Answer Key

1. 6
2. 8
3. 10
4. 12
5. 14
6. 16
7. 18
8. 9
9. 12
10. 15
11. 18
12. 21
13. 24
14. 27
15. 12
16. 16
17. 20
18. 24
19. 28
20. 32
21. 36
22. N/A
23. N/A
24. N/A
25. N/A
26. N/A
27. N/A
28. N/A
29. N/A
30. N/A
31. N/A
32. N/A
33. N/A
34. N/A
35. N/A
36. N/A
37. N/A
38. N/A
39. N/A
40. N/A
41. N/A
42. 1
43. 5
44. 6
45. 17
46. 13
47. 11
48. 37
49. 55
50. 64
51. 71
52. 9
53. 5
54. 33
55. 23
56. 12
57. 16
58. 16
59. 25
60. 30
61. 30
62. 6
63. 11
64. 24
65. 32
66. 25
67. 16
68. 6
69. 33
70. 8
71. 3
72. 21
73. 13
74. 16
75. 13
76. 23
77. 12
78. 7
79. 16
80. 14
81. 14
82. $23 + 18 = 41$
83. $145 - 80 = 65$
84. $21 - 7 - 3 = 11$
85. $13 + 28 = 41$
86. Sally ran $27 - 3 = 24$
    Connie ran: $24 - 5 =$ 19 sec
87. $2(2 + 2) = 8$ miles
88. $20 \div 4 = 5$
89. $20 \div 2 = 10$ hours
90. $3 \times 5 = 15$
91. $400 - 120 = 280$
92. 23 cts
93. 160 grams
94. $40 - 15 = 25$
95. $4 \times 5 = 20$
96. $4 \times 25 + 30 + 12 = 142$
97. $15 \div 5 = 3$ (rounds)
    $3 \times 20 =$ 60 people
98. 70 people
99. 10 flute players
100. 20 trombone players

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Answer Key

1. $\frac{4}{5}$
2. $\frac{6}{7}$
3. $\frac{5}{6}$
4. $\frac{4}{5}$
5. $\frac{4}{5}$
6. $\frac{4}{5}$
7. $\frac{5}{5}$
8. $\frac{4}{4}$
9. $\frac{4}{4}$
10. $\frac{6}{6}$
11. 4
12. 6
13. 12
14. 24
15. 15
16. 21
17. 40
18. 42
19. 32
20. 54
21. 41.76
22. 2.508
23. 8.091
24. 8.714
25. 70.038
26. 66.068
27. 45.608
28. 3.413
29. 84
30. 7.56
31. 31
32. 32
33. 35
34. 30
35. 28
36. 33
37. 18
38. 19
39. 23
40. 21
41. 21
42. 24
43. 56
44. 16
45. 6
46. 56
47. 32
48. 60
49. 108
50. 39
51. 30 - 17 + 3 = 16
52. 20÷2 = 10
    10 + 2 = 12 (present)
    12 + 3 = 15 (in three years)
53. 78 + 82 = 160
    160÷2 = 80
54. 16×2 = 32 ft
55. 27 + 74 = 101
56. 40÷20 = 2
    5÷2 = 2.5 pounds
57. 5×2 = 10
    19 - 10 = 9
    9÷3 = $3.00
58. 1570 + 240 + 390 = $2200
59. 321 - 67 = 254 pages
60. 16×60 = $960
61. 15×20 = $300
62. 200 - 54 = 146 pages
63. 68 + 98 = $166
64. 10:35 + 0:48 = 11:23 A.M.
65. 48×6 = 288 = $2.88
66. 30×5 = 150 = $1.50
67. $90\times\frac{1}{3}$ = 30
    90 - 30 = 60
68. 276 - 6 - 50 = 220
    220÷5 = 44 nickels
69. 3×80 = 240 pages
70. (a) 9:40 - 0:30 = 9:10 A.M.
    (b) 9:40 - 2:30 = 7:10 A.M.
71. 3×90 = 270

