\ +\frac{3}{5}=\frac{24}{40} \\ \hline \frac{39}{40} \end{array}$$

50.
$$\begin{array}{r} \frac{5}{9}=\frac{20}{36} \\ +\ \frac{7}{12}=\frac{21}{36} \\ \hline \frac{41}{36}=1\frac{5}{36} \end{array}$$

51.
$$\begin{array}{r} \frac{3}{8}=\frac{9}{24} \\ \frac{5}{6}=\frac{20}{24} \\ +\frac{7}{12}=\frac{14}{24} \\ \hline \frac{43}{24}=1\frac{19}{24} \end{array}$$

52.
$$\begin{array}{r} \frac{1}{2}=\frac{36}{72} \\ \frac{5}{8}=\frac{45}{72} \\ +\frac{7}{9}=\frac{56}{72} \\ \hline \frac{137}{72}=1\frac{65}{72} \end{array}$$

53. (ii)

Objective C Exercises

54.
$$\begin{array}{r} 2\frac{2}{5}=2\frac{4}{10} \\ +3\frac{3}{10}=3\frac{3}{10} \\ \hline 5\frac{7}{10} \end{array}$$

55.
$$\begin{array}{r} 4\frac{1}{2}=4\frac{6}{12} \\ +5\frac{7}{12}=5\frac{7}{12} \\ \hline 9\frac{13}{12}=10\frac{1}{12} \end{array}$$

56.
$$\begin{array}{r} 3\frac{3}{8}=3\frac{6}{16} \\ +2\frac{5}{16}=2\frac{5}{16} \\ \hline 5\frac{11}{16} \end{array}$$

57.
$$\begin{array}{r} 4 \\ +5\frac{2}{7} \\ \hline 9\frac{2}{7} \end{array}$$

58.
$$\begin{array}{r} 6\frac{8}{9} \\ +12 \\ \hline 18\frac{8}{9} \end{array}$$

59.
$$\begin{array}{r} 7\frac{5}{12}=7\frac{20}{48} \\ +2\frac{9}{16}=2\frac{27}{48} \\ \hline 9\frac{47}{48} \end{array}$$

60.
$$\begin{array}{r} 9\frac{1}{2}=9\frac{11}{22} \\ +3\frac{3}{11}=3\frac{6}{22} \\ \hline 12\frac{17}{22} \end{array}$$

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61.
$$\begin{array}{r} 6 \\ +2\frac{3}{13} \\ \hline 8\frac{3}{13} \end{array}$$

62.
$$\begin{array}{r} 8\frac{21}{40} \\ +\ 6 \\ \hline 14\frac{21}{40} \end{array}$$

63.
$$\begin{array}{r} 8\frac{29}{30} = 8\frac{116}{120} \\ +7\frac{11}{40} = 7\frac{33}{120} \\ \hline 15\frac{149}{120} = 16\frac{29}{120} \end{array}$$

64.
$$\begin{array}{r} 17\frac{5}{16} = 17\frac{15}{48} \\ +3\frac{11}{24} = 3\frac{22}{48} \\ \hline 20\frac{37}{48} \end{array}$$

65.
$$\begin{array}{r} 17\frac{3}{8} = 17\frac{15}{40} \\ +\ 7\frac{7}{20} = \ 7\frac{14}{40} \\ \hline 24\frac{29}{40} \end{array}$$

66.
$$\begin{array}{r} 14\frac{7}{12} = 14\frac{49}{84} \\ +29\frac{13}{21} = 29\frac{52}{84} \\ \hline 43\frac{101}{84} = 44\frac{17}{84} \end{array}$$

67.
$$\begin{array}{r} 5\frac{7}{8} = \ 5\frac{21}{24} \\ +27\frac{5}{12} = 27\frac{10}{24} \\ \hline 32\frac{31}{24} = 33\frac{7}{24} \end{array}$$

68.
$$\begin{array}{r} 7\frac{5}{6} = 7\frac{15}{18} \\ +3\frac{5}{9} = 3\frac{10}{18} \\ \hline 10\frac{25}{18} = 11\frac{7}{18} \end{array}$$

69.
$$\begin{array}{r} 7\frac{5}{9} = 7\frac{20}{36} \\ +2\frac{7}{12} = 2\frac{21}{36} \\ \hline 9\frac{41}{36} = 10\frac{5}{36} \end{array}$$

70.
$$\begin{array}{r} 3\frac{1}{2} = 3\frac{6}{12} \\ 2\frac{3}{4} = 2\frac{9}{12} \\ +1\frac{5}{6} = 1\frac{10}{12} \\ \hline 6\frac{25}{12} = 8\frac{1}{12} \end{array}$$

71.
$$\begin{array}{r} 2\frac{1}{2} = 2\frac{6}{12} \\ 3\frac{2}{3} = 3\frac{8}{12} \\ +4\frac{1}{4} = 4\frac{3}{12} \\ \hline 9\frac{17}{12} = 10\frac{5}{12} \end{array}$$

72.
$$\begin{array}{r} 3\frac{1}{3} = 3\frac{35}{105} \\ 7\frac{1}{5} = 7\frac{21}{105} \\ +2\frac{1}{7} = 2\frac{15}{105} \\ \hline 12\frac{71}{105} \end{array}$$

73.
$$\begin{array}{r} 3\frac{1}{2} = 3\frac{45}{90} \\ 3\frac{1}{5} = 3\frac{18}{90} \\ +8\frac{1}{9} = 8\frac{10}{90} \\ \hline 14\frac{73}{90} \end{array}$$

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74.
$$\begin{aligned} 6\frac{5}{9} &= 6\frac{20}{36} \\ 6\frac{5}{12} &= 6\frac{15}{36} \\ +2\frac{5}{18} &= 2\frac{10}{36} \\ \hline 14\frac{45}{36} &= 15\frac{9}{36} = 15\frac{1}{4} \end{aligned}$$

75.
$$\begin{aligned} 2\frac{3}{8} &= 2\frac{18}{48} \\ 4\frac{7}{12} &= 4\frac{28}{48} \\ +3\frac{5}{16} &= 3\frac{15}{48} \\ \hline 9\frac{61}{48} &= 10\frac{13}{48} \end{aligned}$$

76.
$$\begin{aligned} 11\frac{1}{2} &= 11\frac{2}{4} \\ +\ \frac{3}{4} &= \ \ \frac{3}{4} \\ \hline 11\frac{5}{4} &= 12\frac{1}{4} \end{aligned}$$

The distance is $12\frac{1}{4}$ inches.

77.
$$\begin{aligned} 2\frac{3}{8} &= 2\frac{3}{8} \\ +1\frac{1}{2} &= 1\frac{4}{8} \\ \hline 3\frac{7}{8} & \end{aligned}$$

The pole is $3\frac{7}{8}$ metres long.

78.
$$\begin{aligned} 2\frac{4}{9} &= 2\frac{16}{36} \\ +5\frac{7}{12} &= 5\frac{21}{36} \\ \hline 7\frac{37}{36} &= 8\frac{1}{36} \end{aligned}$$

79.
$$\begin{aligned} 5\frac{5}{6} &= 5\frac{20}{24} \\ +3\frac{3}{8} &= 3\frac{9}{24} \\ \hline 8\frac{29}{24} &= 9\frac{5}{24} \end{aligned}$$

80.
$$\begin{aligned} 4\frac{3}{4} &= 4\frac{9}{12} \\ +9\frac{1}{3} &= 9\frac{4}{12} \\ \hline 13\frac{13}{12} &= 14\frac{1}{12} \end{aligned}$$

81.
$$\begin{aligned} 4\frac{8}{9} &= 4\frac{16}{18} \\ +9\frac{1}{6} &= 9\frac{3}{18} \\ \hline 13\frac{19}{18} &= 14\frac{1}{18} \end{aligned}$$

82.
$$\begin{aligned} 2 &= 2 \\ 4\frac{5}{8} &= 4\frac{45}{72} \\ +2\frac{2}{9} &= 2\frac{16}{72} \\ \hline 8\frac{61}{72} & \end{aligned}$$

83.
$$\begin{aligned} 1\frac{5}{8} &= 1\frac{15}{24} \\ 3 &= 3 \\ +7\frac{7}{24} &= 7\frac{7}{24} \\ \hline 11\frac{22}{24} &= 11\frac{11}{12} \end{aligned}$$

84. Yes

85. No

Objective D Exercises

86. **Strategy** To find the shaft length, add the three distances.

Solution
$$\begin{aligned} \frac{3}{8} &= \frac{6}{16} \\ \frac{11}{16} &= \frac{11}{16} \\ +\frac{1}{4} &= \frac{4}{16} \\ \hline \frac{21}{16} &= 1\frac{5}{16} \end{aligned}$$

The shaft length is $1\frac{5}{16}$ cm.

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87. Strategy To find shaft length, add the lengths of the three parts.

Solution

$$\begin{array}{r} \frac{5}{16} = \frac{5}{16} \\ 6\frac{7}{8} = 6\frac{14}{16} \\ +1\frac{3}{8} = 1\frac{6}{16} \\ \hline 7\frac{25}{16} = 8\frac{9}{16} \end{array}$$

The shaft length is $8\frac{9}{16}$ centimetres.

88. Strategy To find the total thickness, add the table-top thickness to the veneer thickness.

Solution

$$\begin{array}{r} 1\frac{1}{8} = 1\frac{2}{16} \\ +\frac{3}{16} = \frac{3}{16} \\ \hline 1\frac{5}{16} \end{array}$$

The total thickness is $1\frac{5}{16}$ centimetres.

89. The sum represents the height of the table.

90a. Strategy To find the total number of hours worked, add the five amounts.

Solution

$$\begin{array}{r} 5 = 5 \\ 3\frac{3}{4} = 3\frac{9}{12} \\ 2\frac{1}{3} = 2\frac{4}{12} \\ 1\frac{1}{4} = 1\frac{3}{12} \\ +7\frac{2}{3} = 7\frac{8}{12} \\ \hline 18\frac{24}{12} = 20 \end{array}$$

A total of 20 hours was worked.

b. Strategy To find the week's total salary, multiply the hours worked (20) by the pay for 1 hour ($11).

Solution

$$\begin{array}{r} 11 \\ \times\ 20 \\ \hline 220 \end{array}$$

Your total salary for the week is $220.

91. Strategy To find the total course length, add the three sides.

Solution

$$\begin{array}{r} 4\frac{3}{10} = 4\frac{3}{10} \\ 3\frac{7}{10} = 3\frac{7}{10} \\ +2\frac{1}{2} = 2\frac{5}{10} \\ \hline 9\frac{15}{10} = 10\frac{1}{2} \end{array}$$

The total course length is $10\frac{1}{2}$ km.

92. Strategy To find the thickness of the wall, add the thickness of the stud to the thickness of the dry wall on each side of the stud.

Solution

$$\begin{array}{r} 3\frac{5}{8} = 3\frac{5}{8} \\ \frac{1}{2} = \frac{4}{8} \\ +\ \frac{1}{2} = \frac{4}{8} \\ \hline 3\frac{13}{8} = 4\frac{5}{8} \end{array}$$

The total thickness of the wall is $4\frac{5}{8}$ in.

93. Strategy To find the thickness of the wall, add the thickness of the stud to the thickness of the dry wall on each side of the stud.

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Solution

$$\begin{array}{r} 5\frac{5}{8} = 5\frac{5}{8} \\ \frac{1}{2} = \frac{4}{8} \\ +\ \frac{1}{2} = \frac{4}{8} \\ \hline 5\frac{13}{8} = 6\frac{5}{8} \end{array}$$

The total thickness of the wall is $6\frac{5}{8}$ in.

94. Strategy To find the thickness of the wall, add the thickness of the stud to the thickness of the dry wall on each side of the stud.

Solution

$$\begin{array}{r} 3\frac{5}{8} \\ \frac{5}{8} \\ +\ \frac{5}{8} \\ \hline 3\frac{15}{8} = 4\frac{7}{8} \end{array}$$

The total thickness of the wall is $4\frac{7}{8}$ in.

95. Strategy To find the minimum length of bolt needed, add the thickness of each piece of wood to the thickness of the washer and the thickness of the nut.

Solution

$$\begin{array}{r} \frac{1}{2} = \frac{8}{16} \\ \frac{5}{8} = \frac{10}{16} \\ \frac{1}{16} = \frac{1}{16} \\ +\ \frac{3}{16} = \frac{3}{16} \\ \hline \frac{22}{16} = 1\frac{6}{16} = 1\frac{3}{8} \end{array}$$

The bolt must be $1\frac{3}{8}$ in. long.

Critical Thinking

96. $\frac{1}{3} + \frac{1}{6} + \frac{1}{8} + \frac{1}{12} + \frac{2}{5}$

$= \frac{40}{120} + \frac{20}{120} + \frac{15}{120} + \frac{10}{120} + \frac{48}{120}$

$= \frac{133}{120} = 1\frac{13}{120}$

No, this is not possible. The total cannot be greater than 1, which represents all the people surveyed.

Projects or Group Activities

97. $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$

98. There is no smallest unit fraction. No matter how small the unit fraction is, we can always add 1 to the denominator to make it even smaller.

99. $\frac{7}{12} = \frac{4}{12} + \frac{3}{12} = \frac{1}{3} + \frac{1}{4}$

100. $\frac{11}{24} = \frac{8}{24} + \frac{3}{24} = \frac{1}{3} + \frac{1}{8}$

101. $\frac{5}{12} = \frac{3}{12} + \frac{2}{12} = \frac{1}{4} + \frac{1}{6}$

Section 2.5

Concept Check

1. $\frac{5}{11} - \frac{3}{11} = \frac{5-3}{11} = \frac{2}{11}$

2. $\frac{7}{9} - \frac{4}{9} = \frac{7-4}{9} = \frac{3}{9} = \frac{1}{3}$

3. $\frac{11}{18}$

4. $\frac{1}{3}$

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Objective A Exercises

5.
$$\begin{array}{r} \frac{9}{17} \\ -\frac{7}{17} \\ \hline \frac{2}{17} \end{array}$$

6.
$$\begin{array}{r} \frac{11}{15} \\ -\frac{3}{15} \\ \hline \frac{8}{15} \end{array}$$

7.
$$\begin{array}{r} \frac{11}{12} \\ -\frac{7}{12} \\ \hline \frac{4}{12} = \frac{1}{3} \end{array}$$

8.
$$\begin{array}{r} \frac{13}{15} \\ -\frac{4}{15} \\ \hline \frac{9}{15} = \frac{3}{5} \end{array}$$

9.
$$\begin{array}{r} \frac{9}{20} \\ -\frac{7}{20} \\ \hline \frac{2}{20} = \frac{1}{10} \end{array}$$

10.
$$\begin{array}{r} \frac{48}{55} \\ -\frac{13}{55} \\ \hline \frac{35}{55} = \frac{7}{11} \end{array}$$

11.
$$\begin{array}{r} \frac{42}{65} \\ -\frac{17}{65} \\ \hline \frac{25}{65} = \frac{5}{13} \end{array}$$

12.
$$\begin{array}{r} \frac{11}{24} \\ -\frac{5}{24} \\ \hline \frac{6}{24} = \frac{1}{4} \end{array}$$

13.
$$\begin{array}{r} \frac{23}{30} \\ -\frac{13}{30} \\ \hline \frac{10}{30} = \frac{1}{3} \end{array}$$

14.
$$\begin{array}{r} \frac{17}{42} \\ -\frac{5}{42} \\ \hline \frac{12}{42} = \frac{2}{7} \end{array}$$

15.
$$\begin{array}{r} \frac{13}{14} \\ -\frac{5}{14} \\ \hline \frac{8}{14} = \frac{4}{7} \end{array}$$

16.
$$\begin{array}{r} \frac{7}{8} \\ -\frac{5}{8} \\ \hline \frac{2}{8} = \frac{1}{4} \end{array}$$

17.
$$\begin{array}{r} \frac{17}{24} \\ -\frac{11}{24} \\ \hline \frac{6}{24} = \frac{1}{4} \end{array}$$

18.
$$\begin{array}{r} \frac{19}{30} \\ -\frac{11}{30} \\ \hline \frac{8}{30} = \frac{4}{15} \end{array}$$

19. Yes

20. No

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Objective B Exercises

21.
$$\begin{array}{r} \frac{2}{3} = \frac{4}{6} \\ -\frac{1}{6} = \frac{1}{6} \\ \hline \frac{3}{6} = \frac{1}{2} \end{array}$$

22.
$$\begin{array}{r} \frac{7}{8} = \frac{14}{16} \\ -\frac{5}{16} = \frac{5}{16} \\ \hline \frac{9}{16} \end{array}$$

23.
$$\begin{array}{r} \frac{5}{8} = \frac{35}{56} \\ -\frac{2}{7} = \frac{16}{56} \\ \hline \frac{19}{56} \end{array}$$

24.
$$\begin{array}{r} \frac{5}{6} = \frac{35}{42} \\ -\frac{3}{7} = \frac{18}{42} \\ \hline \frac{17}{42} \end{array}$$

25.
$$\begin{array}{r} \frac{5}{7} = \frac{10}{14} \\ -\frac{3}{14} = \frac{3}{14} \\ \hline \frac{7}{14} = \frac{1}{2} \end{array}$$

26.
$$\begin{array}{r} \frac{5}{9} = \frac{25}{45} \\ -\frac{7}{15} = \frac{21}{45} \\ \hline \frac{4}{45} \end{array}$$

27.
$$\begin{array}{r} \frac{8}{15} = \frac{32}{60} \\ -\frac{7}{20} = \frac{21}{60} \\ \hline \frac{11}{60} \end{array}$$

28.
$$\begin{array}{r} \frac{7}{9} = \frac{14}{18} \\ -\frac{1}{6} = \frac{3}{18} \\ \hline \frac{11}{18} \end{array}$$

29.
$$\begin{array}{r} \frac{9}{16} = \frac{18}{32} \\ -\frac{17}{32} = \frac{17}{32} \\ \hline \frac{1}{32} \end{array}$$

30.
$$\begin{array}{r} \frac{29}{60} = \frac{58}{120} \\ -\frac{3}{40} = \frac{9}{120} \\ \hline \frac{49}{120} \end{array}$$

31.
$$\begin{array}{r} \frac{11}{12} = \frac{55}{60} \\ -\frac{3}{5} = \frac{36}{60} \\ \hline \frac{19}{60} \end{array}$$

32.
$$\begin{array}{r} \frac{11}{15} = \frac{33}{45} \\ -\frac{5}{9} = \frac{25}{45} \\ \hline \frac{8}{45} \end{array}$$

33.
$$\begin{array}{r} \frac{11}{24} = \frac{33}{72} \\ -\frac{7}{18} = \frac{28}{72} \\ \hline \frac{5}{72} \end{array}$$

34.
$$\begin{array}{r} \frac{9}{14} = \frac{27}{42} \\ -\frac{5}{42} = \frac{5}{42} \\ \hline \frac{22}{42} = \frac{11}{21} \end{array}$$

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35. $\frac{11}{12} = \frac{55}{60}$
$-\frac{11}{15} = \frac{44}{60}$
$\frac{11}{60}$

36. $\frac{17}{20} = \frac{51}{60}$
$-\frac{7}{15} = \frac{28}{60}$
$\frac{23}{60}$

