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Solutions to Practice Problems in the Text

Chapter One: Fundamentals of Mathematical Modeling

Practice Set 1-2

1. $d = rt$
$125 = 50t$ [Divide both sides by 50.]
$t = 2.5$ hours

2. $d = rt$
$170 = r(2.5)$ [Divide both sides by 2.5.]
68 mph $= r$

3. $I = Prt$
$I = (\$5000)(0.05)(2) = \$500$

4. $I = Prt$
$616 = (2800)r(4)$
$616 = 11200r$
$0.055 = r$

5. $A = \pi r^2$
$A = \pi(3)^2 = (3.14)(9) = 28.26 \text{ in}^2$

6. $A = \pi r^2$
$12.56 = (3.14)r^2$
$4 = r^2$
$\sqrt{4} = 2 \text{ ft} = r$

7. $A = \frac{1}{2}bh$
$36 = \frac{1}{2}(8)h$
$36 = 4h$
$9 \text{ in} = h$

8. $A = \frac{1}{2}bh$
$150 = \frac{1}{2}b(40)$
$150 = 20b$
$7.5 \text{ cm} = b$

9. $A = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{15(15-5)(15-12)(15-13)} =$
$\sqrt{15(10)(3)(2)} = \sqrt{900} = 30 \text{ in}^2$

10. $A = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{6(6-3)(6-4)(6-5)} =$
$\sqrt{6(3)(2)(1)} = \sqrt{36} = 6 \text{ in}^2$

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11. $C = \frac{5}{9}(F - 32) = \frac{5}{9}(68 - 32) = \frac{5}{9}(36) = 20^{o}\ C$

12. $C = \frac{5}{9}(F - 32) = \frac{5}{9}(-4 - 32) = \frac{5}{9}(-36) = -20^{o}\ C$

13. $F = \frac{9}{5}C + 32 = \frac{9}{5}(-10) + 32 = -18 + 32 = 14^{o}\ F$

14. $F = \frac{9}{5}C + 32 = \frac{9}{5}(100) + 32 = 180 + 32 = 212^{o}\ F$

15. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - (-4)}{-1 - 2} = \frac{-3 + 4}{-1 - 2} = \frac{1}{-3} = -\frac{1}{3}$

16. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 0}{-3 - (-1)} = \frac{-2}{-3 + 1} = \frac{-2}{-2} = 1$

17. $z = \frac{x - \bar{x}}{s} = \frac{95 - 100}{15} = \frac{-5}{15} = -\frac{1}{3}$

18. $z = \frac{x - \bar{x}}{s} = \frac{25.2 - 17.3}{7.9} = \frac{7.9}{7.9} = 1$

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

$3^2 + 4^2 = c^2$

$9 + 16 = c^2$

$25 = c^2$

$\sqrt{25} = 5 = c$

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

$12^2 + 5^2 = c^2$

$144 + 25 = c^2$

$169 = c^2$

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$\sqrt{169} = 13 = c$

21. $M = P\left(1+\frac{r}{n}\right)^{nt} = 5000\left(1+\frac{0.045}{12}\right)^{12*10} = 5000\left(1+\frac{0.045}{12}\right)^{120} = \$7834.96$

22. $M = P\left(1+\frac{r}{n}\right)^{nt} = 12{,}000\left(1+\frac{0.0325}{12}\right)^{12*5} = 12{,}000\left(1+\frac{0.0325}{12}\right)^{60} = \$14{,}114.28$

23. $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{-5 \pm \sqrt{(5)^2-4(1)(-6)}}{2(1)} = \frac{-5 \pm \sqrt{25+24}}{2} =$

$\frac{-5+\sqrt{49}}{2} = \frac{-5+7}{2} = \frac{2}{2} = 1 \quad or \quad \frac{-5-\sqrt{49}}{2} = \frac{-5-7}{2} = \frac{-12}{2} = -6$

24. $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{-(-9) \pm \sqrt{(-9)^2-4(2)(-5)}}{2(2)} = \frac{9 \pm \sqrt{81+40}}{4} =$

$\frac{9+\sqrt{121}}{4} = \frac{9+11}{4} = \frac{20}{4} = 5 \quad or \quad \frac{9-\sqrt{121}}{4} = \frac{9-11}{4} = \frac{-2}{4} = -0.5$

25. $y = Ae^{rn} = 1{,}500{,}000e^{0.055*7} = 1{,}500{,}000e^{0.385} = 2{,}204{,}421$ bacteria

26. $y = Ae^{rn} = 45{,}000e^{0.015*10} = 45{,}000e^{0.15} = 52{,}282.5 = 52{,}283$ people

27. $I = Prt$

$\frac{I}{Pt} = \frac{Prt}{Pt}$ [Divide both sides by Pt.]

$\frac{I}{Pt} = r$

28. $V = lwh$

$\frac{V}{lh} = \frac{lwh}{lh}$ [Divide both sides by lh.]

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$\frac{V}{lh} = w$

29. $A = \frac{1}{2}bh$

$2A = bh$ [Multiply both sides by 2.]

$\frac{2A}{h} = b$ [Divide both sides by h to solve for b.]

30. $V = \frac{1}{3}Bh$

$3V = Bh$ [Multiply both sides by 3.]

$\frac{3V}{B} = h$ [Divide both sides by B to solve for h.]

31. $P = 2L + 2W$

$P - 2W = 2L + 2W - 2W$ [Subtract $2W$ from both sides.]