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72. C
    35 - 10 = 25
    25÷5 = 5
73. 987 - 678 = <u>309</u>
74. 5×5 = $25
75. 72÷6 = 12
    12×4 = 48
76. 720÷8 = 90
77. 3×25 = 75
    2×10 = 20
    4×1 = 4
    3 + 2 + 4 = 9 coins
78. 1 dollar = 4 quarters
    4×45 = 180
79. 4240÷4 = 1,060
80. $\frac{1}{8}$×32 = 4
81. 1 - $\frac{1}{2}$ - $\frac{3}{8}$ = $\frac{1}{8}$ = 1/8
82. 875
83. 2×60 + 30 = 150
    150 - 120 = 20 min
84. $\frac{1}{3}$(12 + 24 + 15) = $17
85. $\frac{1}{3}$×60 = <u>20 sec</u>
86. 1910 - 14 = 1896
87. 72÷2 = 36
    36÷4 = 9 marbles
88. $\frac{1}{2}$(24) = $12
89. $\frac{1}{4}$(40) = 10
90. 19.25÷7 = 2.75

Answer Key

1. $\frac{19}{2} = 9\frac{1}{2}$
2. $\frac{40}{3} = 13\frac{1}{3}$
3. $\frac{33}{4} = 8\frac{1}{4}$
4. $\frac{21}{5} = 4\frac{1}{5}$
5. $\frac{19}{6} = 3\frac{1}{6}$
6. $\frac{41}{6} = 6\frac{5}{6}$
7. $\frac{57}{8} = 7\frac{1}{8}$
8. $\frac{47}{9} = 5\frac{2}{9}$
9. $\frac{23}{10} = 2\frac{3}{10}$
10. $\frac{45}{11} = 4\frac{1}{11}$
11. 36
12. 48
13. 66
14. 28
15. 52
16. 84
17. 19
18. 31
19. $52\frac{1}{2}$
20. $43\frac{1}{2}$

21. $\frac{25}{2}$
22. $\frac{7}{2}$
23. $\frac{32}{3}$
24. $\frac{11}{4}$
25. $\frac{29}{3}$
26. $\frac{41}{4}$
27. $\frac{31}{5}$
28. $\frac{31}{6}$
29. $\frac{64}{7}$
30. $\frac{27}{8}$
31. $9\frac{2}{3}$
32. $10\frac{1}{3}$
33. $10\frac{2}{3}$
34. $4\frac{3}{4}$
35. $7\frac{1}{4}$
36. $3\frac{4}{5}$
37. $6\frac{1}{5}$
38. $7\frac{1}{6}$
39. $2\frac{3}{10}$
40. $5\frac{9}{10}$

41. 7.5
42. 5.5
43. 10.75
44. 7.75
45. 10.75
46. 9.25
47. 2.25
48. 4.75
49. 7.5
50. 3.25
51. $\frac{15}{2}$
52. $\frac{13}{4}$
53. $\frac{19}{2}$
54. $\frac{21}{4}$
55. $\frac{29}{4}$
56. $\frac{5}{2}$
57. $\frac{103}{10}$
58. $\frac{67}{20}$
59. $\frac{51}{8}$
60. $\frac{13}{8}$

61. 4/5
62. 7/9
63. 4/9
64. 6/7
65. 9/8
66. 2/9
67. 5/9
68. 5/6
69. 2/3
70. 3/5
71. $\frac{2}{7}$
72. 8/21
73. $\frac{2}{5}$
74. $\frac{4}{21}$
75. $\frac{2}{3}$
76. 9/10
77. $\frac{4}{9}$
78. $\frac{5}{8}$
79. $\frac{3}{5}$
80. 8/9