37. $\frac{13}{20} = \frac{39}{60}$
$-\frac{1}{6} = \frac{10}{60}$
$\frac{29}{60}$

38. $\frac{5}{6} = \frac{15}{18}$
$-\frac{7}{9} = \frac{14}{18}$
$\frac{1}{18}$

39. (i)

Objective C Exercises

40. $5\frac{7}{12}$
$-2\frac{5}{12}$
$3\frac{2}{12} = 3\frac{1}{6}$

41. $16\frac{11}{15}$
$-11\frac{8}{15}$
$5\frac{3}{15} = 5\frac{1}{5}$

42. $6\frac{1}{3}$
-2
$4\frac{1}{3}$

43. $5\frac{7}{8}$
-1
$4\frac{7}{8}$

44. $10 = 9\frac{3}{3}$
$-6\frac{1}{3} = 6\frac{1}{3}$
$3\frac{2}{3}$

45. $3 = 2\frac{21}{21}$
$-2\frac{5}{21} = 2\frac{5}{21}$
$\frac{16}{21}$

46. $6\frac{2}{5} = 5\frac{7}{5}$
$-4\frac{4}{5} = 4\frac{4}{5}$
$1\frac{3}{5}$

47. $16\frac{3}{8} = 15\frac{11}{8}$
$-10\frac{7}{8} = 10\frac{7}{8}$
$5\frac{4}{8} = 5\frac{1}{2}$

48. $16\frac{2}{5} = 16\frac{18}{45} = 15\frac{63}{45}$
$-8\frac{4}{9} = 8\frac{20}{45} = 8\frac{20}{45}$
$7\frac{43}{45}$

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49.
$$\begin{array}{r} 23\frac{7}{8} = 23\frac{21}{24} \\ -16\frac{2}{3} = 16\frac{16}{24} \\ \hline 7\frac{5}{24} \end{array}$$

50.
$$\begin{array}{r} 17 \quad = 16\frac{13}{13} \\ -7\frac{8}{13} = \quad 7\frac{8}{13} \\ \hline 9\frac{5}{13} \end{array}$$

51.
$$\begin{array}{r} 6 = 5\frac{5}{5} \\ -4\frac{3}{5} = 4\frac{3}{5} \\ \hline 1\frac{2}{5} \end{array}$$

52.
$$\begin{array}{r} 23\frac{1}{6} = 23\frac{4}{24} = 22\frac{28}{24} \\ -15\frac{3}{8} = 15\frac{9}{24} = 15\frac{9}{24} \\ \hline 7\frac{19}{24} \end{array}$$

53.
$$\begin{array}{r} 40\frac{4}{9} = 40\frac{8}{18} = 39\frac{26}{18} \\ -24\frac{5}{6} = 24\frac{15}{18} = 24\frac{15}{18} \\ \hline 15\frac{11}{18} \end{array}$$

54.
$$\begin{array}{r} 12\frac{5}{18} = 12\frac{15}{54} = 11\frac{69}{54} \\ -11\frac{11}{27} = 11\frac{22}{54} = 11\frac{22}{54} \\ \hline \frac{47}{54} \end{array}$$

55.
$$\begin{array}{r} 29\frac{1}{2} = 29\frac{2}{4} = 28\frac{6}{4} \\ -7\frac{3}{4} = \quad 7\frac{3}{4} = \quad 7\frac{3}{4} \\ \hline 21\frac{3}{4} \end{array}$$

The distance is $21\frac{3}{4}$ inches.

56.
$$\begin{array}{r} 23\frac{1}{4} = 23\frac{2}{8} = 22\frac{10}{8} \\ -19\frac{3}{8} = 19\frac{3}{8} = 19\frac{3}{8} \\ \hline 3\frac{7}{8} \end{array}$$

The distance is $3\frac{7}{8}$ inches.

57.
$$\begin{array}{r} 23\frac{3}{20} = 23\frac{3}{20} = 22\frac{23}{20} \\ -7\frac{3}{5} = \quad 7\frac{12}{20} = \quad 7\frac{12}{20} \\ \hline 15\frac{11}{20} \end{array}$$

58.
$$\begin{array}{r} 12\frac{3}{8} \quad = 12\frac{9}{24} = 11\frac{33}{24} \\ -7\frac{5}{12} = \quad 7\frac{10}{24} = \quad 7\frac{10}{24} \\ \hline 4\frac{23}{24} \end{array}$$

59.
$$\begin{array}{r} 10\frac{5}{9} = 10\frac{25}{45} = 9\frac{70}{45} \\ -5\frac{11}{15} = 5\frac{33}{45} = 5\frac{33}{45} \\ \hline 4\frac{37}{45} \end{array}$$

60.
$$\begin{array}{r} 6\frac{1}{3} = 6\frac{5}{15} = 5\frac{20}{15} \\ -3\frac{3}{5} = 3\frac{9}{15} = 3\frac{9}{15} \\ \hline 2\frac{11}{15} \end{array}$$

61. No

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Objective D Exercises

62. Strategy Subtract the larger segment of the shaft $\left(7\frac{7}{8} \text{ feet}\right)$ from the total length of the shaft $\left(16\frac{2}{3} \text{ feet}\right)$.

Solution

$$\begin{array}{r} 16\frac{2}{3} = 16\frac{16}{24} = 15\frac{40}{24} \\ -\,7\frac{7}{8} = 7\frac{21}{24} = 7\frac{21}{24} \\ \hline 8\frac{19}{24} \end{array}$$

The missing dimension is $8\frac{19}{24}$ feet.

63. Strategy Subtract the larger shaft segment $\left(2\frac{7}{8} \text{ inches}\right)$ from the total shaft length $\left(12\frac{3}{8} \text{ inches}\right)$.

Solution

$$\begin{array}{r} 12\frac{3}{8} = 11\frac{11}{8} \\ -2\frac{7}{8} = 2\frac{7}{8} \\ \hline 9\frac{4}{8} = 9\frac{1}{2} \end{array}$$

The missing dimension is $9\frac{1}{2}$ inches.

64. Strategy To find how much farther the horses run in the Queen's Plate than in the Preakness Stakes, subtract the distance run in the Preakness Stakes $\left(1\frac{3}{16} \text{ miles}\right)$ from the distance run in the Queen's Plate $\left(1\frac{1}{4} \text{ miles}\right)$.

Solution

$$\begin{array}{r} 1\frac{1}{4} = 1\frac{4}{16} \\ -1\frac{3}{16} = 1\frac{3}{16} \\ \hline \frac{1}{16} \end{array}$$

The horses run $\frac{1}{16}$ mile farther in the Queen's Plate than in the Preakness Stakes.

Strategy To find how much farther the horses run, subtract the distance run in the Preakness Stakes $\left(1\frac{3}{16} \text{ miles}\right)$ from the distance run in the Belmont Stakes $\left(1\frac{1}{2} \text{ miles}\right)$.

Solution

$$\begin{array}{r} 1\frac{1}{2} = 1\frac{8}{16} \\ -1\frac{3}{16} = 1\frac{3}{16} \\ \hline \frac{5}{16} \end{array}$$

The horses run $\frac{5}{16}$ mile farther in the Belmont Stakes than in the Preakness Stakes.

65. Strategy To find the difference in the desk heights, subtract the shorter desk height $\left(56\frac{3}{4} \text{ centimetres}\right)$ from the taller desk height $\left(58\frac{1}{2} \text{ centimetres}\right)$.

Solution

$$\begin{array}{r} 58\frac{1}{2} = 58\frac{2}{4} = 57\frac{6}{4} \\ -\,56\frac{3}{4} = 56\frac{3}{4} = 56\frac{3}{4} \\ \hline 1\frac{3}{4} \end{array}$$

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The new desk is $1\frac{3}{4}$ centimetres shorter than a desk of standard height.

66a. Strategy Add the distance from the starting point to the first checkpoint to the distance from the first checkpoint to the second checkpoint.

Solution
$$\begin{array}{r} 3\frac{3}{8} = 3\frac{9}{24} \\ +4\frac{1}{3} = 4\frac{8}{24} \\ \hline 7\frac{17}{24} \end{array}$$

The distance is $7\frac{17}{24}$ kilometres.

b. Strategy To find the distance, subtract the distance from the starting point to the second checkpoint $\left(7\frac{17}{24} \text{ kilometres}\right)$ from the total distance (12 kilometres).

Solution
$$\begin{array}{r} 12 \quad = 11\frac{24}{24} \\ -7\frac{17}{24} = \ 7\frac{17}{24} \\ \hline 4\frac{7}{24} \end{array}$$

The distance from the second checkpoint to the finish line is $4\frac{7}{24}$ kilometres .

67a. Strategy Add the distance to be travelled the first day $\left(7\frac{3}{8}\text{kilometres}\right)$ to the distance to be travelled the second day $\left(10\frac{1}{3}\text{ kilometres}\right)$.

Solution
$$\begin{array}{r} 7\frac{3}{8} = 7\frac{9}{24} \\ +10\frac{1}{3} = 10\frac{8}{24} \\ \hline 17\frac{17}{24} \end{array}$$

The distance to be travelled during the first two days is $17\frac{17}{24}$ kilometres.

b. Strategy To find the distance, subtract the miles hiked $\left(17\frac{17}{24}\right)$ from the total kilometres $\left(27\frac{1}{2}\right)$.

Solution
$$\begin{array}{r} 27\frac{1}{2} = 27\frac{12}{24} = 26\frac{36}{24} \\ -17\frac{17}{24} = 17\frac{17}{24} = 17\frac{17}{24} \\ \hline 9\frac{19}{24} \end{array}$$

On the third day, $9\frac{19}{24}$ kilometres remain.

68. The difference represents the distance that will remain to be travelled after the first day.

69. The difference represents how much farther the hikers plan to travel on the second day than on the first day.

70. Strategy To find how much weight must be lost during the third month:

- Add the weight lost during the first month $\left(4\frac{1}{4}\text{kilograms}\right)$ to the amount lost during the second month $\left(5\frac{1}{2}\text{kilograms}\right)$.
- Subtract the total lost during the first two months from the total goal (15 kilograms).

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Solution

$$\begin{array}{r} 4\frac{1}{4} = 4\frac{1}{4} \\ +\,5\frac{1}{2} = 5\frac{2}{4} \\ \hline 9\frac{3}{4} \end{array} \qquad \begin{array}{r} 15 = 14\frac{4}{4} \\ -9\frac{3}{4} = 9\frac{3}{4} \\ \hline 5\frac{1}{4} \end{array}$$

The patient has $5\frac{1}{4}$ kilograms more to lose.

71a. The wrestler lost $2\frac{3}{4}$ kilograms in week 1 and $2\frac{1}{4}$ kilograms in week 2, or 4 kilograms total. Since less than 6 kilograms needs to be lost, the wrestler can attain the weight class by losing under 2 kilograms. Yes, this is less than the $2\frac{1}{4}$ kilograms lost in the second week.

b. Strategy To find how much weight must be lost:

- Add the amounts of weight lost during the first two weeks.
- Subtract the current weight loss total from the required amount $\left(5\frac{3}{4} \text{ kilograms}\right)$.

Solution

$$\begin{array}{r} 2\frac{3}{4} \\ +2\frac{1}{4} \\ \hline 4\frac{4}{4} = 5 \end{array} \qquad \begin{array}{r} 5\frac{3}{4} = 4\frac{7}{4} \\ -\ 5 = 4\frac{4}{4} \\ \hline \frac{3}{4} \end{array}$$

The wrestler needs to lose $\frac{3}{4}$ kilograms.

72. Strategy To find the difference:

- Find the thickness of each wall by adding the thickness of each stud to the thickness of two pieces of dry wall for each wall.
- Subtract the smaller total thickness from the larger total thickness.

Solution 2×6 stud wall:

$$\begin{array}{r} 5\frac{5}{8} = 5\frac{5}{8} \\ \frac{1}{2} = \frac{4}{8} \\ +\frac{1}{2} = \frac{4}{8} \\ \hline 5\frac{13}{8} = 6\frac{5}{8} \end{array}$$

2×4 stud wall:

$$\begin{array}{r} 3\frac{5}{8} \\ \frac{5}{8} \\ +\frac{5}{8} \\ \hline 3\frac{15}{8} = 4\frac{7}{8} \end{array}$$

$$\begin{array}{r} 6\frac{5}{8} = 5\frac{13}{8} \\ -4\frac{7}{8} = 4\frac{7}{8} \\ \hline 1\frac{6}{8} = 1\frac{3}{4} \end{array}$$

The difference is $1\frac{3}{4}$ inches.

73. The electrician's income is 1, that is, 100%.

$$\begin{array}{r} 1 = \frac{15}{15} \\ -\frac{4}{15} = \frac{4}{15} \\ \hline \frac{11}{15} \end{array}$$

$\frac{11}{15}$ of the income is not spent for housing.

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Critical Thinking

74. To find the missing number, subtract $2\frac{1}{2}$ from $5\frac{1}{3}$.

$$5\frac{1}{3} = 5\frac{2}{6} = 4\frac{8}{6}$$
$$-2\frac{1}{2} = 2\frac{3}{6} = 2\frac{3}{6}$$
$$2\frac{5}{6}$$

75. To find the missing number, add $1\frac{5}{8}$ to $4\frac{1}{2}$.

$$1\frac{5}{8} = 1\frac{5}{8}$$
$$+4\frac{1}{2} = 4\frac{4}{8}$$
$$5\frac{9}{8} = 6\frac{1}{8}$$

Projects or Group Activities

76. Right diagonal: $\frac{3}{4}+\frac{5}{8}+\frac{1}{2}=\frac{6}{8}+\frac{5}{8}+\frac{4}{8}=\frac{15}{8}$

Left diagonal: $\frac{5}{8}+\frac{7}{8}=\frac{12}{8}; \frac{15}{8}-\frac{12}{8}=\frac{3}{8}$

Top across:

$\frac{3}{8}+\frac{3}{4}=\frac{3}{8}+\frac{6}{8}=\frac{9}{8}; \frac{15}{8}-\frac{9}{8}=\frac{6}{8}=\frac{3}{4}$

Left down:

$\frac{3}{8}+\frac{1}{2}=\frac{3}{8}+\frac{4}{8}=\frac{7}{8}; \frac{15}{8}-\frac{7}{8}=\frac{8}{8}=1$

Middle across: $1+\frac{5}{8}=\frac{8}{8}+\frac{5}{8}=\frac{13}{8}$;

$\frac{15}{8}-\frac{13}{8}=\frac{2}{8}=\frac{1}{4}$

Bottom across: $\frac{1}{2}+\frac{7}{8}=\frac{4}{8}+\frac{7}{8}=\frac{11}{8}$;

$\frac{15}{8}-\frac{11}{8}=\frac{4}{8}=\frac{1}{2}$

$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{4}$
1	$\frac{5}{8}$	$\frac{1}{4}$
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{7}{8}$

Check Your Progress: Chapter 2

1.

	2	3
12 =	(2·2)	3
18 =	2	(3·3)

LCM = $2\cdot2\cdot3\cdot3 = 36$

2.

	2	3
6 =	2	3
9 =		3·3
18 =	(2)	(3·3)

LCM = $2\cdot3\cdot3 = 18$

3.

	2	5	7
2 =	(2)		
5 =		(5)	
7 =			(7)

LCM = $2\cdot5\cdot7 = 70$

4.

	2	3	7
28 =	(2·2)		(7)
36 =	2·2	(3·3)	

LCM = $2\cdot2\cdot3\cdot3\cdot7 = 252$

5.

	2	3
18 =	(2)	3·3
24 =	2·2·2	(3)

GCF = $2\cdot3 = 6$

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6.

	2	3
27 =		$3\cdot3\cdot3$
54 =	2	$3\cdot3\cdot3$

GCF = $3\cdot3\cdot3 = 27$

7.

	2	3	7
3 =		3	
6 =	2	3	
14 =	2		7

GCF = 1

8.

	2	3	5	7
30 =	2	3	5	
70 =	2		5	7
105 =		3	5	7

GCF = 5

9. $\frac{36}{45} = \frac{2\cdot2\cdot\cancel{3}^{1}\cdot\cancel{3}^{1}}{\cancel{3}_{1}\cdot\cancel{3}_{1}\cdot5} = \frac{4}{5}$

10. $\frac{17}{51} = \frac{\cancel{17}^{1}}{3\cdot\cancel{17}_{1}} = \frac{1}{3}$

11. $\frac{25}{36} = \frac{5\cdot5}{2\cdot2\cdot3\cdot3}$; $\frac{25}{36}$ is in simplest form.