$P - 2W = 2L$

$\frac{P - 2W}{2} = L$ [Divide both sides by 2.]

32. $P = 2L + 2W$

$P - 2L = 2L + 2W - 2L$ [Subtract $2L$ from both sides.]

$P - 2L = 2W$

$\frac{P - 2L}{2} = W$ [Divide both sides by 2.]

33. $A = ½(B + b)h$

$2(A) = 2[½(B + b)h]$ [Multiply both sides by 2.]

$2A = (B + b)h$

$2A = Bh + bh$ [Use the Distributive Property.]

$2A - bh = Bh + bh - bh$ [Subtract bh from both sides.]

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$2A - bh = Bh$

$\frac{2A - bh}{h} = B$ [Divide both sides by h to solve for B.]

34. $A = \frac{1}{2}(B + b)h$

$2(A) = 2[\frac{1}{2}(B + b)h]$ [Multiply both sides by 2.]

$2A = (B + b)h$

$\frac{2A}{B + b} = h$ [Divide both sides by $(B + b)$ to solve for h.]

35. $2x + 3y = 6$

$2x + 3y - 2x = 6 - 2x$ [Subtract $2x$ from both sides.]

$3y = 6 - 2x$

$y = 2 - \frac{2}{3}x$ [Divide both sides by 3 to solve for y.]

36. $2x - y = 10$

$2x - y - 2x = 10 - 2x$ [Subtract $2x$ from both sides.]

$-y = 10 - 2x$

$y = -10 + 2x$ [Divide both sides by -1.]

37. $A = \frac{x + y}{2}$

$2A = x + y$ [Multiply both sides by 2.]

$2A - y = x + y - y$ [Subtract y from both sides.]

$2A - y = x$

38. $A = \frac{x + y}{2}$

$2A = x + y$ [Multiply both sides by 2.]

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$2A - x = x + y - x$ [Subtract x from both sides.]

$2A - x = y$

39. $F = \frac{9}{5}C + 32$

$5F = 9C + 160$ [Multiply through by 5.]

$5F - 160 = 9C + 160 - 160$ [Subtract 160 from both sides.]

$5F - 160 = 9C$

$\frac{5}{9}F - \frac{160}{9} = C$ [Divide both sides by 9.]

$\frac{5}{9}(F - 32) = C$ [Factor out $\frac{5}{9}$.]

40. $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}F - \frac{160}{9}$ [Use the distributive property.]

$C + \frac{160}{9} = \frac{5}{9}F - \frac{160}{9} + \frac{160}{9}$ [Add $\frac{160}{9}$ to both sides.]

$C + \frac{160}{9} = \frac{5}{9}F$

$\frac{9}{5}C + 32 = F$ [Multiply through by $\frac{9}{5}$.]

41. BMI $= \frac{W}{H^2} \cdot 703 = \frac{140}{73^2} \cdot 703 = 18.4687... = 18.5$, Normal

42. BMI $= \frac{W}{H^2} \cdot 703 = \frac{160}{60^2} \cdot 703 = 31.2444... = 31.2$, Obese

Practice Set 1-3

1. $\frac{45\,min}{2\,hr} = \frac{45\,min}{120\,min} = \frac{3}{8}$

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2. $\frac{1\ hr}{35\ \text{min}} = \frac{60\ \text{min}}{35\ \text{min}} = \frac{12}{7}$

3. $\frac{4\ in}{4\ ft} = \frac{4\ in}{48\ in} = \frac{1}{12}$

4. $\frac{3\ ft}{60\ in} = \frac{36\ in}{60\ in} = \frac{3}{5}$

5. $\frac{6\ ft}{3\ yd} = \frac{6\ ft}{9\ ft} = \frac{2}{3}$

6. $\frac{2\ yd}{12\ ft} = \frac{6\ ft}{12\ ft} = \frac{1}{2}$

7. $\frac{8\ weeks}{16\ days} = \frac{56\ days}{16\ days} = \frac{7}{2}$

8. $\frac{5\ days}{1\ week} = \frac{5\ days}{7\ days} = \frac{5}{7}$

9. $\frac{25\ mL}{1\ L} = \frac{25\ mL}{1000\ mL} = \frac{1}{40}$

10. $\frac{2400\ mL}{2\ L} = \frac{2400\ mL}{2000\ mL} = \frac{6}{5}$

11. $\frac{304\ miles}{9.5\ gal} = 32$ mi./gal.

12. $\frac{450\ miles}{20\ gal} = 22.5$ mi./gal.

13. $\frac{\$3.50}{10\ \text{min}} = \$0.35/\text{min}.$

14. $\frac{\$86.40}{720\ kWh} = \$0.12/\text{kWh}$

15. $\frac{\$48}{10\ days} = \$4.80/\text{day}$

16. $\frac{\$340}{40\ hr} = \$8.50\ /\ hr$

17. $\frac{24\ lb}{15\ people} = 1.6$ lb./person

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18. $\frac{5.5\,lb}{12\,people} = 0.458\overline{3}$ lb./person

19. $\frac{x}{5} = \frac{3}{4}$

$4x = (3)(5)$ [cross-multiplication property]

$4x = 15$

$x = \frac{15}{4}$

20. $\frac{9}{2x} = \frac{6}{4}$

$(4)(9) = (2x)(6)$ [cross-multiplication property]