81. $\frac{2}{3}$
82. $\frac{5}{7}$
83. $\frac{7}{10}$
84. $\frac{9}{20}$
85. $\frac{14}{25}$
86. $\frac{3}{35}$
87. $\frac{25}{56}$
88. $\frac{16}{75}$
89. $\frac{2}{3}$
90. $\frac{2}{5}$
91. \$840
92. 8 cases
93. 50 minutes
94. 10 (marbles)
95. 5
96. 79 (Wednesday)
97. 12:08 am
98. 60 points
99. \$5.65
100. \$3.55

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101. 5.65 – 3.55 = $2.10

102. 78÷3 = 26

103. 1.35 + 0.35 + 0.85 = 2.55
3 – 2.55 = $0.45

104. 28×15 = 14×2×15 = 14×30 = 420 words

105. 36 in = 3 ft
24 in = 2 ft
12÷2 = 6
9÷3 = 3
6×3 = <u>18 posters</u>

106. <u>B</u>
28×50 = 1,400 sticks needed
7×175 = 1,225 sticks available

107. 1400 – 1225 = 175 sticks short

108. 21÷3 = 7
7 – 2 = 5
7 + 2 = 9

109. 1200÷60÷2 = <u>10 wahsers</u>

110. 3.6×2 + 4.5×4 = 7.2 + 18
= $25.20

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Answer Key

1. 2/3
2. 3/11
3. 4/23
4. 5/37
5. 6/11
6. 7/51
7. 8/25
8. 9/55
9. 9/25
10. 6
11. 31 1/14
12. 76 7/18
13. 60 5/32
14. 32 1/7
15. 74 2/35
16. 66 2/15
17. 31 1/5
18. 47 1/7
19. 75 2/35
20. 32 4/9

21. 6 1/3
22. 10 2/3
23. 2 3/4
24. 4 2/5
25. 6 1/6
26. 4 2/7
27. 4 3/8
28. 3 7/9
29. 6 1/2
30. 3 1/12
31. 1/45
32. 11/225
33. 17/60
34. 23/45
35. 31/108
36. 37/40
37. 43/90
38. 53/108
39. 7/54
40. 9/28

41. 3/20
42. 16/25
43. 141/13
44. 14/3
45. 22/7
46. 15/5
47. 11/25
48. 21/2
49. 3 1/3
50. 16 1/4
51. 180
52. 36
53. 18
54. 24
55. 3 1/2 pounds
56. 4 1/6 feet
57. 150
58. 54
59. 8
60. 42

61. 1 11/24
62. 1/6
63. 29/48
64. 6 1/5
65. 2 11/24
66. 1/16
67. 2 8/25
68. 1 17/32
69. 1 23/24
70. 17/30
71. 7/16
72. 3/100
73. 20
74. 3/20
75. 12
76. 25
77. 12
78. 24
79. 70
80. 3/5

81. 3/7
82. 4 2/5
83. 8 2/7
84. 8 2/3
85. 23 3/4
86. 41 1/4
87. 56 1/4
88. 26 1/9
89. 27 7/9
90. 35
91. 24th house.
92. E: 10, F: 12, G: 15
93. 28
94. \$11.22
95. \$69.24
96. 140
97. 60
98. 25%
99. 360 apples
100. 5.65

1. $2.05 + 10 \times 0.15 = 3.55$
2. $5.65 - 3.55 = 2.10$
3. $5 - 2.05 = 3.15$ (first 3 minutes)
   $3.15 \div 0.15 = 21$
   21 (min)
   $3 + 21 =$ 24 min
4. (a) $4 \times 45 \times 7\% = 180 \times 0.07 = \$12.60$
   (b) $180 + 12.60 = \$192.60$
5. $23+22 = 45$ grams
   $45 \div 5 = 9$ grams

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Answer Key

1. $2x + 2$
2. $-4x + 16$
3. $2x - 26$
4. $3x + 25$
5. $-2x + 24$
6. $-2x - 47$
7. $-x + 28$
8. $-7x + 46$
9. $8x - 28$
10. $-6x + 51$
11. –40
12. 129
13. -27
14. 56
15. –23
16. -19
17. 1
18. -2
19. 13
20. 22