12. $\frac{36}{4} = \frac{\cancel{2}^{1}\cdot\cancel{2}^{1}\cdot3\cdot3}{\cancel{2}_{1}\cdot\cancel{2}_{1}} = 9$

13.
$$\begin{array}{r} \frac{2}{9} \\ +\frac{4}{9} \\ \hline \frac{6}{9} = \frac{2}{3} \end{array}$$

14.
$$\begin{array}{r} \frac{17}{24} \\ -\frac{5}{24} \\ \hline \frac{12}{24} = \frac{1}{2} \end{array}$$

15.
$$\begin{array}{r} \frac{7}{9} = \frac{14}{18} \\ -\frac{7}{18} = \frac{7}{18} \\ \hline \frac{7}{18} \end{array}$$

16.
$$\begin{array}{r} \frac{7}{20} = \frac{7}{20} \\ +\frac{1}{4} = \frac{5}{20} \\ \hline \frac{12}{20} = \frac{3}{5} \end{array}$$

17.
$$\begin{array}{r} \frac{5}{6} = \frac{40}{48} \\ +\frac{11}{16} = \frac{33}{48} \\ \hline \frac{73}{48} = 1\frac{25}{48} \end{array}$$

18.
$$\begin{array}{r} \frac{3}{4} = \frac{39}{52} \\ -\frac{9}{26} = \frac{18}{52} \\ \hline \frac{21}{52} \end{array}$$

19.
$$\begin{array}{r} \frac{2}{3} = \frac{32}{48} \\ -\frac{3}{16} = \frac{9}{48} \\ \hline \frac{23}{48} \end{array}$$

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20.
$$\begin{array}{r} \frac{3}{5}=\frac{12}{20} \\ +\ \frac{1}{4}=\frac{5}{20} \\ \hline \frac{17}{20} \end{array}$$

21.
$$\begin{array}{r} 2\frac{1}{10}=2\frac{3}{30} \\ +\ 7\frac{1}{15}=7\frac{2}{30} \\ \hline 9\frac{5}{30}=9\frac{1}{6} \end{array}$$

22.
$$\begin{array}{r} 11\frac{4}{9}=11\frac{8}{18} \\ +\ 7\frac{1}{6}=\ 7\frac{3}{18} \\ \hline 18\frac{11}{18} \end{array}$$

23.
$$\begin{array}{r} 7\frac{6}{7}=7\frac{12}{14} \\ -\ 1\frac{1}{2}=1\frac{7}{14} \\ \hline 6\frac{5}{14} \end{array}$$

24.
$$\begin{array}{r} 3\frac{13}{28}=3\frac{26}{56} \\ -\ 1\frac{1}{8}=1\frac{7}{56} \\ \hline 2\frac{19}{56} \end{array}$$

25.
$$\begin{array}{r} 5\frac{8}{9}=5\frac{16}{18} \\ +\ 7\frac{5}{6}=7\frac{15}{18} \\ \hline 12\frac{31}{18}=13\frac{13}{18} \end{array}$$

26.
$$\begin{array}{r} 9\frac{3}{4}=9\frac{15}{20} \\ +\ 7\frac{3}{10}=7\frac{6}{20} \\ \hline 16\frac{21}{20}=17\frac{1}{20} \end{array}$$

27.
$$\begin{array}{r} 9\ \ =8\frac{4}{4} \\ -\ 5\frac{3}{4}=5\frac{3}{4} \\ \hline 3\frac{1}{4} \end{array}$$

28.
$$\begin{array}{r} 8\frac{1}{4}=8\frac{3}{12}=7\frac{15}{12} \\ -\ 5\frac{5}{6}=5\frac{10}{12}=5\frac{10}{12} \\ \hline 2\frac{5}{12} \end{array}$$

Section 2.6

Concept Check

1. $\frac{5}{9}\times\frac{2}{3}=\frac{5\cdot 2}{9\cdot 3}=\frac{10}{27}$

2. $\frac{6}{7}\times 4=\frac{6\cdot 4}{7\cdot 1}=\frac{24}{7}=3\frac{3}{7}$

3. Yes

4. Less than

Objective A Exercises

5. $\frac{2}{3}\times\frac{7}{8}=\frac{2\cdot 7}{3\cdot 8}=\frac{\overset{1}{\cancel{2}}\cdot 7}{3\cdot \underset{1}{\cancel{2}}\cdot 2\cdot 2}=\frac{7}{12}$

6. $\frac{1}{2}\times\frac{2}{3}=\frac{1\cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot 3}=\frac{1}{3}$

7. $\frac{5}{16}\times\frac{7}{15}=\frac{5\cdot 7}{16\cdot 15}=\frac{\overset{1}{\cancel{5}}\cdot 7}{2\cdot 2\cdot 2\cdot 2\cdot 3\cdot \underset{1}{\cancel{5}}}=\frac{7}{48}$

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8. $\frac{3}{8}\times\frac{6}{7}=\frac{3\cdot 6}{8\cdot 7}=\frac{3\cdot \overset{1}{\cancel{2}}\cdot 3}{\underset{1}{\cancel{2}}\cdot 2\cdot 2\cdot 7}=\frac{9}{28}$

9. $\frac{1}{6}\times\frac{1}{8}=\frac{1\cdot 1}{6\cdot 8}=\frac{1\cdot 1}{2\cdot 3\cdot 2\cdot 2\cdot 2}=\frac{1}{48}$

10. $\frac{2}{5}\times\frac{5}{6}=\frac{2\cdot 5}{5\cdot 6}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{2}}\cdot 3}=\frac{1}{3}$

11. $\frac{11}{12}\times\frac{6}{7}=\frac{11\cdot 6}{12\cdot 7}=\frac{11\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}\cdot 7}=\frac{11}{14}$

12. $\frac{11}{12}\times\frac{3}{5}=\frac{11\cdot 3}{12\cdot 5}=\frac{11\cdot\overset{1}{\cancel{3}}}{2\cdot 2\cdot\underset{1}{\cancel{3}}\cdot 5}=\frac{11}{20}$

13. $\frac{8}{9}\times\frac{27}{4}=\frac{8\cdot 27}{9\cdot 4}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot 3}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}}=6$

14. $\frac{3}{5}\times\frac{3}{10}=\frac{3\cdot 3}{5\cdot 10}=\frac{3\cdot 3}{5\cdot 2\cdot 5}=\frac{9}{50}$

15. $\frac{5}{6}\times\frac{1}{2}=\frac{5\cdot 1}{6\cdot 2}=\frac{5\cdot 1}{2\cdot 3\cdot 2}=\frac{5}{12}$

16. $\frac{3}{8}\times\frac{5}{12}=\frac{3\cdot 5}{8\cdot 12}=\frac{\overset{1}{\cancel{3}}\cdot 5}{2\cdot 2\cdot 2\cdot 2\cdot 2\cdot\underset{1}{\cancel{3}}}=\frac{5}{32}$

17. $\frac{16}{9}\times\frac{27}{8}=\frac{16\cdot 27}{9\cdot 8}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot 3}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}}=6$

18. $\frac{5}{8}\times\frac{16}{15}=\frac{5\cdot 16}{8\cdot 15}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot\underset{1}{\cancel{5}}}=\frac{2}{3}$

19. $\frac{3}{2}\times\frac{4}{9}=\frac{3\cdot 4}{2\cdot 9}=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{3}}\cdot 3}=\frac{2}{3}$

20. $\frac{5}{3}\times\frac{3}{7}=\frac{5\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 7}=\frac{5}{7}$

21. $\frac{7}{8}\times\frac{3}{14}=\frac{7\cdot 3}{8\cdot 14}=\frac{\overset{1}{\cancel{7}}\cdot 3}{2\cdot 2\cdot 2\cdot 2\cdot\underset{1}{\cancel{7}}}=\frac{3}{16}$

22. $\frac{2}{9}\times\frac{4}{5}=\frac{2\cdot 4}{9\cdot 5}=\frac{2\cdot 2\cdot 2}{3\cdot 3\cdot 5}=\frac{8}{45}$

23. $\frac{7}{10}\times\frac{3}{8}=\frac{7\cdot 3}{10\cdot 8}=\frac{7\cdot 3}{2\cdot 5\cdot 2\cdot 2\cdot 2}=\frac{21}{80}$

24. $\frac{5}{12}\times\frac{6}{7}=\frac{5\cdot 6}{12\cdot 7}=\frac{5\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}\cdot 7}=\frac{5}{14}$

25. $\frac{15}{8}\times\frac{16}{3}=\frac{15\cdot 16}{8\cdot 3}=\frac{\overset{1}{\cancel{3}}\cdot 5\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{3}}}=10$

26. $\frac{5}{6}\times\frac{4}{15}=\frac{5\cdot 4}{6\cdot 15}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot 3\cdot 3\cdot\underset{1}{\cancel{5}}}=\frac{2}{9}$

27. $\frac{1}{2}\times\frac{2}{15}=\frac{1\cdot 2}{2\cdot 15}=\frac{1\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot 3\cdot 5}=\frac{1}{15}$

28. $\frac{3}{8}\times\frac{5}{16}=\frac{3\cdot 5}{8\cdot 16}=\frac{3\cdot 5}{2\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2}=\frac{15}{128}$

29. $\frac{5}{7}\times\frac{14}{15}=\frac{5\cdot 14}{7\cdot 15}=\frac{\overset{1}{\cancel{5}}\cdot 2\cdot\overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}}\cdot 3\cdot\underset{1}{\cancel{5}}}=\frac{2}{3}$

30. $\frac{3}{8}\times\frac{36}{41}=\frac{3\cdot 36}{8\cdot 41}=\frac{3\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot 41}=\frac{27}{82}$

31. $\frac{5}{12}\times\frac{42}{65}=\frac{5\cdot 42}{12\cdot 65}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{3}}\cdot 7}{\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{5}}\cdot 13}=\frac{7}{26}$

32. $\frac{16}{33}\times\frac{55}{72}=\frac{16\cdot 55}{33\cdot 72}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 5\cdot\overset{1}{\cancel{11}}}{3\cdot\underset{1}{\cancel{11}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot 3}=\frac{10}{27}$

33. $\frac{12}{5}\times\frac{5}{3}=\frac{12\cdot 5}{5\cdot 3}=\frac{2\cdot 2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{3}}}=4$

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34. $\frac{17}{9}\times\frac{81}{17}=\frac{17\cdot 81}{9\cdot 17}=\frac{\overset{1}{\cancel{17}}\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot 3\cdot 3}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{17}}}=9$

35. $\frac{10}{21}\times\frac{14}{15}=\frac{10\cdot 14}{21\cdot 15}=\frac{2\cdot\overset{1}{\cancel{5}}\cdot 2\cdot\overset{1}{\cancel{7}}}{3\cdot\underset{1}{\cancel{7}}\cdot 3\cdot\underset{1}{\cancel{5}}}=\frac{4}{9}$

36. $\frac{19}{64}\times\frac{48}{95}=\frac{19\cdot 48}{64\cdot 95}=\frac{\overset{1}{\cancel{19}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot 2\cdot 5\cdot\underset{1}{\cancel{19}}}=\frac{3}{20}$

37. Answers will vary. For example, $\frac{3}{4}$ and $\frac{4}{3}$

38. $\frac{7}{12}\times\frac{15}{42}=\frac{7\cdot 15}{12\cdot 42}=\frac{\overset{1}{\cancel{7}}\cdot\overset{1}{\cancel{3}}\cdot 5}{2\cdot 2\cdot 3\cdot 2\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{7}}}=\frac{5}{24}$

39. $\frac{32}{9}\times\frac{3}{8}=\frac{32\cdot 3}{9\cdot 8}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 3\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}}=\frac{4}{3}=1\frac{1}{3}$

40. $\frac{5}{9}\times\frac{3}{20}=\frac{5\cdot 3}{9\cdot 20}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 3\cdot 2\cdot 2\cdot\underset{1}{\cancel{5}}}=\frac{1}{12}$

41. $\frac{7}{3}\times\frac{15}{14}=\frac{7\cdot 15}{3\cdot 14}=\frac{\overset{1}{\cancel{7}}\cdot\overset{1}{\cancel{3}}\cdot 5}{\underset{1}{\cancel{3}}\cdot 2\cdot\underset{1}{\cancel{7}}}=\frac{5}{2}=2\frac{1}{2}$

42. $\frac{1}{2}\times\frac{8}{15}=\frac{1\cdot 8}{2\cdot 15}=\frac{1\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot 3\cdot 5}=\frac{4}{15}$

43. $\frac{3}{8}\times\frac{12}{17}=\frac{3\cdot 12}{8\cdot 17}=\frac{3\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot 17}=\frac{9}{34}$

Objective B Exercises

44. $4\times\frac{3}{8}=\frac{4\cdot 3}{1\cdot 8}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3}{1\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2}=\frac{3}{2}=1\frac{1}{2}$

45. $14\times\frac{5}{7}=\frac{14\cdot 5}{1\cdot 7}=\frac{2\cdot\overset{1}{\cancel{7}}\cdot 5}{1\cdot\underset{1}{\cancel{7}}}=10$

46. $\frac{2}{3}\times 6=\frac{2\cdot 6}{3\cdot 1}=\frac{2\cdot 2\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 1}=4$

47. $\frac{5}{12}\times 40=\frac{5\cdot 40}{12\cdot 1}=\frac{5\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 5}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot 1}=\frac{50}{3}=16\frac{2}{3}$

48. $\frac{1}{3}\times 1\frac{1}{3}=\frac{1}{3}\times\frac{4}{3}=\frac{1\cdot 2\cdot 2}{3\cdot 3}=\frac{4}{9}$

49. $\frac{2}{5}\times 2\frac{1}{2}=\frac{2}{5}\times\frac{5}{2}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{2}}}=1$

50. $1\frac{7}{8}\times\frac{4}{15}=\frac{15}{8}\times\frac{4}{15}=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{5}}}=\frac{1}{2}$

51. $2\frac{1}{5}\times\frac{5}{22}=\frac{11}{5}\times\frac{5}{22}=\frac{\overset{1}{\cancel{11}}\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot 2\cdot\underset{1}{\cancel{11}}}=\frac{1}{2}$

52. $4\times 2\frac{1}{2}=\frac{4}{1}\times\frac{5}{2}=\frac{2\cdot\overset{1}{\cancel{2}}\cdot 5}{1\cdot\underset{1}{\cancel{2}}}=10$

53. $9\times 3\frac{1}{3}=\frac{9}{1}\times\frac{10}{3}=\frac{\overset{1}{\cancel{3}}\cdot 3\cdot 2\cdot 5}{1\cdot\underset{1}{\cancel{3}}}=30$

54. $2\frac{1}{7}\times 3=\frac{15}{7}\times\frac{3}{1}=\frac{3\cdot 5\cdot 3}{7\cdot 1}=\frac{45}{7}=6\frac{3}{7}$

55. $5\frac{1}{4}\times 8=\frac{21}{4}\times\frac{8}{1}=\frac{3\cdot 7\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 1}=42$

56. $3\frac{2}{3}\times 5=\frac{11}{3}\times\frac{5}{1}=\frac{11\cdot 5}{3\cdot 1}=\frac{55}{3}=18\frac{1}{3}$

57. $4\frac{2}{9}\times 3=\frac{38}{9}\times\frac{3}{1}=\frac{2\cdot 19\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 3\cdot 1}=\frac{38}{3}=12\frac{2}{3}$

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58. $\frac{1}{2}\times 3\frac{3}{7}=\frac{1}{2}\times\frac{24}{7}=\frac{1\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2\cdot 3}{\underset{1}{\cancel{2}}\cdot 7}=\frac{12}{7}=1\frac{5}{7}$

59. $\frac{3}{8}\times 4\frac{4}{5}=\frac{3}{8}\times\frac{24}{5}=\frac{3\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 5}=\frac{9}{5}=1\frac{4}{5}$

60. $6\frac{1}{8}\times\frac{4}{7}=\frac{49}{8}\times\frac{4}{7}=\frac{\overset{1}{\cancel{7}}\cdot 7\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{7}}}=\frac{7}{2}=3\frac{1}{2}$

61. $5\frac{1}{3}\times\frac{5}{16}=\frac{16}{3}\times\frac{5}{16}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 5}{3\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}}=\frac{5}{3}=1\frac{2}{3}$

62. $\frac{3}{8}\times 4\frac{1}{2}=\frac{3}{8}\times\frac{9}{2}=\frac{3\cdot 3\cdot 3}{2\cdot 2\cdot 2\cdot 2}=\frac{27}{16}=1\frac{11}{16}$

63. $\frac{5}{7}\times 2\frac{1}{3}=\frac{5}{7}\times\frac{7}{3}=\frac{5\cdot\overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}}\cdot 3}=\frac{5}{3}=1\frac{2}{3}$

64. $0\times 2\frac{2}{3}=\frac{0}{1}\times\frac{8}{3}=\frac{0\cdot 8}{1\cdot 3}=\frac{0}{3}=0$

65. $6\frac{1}{8}\times 0=\frac{49}{8}\times 0=\frac{49\cdot 0}{8}=0$

66. $2\frac{5}{8}\times 3\frac{2}{5}=\frac{21}{8}\times\frac{17}{5}=\frac{3\cdot 7\cdot 17}{2\cdot 2\cdot 2\cdot 5}=\frac{357}{40}$
$=8\frac{37}{40}$

67. $5\frac{3}{16}\times 5\frac{1}{3}=\frac{83}{16}\times\frac{16}{3}=\frac{83\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3}$
$=\frac{83}{3}=27\frac{2}{3}$

68. $5\frac{1}{5}\times 3\frac{1}{13}=\frac{26}{5}\times\frac{40}{13}=\frac{2\cdot\overset{1}{\cancel{13}}\cdot 2\cdot 2\cdot 2\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{13}}}=16$

69. $3\frac{3}{4}\times 2\frac{3}{20}=\frac{15}{4}\times\frac{43}{20}$
$=\frac{3\cdot\overset{1}{\cancel{5}}\cdot 43}{2\cdot 2\cdot 2\cdot 2\cdot\underset{1}{\cancel{5}}}$
$=\frac{129}{16}=8\frac{1}{16}$

70. $12\frac{3}{5}\times 1\frac{3}{7}=\frac{63}{5}\times\frac{10}{7}=\frac{3\cdot 3\cdot\overset{1}{\cancel{7}}\cdot 2\cdot\overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{7}}}=18$

71. $6\frac{1}{2}\times 1\frac{3}{13}=\frac{13}{2}\times\frac{16}{13}=\frac{\overset{1}{\cancel{13}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{13}}}=8$

72. $4\frac{3}{8}\times\frac{4}{5}=\frac{35}{8}\times\frac{4}{5}=\frac{\overset{1}{\cancel{5}}\cdot 7\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{5}}}=\frac{7}{2}=3\frac{1}{2}$

The height is $3\frac{1}{2}$ inches.

73. $4\times 13\frac{1}{2}=\frac{4}{1}\times\frac{27}{2}=\frac{\overset{1}{\cancel{2}}\cdot 2\cdot 3\cdot 3\cdot 3}{\underset{1}{\cancel{2}}}=54$

The distance is 54 metres.

74. True

75. $2\frac{1}{2}\times 3\frac{3}{5}=\frac{5}{2}\times\frac{18}{5}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot 3\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{5}}}=9$

76. $4\frac{3}{8}\times 3\frac{3}{5}=\frac{35}{8}\times\frac{18}{5}=\frac{\overset{1}{\cancel{5}}\cdot 7\cdot\overset{1}{\cancel{2}}\cdot 3\cdot 3}{2\cdot 2\cdot 2\cdot\underset{1}{\cancel{5}}}$
$=\frac{63}{4}=15\frac{3}{4}$

77. $2\frac{1}{8}\times\frac{5}{17}=\frac{17}{8}\times\frac{5}{17}=\frac{\overset{1}{\cancel{17}}\cdot 5}{2\cdot 2\cdot 2\cdot\underset{1}{\cancel{17}}}=\frac{5}{8}$

78. $12\frac{2}{5}\times 3\frac{7}{31}=\frac{62}{5}\times\frac{100}{31}$
$=\frac{2\cdot\overset{1}{\cancel{31}}\cdot 2\cdot 2\cdot\overset{1}{\cancel{5}}\cdot 5}{\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{31}}}$
$=40$

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79. $1\frac{3}{8} \times 2\frac{1}{5} = \frac{11}{8} \times \frac{11}{5} = \frac{121}{40} = 3\frac{1}{40}$

80. $3\frac{1}{8} \times 2\frac{4}{7} = \frac{25}{8} \times \frac{18}{7} = \frac{5 \cdot 5 \cdot \overset{1}{2} \cdot 3 \cdot 3}{\underset{1}{2} \cdot 2 \cdot 2 \cdot 7}$

$= \frac{225}{28} = 8\frac{1}{28}$

Objective C Exercises

81. Less than \$35, because $2\frac{3}{4} < 3$

82. Less than 4 feet, because $\frac{1}{3}$ of 9 feet is approximately 3 feet; therefore, $\frac{1}{3}$ of $9\frac{1}{4}$ feet is approximately 3 feet.

83. **Strategy** To find the cost of the salmon, multiply the amount of salmon $\left(2\frac{3}{4} \text{ kilograms}\right)$ by the cost per kilograms (\$12).

Solution $2\frac{3}{4} \times 12 = \frac{11}{4} \times \frac{12}{1}$

$= \frac{11 \cdot \overset{1}{\cancel{4}} \cdot 3}{\underset{1}{\cancel{4}} \cdot 1} = 33$

The salmon costs \$33.

84. **Strategy** To find how far a person can walk in $\frac{1}{3}$ hour, multiply the distance walked in 1 hour $\left(2\frac{1}{2} \text{kilometres}\right)$ by $\frac{1}{3}$.

Solution $2\frac{1}{2} \times \frac{1}{3} = \frac{5}{2} \times \frac{1}{3} = \frac{5 \cdot 1}{2 \cdot 3} = \frac{5}{6}$

A person can walk $\frac{5}{6}$ kilometres in $\frac{1}{3}$ hour.