$36 = 12x$

$3 = x$

21. $\frac{30}{126} = \frac{5}{3x}$

$(3x)(30) = 5(126)$ [cross-multiplication property]

$90x = 630$

$x = 7$

22. $\frac{2x}{7} = \frac{8}{14}$

$(2x)(14) = (7)(8)$ [cross-multiplication property]

$28x = 56$

$x = 2$

23. $\frac{3x+6}{35} = \frac{2x-18}{5}$

$5(3x + 6) = 35(2x - 18)$ [cross-multiplication property]

$15x + 30 = 70x - 630$ [distributive property]

$15x + 30 - 70x = 70x - 630 - 70x$

$-55x + 30 = -630$

$-55x + 30 - 30 = -630 - 30$

$-55x = -660$

$x = 12$

24. $\frac{x-2}{7} = \frac{2x+2}{28}$

$28(x - 2) = 7(2x + 2)$ [cross-multiplication property]

$28x - 56 = 14x + 14$ [distributive property]

$28x - 56 - 14x = 14x + 14 - 14x$

$14x - 56 = 14$

$14x - 56 + 56 = 14 + 56$

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$$14x = 70$$
$$x = 5$$

25. $\frac{15}{18} = \frac{x-1}{x}$

$(15)(x) = 18(x - 1)$ [cross-multiplication property]
$15x = 18x - 18$ [distributive property]
$15x - 18x = 18x - 18 - 18x$
$-3x = -18$
$x = 6$

26. $\frac{3}{x+4} = \frac{5}{2x+3}$

$3(2x + 3) = 5(x + 4)$ [cross-multiplication property]
$6x + 9 = 5x + 20$ [distributive property]
$6x + 9 – 5x = 5x + 20 – 5x$
$x + 9 = 20$
$x + 9 – 9 = 20 – 9$
$x = 11$

27. $\frac{3}{x+1} = \frac{18}{9x-3}$

$3(9x - 3) = 18(x + 1)$ [cross-multiplication property]
$27x - 9 = 18x + 18$ [distributive property]
$27x - 9 - 18x = 18x + 18 - 18x$
$9x - 9 = 18$
$9x - 9 + 9 = 18 + 9$
$9x = 27$
$x = 3$

28. $\frac{x+8}{6} = \frac{2x-8}{3}$

$3(x + 8) = 6(2x – 8)$ [cross-multiplication property]
$3x + 24 = 12x – 48$ [distributive property]
$3x + 24 -12x = 12x – 48 – 12x$
$-9x + 24 = -48$
$-9x + 24 – 24 = -48 – 24$
$-9x = -72$
$x = 8$

29. Unit rate equals cost divided by the number of square feet.
$\$2235 \div 1500 \text{ ft}^2 = \$1.49/\text{ft}^2$

30. Unit rate equals cost divided by the number of yards.
$\$47.80 \div 4 \text{ yd} = \$11.95/\text{yd}$

31. Cost per ounce = $\$8.99 \div 16 \text{ oz} = \$0.561875$ per ounce

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32. Cost per can = \$7.14 ÷ 6 cans = \$1.19 per can

33. Brand X: \$1.49 ÷ 8 oz = \$0.18625/ ounce
Brand Z: \$2.12 ÷ 12 oz = \$0.1766…/ounce
Brand Z is the better buy because it costs less per ounce.

34. five 2-L colas: \$4.95 ÷ 5 = \$0.99/bottle
three 2-L colas: \$2.99 ÷ 3 = \$0.99666../bottle
Purchasing five 2-L colas for \$4.95 is a better buy.

35. Let $\frac{120\ cal}{\frac{3}{4}\ cup} = \frac{x}{1\ cup}$.

(1)(120) = ¾x [Cross multiply.]
120 = ¾x
160 calories = x [Multiply both sides by 4/3.]

36. Let $\frac{8\ oz}{90\ cal} = \frac{28\ oz}{x}$.

8x = (90)(28) [Cross multiply.]
8x = 2520
x = 315 calories

37. Let $\frac{2.5\ dozen}{1.25\ cups} = \frac{x\ dozen}{3\ cups}$.

(3)(2.5) = 1.25x [Cross multiply.]
7.5 = 1.25x
6 = x
Answer is 6 dozen or 72 muffins.

38. If each of 30 students has 2 cookies, then 60 cookies are needed. 60 ÷ 12 = 5 doz.

Let $\frac{3\ dozen}{2.5\ cups} = \frac{5\ dozen}{x}$

3x = (5)(2.5) [Cross multiply.]
3x = 12.5
x = 4.16666… = $4\frac{1}{6}$ cups

39. Let $\frac{5\ ft\ 4\ in}{10.5\ ft} = \frac{x}{20\ ft}$. Convert the measurements to inches as follows: 5 ft 4 in = 5(12) + 4 = 64 inches; 10.5 ft = 10.5 × 12 in = 126 inches; 20 ft = 20 × 12 in = 240 inches.
Now substitute:

$\frac{64\ in}{126\ in} = \frac{x}{240\ in}$

(64)(240) = 126x

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15360 = 126x
121.9 inches = x
Converting to feet and inches: 121.9 inches ÷ 12in/ft = 10 ft. 1.9 in.