21. 2, 3, 4, 6, 9, 12, 18, 36
22. 2, 3, 4, 6, 8, 12, 16, 24, 48
23. 2, 5, 10, 25, 50
24. 2, 4, 8, 16, 32, 64
25. 2, 3, 6, 11, 22, 33, 66
26. 3, 5, 15, 25, 75
27. 3, 9, 27, 81
28. 3, 6, 14, 28, 84
29. 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 24, 30, 40, 60, 120
30. 53, 59, 61, 67
31. 1
32. 23
33. –15
34. 22
35. –1
36. –11
37. 21
38. –18
39. 25
40. –5

41. –3
42. –20
43. 6
44. –12
45. –4
46. –10
47. 11
48. –7
49. 3
50. –27
51. 14 1/3
52. 14 1/3
53. 3 1/2
54. 3 1/10
55. 2 14/15
56. 3 1/4
57. 3 7/8
58. 1 1/4
59. 11 1/2
60. 8 ¾

61. 2 103/108
62. 4 & 10
63. 150
64. 125
65. 7/9
66. 38 2/3
67. 9
68. 13 1/2
69. 3/11
70. 9
71. -3
72. 1/3
73. -5
74. -3
75. -2
76. -1
77. 1
78. 2
79. 3
80. 2

81. (a) 75% (b) 20% (c) 40% (d) 60% (e) 80%
82. $40.00
83. $24
84. 40%
85. 176%
86. 150 acres
87. 432÷27 = 16 gal
88. $168.00
89. 80
90. 120
91. 200
92. 70
93. 130 votes
94. C
95. -9
96. 40×5 = 200 mi
97. 66 2/3 mph
98. 8 hr
99. 400 mi
100. 50 mph

Answer Key

1. -0.04
2. -1.2
3. $\frac{4}{3}$
4. 0.4
5. 2
6. 4
7. 1.4
8. -0.4
9. $\frac{-5}{3}$
10. -1.2
11. 2^9
12. 8^5
13. 2^6
14. 2^{11}
15. 8^4
16. 8^5
17. 8^2
18. 2^6
19. 2^7
20. 4^6

21. 16^3
22. 3^3
23. 27^6
24. 27^3
25. $3^6 \div 9^2 = 3^6 \div 3^4 = 3^2$
26. $25^3 = (5^2)^3 = 5^6$
27. $25^2 \times 5^4 = 5^4 \times 5^4 = 5^8$
28. 25^3
29. 5^7
30. 125^6
31. $x^2 - 4x - 21$
32. $x^2 - 6x - 7$
33. $x^2 - 11x + 28$
34. $x^2 - 12x + 35$
35. $x^2 - 5x - 14$
36. $x^2 - 2x - 35$
37. $3x^2 - 10x - 8$
38. $6x^2 + 7x + 2$
39. $9x^2 - 9x + 2$
40. $18x^2 + 51x + 8$

41. 32, –144, 18
42. 3, –2.4, 25
43. 27, –36, 14
44. 27, 36, 11
45. 27, 54, 17
46. 3, 3, –4, –37
47. 3, 1, –7, –133
48. 3, 2, –7, –138
49. 2, 5, 3, –43
50. 3, 5, –3, –21
51. $30y^4z^5$
52. $36x^5yz^4$
53. $4x^2z^2$
54. $6x^5y^3z^3$
55. $5\frac{y^2z}{x}$
56. $4x^2y^2z^2$
57. $1\frac{1}{2}x^2z$
58. $10x$
59. $12x^4y^2z^2$
60. $3y^2z$

61. 3×10^{11}
62. 6.3×10^9
63. 7.2×10^{19}
64. 1×10^{12}
65. 8.1×10^{14}
66. 5×10^{44}
67. 1.44×10^{15}
68. 1.6×10^{19}
69. 5×10^{24}
70. 2.56×10^{25}
71. \$147
72. 25%
73. <u>\$99</u>
74. <u>20%</u>
75. <u>\$52</u>
76. <u>30%</u>
77. 18
78. <u>\$528</u>
79. 582 - 528 = <u>\$54</u>
80. 54 ÷ 18 = <u>\$3</u>