85. **Strategy** To find the length cut, multiply the length of the board $\left(9\frac{1}{4} \text{ feet}\right)$ by $\frac{1}{3}$.

Solution $\frac{1}{3} \times 9\frac{1}{4} = \frac{1}{3} \times \frac{37}{4}$

$= \frac{1 \cdot 37}{3 \cdot 4} = \frac{37}{12}$

$= 3\frac{1}{12}$

The length of the board cut off is $3\frac{1}{12}$ feet.

86. **Strategy** To find the perimeter of the square, multiply the length of 1 side $\left(16\frac{1}{4} \text{centimetres}\right)$ by 4.

Solution $16\frac{1}{2} \times 4 = \frac{33}{2} \times \frac{4}{1}$

$= \frac{33 \cdot \overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}}} = 66$

The perimeter of the square is 66 centimetres.

87. **Strategy** To find the area of the square, multiply the length of one side $\left(5\frac{1}{2} \text{ metres}\right)$ by itself $\left(5\frac{1}{2} \text{ metres}\right)$.

Solution $5\frac{1}{2} \times 5\frac{1}{2} = \frac{11}{2} \times \frac{11}{2}$

$= \frac{11 \cdot 11}{2 \cdot 2} = \frac{121}{4}$

$= 30\frac{1}{4}$

The area of the square is $30\frac{1}{4}$ square metres.

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88. **Strategy** To find the area of the rectangle, multiply the length by the width.

Solution $4\frac{2}{5} \times 3\frac{3}{10} = \frac{22}{5} \times \frac{33}{10}$

$$= \frac{\overset{1}{2} \cdot 11 \cdot 3 \cdot 11}{5 \cdot \underset{1}{2} \cdot 5}$$

$$= \frac{363}{25} = 14\frac{13}{25}$$

The area of the rectangle is $14\frac{13}{25}$ square centimetres.

89. **Strategy** To find the number of acres turned into ethanol, multiply the total number of acres planted each year (3 million) by $\frac{6}{10}$.

Solution $3 \times \frac{6}{10} = \frac{3}{1} \times \frac{6}{10}$

$$= \frac{3 \cdot 6}{1 \cdot 10} = \frac{18}{10} = \frac{9}{5} = 1\frac{4}{5}$$

$1\frac{4}{5}$ million acres of corn are turned into ethanol each year.

90. $6\frac{1}{2} \times \frac{3}{8} = \frac{13}{2} \times \frac{3}{8} = \frac{39}{16} = 2\frac{7}{16}$

The weight of the $6\frac{1}{2}$-foot steel rod is $2\frac{7}{16}$ pounds.

91. $12\frac{7}{12} \times 4\frac{1}{3} = \frac{151}{12} \times \frac{13}{3} = \frac{1963}{36} = 54\frac{19}{36}$

The weight of the $12\frac{7}{12}$-foot steel rod is $54\frac{19}{36}$ pounds.

92. $8\frac{5}{8} \times 1\frac{1}{4} = \frac{69}{8} \times \frac{5}{4} = \frac{345}{32} = 10\frac{25}{32}$

$10\frac{3}{4} \times 2\frac{1}{2} = \frac{43}{4} \times \frac{5}{2} = \frac{215}{8} = 26\frac{7}{8}$

$10\frac{25}{32} + 26\frac{7}{8} = 10\frac{25}{32} + 26\frac{28}{32}$

$$= 36\frac{53}{32} = 37\frac{21}{32}$$

The total weight is $37\frac{21}{32}$ pounds.

93. **Strategy** To find the total cost of the capes, multiply the amount of material each cape requires by the cost of 1 yard and by the number of capes needed.

Solution $1\frac{1}{2} \times 12 \times 22 = \frac{3}{2} \times 12 \times 22$

$$= \frac{3 \times 12 \times 22}{2}$$

$$= \frac{792}{2} = 396$$

The total cost is \$396.

94. **Strategy** To find the distance from the wall to the centre of the drain, multiply the distance of the front face of the cabinet from the wall $\left(23\frac{1}{2} \text{ inches}\right)$ by $\frac{1}{2}$.

Solution $23\frac{1}{2} \times \frac{1}{2} = \frac{47}{2} \times \frac{1}{2}$

$$= \frac{47 \cdot 1}{2 \cdot 2} = \frac{47}{4}$$

$$= 11\frac{3}{4}$$

The distance is $11\frac{3}{4}$ inches.

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Critical Thinking

95. $\frac{1}{2}$; Any number multiplied by 1 is the number.

96. Student explanations should include the idea that every 4 years we must add 1 day to the usual 365-day year.

97. *A*. The product of any two positive rational numbers, each less than 1, is less than either of the two numbers.

Projects or Group Activities

98. $\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{9}$

$1\frac{1}{9}$ $\frac{1}{6}$ $1\frac{1}{2}$

$2\frac{1}{4}$ $\frac{5}{18}$ $\frac{4}{9}$

More than one answer is possible.

Section 2.7

Concept Check

1. $\frac{7}{3}$

2. $\frac{1}{7}$

3. $\frac{5}{4}$

4. 6

5. $\frac{3}{8} \div \frac{4}{9} = \frac{3}{8} \times \frac{9}{4} = \frac{27}{32}$

6. No

Objective A Exercises

7. $\frac{1}{3} \div \frac{2}{5} = \frac{1}{3} \times \frac{5}{2} = \frac{1 \cdot 5}{3 \cdot 2} = \frac{5}{6}$

8. $\frac{3}{7} \div \frac{3}{2} = \frac{3}{7} \times \frac{2}{3} = \frac{\overset{1}{\cancel{3}} \cdot 2}{7 \cdot \underset{1}{\cancel{3}}} = \frac{2}{7}$

9. $\frac{3}{7} \div \frac{3}{7} = \frac{3}{7} \times \frac{7}{3} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}} \cdot \underset{1}{\cancel{3}}} = 1$

10. $0 \div \frac{1}{2} = 0 \times \frac{2}{1} = 0$

11. $0 \div \frac{3}{4} = 0 \times \frac{4}{3} = 0$

12. $\frac{16}{33} \div \frac{4}{11} = \frac{16}{33} \times \frac{11}{4} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{11}}}{3 \cdot \underset{1}{\cancel{11}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}}} = \frac{4}{3} = 1\frac{1}{3}$

13. $\frac{5}{24} \div \frac{15}{36} = \frac{5}{24} \times \frac{36}{15} = \frac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{5}}} = \frac{1}{2}$

14. $\frac{11}{15} \div \frac{1}{12} = \frac{11}{15} \times \frac{12}{1} = \frac{11 \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 5} = \frac{44}{5} = 8\frac{4}{5}$

15. $\frac{1}{9} \div \frac{2}{3} = \frac{1}{9} \times \frac{3}{2} = \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 3 \cdot 2} = \frac{1}{6}$

16. $\frac{10}{21} \div \frac{5}{7} = \frac{10}{21} \times \frac{7}{5} = \frac{2 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{7}}}{3 \cdot \underset{1}{\cancel{7}} \cdot \underset{1}{\cancel{5}}} = \frac{2}{3}$

17. $\frac{2}{5} \div \frac{4}{7} = \frac{2}{5} \times \frac{7}{4} = \frac{\overset{1}{\cancel{2}} \cdot 7}{5 \cdot \underset{1}{\cancel{2}} \cdot 2} = \frac{7}{10}$

18. $\frac{3}{8} \div \frac{5}{12} = \frac{3}{8} \times \frac{12}{5} = \frac{3 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 5} = \frac{9}{10}$

19. $\frac{1}{2} \div \frac{1}{4} = \frac{1}{2} \times \frac{4}{1} = \frac{\overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}}} = 2$

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20. $\frac{1}{3} \div \frac{1}{9} = \frac{1}{3} \times \frac{9}{1} = \frac{\overset{1}{\cancel{3}} \cdot 3}{\underset{1}{\cancel{3}}} = 3$

21. $\frac{1}{5} \div \frac{1}{10} = \frac{1}{5} \times \frac{10}{1} = \frac{2 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}}} = 2$

22. $\frac{4}{15} \div \frac{2}{5} = \frac{4}{15} \times \frac{5}{2} = \frac{\overset{1}{\cancel{2}} \cdot 2 \cdot \overset{1}{\cancel{5}}}{3 \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{2}}} = \frac{2}{3}$

23. $\frac{7}{15} \div \frac{14}{5} = \frac{7}{15} \times \frac{5}{14} = \frac{\overset{1}{\cancel{7}} \cdot \overset{1}{\cancel{5}}}{3 \cdot \underset{1}{\cancel{5}} \cdot 2 \cdot \underset{1}{\cancel{7}}} = \frac{1}{6}$

24. $\frac{5}{8} \div \frac{15}{2} = \frac{5}{8} \times \frac{2}{15} = \frac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 3 \cdot \underset{1}{\cancel{5}}} = \frac{1}{12}$

25. $\frac{14}{3} \div \frac{7}{9} = \frac{14}{3} \times \frac{9}{7} = \frac{2 \cdot \overset{1}{\cancel{7}} \cdot \overset{1}{\cancel{3}} \cdot 3}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{7}}} = 6$

26. $\frac{7}{4} \div \frac{9}{2} = \frac{7}{4} \times \frac{2}{9} = \frac{7 \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 3} = \frac{7}{18}$

27. $\frac{5}{9} \div \frac{25}{3} = \frac{5}{9} \times \frac{3}{25} = \frac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 3 \cdot \underset{1}{\cancel{5}} \cdot 5} = \frac{1}{15}$

28. $\frac{5}{16} \div \frac{3}{8} = \frac{5}{16} \times \frac{8}{3} = \frac{5 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 3} = \frac{5}{6}$

29. $\frac{2}{3} \div \frac{1}{3} = \frac{2}{3} \times \frac{3}{1} = \frac{2 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}} = 2$

30. $\frac{4}{9} \div \frac{1}{9} = \frac{4}{9} \times \frac{9}{1} = \frac{2 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}}} = 4$

31. $\frac{5}{7} \div \frac{2}{7} = \frac{5}{7} \times \frac{7}{2} = \frac{5 \cdot \overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}} \cdot 2} = \frac{5}{2} = 2\frac{1}{2}$

32. $\frac{5}{6} \div \frac{1}{9} = \frac{5}{6} \times \frac{9}{1} = \frac{5 \cdot \overset{1}{\cancel{3}} \cdot 3}{2 \cdot \underset{1}{\cancel{3}}} = \frac{15}{2} = 7\frac{1}{2}$

33. $\frac{2}{3} \div \frac{2}{9} = \frac{2}{3} \times \frac{9}{2} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}} \cdot 3}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{2}}} = 3$

34. $\frac{5}{12} \div \frac{5}{6} = \frac{5}{12} \times \frac{6}{5} = \frac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{5}}} = \frac{1}{2}$

35. $\frac{7}{8} \div \frac{3}{4} = \frac{7}{8} \times \frac{4}{3} = \frac{7 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 3} = \frac{7}{6} = 1\frac{1}{6}$

36. $\frac{7}{12} \div \frac{3}{4} = \frac{7}{12} \times \frac{4}{3} = \frac{7 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 3 \cdot 3} = \frac{7}{9}$

37. $\frac{5}{7} \div \frac{3}{14} = \frac{5}{7} \times \frac{14}{3} = \frac{5 \cdot 2 \cdot \overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}} \cdot 3} = \frac{10}{3} = 3\frac{1}{3}$

38. $\frac{6}{11} \div \frac{9}{32} = \frac{6}{11} \times \frac{32}{9} = \frac{2 \cdot \overset{1}{\cancel{3}} \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{11 \cdot \underset{1}{\cancel{3}} \cdot 3}$

$= \frac{64}{33} = 1\frac{31}{33}$

39. True

40. True

Objective B Exercises

41. $4 \div \frac{2}{3} = \frac{4}{1} \times \frac{3}{2} = \frac{\overset{1}{\cancel{2}} \cdot 2 \cdot 3}{\underset{1}{\cancel{2}}} = 6$

42. $\frac{2}{3} \div 4 = \frac{2}{3} \times \frac{1}{4} = \frac{\overset{1}{\cancel{2}}}{3 \cdot \underset{1}{\cancel{2}} \cdot 2} = \frac{1}{6}$

43. $\frac{3}{2} \div 3 = \frac{3}{2} \times \frac{1}{3} = \frac{\overset{1}{\cancel{3}}}{2 \cdot \underset{1}{\cancel{3}}} = \frac{1}{2}$

44. $3 \div \frac{3}{2} = \frac{3}{1} \times \frac{2}{3} = \frac{\overset{1}{\cancel{3}} \cdot 2}{\underset{1}{\cancel{3}}} = 2$

45. $\frac{5}{6} \div 25 = \frac{5}{6} \times \frac{1}{25} = \frac{\overset{1}{\cancel{5}}}{2 \cdot 3 \cdot \underset{1}{\cancel{5}} \cdot 5} = \frac{1}{30}$

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46. $22 \div \frac{3}{11} = \frac{22}{1} \times \frac{11}{3} = \frac{2 \cdot 11 \cdot 11}{3} = \frac{242}{3} = 80\frac{2}{3}$

47. $6 \div 3\frac{1}{3} = \frac{6}{1} \div \frac{10}{3} = \frac{6}{1} \times \frac{3}{10} = \frac{\overset{1}{\cancel{2}} \cdot 3 \cdot 3}{\underset{1}{\cancel{2}} \cdot 5} = \frac{9}{5} = 1\frac{4}{5}$

48. $5\frac{1}{2} \div 11 = \frac{11}{2} \div \frac{11}{1} = \frac{11}{2} \times \frac{1}{11} = \frac{\overset{1}{\cancel{11}}}{2 \cdot \underset{1}{\cancel{11}}} = \frac{1}{2}$

49. $6\frac{1}{2} \div \frac{1}{2} = \frac{13}{2} \div \frac{1}{2} = \frac{13}{2} \times \frac{2}{1} = \frac{13 \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}} = 13$

50. $\frac{3}{8} \div 2\frac{1}{4} = \frac{3}{8} \div \frac{9}{4} = \frac{3}{8} \times \frac{4}{9} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot \underset{1}{\cancel{3}} \cdot 3} = \frac{1}{6}$

51. $8\frac{1}{4} \div 2\frac{3}{4} = \frac{33}{4} \div \frac{11}{4} = \frac{33}{4} \times \frac{4}{11}$

$$= \frac{3 \cdot \overset{1}{\cancel{11}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{11}}} = 3$$

52. $3\frac{5}{9} \div 32 = \frac{32}{9} \div \frac{32}{1} = \frac{32}{9} \times \frac{1}{32}$

$$= \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{3 \cdot 3 \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}}} = \frac{1}{9}$$

53. $4\frac{1}{5} \div 21 = \frac{21}{5} \div \frac{21}{1} = \frac{21}{5} \times \frac{1}{21} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{7}}}{5 \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{7}}} = \frac{1}{5}$

54. $6\frac{8}{9} \div \frac{31}{36} = \frac{62}{9} \div \frac{31}{36} = \frac{62}{9} \times \frac{36}{31}$

$$= \frac{2 \cdot \overset{1}{\cancel{31}} \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{31}}} = 8$$

55. $\frac{11}{12} \div 2\frac{1}{3} = \frac{11}{12} \div \frac{7}{3} = \frac{11}{12} \times \frac{3}{7}$

$$= \frac{11 \cdot \overset{1}{\cancel{3}}}{2 \cdot 2 \cdot \underset{1}{\cancel{3}} \cdot 7} = \frac{11}{28}$$

56. $\frac{7}{8} \div 3\frac{1}{4} = \frac{7}{8} \div \frac{13}{4} = \frac{7}{8} \times \frac{4}{13}$

$$= \frac{7 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 13} = \frac{7}{26}$$

57. $35 \div \frac{7}{24} = \frac{35}{1} \times \frac{24}{7} = \frac{5 \cdot \overset{1}{\cancel{7}} \cdot 2 \cdot 2 \cdot 2 \cdot 3}{\underset{1}{\cancel{7}}} = 120$

58. $\frac{3}{8} \div 2\frac{3}{4} = \frac{3}{8} \div \frac{11}{4} = \frac{3}{8} \times \frac{4}{11}$

$$= \frac{3 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 11} = \frac{3}{22}$$

59. $\frac{11}{18} \div 2\frac{2}{9} = \frac{11}{18} \div \frac{20}{9} = \frac{11}{18} \times \frac{9}{20}$

$$= \frac{11 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{2 \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 2 \cdot 2 \cdot 5} = \frac{11}{40}$$

60. $\frac{21}{40} \div 3\frac{3}{10} = \frac{21}{40} \div \frac{33}{10} = \frac{21}{40} \times \frac{10}{33}$

$$= \frac{\overset{1}{\cancel{3}} \cdot 7 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{3}} \cdot 11} = \frac{7}{44}$$

61. $2\frac{1}{16} \div 2\frac{1}{2} = \frac{33}{16} \div \frac{5}{2} = \frac{33}{16} \times \frac{2}{5}$

$$= \frac{3 \cdot 11 \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 2 \cdot 5} = \frac{33}{40}$$

62. $7\frac{3}{5} \div 1\frac{7}{12} = \frac{38}{5} \div \frac{19}{12} = \frac{38}{5} \times \frac{12}{19}$

$$= \frac{2 \cdot \overset{1}{\cancel{19}} \cdot 2 \cdot 2 \cdot 3}{5 \cdot \underset{1}{\cancel{19}}} = \frac{24}{5}$$

$$= 4\frac{4}{5}$$

63. $1\frac{2}{3} \div \frac{3}{8} = \frac{5}{3} \div \frac{3}{8} = \frac{5}{3} \times \frac{8}{3}$

$$= \frac{5 \cdot 2 \cdot 2 \cdot 2}{3 \cdot 3} = \frac{40}{9}$$

$$= 4\frac{4}{9}$$

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64. $16 \div \frac{2}{3} = \frac{16}{1} \times \frac{3}{2} = \frac{\overset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 2 \cdot 3}{\underset{1}{\cancel{2}}} = 24$

65. $1\frac{5}{8} \div 4 = \frac{13}{8} \div \frac{4}{1} = \frac{13}{8} \times \frac{1}{4}$

$= \frac{13}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{13}{32}$

66. $13\frac{3}{8} \div \frac{1}{4} = \frac{107}{8} \times \frac{4}{1} = \frac{107 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}}}$

$= \frac{107}{2} = 53\frac{1}{2}$

67. $16 \div 1\frac{1}{2} = 16 \div \frac{3}{2} = \frac{16}{1} \times \frac{2}{3} = \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{3}$

$= \frac{32}{3} = 10\frac{2}{3}$

68. $9 \div \frac{7}{8} = \frac{9}{1} \div \frac{7}{8} = \frac{9}{1} \times \frac{8}{7} = \frac{3 \cdot 3 \cdot 2 \cdot 2 \cdot 2}{7}$

$= \frac{72}{7} = 10\frac{2}{7}$

69. $1\frac{1}{3} \div 5\frac{8}{9} = \frac{4}{3} \div \frac{53}{9} = \frac{4}{3} \times \frac{9}{53}$

$= \frac{2 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot 3}{\underset{1}{\cancel{3}} \cdot 53} = \frac{12}{53}$

70. $13\frac{2}{3} \div 0$

Division by zero is undefined.