40. Let $\frac{5\,ft\,10\,in}{8\,ft\,9\,in} = \frac{x}{14\ ft}$. Convert the measurements to inches as follows: 5 ft 10 in = 5(12) + 10 = 70 inches, 8 ft 9 in = 8(12) + 9 = 105 inches, and 14 ft = 14(12) = 168 inches. Now substitute:

$$\frac{70\ in}{105\ in} = \frac{x}{168\ in}.$$

(70)(168) = 105x [Cross multiply.]
11760 = 105x
112 inches = x
(112 inches = 9 feet 4 inches)

41. Let $\frac{1.8A}{18V} = \frac{5.4A}{x}$.

(18)(5.4) = 1.8A [Cross multiply.]
97.2 = 1.8A
54 V = A

42. Let $\frac{10\,A}{50\,V} = \frac{25A}{x}$

10x = (25)(50) [Cross multiply.]
10x = 1250
x = 125 V

43. Let $\frac{110\,lb}{19.4\,lb} = \frac{200\,lb}{x}$

110x = (19.4)(200) [Cross multiply.]
110x = 3880
x = 35.2727… or approximately 35.3 lb.

44. Let $\frac{110\,lb}{19.4\,lb} = \frac{155\,lb}{x}$

110x = (19.4)(155) [Cross multiply.]
110x = 3007
x = 27.336363... or approximately 27.3 lb.

45. Let $\frac{10\,lb}{400\ ft^2} = \frac{x}{500\ ft^2}$

(10)(500) = 400x [Cross multiply.]
5000 = 400x

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12.5 lb = x

46. Let $\frac{20}{1} = \frac{256\,oz}{x}$ [2 gallons = 256 oz.]

20x = (256)(1) [Cross multiply.]

20x = 256

x = 12.8 oz.

47. Let $\frac{\$240}{1200\,words} = \frac{x}{1500\,words}$.

(240)(1500) = 1200x [Cross multiply.]

360,000 = 1200x

$300 = x

48. Let $\frac{1500\,doughnuts}{9\,hours} = \frac{300\,doughnuts}{x}$

1500x = (9)(300) [Cross multiply.]

1500x = 2700

x = 1.8 hr.

49. Let $\frac{1\,adult}{15\,children} = \frac{3\,adults}{x}$

x = (3)(15) [Cross multiply.]

x = 45 children

50. Let $\frac{1\,adult}{6\,infants} = \frac{x}{15\,infants}$

15 = 6x [Cross multiply.]

2.5 adults = x

Therefore, 3 adults are needed for 15 infants.

51. Let $\frac{1\,inch}{8\ feet} = \frac{2.75\,inches}{x}$

x = (8)(2.75) [Cross multiply.]

x = 22 feet

Let $\frac{1\,inch}{8\ feet} = \frac{1.9375\,inches}{x}$

x = (8)(1.9375) [Cross multiply.]

x = 15.5 feet

Dimensions are 22 ft × 15.5 ft

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52. Let $\frac{1\,inch}{10\,miles} = \frac{x}{185\,miles}$

(1)(185) = 10x [Cross multiply.]

18.5 in = x

53. Let $\frac{Mach\,1}{761.2\,mph} = \frac{Mach\,3.1}{x}$

1x = (3.1)(761.2) [Cross multiply.]

x = 2359.72 mph

54. Let $\frac{Mach\,1}{761.2\,mph} = \frac{x}{1903\,mph}$

761.2x = (1)(1903) [Cross multiply.]

x = 2.5 (Mach 2.5)

55. Let $\frac{400\,ft}{1\,day} = \frac{1000\ ft}{x}$

(1)(1000) = 400x [Cross multiply.]

1000 = 400x

2.5 days = x

56. Let $\frac{8\,sq/day}{1\,roofer} = \frac{x}{2\,roofers}$

(2)(8 sq/day) = x [Cross multiply.]

16 sq/day = x

Since 2 roofers can do 16 squares per day, they can do 32 squares in 2 days.

57. Let $\frac{40\,mg}{1\,mL} = \frac{60\,mg}{x}$.

40x = (1)(60) [Cross multiply.]

40x = 60

x = 1.5 mL

58. Let $\frac{100\,mg}{1\,kg} = \frac{x}{9.3\,kg}$.

(100)(9.3) = 1x [Cross multiply.]

930 mg = x

59. Let $\frac{1.8\,mi}{30\ \text{min}} = \frac{x}{45\ \text{min}}$

(1.8)(45) = 30x [Cross multiply.]

81 = 30x

2.7 miles = x

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60. Let $\frac{1\,mph}{1.609\,kph} = \frac{x}{98\,kph}$

$(1)(98) = 1.609x$

$98 = 1.609x$

$60.9 \text{ mph} = x$

Practice Set 1-.4

1. $2x + 6$
2. $2x - 3$
3. $7x - 2$
4. $3 + 4x$
5. $3(4 + x)$
6. $2(x - 6)$
7. $\frac{1}{3}x - 5$
8. $x - \frac{3}{4}x$
9. Let Bill's salary = x. Then, Ann's salary = x + $5000
10. Let Monday's attendance = x. Then, Friday's is ½x + 3
11. Let the width = x. Then, the length = 2x + 5.
12. Let the short rod = x. Then, each subsequent rod is 1 inch longer: x + 1 and x + 2.
13. $5x + 5 = 2x - 10$

$5x + 5 - 2x = 2x - 10 - 2x$

$3x + 5 = -10$

$3x + 5 - 5 = -10 - 5$

$3x = -15$

$x = -5$

14. $8x - 16 = 80$

$8x - 16 + 16 = 80 + 16$

$8x = 96$

$x = 12$

15. Emily has saved x. Elena has saved 2x (twice as much).

$x + 2x = 72$

$3x = 72$

x = 24 so Emily has saved $24 and Elena has saved 2($24) = $48.