81. 1 - 20% = 0.8
    4.5×0.8 = 3.6 (each tie)
    180÷3.6 = 50 (ties)
82. 800÷2 = 400
    1 + 15% = 1.15 (including tax)
    400×1.15 = \$460
83. Let x be the number of entrants. Then, we have
    $x \times 5\% = 30$
    $x = 30 \div 0.05 = 600$
84. 85: 15 = 17: 3 = 34: <u>6</u>
    Ans = 6 questions
85. 1 + 10% = 1.1
    4000×1.1 = \$4,400
86. 4,400×1.1 = \$4,840
87. 2(12 + 15) = 54 (old)
    54×.8 = 43.2 ft (new)
88. 54×.2 = <u>10.8</u>
89. 12×0.8 = 9.6
    15×0.5 = 12
    12×9.6 = 12×10 – 4.8 = <u>115.2</u>
90. 0.8×0.8 = 0.64
    1 – 0.64 = 0.36 = <u>36%</u>

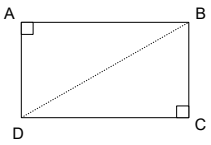
Answer Key

1. $\angle ABC = \angle ACB$ (AB = AC, given)
   $\angle 1 = \angle 2$ (DB = DC, given)
   $\angle 3 + \angle 1 = \angle ABC$
   $\angle 4 + \angle 2 = \angle ACB$
   $\angle 1 = \angle 2$ (cancellation property)

2. 1) $\angle 1 = \angle 2$ (given)
   2) CF = BF (midpoint)
   AB = AC (given)
   BE = $\frac{1}{2}$AB (midpoint)
   CD = $\frac{1}{2}$AC (midpoint)
   3) BE = CD (transitivity)
   Combining 1), 2) and 3), we conclude that $\Delta BEF \cong \Delta CDF$ (SAS).
   Therefore, FE = FD and ΔFED is an isosceles triangle.

3. Using Pythagorean theorem, we have know the third side can be derived given two sides. Therefore, LL and HL is a special case of SSS. AS is again a special case of AAS of ASA since both have a right angle and an acute angle, the third angle can be also derived.

4. AB = BC
   $\angle A = \angle C = 90°$
   AB = CD
   $\Delta ABD \cong \Delta DCB$.



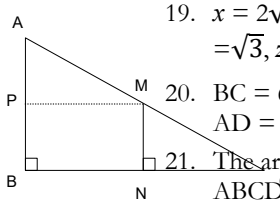
5. Method I:
   Since BE is the altitude to side AC, we have
   area(ΔABC) = $\frac{1}{2}$AC×BE
   Similarly, we have
   area(ΔABC) = $\frac{1}{2}$AC×CD
   Thus, by cancellation we have
   BE = CD

   Method II:
   Two right triangles ΔAEB and ΔADC are congruent for AAS (since AB = AC and $\angle A$ is shared).

6. Method I:
   CD = BE (given)
   $\frac{1}{2}$AB×AD = $\frac{1}{2}$AC×BE (the area)
   AB = AC (cancellation)

   Method II:
   ΔBCD is a right triangle (CD is an altitude)
   ΔCBE is a right triangle (BE is an altitude)
   CD = BE (given)
   BC = BC (common)
   $\Delta BCD \cong \Delta CBE$ (HL)
   Therefore, $\angle DBC = \angle BCE$

7. Draw MP so that MP⊥AB.
   $\angle AMP = \angle MCN$ (corresponding angles)
   PM = BN (BPMN is a rectangle)
   Thus, $\Delta APM \cong \Delta MNC$ (AS for right triangle)
   Therefore,
   AM = MC.