71. $82\frac{3}{5} \div 19\frac{1}{10} = \frac{413}{5} \div \frac{191}{10} = \frac{413}{5} \times \frac{10}{191}$

$= \frac{7 \cdot 59 \cdot 2 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot 191} = \frac{826}{191} = 4\frac{62}{191}$

72. $45\frac{3}{5} \div 15 = \frac{228}{5} \div \frac{15}{1} = \frac{228}{5} \times \frac{1}{15}$

$= \frac{2 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot 19}{5 \cdot \underset{1}{\cancel{3}} \cdot 5} = \frac{76}{25} = 3\frac{1}{25}$

73. $102 \div 1\frac{1}{2} = \frac{102}{1} \div \frac{3}{2} = \frac{102}{1} \times \frac{2}{3}$

$= \frac{2 \cdot \overset{1}{\cancel{3}} \cdot 17 \cdot 2}{\underset{1}{\cancel{3}}} = 68$

74. $0 \div 3\frac{1}{2} = 0 \div \frac{7}{2} = 0$

75. $8\frac{2}{7} \div 1 = \frac{58}{7} \div 1 = \frac{58}{7} \times 1 = \frac{58}{7} = 8\frac{2}{7}$

76. $6\frac{9}{16} \div 1\frac{3}{32} = \frac{105}{16} \div \frac{35}{32} = \frac{105}{16} \times \frac{32}{35}$

$= \frac{3 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{7}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{7}}} = 6$

77. $8\frac{8}{9} \div 2\frac{13}{18} = \frac{80}{9} \div \frac{49}{18} = \frac{80}{9} \times \frac{18}{49}$

$= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5 \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 7 \cdot 7}$

$= \frac{160}{49} = 3\frac{13}{49}$

78. $10\frac{1}{5} \div 1\frac{7}{10} = \frac{51}{5} \div \frac{17}{10} = \frac{51}{5} \times \frac{10}{17}$

$= \frac{3 \cdot \overset{1}{\cancel{17}} \cdot 2 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{17}}} = 6$

79. $7\frac{3}{8} \div 1\frac{27}{32} = \frac{59}{8} \div \frac{59}{32} = \frac{59}{8} \times \frac{32}{59}$

$= \frac{\overset{1}{\cancel{59}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{59}}} = 4$

80. $7\frac{7}{9} \div 5\frac{5}{6} = \frac{70}{9} \div \frac{35}{6} = \frac{70}{9} \times \frac{6}{35}$

$= \frac{2 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{7}} \cdot 2 \cdot 3}{\underset{1}{\cancel{3}} \cdot 3 \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{7}}} = \frac{4}{3} = 1\frac{1}{3}$

81. $2\frac{3}{4} \div 1\frac{23}{32} = \frac{11}{4} \div \frac{55}{32} = \frac{11}{4} \times \frac{32}{35}$

$= \frac{\overset{1}{\cancel{11}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 5 \cdot \underset{1}{\cancel{11}}} = \frac{8}{5} = 1\frac{3}{5}$

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82. $8\frac{1}{4} \div 1\frac{5}{11} = \frac{33}{4} \div \frac{16}{11} = \frac{33}{4} \times \frac{11}{16}$

$$= \frac{3 \cdot 11 \cdot 11}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{363}{64}$$

$$= 5\frac{43}{64}$$

83. $\frac{14}{77} \div 3\frac{1}{9} = \frac{14}{77} \div \frac{28}{9} = \frac{14}{17} \times \frac{9}{28}$

$$= \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{7}} \cdot 3 \cdot 3}{17 \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot \underset{1}{\cancel{7}}} = \frac{9}{34}$$

84. False

85. False

Objective C Exercises

86. Greater than 22, because $\frac{3}{4} < 1$

87. Less than 16, because $1\frac{1}{3} > 1$

88. **Strategy** To find how many boxes can be filled with 22 cups of cereal, divide 22 by the amount per box $\left(\frac{3}{4} \text{ cup}\right)$.

Solution $22 \div \frac{3}{4} = 22 \times \frac{4}{3}$

$$= \frac{22 \cdot 4}{3}$$

$$= \frac{88}{3} = 29\frac{1}{2}$$

$29\frac{1}{2}$ boxes can be filled.

89. **Strategy** To find the number of servings in 400 grams of cereal, divide 400 by the amount in each serving $\left(25\frac{2}{5} \text{ grams}\right)$.

Solution $400 \div 25\frac{3}{5} = 400 \div \frac{128}{5}$

$$= 400 \times \frac{5}{128} = \frac{400 \cdot 5}{128}$$

$$= \frac{2000}{128} = 15\frac{80}{128}$$

$$= 15\frac{5}{8}$$

There are $15\frac{5}{8}$ servings in 400 grams of cereal.

90. **Strategy** To find the cost of a similar diamond weighing 1 karat, divide the cost of the purchased diamond ($1200) by its weight $\left(\frac{5}{8} \text{ karat}\right)$.

Solution $1200 \div \frac{5}{8} = 1200 \times \frac{8}{5}$

$$= \frac{1200 \cdot 8}{5} = 1920$$

The cost of a similar diamond weighing 1 karat is $1920.

91. **Strategy** To find the cost of each acre, divide the total cost ($200 000) by the number of acres $\left(8\frac{1}{3}\right)$.

Solution $200\,000 \div 8\frac{1}{3} = 200\,000 \div \frac{25}{3}$

$$= 200\,000 \times \frac{3}{25}$$

$$= \frac{200\,000 \cdot 3}{25}$$

$$= 24\,000$$

Each acre costs $24 000.

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92. Strategy To find how many kilometres the car can travel on 1 litre of gasoline, divide the distance (440 kilometres) by the amount of gasoline used $\left(47\frac{1}{2} \text{ litres}\right)$.

Solution
$$440 \div 47\frac{1}{2} = \frac{440}{1} \div \frac{95}{2}$$
$$= \frac{440}{1} \times \frac{2}{95}$$
$$= \frac{2 \cdot 2 \cdot \overset{1}{\cancel{5}} \cdot 11 \cdot 2}{\underset{1}{\cancel{5}} \cdot 95}$$
$$= \frac{176}{19} = 9\frac{5}{19}$$

The car can travel $9\frac{5}{19}$ kilometres on 1 gallon of gasoline.

93. Strategy To find the number of turns, divide the distance for the nut to move $\left(4\frac{4}{5} \text{ centimetres}\right)$ by the distance the nut moves for each turn $\left(\frac{2}{5} \text{ centimetres}\right)$.

Solution
$$4\frac{4}{5} \div \frac{2}{5} = \frac{24}{5} \div \frac{2}{5}$$
$$= \frac{24}{5} \times \frac{5}{2}$$
$$= \frac{24 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot 2}$$
$$= 12$$

The nut will make 12 turns in moving $4\frac{4}{5}$ centimetres.

94a. Strategy To find the number of acres, subtract the number of acres set aside $\left(1\frac{1}{2}\right)$ from the total number of acres $\left(9\frac{3}{4}\right)$.

Solution
$$9\frac{3}{4} = 9\frac{3}{4}$$
$$-1\frac{1}{2} = 1\frac{2}{4}$$
$$8\frac{1}{4}$$

$8\frac{1}{4}$ acres are available for housing.

b. Strategy To find the number of parcels, divide the number of acres available $\left(8\frac{1}{4}\right)$ by the number of acres in one parcel $\left(\frac{1}{4}\right)$.

Solution
$$8\frac{1}{4} \div \frac{1}{4} = \frac{33}{4} \div \frac{1}{4} = \frac{33}{4} \times \frac{4}{1}$$
$$= \frac{33 \cdot \overset{1}{\cancel{4}}}{\underset{1}{\cancel{4}} \cdot 1} = 33$$

33 parcels of land can be sold.

95a. Strategy To find the total weight of the fat and bone, subtract the weight after trimming $\left(4\frac{1}{3} \text{ kilograms}\right)$ from the original weight $\left(5\frac{3}{4} \text{ kilograms}\right)$.

Solution
$$5\frac{3}{4} = 5\frac{9}{12}$$
$$-4\frac{1}{3} = 4\frac{4}{12}$$
$$1\frac{5}{12}$$

The total weight of the fat and bone was $1\frac{5}{12}$ kilograms.

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b. Strategy To find the number of servings, divide the weight after trimming $\left(4\frac{1}{3} \text{ kilograms}\right)$ by the weight of one serving $\left(\frac{1}{3} \text{ kilogram}\right)$.

Solution
$$4\frac{1}{3} \div \frac{1}{3} = \frac{13}{3} \div \frac{1}{3}$$
$$= \frac{13}{3} \times \frac{3}{1}$$
$$= \frac{13 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 1} = 13$$

The chef can cut 13 servings from the roast.

96. Strategy To find the length of the remaining piece:

- Divide the total length (5 metres) by the length of each shelf $\left(1\frac{1}{6} \text{ metres}\right)$.
- Multiply the fraction left over by the length of one shelf.

Solution
$$5 \div 1\frac{1}{6} = 5 \div \frac{7}{6}$$
$$= \frac{5}{1} \times \frac{6}{7} = \frac{5 \cdot 6}{7} = \frac{30}{7}$$
$$= 4\frac{2}{7}$$

$$\frac{2}{7} \times 1\frac{1}{6} = \frac{2}{7} \times \frac{7}{6}$$
$$= \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{7}}}{\underset{1}{\cancel{7}} \cdot \underset{1}{\cancel{2}} \cdot 3} = \frac{1}{3}$$

The length of the remaining piece is $\frac{1}{3}$ metre.

97. Strategy To find the distance between each post:

- Find the total distance taken up by the five posts $\left(1\frac{1}{4} \text{ inches each}\right)$.
- Subtract that sum from the total distance between the posts $\left(22\frac{3}{4} \text{ inches}\right)$.
- Divide the remaining distance by 6, the number of spaces between each of the five inserted posts and the end posts.

Solution
$$5 \times 1\frac{1}{4} = \frac{5}{1} \times \frac{5}{4} = \frac{5 \cdot 5}{1 \cdot 4} = \frac{25}{4}$$
$$22\frac{3}{4} - \frac{25}{4} = \frac{91}{4} - \frac{25}{4} = \frac{66}{4}$$
$$\frac{66}{4} \div 6 = \frac{66}{4} \times \frac{1}{6} = \frac{\overset{11}{\cancel{66}} \cdot 1}{4 \cdot \underset{1}{\cancel{6}}}$$
$$= \frac{11}{4} = 2\frac{3}{4}$$

The distance between each post is $2\frac{3}{4}$ inches.

98. Strategy To find the distance between each post:

- Find the total distance taken up by the 10 posts $\left(1\frac{1}{2} \text{ inches each}\right)$.
- Subtract that sum from the total distance between the posts $\left(42\frac{1}{2} \text{ inches}\right)$.

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- Divide the remaining distance by 11, the number of spaces between each of the ten inserted posts and the end posts.

Solution $10 \times 1\frac{1}{2} = \frac{10}{1} \times \frac{3}{2}$

$$= \frac{\overset{5}{\cancel{10}} \cdot 3}{1 \cdot \underset{1}{\cancel{2}}} = \frac{15}{1} = 15$$

$$42\frac{1}{2} - 15 = \frac{85}{2} - \frac{15}{1}$$

$$= \frac{85}{2} - \frac{30}{2} = \frac{55}{2}$$

$$\frac{55}{2} \div 11 = \frac{55}{2} \times \frac{1}{11} = \frac{\overset{5}{\cancel{55}} \cdot 1}{2 \cdot \underset{1}{\cancel{11}}}$$

$$= \frac{5}{2} = 2\frac{1}{2}$$

The distance between each post is $2\frac{1}{2}$ inches.

Critical Thinking

99. $\frac{2}{3} - \boxed{\frac{1}{2}} = \frac{4}{6} - \frac{3}{6} = \frac{1}{6}$

100. $\boxed{\frac{5}{6}} - \frac{5}{8} = \frac{20}{24} - \frac{15}{24} = \frac{5}{24}$

101. $\boxed{\frac{1}{2}} + \frac{3}{5} = \frac{5}{10} + \frac{6}{10} = \frac{11}{10} = 1\frac{1}{10}$

102. $\frac{5}{9} + \boxed{\frac{1}{6}} = \frac{10}{18} + \frac{3}{18} = \frac{13}{18}$

103. $\frac{3}{4} \cdot \boxed{\frac{2}{3}} = \frac{6}{12} = \frac{1}{2}$

104. $\boxed{2\frac{5}{8}} \cdot \frac{2}{3} = \frac{21}{8} \cdot \frac{2}{3} = \frac{\overset{1}{\cancel{3}} \cdot 7 \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot \underset{1}{\cancel{3}}} = \frac{7}{4} = 1\frac{3}{4}$

105. $\boxed{\frac{2}{3}} \div \frac{3}{4} = \frac{2}{3} \cdot \frac{4}{3} = \frac{8}{9}$

106. $\frac{3}{4} \div \boxed{1\frac{1}{8}} = \frac{3}{4} \div \frac{9}{8} = \frac{3}{4} \cdot \frac{8}{9} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{3}} \cdot 3} = \frac{2}{3}$

107. Strategy To find the bank-recommended maximum monthly house payment, multiply your monthly income ($4500) by $\frac{1}{3}$.

Solution $4500 \times \frac{1}{3} = \frac{4500}{3} = 1500$

The bank would recommend that your maximum monthly house payment be $1500.

108. Strategy To find how much higher the grass plots were mowed for the study $\left(\frac{3}{20} \text{ inch}\right)$ than the more common heights used in tournaments $\left(\frac{1}{10} \text{ inch or } \frac{1}{8} \text{ inch}\right)$, subtract each of the shorter heights from the higher height.

Solution $\frac{3}{20} - \frac{1}{10} = \frac{3}{20} - \frac{2}{20} = \frac{1}{20}$

$\frac{3}{20} - \frac{1}{8} = \frac{6}{40} - \frac{5}{40} = \frac{1}{40}$

The grass plots in the study are $\frac{1}{20}$ inch or $\frac{1}{40}$ inch higher.

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109. Strategy Multiply the length of one side (28 centimetres) by $\frac{1}{2}$ and multiply the thickness $\left(\frac{7}{8}\text{ centimetre}\right)$ by 2.

Solution $\frac{1}{2}\times 28 = 14$ centimetres on one side.

The thickness is $2\times\frac{7}{8}=\frac{7}{4}=1\frac{3}{4}$ centimetres.

The other dimension (28 centimetres) remains the same.

The dimensions of the board when it is closed are 28 centimetres by 14 centimetres by $1\frac{3}{4}$ centimetres.

110. Strategy To find the number of miles:

- Find out how many units of $\frac{1}{2}$ centimetre there are in $4\frac{3}{10}$ centimetres.
- Multiply by 60 kilometres.

Solution $4\frac{3}{10}\div\frac{1}{2}=\frac{43}{10}\times\frac{2}{1}=\frac{43}{5}$ units

Then, because each unit represents 60 kilometres,

$\frac{43}{5}\times\frac{60}{1}=516$

The distance is 516 kilometres.

111. First, find the spacing between the three columns.

$\frac{2}{5}\times 2=\frac{2}{5}\times\frac{2}{1}=\frac{4}{5}$ centimetre

Second, find the remaining space for the columns.

$18\frac{1}{2}-\frac{4}{5}=18\frac{5}{10}-\frac{8}{10}=17\frac{15}{10}-\frac{8}{10}$

$=17\frac{7}{10}$ centimetres

Third, divide that space among the three columns.

$17\frac{7}{10}\div 3=\frac{177}{10}\times\frac{1}{3}=\frac{177}{30}=5\frac{27}{30}$

$=5\frac{9}{10}$ centimetres

Projects or Group Activities

112. Internet Explorer: $\frac{9}{25}$

Firefox: $\frac{7}{25}$

Chrome: $\frac{9}{50}$

$\frac{9}{25}+\frac{7}{25}+\frac{9}{50}=\frac{18}{50}+\frac{14}{50}+\frac{9}{50}=\frac{41}{50}$

$\frac{41}{50}$ of the market

113. Safari: $\frac{3}{50}$

Opera: $\frac{1}{50}$

$\frac{3}{50}\div\frac{1}{50}=\frac{3}{\cancel{50}_{1}}\cdot\frac{\overset{1}{\cancel{50}}}{1}=3$

3 times more people

114. $\frac{9}{50}\cdot 2=\frac{9}{\cancel{50}_{2}}\cdot\frac{\overset{2}{\cancel{2}}}{1}=\frac{9}{25}$ billion, or

360 000 000, or 360 million

115. $\frac{9}{50}+\frac{3}{50}+\frac{1}{50}+\frac{7}{25}+\frac{9}{25}$

$=\frac{9}{50}+\frac{3}{50}+\frac{1}{50}+\frac{14}{50}+\frac{18}{50}=\frac{45}{50}$

$1-\frac{45}{50}=\frac{50}{50}-\frac{45}{50}=\frac{5}{50}=\frac{1}{10}$

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Section 2.8

Concept Check

1. Equal to

2. Greater than

3. Less than

4. (ii)

Objective A Exercises

5. $\frac{11}{40} < \frac{19}{40}$

6. $\frac{92}{103} > \frac{19}{103}$

7. $\frac{2}{3} = \frac{14}{21}, \frac{5}{7} = \frac{15}{21}, \frac{2}{3} < \frac{5}{7}$

8. $\frac{2}{5} = \frac{16}{40}, \frac{3}{8} = \frac{15}{40}, \frac{2}{5} > \frac{3}{8}$

9. $\frac{5}{8} = \frac{15}{24}, \frac{7}{12} = \frac{14}{24}, \frac{5}{8} > \frac{7}{12}$

10. $\frac{11}{16} = \frac{33}{48}, \frac{17}{24} = \frac{34}{48}, \frac{11}{16} < \frac{17}{24}$

11. $\frac{7}{9} = \frac{28}{36}, \frac{11}{12} = \frac{33}{36}, \frac{7}{9} < \frac{11}{12}$

12. $\frac{5}{12} = \frac{25}{60}, \frac{7}{15} = \frac{28}{60}, \frac{5}{12} < \frac{7}{15}$

13. $\frac{13}{14} = \frac{39}{42}, \frac{19}{21} = \frac{38}{42}, \frac{13}{14} > \frac{19}{21}$

14. $\frac{13}{18} = \frac{26}{36}, \frac{7}{12} = \frac{21}{36}, \frac{13}{18} > \frac{7}{12}$

15. $\frac{7}{24} = \frac{35}{120}, \frac{11}{30} = \frac{44}{120}, \frac{7}{24} < \frac{11}{30}$

16. $\frac{13}{36} = \frac{52}{144}, \frac{19}{48} = \frac{57}{144}, \frac{13}{36} < \frac{19}{48}$

17. $\frac{4}{5}$ is larger.