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16. Let the lower grade = x. The higher grade is x + 56.

$$x + (x + 56) = 128$$
$$2x + 56 = 128$$
$$2x + 56 - 56 = 128 - 56$$
$$2x = 72$$
$$x = 36$$

so the lower grade is 36 and the higher is 36 + 56 = 92.

17. Let x = the shorter piece. The longer piece will be 2x.

$$x + 2x = 60 \text{ meters}$$
$$3x = 60 \text{ meters}$$
$$x = 20 \text{ meters}$$

The shorter piece is 20 meters long and the longer piece is 2(20) = 40 meters long.

18. Let Joshua's age = x and Mario's age be x + 18.

$$x + (x + 18) = 46$$
$$2x + 18 = 46$$
$$2x + 18 - 18 = 46 - 18$$
$$2x = 28$$
$$x = 14$$

So, Joshua is 14 years old and Mario is 14 + 18 = 32 years old.

19. Using the definition of an average, let x equal the missing grade.

$$\frac{88 + 91 + 95 + x}{4} = 90$$
$$88 + 91 + 95 + x = 4(90)$$
$$274 + x = 360$$
$$274 - 274 + x = 360 - 274$$
$$x = 86$$

In order to have a 90 average, she must make 86 on the last test.

20. Using the definition of an average, let x equal the missing grade.

$$\frac{60 + 92 + 78 + 89 + x}{5} = 84$$
$$60 + 92 + 78 + 89 + x = 5(84)$$
$$319 + x = 420$$
$$319 - 319 + x = 420 - 319$$
$$x = 101$$

In order to have a B average, she must make 101 on the last test. On a normal grading scale, this will be impossible.

21. Let x = the number of kilowatt-hours. Write the equation and solve.

$$\$20.00 + \$0.14x = \$85.78$$
$$20.00 - 20.00 + 0.14x = 85.78 - 20.00$$
$$0.14x = 65.78$$

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$$x = \frac{65.78}{0.14} = 470\ kWh \quad \text{(rounded)}$$

22. Let x = number of "out of area" minutes.
$\$29.95 + \$9.95 + \$0.40x = \$69.90$
$39.90 + 0.40x = 69.90$
$39.90 - 39.90 + 0.40x = 69.90 - 39.90$
$0.40x = 30$
$x = 75$
She was charged for 75 "out of area" minutes.

23. Let x = the taxi fare. Since 1/11 of a mile costs \$0.20, the cost of one mile = $\$0.20 \times 11 = \$2.20$.
$x = \$3.20 + 18(\$2.20/\text{mile}) + \$1.20 = \$44.00$

24. Let x = the taxi fare. Since 1/5 of a mile costs \$0.40, the cost of one mile = $\$0.40 \times 5 = \$2.00$.
$x = \$2.50 + 16(\$2.00/\text{mile}) = \$34.50$

25. The opponent scored x points in the game. Mighty Mites scored 39 points. This amount (39) is 2x - 1.
$2x - 1 = 39$
$2x - 1 + 1 = 39 + 1$
$2x = 40$
$x = 20$
The opponent scored 20 points.

26. Let the number of games Jim won = x and the number that Gaylord won = x + 99.
$x + (x + 99) = 529$
$2x + 99 = 529$
$2x + 99 - 99 = 529 - 99$
$2x = 430$
$x = 215$
Jim won 215 games and Gaylord won 215 + 99 = 314 games.

27. Let the integers be x, x + 1 and x + 2. Write the equation for the sum and solve.
$x + (x + 1) + (x + 2) = 87$
$3x + 3 = 87$
$3x + 3 - 3 = 87 - 3$
$3x = 84$
$x = 28$
The integers are x = 28, x + 1 = 29 and x + 2 = 30.

28. Let the integers be x, x + 1 and x + 2. Write the equation for the sum and solve.
$x + (x + 1) + (x + 2) = 100$

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$$3x + 3 = 100$$
$$3x + 3 - 3 = 100 - 3$$
$$3x = 97$$
$$x = 32.333...$$

Since this number is not an integer, there is not a set of consecutive integers that satisfies the requirements of this problem.

29. Let the odd integers be x, x + 2, and x + 4. Write the equation for the sum and solve.

$$x + (x + 2) + (x + 4) = -273$$
$$3x + 6 = -273$$
$$3x + 6 - 6 = -273 - 6$$
$$3x = -279$$
$$x = -93$$

The three integers are x = -93, x + 2 = -91, and x + 4 = -89.

30. Let the odd integers be x, x + 2, and x + 4. Write the equation for the sum and solve.

$$x + (x + 2) + (x + 4) = 1503$$
$$3x + 6 = 1503$$
$$3x + 6 - 6 = 1503 - 6$$
$$3x = 1497$$
$$x = 499$$

The three integers are x = 499, x + 2 = 501, and x + 4 = 503.

31. Let x = the value of the lot. Then, 6.5x = the value of the house.

$$x + 6.5x = \$175{,}000$$
$$7.5x = \$175{,}000$$
$$x = \$23{,}333.33$$

So, the lot is worth approximately $23,333 and the house is worth about $151,667.