8. 12
   BD = 5
   $AD^2 = AB^2 - BD^2$
   $= 13^2 - 5^2 = 12^2$
   AD = 12

9. 60
   area(ΔABC) = $\frac{1}{2}(10)(12) = 60$

10. $\frac{120}{13}$
    $\frac{1}{2}(13)(h) = 60$
    $h = \frac{120}{13}$

11. $\angle BMC = 180° - 60° - 60° = 60°$. Now that the measure of each interior angle of ΔBCM is 60°, ΔBCM is an equilateral triangle. Therefore, MC = MB = BC = 1.

12. $\angle MCA = 90° - 60° = 30°$. Thus, ΔMAC is an isosceles triangle with MA = MC = 1.

13. M is the midpoint of AB. AB = 2.

14. $AC^2 = AB^2 - BC^2 = 4 - 1 = 3$
    $AC = \sqrt{3}$

15. $1: \sqrt{3} :2$

16. ΔABD is an equilateral triangle.
    AB = BD = 2BC = 2.

17. $AC^2 = AB^2 - BC^2 = 4 - 1 = 3$
    $AC = \sqrt{3}$

18. $1: \sqrt{3} :2$

19. $x = 2\sqrt{3}, y = 1, h = \sqrt{3}, z = 3$

20. BC = 6, $AC = 6\sqrt{2}$, AD = 12

21. The area of rectangle ABCD is $(a + b)^2$
    The combined area of the four right triangles is $(a^2 + b^2$
    Thus, the shaded region has an area of $(a + b)^2 - (a^2 + b^2) = 2ab$

22. $\frac{1}{2}(a + b)(a + b) = \frac{1}{2}(a+b)^2$

23. ab

24. $\frac{1}{2}(a+b)^2 - ab = \frac{1}{2}(a^2 + b^2)$

25. $\frac{1}{2}c^2$

26. $a^2 + b^2 = c^2$

27. BD = 9, CD = 5, BC = 14,
    area(ΔABC) = $\frac{1}{2}(12)(14) = 84$

28. $\sqrt{116}$
    BC = 13, CE = 10, DE = 4, therefore
    $CD^2 = CE^2 + DE^2$
    $CD^2 = 10^2 + 4^2 = 116$
    $CD = \sqrt{116}$

29. 2ab

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30. $(b-a)^2$

31. $(b-a)^2 + 2ab$

32. The area of square ABCD
$= c^2$
$= (b-a)^2 + 2ab$
Thus, $c^2 = a^2 + b^2$

33. $AB^2 = a^2 + (a-b)^2 = 2a^2 - 2ab - b^2$

34. Let c = AB = CD, then we have
$a + c)^2 + c^2 = b^2$
$a^2 + 2ac + 2c^2 = b^2$
$b^2 - a^2 = 2ac + 2c^2 = 2(a + c)c$
The area of one rectangle is
$a + c)c$
The area of the shaded region is
$4(a + c)c = 2(b^2 - a^2)$

35. AB = BE
$\angle EBC = \angle ABF$
BC = BF
$\Delta EBC \cong \Delta ABF$ (SAS)

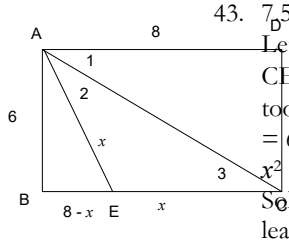
36. area(ΔEBC) = area(ΔEBA) since CD//BE
Thus, area(ΔEBC) = $\frac{1}{2}$area($\square ABED$)

37. area(ΔABF) = area(ΔPBF) since BF//AQ
Thus, area(ΔEBC) = $\frac{1}{2}$area($\square ABED$)

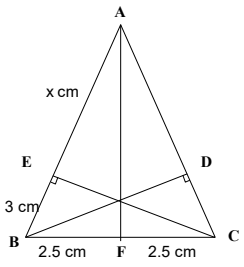
38. By all the previous results.