Objective B Exercises

18. $\left(\frac{3}{8}\right)^2 = \frac{3}{8} \cdot \frac{3}{8} = \frac{9}{64}$

19. $\left(\frac{5}{12}\right)^2 = \frac{5}{12} \cdot \frac{5}{12} = \frac{25}{144}$

20. $\left(\frac{2}{9}\right)^3 = \frac{2}{9} \cdot \frac{2}{9} \cdot \frac{2}{9} = \frac{8}{729}$

21. $\left(\frac{1}{2}\right) \cdot \left(\frac{2}{3}\right)^2 = \left(\frac{1}{2}\right) \cdot \left(\frac{2}{3} \cdot \frac{2}{3}\right) = \frac{\overset{1}{\cancel{2}} \cdot 2}{\underset{1}{\cancel{2}} \cdot 3 \cdot 3} = \frac{2}{9}$

22. $\left(\frac{2}{3}\right) \cdot \left(\frac{1}{2}\right)^4 = \left(\frac{2}{3}\right) \cdot \left(\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}\right)$

$= \frac{\overset{1}{\cancel{2}} \cdot 1 \cdot 1 \cdot 1 \cdot 1}{3 \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 2} = \frac{1}{24}$

23. $\left(\frac{1}{3}\right)^2 \cdot \left(\frac{3}{5}\right)^3 = \left(\frac{1}{3} \cdot \frac{1}{3}\right) \cdot \left(\frac{3}{5} \cdot \frac{3}{5} \cdot \frac{3}{5}\right)$

$= \frac{1 \cdot 1 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}} \cdot 3}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 5 \cdot 5 \cdot 5} = \frac{3}{125}$

24. $\left(\frac{2}{5}\right)^3 \cdot \left(\frac{5}{7}\right)^2 = \left(\frac{2}{5} \cdot \frac{2}{5} \cdot \frac{2}{5}\right) \cdot \left(\frac{5}{7} \cdot \frac{5}{7}\right)$

$= \frac{2 \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}} \cdot 5 \cdot 7 \cdot 7} = \frac{8}{245}$

25. $\left(\frac{5}{9}\right)^3 \cdot \left(\frac{18}{25}\right)^2 = \left(\frac{5}{9} \cdot \frac{5}{9} \cdot \frac{5}{9}\right) \cdot \left(\frac{18}{25} \cdot \frac{18}{25}\right)$

$= \frac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}} \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}} \cdot 2 \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 3 \cdot 3 \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}} \cdot 5} = \frac{4}{45}$

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26. $\frac{1}{2}-\frac{1}{3}+\frac{2}{3}=\frac{3}{6}-\frac{2}{6}+\frac{2}{3}$

$=\frac{1}{6}+\frac{2}{3}$

$=\frac{1}{6}+\frac{4}{6}$

$=\frac{5}{6}$

27. $\frac{2}{5}+\frac{3}{10}-\frac{2}{3}=\frac{4}{10}+\frac{3}{10}-\frac{2}{3}$

$=\frac{7}{10}-\frac{2}{3}$

$=\frac{21}{30}-\frac{20}{30}$

$=\frac{1}{30}$

28. $\frac{1}{3}\div\frac{1}{2}+\frac{3}{4}=\frac{1}{3}\cdot\frac{2}{1}+\frac{3}{4}$

$=\frac{2}{3}+\frac{3}{4}$

$=\frac{8}{12}+\frac{9}{12}$

$=\frac{17}{12}=1\frac{5}{12}$

29. $\frac{3}{7}\cdot\frac{14}{15}+\frac{4}{5}=\frac{2}{5}+\frac{4}{5}$

$=\frac{6}{5}=1\frac{1}{5}$

30. $\frac{7}{9}-\frac{2}{3}\cdot\frac{4}{5}=\frac{7}{9}-\frac{8}{15}$

$=\frac{35}{45}-\frac{24}{45}$

$=\frac{11}{45}$

31. $\frac{5}{8}+\frac{1}{8}\cdot\frac{2}{3}=\frac{5}{8}+\frac{2}{24}$

$=\frac{15}{24}+\frac{2}{24}$

$=\frac{17}{24}$

32. $\frac{3}{2}\cdot\frac{4}{5}-\frac{1}{2}\cdot\frac{2}{3}=\frac{3}{\cancel{4}_{1}}\cdot\frac{\overset{1}{\cancel{4}}}{5}-\frac{1}{\cancel{2}_{1}}\cdot\frac{\overset{1}{\cancel{2}}}{3}$

$=\frac{3}{5}-\frac{1}{3}$

$=\frac{9}{15}-\frac{5}{15}$

$=\frac{4}{15}$

33. $\frac{5}{6}\div\frac{2}{3}-\frac{3}{4}\cdot\frac{1}{2}=\frac{5}{\cancel{6}_{2}}\cdot\frac{\overset{1}{\cancel{3}}}{2}-\frac{3}{4}\cdot\frac{1}{2}$

$=\frac{5}{4}-\frac{3}{8}$

$=\frac{10}{8}-\frac{3}{8}$

$=\frac{7}{8}$

34. $\frac{1}{3}+\frac{3}{5}\cdot\frac{4}{9}-\frac{1}{2}=\frac{1}{3}+\frac{\overset{1}{\cancel{3}}}{5}\cdot\frac{4}{\cancel{9}_{3}}-\frac{1}{2}$

$=\frac{1}{3}+\frac{4}{15}-\frac{1}{2}$

$=\frac{10}{30}+\frac{8}{30}-\frac{15}{30}$

$=\frac{3}{30}=\frac{1}{10}$

35. $\frac{7}{8}-\frac{2}{3}\cdot\frac{1}{2}+\frac{5}{6}=\frac{7}{8}-\frac{\overset{1}{\cancel{2}}}{3}\cdot\frac{1}{\cancel{2}_{1}}+\frac{5}{6}$

$=\frac{7}{8}-\frac{1}{3}+\frac{5}{6}$

$=\frac{21}{24}-\frac{8}{24}+\frac{20}{24}$

$=\frac{33}{24}$

$=1\frac{9}{24}$

$=1\frac{3}{8}$

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36. $\frac{8}{9}-\frac{3}{4}\div\frac{9}{10}+\frac{4}{9}=\frac{8}{9}-\frac{\cancel{3}^{1}}{4}\cdot\frac{10}{\cancel{9}_{3}}+\frac{4}{9}$

$=\frac{8}{9}-\frac{5}{6}+\frac{4}{9}$

$=\frac{16}{18}-\frac{15}{18}+\frac{8}{18}$

$=\frac{9}{18}=\frac{1}{2}$

37. $\frac{5}{6}+\frac{1}{2}\div\frac{3}{4}-\frac{5}{8}=\frac{5}{6}+\frac{1}{\cancel{2}_{1}}\cdot\frac{\cancel{4}^{2}}{3}-\frac{5}{8}$

$=\frac{5}{6}+\frac{2}{3}-\frac{5}{8}$

$=\frac{20}{24}+\frac{16}{24}-\frac{15}{24}$

$=\frac{21}{24}$

$=\frac{7}{8}$

38. $\left(\frac{3}{4}\right)^2-\frac{5}{12}=\frac{9}{16}-\frac{5}{12}$

$=\frac{27}{48}-\frac{20}{48}$

$=\frac{7}{48}$

39. $\left(\frac{3}{5}\right)^3-\frac{3}{25}=\frac{27}{125}-\frac{3}{25}$

$=\frac{27}{125}-\frac{15}{125}$

$=\frac{12}{125}$

40. $\frac{5}{6}\cdot\left(\frac{2}{3}-\frac{1}{6}\right)+\frac{7}{18}=\frac{5}{6}\cdot\left(\frac{4}{6}-\frac{1}{6}\right)+\frac{7}{18}$

$=\frac{5}{6}\cdot\frac{3}{6}+\frac{7}{18}$

$=\frac{5}{12}+\frac{7}{18}$

$=\frac{15}{36}+\frac{14}{36}$

$=\frac{29}{36}$

41. $\frac{3}{4}\cdot\left(\frac{11}{12}-\frac{7}{8}\right)+\frac{5}{16}=\frac{3}{4}\cdot\left(\frac{22}{24}-\frac{21}{24}\right)+\frac{5}{16}$

$=\frac{3}{4}\cdot\frac{1}{24}+\frac{5}{16}$

$=\frac{1}{32}+\frac{5}{16}$

$=\frac{1}{32}+\frac{10}{32}$

$=\frac{11}{32}$

42. $\frac{7}{12}-\left(\frac{2}{3}\right)^2+\frac{5}{8}=\frac{7}{12}-\frac{4}{9}+\frac{5}{8}$

$=\frac{21}{36}-\frac{16}{36}+\frac{5}{8}$

$=\frac{5}{36}+\frac{5}{8}$

$=\frac{10}{72}+\frac{45}{72}$

$=\frac{55}{72}$

43. $\frac{11}{16}-\left(\frac{3}{4}\right)^2+\frac{7}{12}=\frac{11}{16}-\frac{9}{16}+\frac{7}{12}$

$=\frac{2}{16}+\frac{7}{12}$

$=\frac{1}{8}+\frac{7}{12}$

$=\frac{3}{24}+\frac{14}{24}$

$=\frac{17}{24}$

44. $\frac{3}{4}\cdot\left(\frac{4}{9}\right)^2+\frac{1}{2}=\frac{3}{4}\cdot\frac{16}{81}+\frac{1}{2}$

$=\frac{4}{27}+\frac{1}{2}$

$=\frac{8}{54}+\frac{27}{54}$

$=\frac{35}{54}$

45. $\frac{9}{10}\cdot\left(\frac{2}{3}\right)^3+\frac{2}{3}=\frac{9}{10}\cdot\frac{8}{27}+\frac{2}{3}$

$=\frac{4}{15}+\frac{2}{3}$

$=\frac{4}{15}+\frac{10}{15}$

$=\frac{14}{15}$

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46. $\left(\frac{1}{2}+\frac{3}{4}\right)\div\frac{5}{8}=\left(\frac{2}{4}+\frac{3}{4}\right)\div\frac{5}{8}$

$=\frac{5}{4}\cdot\frac{8}{5}$

$=2$

47. $\left(\frac{2}{3}+\frac{5}{6}\right)\div\frac{5}{9}=\left(\frac{4}{6}+\frac{5}{6}\right)\div\frac{5}{9}$

$=\frac{9}{6}\cdot\frac{9}{5}$

$=\frac{27}{10}$

$=2\frac{7}{10}$

48. $\frac{3}{8}\div\left(\frac{5}{12}+\frac{3}{8}\right)=\frac{3}{8}\div\left(\frac{10}{24}+\frac{9}{24}\right)$

$=\frac{3}{8}\div\frac{19}{24}$

$=\frac{3}{8}\cdot\frac{24}{19}$

$=\frac{9}{19}$

49. $\frac{7}{12}\div\left(\frac{2}{3}+\frac{5}{9}\right)=\frac{7}{12}\div\left(\frac{6}{9}+\frac{5}{9}\right)$

$=\frac{7}{12}\div\frac{11}{9}$

$=\frac{7}{12}\cdot\frac{9}{11}$

$=\frac{21}{44}$

50. $\left(\frac{3}{8}\right)^2\div\left(\frac{3}{7}+\frac{3}{14}\right)=\left(\frac{3}{8}\right)^2\div\left(\frac{6}{14}+\frac{3}{14}\right)$

$=\left(\frac{3}{8}\right)^2\div\frac{9}{14}$

$=\frac{9}{64}\cdot\frac{14}{9}$

$=\frac{7}{32}$

51. $\left(\frac{5}{6}\right)^2\div\left(\frac{5}{12}+\frac{2}{3}\right)=\left(\frac{5}{6}\right)^2\div\left(\frac{5}{12}+\frac{8}{12}\right)$

$=\left(\frac{5}{6}\right)^2\div\frac{13}{12}$

$=\frac{25}{36}\cdot\frac{12}{13}$

$=\frac{25}{39}$

52. $\frac{2}{5}\div\frac{3}{8}\cdot\frac{4}{5}=\frac{2}{5}\cdot\frac{8}{3}\cdot\frac{4}{5}$

$=\frac{16}{15}\cdot\frac{4}{5}$

$=\frac{64}{75}$

53. $\left(\frac{1}{6}+\frac{1}{2}\right)^2+\frac{2}{3}=\left(\frac{1}{6}+\frac{3}{6}\right)^2+\frac{2}{3}$

$=\left(\frac{4}{6}\right)^2+\frac{2}{3}$

$=\left(\frac{2}{3}\right)^2+\frac{2}{3}$

$=\frac{4}{9}+\frac{6}{9}$

$=\frac{10}{9}$

$=1\frac{1}{9}$

54. $\left(\frac{7}{8}-\frac{1}{2}\right)^2-\frac{1}{16}=\left(\frac{7}{8}-\frac{4}{8}\right)^2-\frac{1}{16}$

$=\left(\frac{3}{8}\right)^2-\frac{1}{16}$

$=\frac{9}{64}-\frac{1}{16}$

$=\frac{9}{64}-\frac{4}{64}$

$=\frac{5}{64}$

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55. $\frac{5}{6}+\left(\frac{3}{4}-\frac{1}{2}\right)^2=\frac{5}{6}+\left(\frac{3}{4}-\frac{2}{4}\right)^2$

$=\frac{5}{6}+\left(\frac{1}{4}\right)^2$

$=\frac{5}{6}+\frac{1}{16}$

$=\frac{40}{48}+\frac{3}{48}$

$=\frac{43}{48}$

56a. $\frac{2}{9}\cdot\left(\frac{5}{6}+\frac{3}{4}\right)\div\frac{3}{5}$

b. $\frac{2}{9}\cdot\frac{5}{6}+\left(\frac{3}{4}\div\frac{3}{5}\right)$

Critical Thinking

57a. $\frac{13}{50}=\frac{26}{100}$ Location

$\frac{1}{4}=\frac{25}{100}$ Food Quality

More people choose location.

b. $\frac{1}{4}=\frac{25}{100}$ Food Quality

$\frac{13}{50}=\frac{26}{100}$ Location

$\frac{4}{25}=\frac{16}{100}$ Menu

$\frac{2}{25}=\frac{8}{100}$ Price

$\frac{3}{25}=\frac{12}{100}$ Speed

$\frac{3}{100}=\frac{3}{100}$ Other

The criterion that was cited by most people was location.

Projects or Group Activities

58. $\frac{7}{8}+\frac{2}{3}\left(\frac{1}{2}+\frac{5}{6}\right)=\frac{7}{8}+\frac{2}{3}\left(\frac{3}{6}+\frac{5}{6}\right)$

$=\frac{7}{8}+\frac{2}{3}\left(\frac{8}{6}\right)$

$=\frac{7}{8}+\frac{\overset{1}{\cancel{2}}}{3}\cdot\frac{8}{\underset{3}{\cancel{6}}}$

$=\frac{7}{8}+\frac{8}{9}$

$=\frac{63}{72}+\frac{64}{72}$

$=\frac{127}{72}$

$=1\frac{55}{72}$

59. $\left(\frac{7}{8}+\frac{2}{3}\right)\frac{1}{2}+\frac{5}{6}=\left(\frac{21}{24}+\frac{16}{24}\right)\frac{1}{2}+\frac{5}{6}$

$=\left(\frac{37}{24}\right)\frac{1}{2}+\frac{5}{6}$

$=\frac{37}{48}+\frac{5}{6}$

$=\frac{37}{48}+\frac{40}{48}$

$=\frac{77}{48}$

$=1\frac{29}{48}$

60. $\frac{7}{8}+\left(\frac{2}{3}\cdot\frac{1}{2}\right)+\frac{5}{6}=\frac{7}{8}+\left(\frac{\overset{1}{\cancel{2}}}{3}\cdot\frac{1}{\underset{1}{\cancel{2}}}\right)+\frac{5}{6}$

$=\frac{7}{8}+\frac{1}{3}+\frac{5}{6}$

$=\frac{21}{24}+\frac{8}{24}+\frac{20}{24}$

$=\frac{49}{24}$

$=2\frac{1}{24}$

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Chapter 2 Review Exercises

1. $\frac{30}{45}=\frac{2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{5}}}{3\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{5}}}=\frac{2}{3}$

2. $\left(\frac{3}{4}\right)^3\cdot\frac{20}{27}-\frac{1}{8}=\left(\frac{3}{4}\cdot\frac{3}{4}\cdot\frac{3}{4}\right)\left(\frac{20}{27}\right)-\frac{1}{8}$

$$=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 5}{2\cdot 2\cdot 2\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}}-\frac{1}{8}$$

$$=\frac{5}{16}-\frac{1}{8}$$

$$=\frac{5}{16}-\frac{2}{16}$$

$$=\frac{3}{16}$$

3. $\frac{13}{4}$

4. $44\div 11=4;\frac{8\cdot 4}{11\cdot 4}=\frac{32}{44}$

5. $\frac{11}{18}=\frac{44}{72},\frac{17}{24}=\frac{51}{72},\frac{11}{18}<\frac{17}{24}$

6.
$$\begin{array}{r} 18\frac{1}{6}=18\frac{7}{42}=17\frac{49}{42}\\ -3\frac{5}{7}=3\frac{30}{42}=3\frac{30}{42}\\ \hline 14\frac{19}{42}\end{array}$$

7. $\frac{2}{7}\left(\frac{5}{8}-\frac{1}{3}\right)\div\frac{3}{5}=\frac{2}{7}\left(\frac{15}{24}-\frac{8}{24}\right)\div\frac{3}{5}$

$$=\frac{2}{7}\left(\frac{7}{24}\right)\div\frac{3}{5}=\frac{1}{12}\div\frac{3}{5}=\frac{1}{12}\times\frac{5}{3}=\frac{5}{36}$$

8. $2\frac{1}{3}\times 3\frac{7}{8}=\frac{7}{3}\times\frac{31}{8}=\frac{7\cdot 31}{3\cdot 8}=\frac{217}{24}=9\frac{1}{24}$

9. $1\frac{1}{3}\div\frac{2}{3}=\frac{4}{3}\div\frac{2}{3}=\frac{4}{3}\times\frac{3}{2}=\frac{4\cdot 3}{3\cdot 2}=\frac{2\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{2}}}=2$

10.
$$\begin{array}{r} \frac{17}{24}=\frac{34}{48}\\ -\frac{3}{16}=\frac{9}{48}\\ \hline \frac{25}{48}\end{array}$$

11. $8\frac{2}{3}\div 2\frac{3}{5}=\frac{26}{3}\div\frac{13}{5}=\frac{26}{3}\times\frac{5}{13}$

$$=\frac{26\cdot 5}{3\cdot 13}=\frac{2\cdot\overset{1}{\cancel{13}}\cdot 5}{3\cdot\underset{1}{\cancel{13}}}$$

$$=\frac{10}{3}=3\frac{1}{3}$$

12.

	2	3	5
$20=$	$2\cdot 2$		5
$48=$	$2\cdot 2\cdot 2\cdot 2$	3	

GCF $=2\cdot 2=4$

13. $36\div 12=3;\frac{2\cdot 12}{3\cdot 12}=\frac{24}{36}$

14. $\frac{15}{28}\div\frac{5}{7}=\frac{15}{28}\times\frac{7}{5}=\frac{15\cdot 7}{28\cdot 5}=\frac{3\cdot\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{7}}}{2\cdot 2\cdot\underset{1}{\cancel{7}}\cdot\underset{1}{\cancel{5}}}=\frac{3}{4}$

15.
$$\begin{array}{r} \frac{2}{3}=\frac{12}{18}\\ \frac{5}{6}=\frac{15}{18}\\ +\frac{2}{9}=\frac{4}{18}\\ \hline \frac{31}{18}=1\frac{13}{18}\end{array}$$

16. $2\frac{1}{4}\times 7\frac{1}{3}=\frac{9}{4}\times\frac{22}{3}=\frac{9\cdot 22}{4\cdot 3}=\frac{3\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{2}}\cdot 11}{\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}}$

$$=\frac{33}{2}=16\frac{1}{2}$$

17.