32. Let x = the value of the lot. Then, 7x = the value of the house.

$$x + 7x = \$164{,}000$$
$$8x = \$164{,}000$$
$$x = \$20{,}500$$

So, the lot is worth approximately $22,500 and the house is worth about $143,500.

33. $x = \dfrac{949\ yen}{146\ yen/dollar} = \$6.50.$

34. $x = \dfrac{65\ pounds}{0.549\ pounds/dollar} = \$118.40$

35. $time = \dfrac{\textbf{\textit{distance}}}{\textbf{\textit{speed}}} = \dfrac{500mi}{170.265mi/hr} = 2.936598831hr$ = about 2 hr 56 min

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36. $x = 500 \text{ miles} \div 74.602 \text{ mph} = 6.702$ hours. Convert 0.702 to minutes by multiplying $0.702(60) = 42.12$ to give the answer of approximately 3 hours and 42 minutes.

37. Let the number of males and females at the beginning of the semester = x.
If 8 males drop the class, there are $x - 8$ males remaining. Now the number of females is twice the number of males remaining.

$$\begin{aligned} x &= 2(x - 8) \\ x &= 2x - 16 \\ x - 2x &= 2x - 16 - 2x \\ -x &= -16 \\ x &= 16 \end{aligned}$$

There were 16 males and 16 females at the beginning of the semester.

38. Let x = the number of Democrats and the number of Republicans in the Senate.

$$\begin{aligned} x + x + 2 &= 100 \\ 2x + 2 &= 100 \\ 2x + 2 - 2 &= 100 - 2 \\ 2x &= 98 \\ x &= 49 \end{aligned}$$

There were 49 Democrats and 49 Republicans in the Senate.

39. Let x = the number of bags of apples.

$$\begin{aligned} 5x + 2x &= 252 \\ 7x &= 252 \\ x &= 36 \end{aligned}$$

There are 36 bags containing 5 lb. of apples and 36 bags containing 2 lb. of apples.

40. Let x = the number of seats in Theater B, $x + 150$ = the number of seats in Theater A.

$$\begin{aligned} (x + 150) + x + 270 &= 800 \\ 2x + 420 &= 800 \\ 2x + 420 - 420 &= 800 - 420 \\ 2x &= 380 \\ x &= 190 \end{aligned}$$

The number of seats in Theater A is $x + 150 = 190 + 150 = 340$.

41. Let x = profit from the automotive division. Then $x - 273$ represents the profit from financial services.

$$\begin{aligned} x + (x - 273 \text{ million}) &= 483 \text{ million} \\ 2x - 273 \text{ million} &= 483 \text{ million} \\ 2x - 273 \text{ million} + 273 \text{ million} &= 483 \text{ million} + 273 \text{ million} \\ 2x &= 756 \text{ million} \\ x &= 378 \text{ million} \end{aligned}$$

The profit from the automotive division was 378 million and from financial services

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was 378 million – 273 million = 105 million.

42. Let x = salary of Palmisano and x - $3.91 million = Moonvie's salary.

$$x + x - 3.91 \text{ million} = 56.73 \text{ million}$$
$$2x - 3.91 \text{ million} + 3.91 \text{ million} = 56.73 \text{ million} + 3.91 \text{ million}$$
$$2x = 60.64 \text{ million}$$
$$x = 30.32 \text{ million}$$

Therefore, Palmisano made $30.32 million and Moonvie made $26.41 million in 2010.

43. Let x = attendance at the Ohio State game and x – 1044 = attendance at the Penn State game. Total attendance for the two teams in 2010 was 209,512.

$$x + x - 1044 = 209{,}512$$
$$2x - 1044 = 209{,}512$$
$$2x - 1044 + 1044 = 209{,}512 + 1044$$
$$2x = 210{,}556$$
$$x = 105{,}278$$

Therefore, the attendance at the Ohio State game was 105,278 and the attendance at the Penn State game was 105,278 – 1044 = 104,234.

44. Let x = the middle-sized piece. The longest is 3x and the shortest is 3x - 23. The total length of the pipe is 40 inches. Therefore,

$$3x + x + 3x - 23 = 40$$
$$7x - 23 = 40$$
$$7x - 23 + 23 = 40 + 23$$
$$7x = 63$$
$$x = 9$$

Therefore, the middle sized piece is 9 in., the longest is 3(9) = 27 in. and the shortest is 3x - 23 = 3(9) - 23 = 4 in.

45. Let x = the original price of the radio. Savings = 15% of retail price or 0.15x.

$$x – 0.15x = \$127.46$$
$$0.85x = \$127.46$$
$$x = \$149.95$$

The original price of the radio was $149.95.

46. Let x = the original price of the watch. Savings = 25% of retail price or 0.25x.

$$x – 0.25x = \$168.75$$
$$0.75x = \$168.75$$
$$x = \$225$$

The original price of the watch was $225.00.

47. Let x = the wholesale price of the shoes. The markup amount is 65% times x.

$$x + 0.65x = \$125.40$$
$$1.65x = \$125.40$$
$$x = \$76$$

The wholesale price of the shoes was $76.00.

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48. Let x = the wholesale price of the shoes. The markup amount is 40% times x.

$$x + 0.40x = \$63$$
$$1.4x = \$63$$
$$x = \$45$$

The wholesale price of the shoes was $45.00.