39. Since
area($\square ABED$) = area ($\square BFQP$)
Similarly,
area($\square ACHI$) = area ($\square PQGC$)
We have
area($\square ABED$) + area($\square ACHI$) = area($\square BCGF$)
Thus,
$AB^2 + AC^2 = BC^2$

40. $\angle 3 = \angle 1$ (corresponding angle)
$\angle 1 = \angle 2$ (given)
$\angle 2 = \angle 3 \Rightarrow$ AE = CE (isosceles)
Let x = CE, then AE $= x$ and BE $= 8 - x$.
Now that ΔABE is a right triangle, we have
$6^2 + (8-x)^2 = x^2$
$100 - 16x = 0$
$x = \frac{25}{4}$



41. $4\frac{1}{6}$
According to Pythagorean theorem, CD = BE = 3 cm.



Further, let AF be another altitude. It follows that $\Delta ABF \approx \Delta CBE$ since $\angle B$ is shared and both are right triangles. Thus, we have
$\frac{x+3}{2.5} = \frac{5}{3}$
$3x + 9 = 12.5$
$3x = 3.5$
$x = 1\frac{1}{6}$
Therefore,
$AB = 1\frac{1}{6} + 3 = 4\frac{1}{6}$

42. 8 (ft)
The ladder reaches 24 ft high since
$25^2 = 7^2 + 24^2$
The ground end of the ladder will become 15 ft away from the wall since
$25^2 = 20^2 + 15^2$
Thus, the displacement of the ladder is 15 – 7 = 8 (ft).

43. 7.5
Let x be the length of CE. Thus, EF = x, too. AE = $12 - x$, AF = 6. Thus, we have
$x^2 = (12-x)^2 + 6^2$
Solving the equation leads to
$x = 7.5$

44. 5/3
Since CF = CD = 5, BF = 4, hence AF = 1.
Let x = DE = EF, hence AE = $3 - x$, since ΔAEF is a right triangle we have
$EF^2 = AE^2 + AF^2$
$x^2 = (3-x)^2 + 1^2$
$x^2 = x^2 - 6x + 9 + 1$
$6x = 10$
$x = 5/3$

45. 10
AC = 16
AO = BO = $\frac{1}{2}$AO = 8
OP = 8 – 2 = 6
Therefore,
$DP^2 = DO^2 + PO^2$
DP = 10

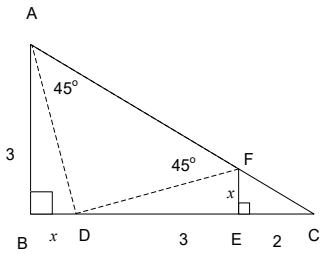
46. $6\sqrt{2}$
AF = 6, DF = 6, thus
$AD = 6\sqrt{2}$

47. 234
BD = 25, BC = 24,
area(ΔABD) = $\frac{1}{2}15\times20 = 150$
area(ΔCBD) = $\frac{1}{2}7\times24 = 84$
area(ABCD) = 150 + 84 = 234

48. $3\sqrt{2}$
$AE^2 = AB^2 - BE^2$
$DE^2 = CD^2 - CE^2$
$AD^2 = AE^2 + DE^2$
$= AB^2 + CD^2 - (BE^2 + CE^2)$
$= AB^2 + CD^2 - BC^2$
$= 25 + 9 - 16 = 18$
$AD = 3\sqrt{2}$

49. $AE^2 = AB^2 - BE^2$
$DE^2 = CD^2 - CE^2$
$AD^2 = AE^2 + DE^2$
$= AB^2 + CD^2 - (BE^2 + CE^2)$
$= AB^2 + CD^2 - BC^2$
Therefore, $AD^2 + BC^2 = AB^2 + CD^2$

50. $\frac{EF}{CE} = \frac{AB}{BC}$
$\frac{x}{2} = \frac{3}{5+x}$
$x(5+x) = 6$
$x^2 + 5x - 6 = 0$
$(x+6)(x-1) = 0$
$x = 1$
area(ΔABC) = 9



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