	2	3
$18=$	2	$3\cdot 3$
$12=$	$2\cdot 2$	$3\cdot 3$

LCM $=2\cdot 2\cdot 3\cdot 3=36$

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18. $\frac{16}{24}=\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 11}=\frac{4}{11}$

19.
$$\begin{array}{r} \frac{3}{8} \\ \frac{5}{8} \\ +\frac{1}{8} \\ \hline \frac{9}{8}=1\frac{1}{8} \end{array}$$

20. $\frac{11}{50}\times\frac{25}{44}=\frac{11\cdot 25}{50\cdot 44}=\frac{\overset{1}{11}\cdot\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{5}}}{2\cdot\underset{1}{\cancel{5}}\cdot\underset{1}{\cancel{5}}\cdot 2\cdot 2\cdot\underset{1}{11}}=\frac{1}{8}$

21.
$$\begin{array}{r} 4\frac{4}{9}=4\frac{24}{54} \\ 2\frac{1}{6}=2\frac{9}{54} \\ +11\frac{17}{27}=11\frac{34}{54} \\ \hline 17\frac{67}{54}=18\frac{13}{54} \end{array}$$

22.

	3	5
15 =	3	⑤
25 =		5 · 5

GCF = 5

23. $5\overline{)17}\ \begin{array}{r} 3 \\ -15 \\ \hline 2 \end{array}$ $\qquad \frac{17}{5}=3\frac{2}{5}$

24. $\left(\frac{4}{5}-\frac{2}{3}\right)^2\div\frac{4}{15}=\left(\frac{12}{15}-\frac{10}{15}\right)^2\div\frac{4}{15}$

$=\left(\frac{2}{15}\right)^2\div\frac{4}{15}=\left(\frac{2}{15}\right)\left(\frac{2}{15}\right)\div\frac{4}{15}$

$=\frac{4}{225}\times\frac{15}{4}=\frac{4\cdot 15}{225\cdot 4}=\frac{1}{15}$

25.
$$\begin{array}{r} \frac{3}{8}=\frac{9}{24} \\ 1\frac{2}{3}=1\frac{16}{24} \\ +3\frac{5}{6}=3\frac{20}{24} \\ \hline 4\frac{45}{24}=5\frac{21}{24}=5\frac{7}{8} \end{array}$$

26.

	2	3
18 =	②	3 · 3
27 =		3 · 3 · 3

LCM $= 2\cdot 3\cdot 3\cdot 3 = 54$

27.
$$\begin{array}{r} \frac{11}{18} \\ -\frac{5}{18} \\ \hline \frac{6}{18}=\frac{1}{3} \end{array}$$

28. $2\frac{5}{7}=\frac{14+5}{7}=\frac{19}{7}$

29. $\frac{5}{6}\div\frac{5}{12}=\frac{5}{6}\cdot\frac{12}{5}=\frac{5\cdot 12}{6\cdot 5}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{5}}}=2$

30. $\frac{5}{12}\times\frac{4}{25}=\frac{5\cdot 4}{12\cdot 25}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot\underset{1}{\cancel{5}}\cdot 5}=\frac{1}{15}$

31.
$$\begin{array}{r} 16\ =\ 15\frac{8}{8} \\ -5\frac{7}{8}=5\frac{7}{8} \\ \hline 10\frac{1}{8} \end{array}$$

32. $1\frac{7}{8}$

33. **Strategy** To find the total rainfall for the three months, add the amounts of rain from each month $\left(5\frac{1}{2}, 6\frac{3}{10}, \text{ and } 8 \text{ centimetres}\right)$.

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Solution
$$5\frac{1}{2}=5\frac{10}{20}$$
$$6\frac{3}{10}=6\frac{6}{20}$$
$$+\quad 8=8$$
$$19\frac{16}{20}=19\frac{4}{5}$$

The total rainfall for the three months was $19\frac{4}{5}$ centimetres.

34. Strategy To find the cost of each acre, divide the total cost ($168 000) by the number of acres $\left(4\frac{2}{3}\right)$.

Solution
$$168\,000\div 4\frac{2}{3}=168\,000\div\frac{14}{3}$$
$$=168\,000\times\frac{3}{14}$$
$$=36\,000$$

The cost per acre was $36 000.

35. Strategy To find how many kilometres the second checkpoint is from the finish line:

- Add the distance to the first checkpoint $\left(4\frac{1}{2}\text{ kilometres}\right)$ to the distance between the first checkpoint and the second checkpoint $\left(5\frac{3}{4}\text{ kilometres}\right)$.
- Subtract the total distance to the second checkpoint from the entire length of the race (15 kilometres).

Solution
$$4\frac{1}{2}=4\frac{2}{4}$$
$$+5\frac{3}{4}=5\frac{3}{4}$$
$$9\frac{5}{4}=10\frac{1}{4}$$

$$15=14\frac{4}{4}$$
$$-10\frac{1}{4}=10\frac{1}{4}$$
$$4\frac{3}{4}$$

The second checkpoint is $4\frac{3}{4}$ kilometres from the finish line.

36. Strategy To find how many kilometres the car can travel, multiply the number of kilometres the car can travel on 1 litre (9) by the number of litres used $\left(6\frac{3}{4}\right)$.

Solution
$$9\times 6\frac{3}{4}=9\times\frac{27}{4}$$
$$=\frac{9\cdot 27}{4}=\frac{243}{4}=60\frac{3}{4}$$

The car can travel $60\frac{3}{4}$ kilometres.

Chapter 2 Test

1. $\frac{9}{11}\times\frac{44}{81}=\frac{9\cdot 44}{11\cdot 81}=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot 2\cdot 2\cdot\overset{1}{\cancel{11}}}{\underset{1}{\cancel{11}}\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot 3\cdot 3}=\frac{4}{9}$

2.

	2	3	5
$24=$	$2\cdot 2\cdot 2$	3	
$80=$	$2\cdot 2\cdot 2\cdot 2$		5

$\text{GCF}=2\cdot 2\cdot 2=8$

3. $\frac{5}{9}\div\frac{7}{18}=\frac{5}{9}\times\frac{18}{7}=\frac{5\cdot 2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}\cdot 7}=\frac{10}{7}=1\frac{3}{7}$

4.
$$\left(\frac{3}{4}\right)^2\div\left(\frac{2}{3}+\frac{5}{6}\right)-\frac{1}{12}=\left(\frac{3}{4}\cdot\frac{3}{4}\right)\div\left(\frac{4}{6}+\frac{5}{6}\right)-\frac{1}{12}$$

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5. $9\frac{4}{5} = \frac{45+4}{5} = \frac{49}{5}$

6. $5\frac{2}{3} \times 1\frac{7}{17} = \frac{17}{3} \times \frac{24}{17} = \frac{17 \cdot 24}{3 \cdot 17}$

$$= \frac{\overset{1}{\cancel{17}} \cdot 2 \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{17}}} = 8$$

7. $\frac{40}{64} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 5}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 2} = \frac{5}{8}$

8. $\frac{3}{8} = \frac{9}{24}, \frac{5}{12} = \frac{10}{24}, \frac{3}{8} < \frac{5}{12}$

9. $\left(\frac{1}{4}\right)^3 \div \left(\frac{1}{8}\right)^2 - \frac{1}{6} = \left(\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}\right) \div \left(\frac{1}{8} \cdot \frac{1}{8}\right) - \frac{1}{6}$

$= \frac{1}{64} \div \frac{1}{64} - \frac{1}{6}$

$= \frac{1}{64} \times \frac{64}{1} - \frac{1}{6}$

$= 1 - \frac{1}{6}$

$= \frac{6}{6} - \frac{1}{6} = \frac{5}{6}$

10.

	2	3	5
$24 =$	$2 \cdot 2 \cdot 2$	③	
$40 =$	$2 \cdot 2 \cdot 2$		⑤

LCM $= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 = 120$

11.

$$\begin{array}{r} \frac{17}{24} \\ -\frac{11}{24} \\ \hline \frac{6}{24} = \frac{1}{4} \end{array}$$

12.

$$\begin{array}{r} 3 \\ 5\overline{)18} \\ -15 \\ \hline 3 \end{array} \qquad \frac{18}{5} = 3\frac{3}{5}$$

13. $6\frac{2}{3} \div 3\frac{1}{6} = \frac{20}{3} \div \frac{19}{6} = \frac{20}{3} \times \frac{6}{19}$

$$= \frac{2 \cdot 2 \cdot 5 \cdot 2 \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 19} = \frac{40}{19} = 2\frac{2}{19}$$

14. $72 \div 8 = 9$; $\frac{5 \cdot 9}{8 \cdot 9} = \frac{45}{72}$

15.

$$\begin{array}{r} \frac{5}{6} = \frac{75}{90} \\ \frac{7}{9} = \frac{70}{90} \\ +\frac{1}{15} = \frac{6}{90} \\ \hline \frac{151}{90} = 1\frac{61}{90} \end{array}$$

16.

$$\begin{array}{r} 23\frac{1}{8} = 23\frac{11}{88} = 22\frac{99}{88} \\ -9\frac{9}{44} = 9\frac{18}{88} = 9\frac{18}{88} \\ \hline 13\frac{81}{88} \end{array}$$

17.

$$\begin{array}{r} \frac{9}{16} = \frac{27}{48} \\ -\frac{5}{12} = \frac{20}{48} \\ \hline \frac{7}{48} \end{array}$$

18. $\left(\frac{2}{3}\right)^4 \left(\frac{27}{32}\right) + \frac{1}{32} = \left(\frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3}\right)\left(\frac{27}{32}\right) + \frac{1}{32}$

$$= \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 3 \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2} + \frac{1}{32}$$

$= \frac{1}{6} + \frac{1}{32}$

$= \frac{16}{96} + \frac{3}{96}$

$= \frac{19}{96}$

19.

$$\begin{array}{r} \frac{7}{12} \\ \frac{11}{12} \\ +\frac{5}{12} \\ \hline \frac{23}{12} = 1\frac{11}{12} \end{array}$$

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20. $12\frac{5}{12} = 12\frac{25}{60}$

$+\,9\frac{17}{20} = 9\frac{51}{60}$

$21\frac{76}{60} = 22\frac{16}{60} = 22\frac{4}{15}$

21. $\frac{11}{4}$

22. **Strategy** To find the electrician's earnings, multiply daily earnings ($240) by the number of days worked $\left(3\frac{1}{2}\right)$.

Solution $240 \times 3\frac{1}{2} = 240 \times \frac{7}{2}$

$= \frac{240 \cdot 7}{2} = 840$

The electrician earns $840.

23. **Strategy** To find how many lots were available:

- Find how many acres were being developed by subtracting the amount set aside for the park $\left(1\frac{3}{4} \text{ acres}\right)$ from the total parcel $\left(7\frac{1}{4} \text{ acres}\right)$.
- Divide the amount being developed by the size of each lot $\left(\frac{1}{2} \text{ acre}\right)$.

Solution $7\frac{1}{4} = 6\frac{5}{4}$

$-1\frac{3}{4} = 1\frac{3}{4}$

$5\frac{2}{4} = 5\frac{1}{2}$

$5\frac{1}{2} \div \frac{1}{2} = \frac{11}{2} \times \frac{2}{1} = \frac{11 \cdot 2}{2} = 11$

11 lots were available for sale.

24. **Strategy** Multiply the numerical value of each measurement in inches by 2 and change the units to feet.

Solution Wall *a*:

$6\frac{1}{4} \times 2 = \frac{25}{4} \times \frac{2}{1} = \frac{25 \cdot \overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}} \cdot 1}$

$= \frac{25}{2} = 12\frac{1}{2}$

The actual length of wall *a* is $12\frac{1}{2}$ feet.

Wall *b*: $9 \times 2 = 18$

The actual length of wall *b* is 18 feet.

Wall *c*:

$7\frac{7}{8} \times 2 = \frac{63}{8} \times \frac{2}{1} = \frac{63 \cdot \overset{1}{\cancel{2}}}{\underset{4}{\cancel{8}} \cdot 1}$

$= \frac{63}{4} = 15\frac{3}{4}$

The actual length of wall *c* is $15\frac{3}{4}$ feet.

25. **Strategy** To find the total rainfall for the 3-month period, add the rainfall amounts for each of the months $\left(11\frac{1}{2}, 7, \text{ and } 2\frac{7}{10} \text{ centimetres}\right)$.

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Solution
$$11\frac{1}{2} = 11\frac{5}{10}$$
$$7 \;=\; 7$$
$$+2\frac{7}{10} \;=\; 2\frac{7}{10}$$
$$20\frac{12}{10} = 21\frac{1}{5}$$

The total rainfall for the period was $21\frac{1}{5}$ centimetres.

Cumulative Review Exercises

1. 290 000

2.
$$\begin{array}{r} {\scriptstyle 9\ \ 9\ 13}\\ 3\not{9}\not{0}\ 0\not{4}7 \\ -\ 98\,769 \\ \hline 291\,278 \end{array}$$

3.
$$\begin{array}{r} 926 \\ \times\ \ 79 \\ \hline 8334 \\ 6482 \\ \hline 73\ 154 \end{array}$$

4.
$$\begin{array}{r|l} & 540\ \text{r}12 \\ \hline 57 & 30\,792 \\ & -285 \\ & \hline 229 \\ & -228 \\ & \hline 12 \\ & -0 \\ & \hline 12 \end{array}$$

5. $4\cdot(6-3)\div 6-1 = 4\cdot 3\div 6-1$
$= 12\div 6-1$
$= 2-1$
$= 1$

6.
$$\begin{array}{r|l} & 44 \\ \hline 2 & 22 \\ 2 & 11 \\ 11 & 1 \end{array}$$
$44 = 2\cdot 2\cdot 11$

7.
$$\begin{array}{r|cccc} & 2 & 3 & 5 & 7 \\ \hline 30 = & \textcircled{2} & \textcircled{3} & \textcircled{5} & \\ 42 = & 2 & 3 & & \textcircled{7} \end{array}$$
$\text{LCM} = 2\cdot 3\cdot 5\cdot 7 = 210$

8.
$$\begin{array}{r|cc} & 2 & 3\ \ 5 \\ \hline 60 = & \textcircled{2}\cdot\textcircled{2} & 3\ \ \textcircled{5} \\ 80 = & 2\cdot 2\cdot 2\cdot 2 & \ \ 5 \end{array}$$
$\text{GCF} = 2\cdot 2\cdot 5 = 20$

9. $7\frac{2}{3} = \frac{21+2}{3} = \frac{23}{3}$

10.
$$\begin{array}{r|l} & 6\ \text{r}1 \\ \hline 4 & 25 \\ & -24 \\ & \hline 1 \end{array}$$
$\frac{25}{4} = 6\frac{1}{4}$

11. $48\div 16 = 3$; $\frac{5\cdot 3}{16\cdot 3} = \frac{15}{48}$

12. $\frac{24}{60} = \frac{2\cdot\overset{1}{\not 2}\cdot\overset{1}{\not 2}\cdot\overset{1}{\not 3}}{\underset{1}{\not 2}\cdot\underset{1}{\not 2}\cdot\underset{1}{\not 3}\cdot 5} = \frac{2}{5}$

13.
$$\frac{7}{12} = \frac{28}{48}$$
$$+\frac{9}{16} = \frac{27}{48}$$
$$\frac{55}{48} = 1\frac{7}{48}$$

14.
$$3\frac{7}{8} = 3\frac{42}{48}$$
$$7\frac{5}{12} = 7\frac{20}{48}$$
$$+2\frac{15}{16} = 2\frac{45}{48}$$
$$12\frac{107}{48} = 14\frac{11}{48}$$

15.
$$\frac{11}{12} = \frac{22}{24}$$
$$-\frac{3}{8} = \frac{9}{24}$$
$$\frac{13}{24}$$

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16. $5\frac{1}{6} = 5\frac{3}{18} = 4\frac{21}{18}$

$-3\frac{7}{18} = 3\frac{7}{18} = 3\frac{7}{18}$

$1\frac{14}{18} = 1\frac{7}{9}$

17. $\frac{3}{8} \times \frac{14}{15} = \frac{3 \cdot 14}{8 \cdot 15} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{2}} \cdot 7}{2 \cdot 2 \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{3}} \cdot 5} = \frac{7}{20}$

18. $3\frac{1}{8} \times 2\frac{2}{5} = \frac{25}{8} \times \frac{12}{5} = \frac{25 \cdot 12}{8 \cdot 5}$

$= \frac{5 \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{2 \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{5}}} = \frac{15}{2} = 7\frac{1}{2}$

19. $\frac{7}{16} \div \frac{5}{12} = \frac{7}{16} \times \frac{12}{5} = \frac{7 \cdot 12}{16 \cdot 5}$

$= \frac{7 \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 3}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 5} = \frac{21}{20} = 1\frac{1}{20}$

20. $6\frac{1}{8} \div 2\frac{1}{3} = \frac{49}{8} \div \frac{7}{3} = \frac{49}{8} \times \frac{3}{7} = \frac{49 \cdot 3}{8 \cdot 7}$

$= \frac{7 \cdot \overset{1}{\cancel{7}} \cdot 3}{2 \cdot 2 \cdot 2 \cdot \underset{1}{\cancel{7}}} = \frac{21}{8} = 2\frac{5}{8}$

21. $\left(\frac{1}{2}\right)^3 \cdot \frac{8}{9} = \left(\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}\right) \cdot \frac{8}{9} = \frac{1}{8} \cdot \frac{8}{9} = \frac{1}{9}$

22. $\left(\frac{1}{2} + \frac{1}{3}\right) \div \left(\frac{2}{5}\right)^2 = \left(\frac{3}{6} + \frac{2}{6}\right) \div \left(\frac{2}{5} \cdot \frac{2}{5}\right)$

$= \frac{5}{6} \div \frac{4}{25} = \frac{5}{6} \times \frac{25}{4} = \frac{5 \cdot 25}{6 \cdot 4} = \frac{125}{24} = 5\frac{5}{24}$

23. **Strategy** To find the amount in the chequing account:

- Find the total of the cheques written by adding the cheque amounts ($128, $54, and $315).
- Subtract the total of the cheques written from the original balance in the chequing account ($1359).

Solution

128	1359
54	−497
+315	862
497	

The amount in the chequing account was $862.

24. **Strategy** To find the total income from the sale of the tickets:

- Find the income from the adult tickets by multiplying the ticket price ($11) by the number of tickets sold (87).
- Find the income from the student tickets by multiplying the ticket price ($8) by the number of tickets sold (135).
- Find the total income by adding the income from the adult tickets to the income from the student tickets.

Solution

87	135	957
× 11	× 8	+1080
957	1080	2037

The total income from the tickets was $2037.

25. **Strategy** To find the total weight, add the three weights.

Solution

$1\frac{1}{2} = 1\frac{12}{24}$

$7\frac{7}{8} = 7\frac{21}{24}$

$+2\frac{2}{3} = 2\frac{16}{24}$

$10\frac{49}{24} = 12\frac{1}{24}$

The total weight is $12\frac{1}{24}$ kilograms.