49. Let x = Drema's contributions. The company's contributions = 20% of x.

$$x + 0.20x = \$1200$$
$$1.2x = \$1200$$
$$x = \$1000$$

Drema deposited $1000 into the account.

50. Let x = the population four years ago. The growth of the population is 5% of x.

$$x + 0.05x = 882$$
$$1.05x = 882$$
$$x = 840$$

There were 840 people in the town four years ago.

51. BMI = $\frac{W}{H^2} \cdot 703 = \frac{120}{60^2} \cdot 703 = 23.4333... = 23.4$, Normal

52. . BMI = $\frac{W}{H^2} \cdot 703 = \frac{195}{67^2} \cdot 703 = 30.53798... = 30.5$, Obese

Chapter 1 Review Problems

1.. $I = Prt$

$t = \frac{I}{Pr}$ [Divide both sides by Pr.]

2. $2x + 3y = 9$

$3y = -2x + 9$ [Subtract $2x$ from both sides.]

$y = -\frac{2}{3}x + 3$ [Divide all terms by 3.]

3. $C = \pi d$

$d = \frac{C}{\pi}$ [Divide both sides by π.]

4. $a + b + c = P$

$c = P - a - b$ [Subtract a and b from both sides.]

5. $\frac{27\,min}{3\,hr} = \frac{27\,min}{180\,min} = \frac{3}{20}$

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6. $\frac{4\ weeks}{21\ days} = \frac{28\ days}{21\ days} = \frac{4}{3}$

7. $\frac{6\ in}{5\ ft} = \frac{6\ in}{60\ in} = \frac{1}{10}$

8. $\frac{\$60}{5\ hr} = \$12/\text{hour}$

9. $\frac{44\ bushels}{8\ trees} = 5.5\ \text{bushels/tree}$

10. $\frac{\$12.80}{3.5\ lb} = \$3.66/\text{lb.}$

11. $\frac{x}{3} = \frac{4}{7}$

$7x = 12$

$x = \frac{12}{7}$

12. $\frac{2}{3} = \frac{8}{2x}$

$4x = 24$

$x = 6$

13. $\frac{x-3}{8} = \frac{3}{4}$

$4x - 12 = 24$

$4x - 12 + 12 = 24 + 12$

$4x = 36$

$x = 9$

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

$12x - 9 = 14x - 7$

$12x - 9 - 14x = 14x - 7 - 14x$

$-2x - 9 + 9 = -7 + 9$

$-2x = 2$

$x = -1$

15. $A = \frac{1}{2}bh$. Substitute: $A = \frac{1}{2}(3\ \text{in})(4\ \text{in}) = 6\ \text{in}^2$

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16. Let $\frac{2400\,L}{50\,min} = \frac{x}{30\,min}$. Cross multiply.

72000 = 50x

1440 liters = x

17. Let $\frac{3}{4} = \frac{x}{92}$. Cross multiply.

276 = 4x

69 dentists = x

18. Let *x* = total number of minutes that you talk. Then, $1.24 + (x - 4)($0.28) = $3.76

1.24 + 0.28x - 1.12 = 3.76

0.12 + 0.28x = 3.76

0.12 + 0.28x - 0.12 = 3.76 - 0.12

0.28x = 3.64

x = 13 The call was 13 minutes long.

19. Let x = number of minutes per month. Then, $50 + $0.36x = $99.68.

0.36x = 99.68 - 50

0.36x = 49.68

x = 138 minutes

20. Let x = labor time (per hour). Then, $40 + $30x = $115

40 + 30x - 40 = 115 - 40

30x = 75

x = 2.5 hours

21. Let the shorter piece be *x* and the longer be *x + 3*. Then, x + (x + 3) = 33

2x + 3 = 33

2x + 3 - 3 = 33 - 3

2x = 30

x = 15 in (short piece) and x + 3 = 15 + 3 = 18 in (long piece)

22. Let the short piece = *x*, the middle-sized piece = *x + 14*, and the long piece = *3x*.

Then, x + (x + 14) + 3x = 79

5x + 14 = 79

5x + 14 - 14 = 79 - 14

5x = 65

x = 13 cm (short)

x + 14 = (13) + 14 = 27 cm (middle)

3x = 3(13) = 39 cm (long)

23. Let the calculator be *x* and the cassette player be *x + 140.*

Then, x + (x + 140) = 208

2x + 140 = 208

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$2x + 140 - 140 = 208 - 140$
$2x = 68$
$x = \$34.00$ which is the cost of the calculator

24. Let n = the number of nickels and $2n - 2$ = the number of dimes.
Then, $n + (2n - 2) = 52$.
$3n - 2 = 52$
$3n - 2 + 2 = 52 + 2$
$3n = 54$
$n = 18$ There are 18 nickels and 34 dimes in the bank for a total of \$4.30.

25. Use the formula $d = rt$ and substitute values.
$182 \text{ mi} = (52 \text{ mph})(t)$
$t = 3.5$ hours

26. $T = UN + F$ Substitute the given values and solve.
$\$16{,}750 = \$15N + \$2500$
$16750 - 2500 = 15N + 2500 - 2500$
$14250 = 15N$
$N = 950$ units produced

26. First remove the parentheses by use of the distributive property, then add 2 to the 12.
$2 + 3(2x + 4) = 2 + 6x + 12 = 6x + 14$.