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26. Strategy Subtract the length of the cut piece from the original length of the board.

Solution
$$2\frac{1}{10} = 2\frac{1}{10} = 1\frac{11}{10}$$
$$-1\frac{1}{2} = 1\frac{5}{10} = 1\frac{5}{10}$$
$$\frac{6}{10} = \frac{3}{5}$$

The length of the remaining piece is $\frac{3}{5}$ metre .

27. Strategy To find how many kilometres the car can travel, multiply the number of litres used $\left(8\frac{1}{2}\right)$ by the number of kilometres that the car travels on each litre (7).

Solution $7 \times 8\frac{1}{2} = 7 \times \frac{17}{2} = \frac{119}{2} = 59\frac{1}{2}$

The car travels $59\frac{1}{2}$ kilometres on $8\frac{1}{2}$ litres of gas.

28. Strategy To find how many parcels can be sold:

- Find the amount of land that can be developed by subtracting the land donated for a park (2 acres) from the total amount of land purchased $\left(10\frac{1}{3}\text{ acres}\right)$.
- Divide the amount of land that can be developed by the size of each parcel $\left(\frac{1}{3}\text{ acres}\right)$.

Solution
$$10\frac{1}{3}$$
$$-2$$
$$8\frac{1}{3}$$
$$8\frac{1}{3} \div \frac{1}{3} = \frac{25}{3} \div \frac{1}{3} = \frac{25}{3} \times \frac{3}{1} = 25$$

25 parcels can be sold from the remaining land.

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2 Fractions

Section 2.1: The Least Common Multiple and Greatest Common Factor

■ Objective 2.1A

To find the least common multiple (LCM)

New Vocabulary

multiples of a number
common multiple
least common multiple (LCM)

Discuss the Concepts

1. How can you find the multiples of 12?
2. How can you find some common multiples of 8 and 12?
3. Why is 24 the least common multiple of 8 and 12?

Concept Check

Find the LCM of 16, 20, and 40 by first listing the multiples of each number and then using the prime factorization method shown on page 68 of the textbook. **80**

Optional Student Activity

The ancient Mayans used two calendars, a civil calendar of 365 days and a sacred calendar of 260 days. If a civil year and the sacred year begin on the same day, how many civil years and how many sacred years will pass before this situation occurs again?

The LCM of 365 and 260 is 18 980.
18 980 ÷ 365 = 52
18 980 ÷ 260 = 73
The situation occurs again after 52 civil years and 73 sacred years.

■ Objective 2.1B

To find the greatest common factor (CGF)

Vocabulary to Review

factors of a number **[1.8A]**

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New Vocabulary

common factor
greatest common factor (GCF)

Discuss the Concepts

1. How can you find the factors of 24?
2. How can you find the common factors of 12 and 24?
3. Why is 12 the greatest common factor of 12 and 24?

Concept Check

Find the product of the GCF of 225 and 444 and the LCM of 225 and 444.
GCF = 3; LCM = 33 300; 3(33 300) = 99 900

Concept Check

Find the GCF of $2^5 \cdot 3^9 \cdot 5^7$ and $2^7 \cdot 3^2 \cdot 5^4$.
$2^5 \cdot 3^2 \cdot 5^4 = 180\,000$

Optional Student Activity

What number must be multiplied by 200 so that the product has exactly 15 factors?
2; Factors: 1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80, 100, 200, 400

Section 2.2: Introduction to Fractions

■ Objective 2.2A

To write a fraction that represents part of a whole

New Vocabulary

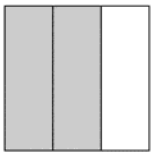
fraction
fraction bar
numerator
denominator
proper fraction
mixed number
improper fraction

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Discuss the Concepts

Explain why the shaded portion of the diagram can be described as $\frac{2}{3}$.



Concept Check

Write a proper fraction and explain why it is a proper fraction.
Write a mixed number and explain why it is a mixed number.
Write an improper fraction and explain why it is an improper fraction.

Optional Student Activity

Use the symbol < , >, or = to compare each number with the number 1.

1. $\frac{3}{7}$ $\frac{3}{7} < 1$
2. $\frac{9}{9}$ $\frac{9}{9} = 1$
3. $\frac{8}{5}$ $\frac{8}{5} > 1$

■ Objective 2.2B

To write an improper fraction as a mixed number or a whole number, and a mixed number as an improper fraction

Vocabulary to Review

improper fraction **[2.2A]**
mixed number **[2.2A]**

Discuss the Concepts

1. Explain the procedure for rewriting an improper fraction as a mixed number or a whole number.
2. Explain the procedure for rewriting a mixed number as an improper fraction.

Concept Check

Match the equivalent mixed numbers and improper fractions.

1. $\frac{9}{2}$ **a.** $2\frac{7}{9}$
2. $\frac{25}{9}$ **b.** $2\frac{2}{9}$

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3. $\frac{19}{4}$ **c.** $4\frac{1}{2}$

4. $\frac{15}{4}$ **d.** $3\frac{3}{4}$

5. $\frac{20}{9}$ **e.** $4\frac{3}{4}$

1. c **2. a** **3. e** **4. d** **5. b**

Section 2.3: Writing Equivalent Fractions

■ Objective 2.3A

To find equivalent fractions by raising to higher terms

Properties to Review

Multiplication Property of One **[1.4A]**

New Vocabulary

equivalent fractions

Discuss the Concepts

Explain the procedure for finding equivalent fractions.

Optional Student Activity

1. Divide two-thirds of a circle into sixths and write the equivalent fraction.

2. Divide one-third of a circle into ninths and write the equivalent fraction.

3. Divide three-fourths of a circle into eighths and write the equivalent fraction.

4. Divide one-fourth of a circle into twelfths and write the equivalent fraction.

1. $\frac{4}{6}$ **2.** $\frac{3}{9}$ **3.** $\frac{6}{8}$ **4.** $\frac{3}{12}$

■ Objective 2.3B

To write a fraction in simplest form

Vocabulary to Review

common factors **[2.1B]**

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New Vocabulary

simplest form of a fraction

Discuss the Concepts

Explain the procedure for simplifying fractions.

Concept Check

Name the equivalent fractions in the list below. Then name the fractions that are written in simplest form.

$\frac{6}{8}$ $\frac{15}{20}$ $\frac{9}{16}$ $\frac{3}{4}$ $\frac{18}{24}$

The equivalent fractions are $\frac{6}{8}, \frac{12}{16}, \frac{3}{4}$, and $\frac{18}{24}$. The fractions $\frac{3}{4}$ and $\frac{9}{16}$ are in simplest form.

Section 2.4: Addition of Fractions and Mixed Numbers

■ Objective 2.4A

To add fractions with the same denominator

Vocabulary to Review

numerator **[2.2A]**
denominator **[2.2A]**

Discuss the Concepts

Explain the procedure for adding two fractions with the same denominator.

Concept Check

Which of the following fractions, when added together, have a sum of 2?

$\frac{1}{9}, \frac{2}{9}, \frac{4}{9}, \frac{5}{9}, \frac{7}{9}$

$\frac{2}{9}, \frac{4}{9}, \frac{5}{9}$, and $\frac{7}{9}$

■ Objective 2.4B

To add fractions with different denominators

Vocabulary to Review

least common multiple (LCM) **[2.1A]**

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New Vocabulary

least common denominator (LCD)

Discuss the Concepts

Explain why two fractions must have the same denominator before they can be added.

Optional Student Activity

Without calculating, decide which is greater. Explain your reasoning.

1. $\frac{1}{2}+\frac{2}{3}$ or $\frac{1}{4}+\frac{2}{5}$

2. $\frac{5}{6}+\frac{4}{9}$ or $\frac{3}{8}+\frac{3}{20}$

1. $\mathbf{\frac{1}{2}+\frac{2}{3}}$

2. $\mathbf{\frac{5}{6}+\frac{4}{9}}$

Explanations will vary. For example, in Exercise 1, $\frac{1}{2}>\frac{1}{4}$ and $\frac{2}{3}>\frac{2}{5}$ so the first expression must be greater than the second.

■ Objective 2.4C

To add whole numbers, mixed numbers, and fractions

Discuss the Concepts

Explain the steps involved in adding $3\frac{5}{6}$ and $4\frac{7}{12}$.

Concept Check

Find the sum of $\frac{1}{2}+1+1\frac{1}{2}+2+2\frac{1}{2}+\ \ldots\ +19\frac{1}{2}+20$.

The three dots mean that the pattern continues. **410**

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Optional Student Activity

In a magic square, the sums across, down, and diagonally are the same. Determine whether these squares are magic squares. **Yes**

1	$\frac{3}{8}$	$\frac{1}{2}$
$\frac{1}{8}$	$\frac{5}{8}$	$1\frac{1}{8}$
$\frac{3}{4}$	$\frac{7}{8}$	$\frac{1}{4}$

2	$\frac{3}{4}$	1
$\frac{1}{4}$	$1\frac{1}{4}$	$2\frac{1}{4}$
$1\frac{1}{2}$	$1\frac{3}{4}$	$\frac{1}{2}$

■ Objective 2.4D

To solve application problems

Optional Student Activity

The following are the average portions of each day that a person spends for each activity.

Sleeping, $\frac{1}{3}$

Working, $\frac{1}{3}$

Personal hygiene, $\frac{1}{24}$

Eating, $\frac{1}{8}$

Rest and relaxation, $\frac{1}{12}$

Do these five activities account for an entire day? Explain your answer.

No. These activities account for only 22 hours.

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Section 2.5: Subtraction of Fractions and Mixed Numbers

■ Objective 2.5A

To subtract fractions with the same denominator

Discuss the Concepts

1. Explain the procedure for subtracting two fractions with the same denominator.
2. What is the difference between the procedure for adding two fractions with the same denominator and the procedure for subtracting two fractions with the same denominator?

Concept Check

Which of the following fractions, when subtracted, have a difference of $\frac{2}{5}$?

$$\frac{4}{5}, \frac{3}{5}, \frac{2}{5}, \frac{1}{5}$$

$\frac{4}{5}$ and $\frac{2}{5}$, $\frac{3}{5}$ and $\frac{1}{5}$

> **Optional Student Activity**
> Use a diagram to illustrate and explain subtraction of two fractions with the same denominator.

■ Objective 2.5B

To subtract fractions with different denominators

Concept Check

Which expression is larger?

1. $\frac{11}{12} - \frac{2}{3}$ or $\frac{2}{3} - \frac{1}{8}$
2. $\frac{3}{5} - \frac{1}{3}$ or $\frac{9}{10} - \frac{7}{8}$

1. $\frac{2}{3} - \frac{1}{8}$ 2. $\frac{3}{5} - \frac{1}{3}$

■ Objective 2.5C

To subtract whole numbers, mixed numbers, and fractions

Discuss the Concepts

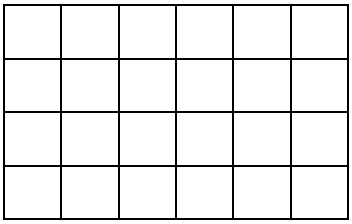
In subtraction of mixed numbers, when is borrowing necessary?

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Optional Student Activity

Use the diagram below to illustrate the difference between $\frac{5}{6}$ and $\frac{1}{8}$.



Why does the figure have 24 squares? Would it be possible to illustrate the difference between $\frac{5}{6}$ and $\frac{1}{8}$ if there were 48 squares in the figure? What if there were 16 squares? Make a list of some of the possible numbers of squares that could be used to illustrate the difference between $\frac{5}{6}$ and $\frac{1}{8}$.

■ Objective 2.5D

To solve application problems

Optional Student Activity

A university final exam is $2\frac{1}{2}$ hours long. Complete the table below. Fill in the second column by calculating the test time remaining, given the time, in hours, that has already elapsed, which is shown in the first column.

Time Elapsed	*Time Remaining*
$\frac{1}{4}$	$\mathbf{2\frac{1}{4}}$
$\frac{3}{4}$	$\mathbf{1\frac{3}{4}}$
$1\frac{1}{2}$	$\mathbf{1}$
$1\frac{3}{4}$	$\mathbf{\frac{3}{4}}$
$2\frac{1}{4}$	$\mathbf{\frac{1}{4}}$

Section 2.6: Multiplication of Fractions and Mixed Numbers

■ Objective 2.6A

To multiply fractions

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Vocabulary to Review

product **[1.4A]**

Discuss the Concepts

Explain why you need a common denominator when adding or subtracting two fractions and why you don't need a common denominator when multiplying two fractions.

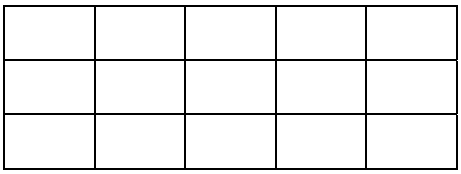
Concept Check

If two positive fractions, each less than 1, are multiplied, is the product always less than 1?

Yes

Optional Student Activity

a. Shade $\frac{1}{3}$ of the diagram shown below.



b. Shade $\frac{2}{5}$ of the $\frac{1}{3}$ of the diagram you already shaded.

c. Then use the diagram to find the product of $\frac{2}{5}$ and $\frac{1}{3}$.

a. 5 of the 15 parts should be shaded.

b. 2 of the 15 parts should be shaded.

c. $\frac{2}{15}$

■ Objective 2.6B

To multiply whole numbers, mixed numbers, and fractions

Discuss the Concepts

Describe the steps involved in multiplying $6\frac{1}{2}$ times 4.

Concept Check

Which expression results in the largest product? Which results in the smallest product?

a. $5\frac{1}{3}\times 2\frac{5}{8}$

b. $6\frac{3}{7}\times 2\frac{4}{5}$

c. $4\frac{4}{5}\times 2\frac{1}{12}$

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d. $6\frac{1}{4} \times 2\frac{6}{25}$

Part b is the largest product (18), and part c is the smallest product (10).

> **Optional Student Activity**
>
> Find two fractions evenly spaced between $\frac{3}{8}$ and $\frac{2}{5}$. $\mathbf{\frac{23}{60}}$ **and** $\mathbf{\frac{47}{120}}$

■ Objective 2.6C

To solve application problems

> **Optional Student Activity**
>
> You walk at a rate of $4\frac{1}{2}$ kilometres per hour. Complete the table below. Fill in the second column by calculating the distance walked in the number of hours shown in the first column.
>
> | *Time Walking* | *Distance Walked* |
> |---|---|
> | $1\frac{1}{2}$ | $\mathbf{6\frac{3}{4}}$ |
> | 2 | **9** |
> | $2\frac{1}{2}$ | $\mathbf{11\frac{1}{4}}$ |
> | $3\frac{1}{4}$ | $\mathbf{14\frac{5}{8}}$ |

Section 2.7: Division of Fractions and Mixed Numbers

■ Objective 2.7A

To divide fractions

New Vocabulary

reciprocal of a fraction
inverting a fraction

Discuss the Concepts

Explain why we "invert and multiply" when dividing a fraction by a fraction.

Concept Check

Show by example that (1) the Commutative Property is not satisfied by division of fractions and (2) the Associative Property is not satisfied by division of fractions.

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Answers will vary. For example:

(1) $\frac{1}{2} \div \frac{1}{4} = 2, \frac{1}{4} \div \frac{1}{2} = \frac{1}{2}$

(2)

$$\left(\frac{1}{2} \div \frac{1}{4}\right) \div \frac{1}{8} = 16$$

$$\frac{1}{2} \div \left(\frac{1}{4} \div \frac{1}{8}\right) = \frac{1}{4}$$

Optional Student Activity

Find the sum of the reciprocals of all the whole-number factors of 24.

$2\frac{1}{2}$

■ Objective 2.7B

To divide whole numbers, mixed numbers, and fractions

Concept Check

(Note: This is a classic problem that students frequently miss.) What is 8 divided by one-half? **16**

Optional Student Activity

Shown below is the net weight of four different boxes of cereal. Find the number of $\frac{3}{4}$-ounce servings in each box.

a. Kellogg Honey Crunch Corn Flakes: 24 ounces

b. Nabisco Instant Cream of Wheat: 28 ounces

c Post Shredded Wheat: 18 ounces

d. Quaker Oats: 42 ounces

a. 32 servings

b. $37\frac{1}{3}$ **servings**

c. 24 servings

d. 56 servings

(Note: For a two-step problem, ask students how many more $\frac{3}{4}$ -ounce servings are in a box of Quaker Oats than are in a box of Nabisco Cream of Wheat. The answer is $18\frac{2}{3}$ more servings.)

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■ Objective 2.7C

To solve application problems

Concept Check

(Note: Example 9 and You Try It 9 on page 110 are difficult for students. Use the following problem if you have worked through these examples with your students and want to have them work through another, similar problem either on their own or in small groups.)

Optional Student Activity

A diet regime is formulated so that participants will lose $\frac{3}{4}$ kilogram per week.

Complete the table below. Fill in the second column by calculating the number of weeks it will take a client to lose the amount of weight shown in the first column.

Kilograms to Lose	*Weeks to Lose Them*
6	8
10	$\mathbf{13\frac{1}{3}}$
3	**4**
$8\frac{3}{4}$	$\mathbf{11\frac{2}{3}}$

A 4-metre piece of wood molding is cut into pieces $1\frac{1}{2}$ metres long. What is the length of the piece that remains after as many pieces as possible have been cut? $\mathbf{\frac{2}{3}}$ **metre**

Section 2.8: Order, Exponents, and the Order of Operations

■ Objective 2.8A

To identify the order relation between two fractions

Vocabulary to Review

number line **[1.1A]**
graph of a whole number **[1.1A]**

Discuss the Concepts

1. If two fractions have the same denominator, how can you determine which fraction is larger than the other?
2. If two fractions have different denominators, how can you determine which fraction is larger than the other?

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Concept Check

Put the following fractions in order from smallest to largest.

$$\frac{17}{30}, \frac{7}{12}, \frac{8}{15}, \frac{17}{25}, \frac{5}{9}, \frac{13}{24}$$

$$\mathbf{\frac{8}{15}, \frac{13}{24}, \frac{5}{9}, \frac{17}{30}, \frac{7}{12}, \frac{17}{25}}$$

Optional Student Activity

Use a diagram to show that $\frac{2}{3}$ is greater than $\frac{5}{8}$.

■ Objective 2.8B

To use the Order of Operations to simplify expressions

New Vocabulary

exponential expression

Procedures to Review

Order of Operations **[1.7A]**

Discuss the Concepts

In simplifying the expression

$$\frac{3}{4} + \frac{1}{2} \cdot \frac{8}{9}$$

why can't you begin by adding $\frac{3}{4}$ and $\frac{1}{2}$?

Optional Student Activity

Find the sum of the fraction halfway between $\frac{4}{5}$ and $\frac{2}{3}$ and the fraction halfway between $\frac{1}{2}$ and $\frac{1}{3}$. $\mathbf{1\frac{3}{20}}$

Optional Student Activity

Find the product of

$$\left(1-\frac{1}{2^2}\right)\left(1-\frac{1}{3^2}\right)\left(1-\frac{1}{4^2}\right) \ldots \left(1-\frac{1}{9^2}\right)\left(1-\frac{1}{10^2}\right)$$

The dots mean that the pattern continues. $\mathbf{\frac{11}{20}}$

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