28. $5x + 3 = 6x$
$5x + 3 - 5x = 6x - 5x$
$3 = x$

29. for any triangle, $A + B + C = 180^\circ$
Let A = the first angle
The second angle, $B = 3A$
The third angle, $C = \frac{2}{3}(3A) = 2A$
$A + 3A + 2A = 180^\circ$
$6A = 180^\circ$
$A = 30^\circ$, $B = 3(30^\circ) = 90^\circ$, $C = 2(30^\circ) = 60^\circ$

30. First convert all the measurements to the same units, like inches.
5 ft 3 in = 63 in, 10 ft 6 in = 126 in, and 52 ft = 624 in
Now set up a proportion like: $\frac{63in}{126in} = \frac{x}{624in}$
Cross multiply: $(63\text{in})(624\text{in}) = (126\text{in})(x)$
Divide by 126in: $x = 312\text{in} = 26\text{ft}$

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Chapter 1 Test

1. $V = lwh$

   $w = \dfrac{V}{lh}$ [Divide both sides by lh.]

2. $h = vt - 16t^2$

   $h + 16t^2 = vt$ [Add $16t^2$ to both sides.]

   $\dfrac{h+16t^2}{t} = v$ [Divide both sides by t.]

3. $\dfrac{4\ hr}{1\ day} = \dfrac{4\ hr}{24\ hr} = \dfrac{1}{6}$

4. $\dfrac{10\ ft}{160\ in} = \dfrac{120\ in}{160\ in} = \dfrac{3}{4}$

5. $\dfrac{\$413.20}{4\ days} = \$103.30/day$

6. $\dfrac{7.5\ lb}{6\ people} = 1.25\ lb/\ person$

7. $\dfrac{50\ eggs}{10\ chickens} = 5\ eggs\ /\ chicken$

8. $\dfrac{7}{12} = \dfrac{3x}{10}$

   $70 = 36x$

   $\dfrac{70}{36} = \dfrac{35}{18} = x$

9. $\dfrac{x-4}{8} = \dfrac{2x+3}{9}$

   $9(x - 4) = 8(2x + 3)$

   $9x - 36 = 16x + 24$

   $9x - 36 - 16x = 16x + 24 - 16x$

   $-7x - 36 = 24$

   $-7x - 36 + 36 = 24 + 36$

   $-7x = 60$

   $x = -\dfrac{60}{7}$

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10. Let x = defective bulbs. Then, $\frac{3}{85} = \frac{x}{510}$.

$$85x = 1530$$
$$x = 18 \text{ bulbs}$$

11. Let x = parts produced. Then, $\frac{300\ parts}{20\ \text{min}} = \frac{x}{45\ \text{min}}$.

$$20x = 13500$$
$$x = 675 \text{ parts}$$

12. Given $P = 2L + 2W$. Substitute the given values into the formula.

$$P = 2(20 \text{ ft.}) + 2(12 \text{ ft.}) = 64 \text{ ft.}$$

13. Company A Plan: \$20 + 0.10m (where m = miles driven)
Company B Plan: \$10 + 0.30m
To find the number of miles where the two costs are equal, set these two expressions equal.

$$\$20 + 0.10m = \$10 + 0.30m$$
$$20 + 0.10m - 0.10m = 10 + 0.30m - 0.10m$$
$$20 = 10 + 0.20m$$
$$20 - 10 = 10 + 0.20m - 10$$
$$10 = 0.20m$$
$$50 = m, \text{ so at 50 miles the costs are the same for both plans}$$

14. Let the number of passengers on one ship = x.
The second ship holds twice as many passengers = $2x$
Write the equation $x + 2x = 2250$ and solve.

$$3x = 2250$$
$$x = 750 \text{ so the smaller ship holds 750 passengers}$$

15. Let Sarah's age be x. Then, Michelle's age is $5x - 10$. Write the equation and solve.

$$x + 5x - 10 = 44$$
$$6x - 10 = 44$$
$$6x - 10 + 10 = 44 + 10$$
$$6x = 54$$
$$x = 9 \quad \text{so Sarah is 9 years and Michelle is } 5(9)-10 = 35 \text{ years.}$$

16. Let the short board = x and the longer one be $3x + 1$. Write the equation.

$$x + 3x + 1 = 21$$
$$4x + 1 = 21$$
$$4x + 1 - 1 = 21 - 1$$
$$4x = 20$$
$$x = 5 \text{ so the short board is 5 ft. and the longer is } 3(5) + 1 = 16 \text{ ft.}$$

17. x + 12.3% of x is now \$2.83 per gallon

$$x + 0.123x = \$2.83$$

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1.123x = $2.83
x = $2.52 per gallon

18. P – 22% of P is now 28,000 people, after 8 years
P – 0.22P = 28,000
0.78P = 28,000
P = 35,897.4359 = 35,898 whole people 8 years ago
Now divide the amount of decrease in population by 8 years to get a rough average yearly decrease in population:
35,898 – 28,000 = 7898 people in 8 years
7898/8 = 987.25 or about 988 people per year decrease in population

19. The average of the four grades needs to equal at least 84 so:
(75 + 82 + 80 + x)/4 = 84 [multiply by 4]
75 + 82 + + 80 + x = 336
237 + x = 336
x = 99 is the least the student can make an have an overall average of 84

20. Let L = lot value, H = house value = 7.5L
L + 7.5L = $152,000
8.5L = $152,000
L = $17,882.35294 or about $17,882 for the lot
H = 7.5L = $134,117.6471 or about $138,118 for the house

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