# *Intermediate Algebra For College Students 10th edition Angel Solutions Manual*

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# Chapter 2

## Exercise Set 2.1

1. The parts that are added in an algebraic expression are called the terms of the expression.
2. Terms that have identical variable parts are called like terms.
3. The goal in solving equations is to isolate the variable on one side of the equation.
4. We can eliminate fractions from an equation by multiplying both sides of the equation by the least common denominator.
5. An equation that is always true is known as a(n) identity.
6. An equation that true for only specific values of the variable is known as a(n) conditional equation.
7. An equation that is never true is known as a(n) contradiction.
8. The degree of a term is the sum of the exponents on the variables in the term.
9. The symbol $\varnothing$ is used to indicate the solution set of a contradiction.
10. The symbol $\mathbb{R}$ is used to indicate the solution set of an identity.
11. symmetric property
12. symmetric property
13. transitive property
14. transitive property
15. reflexive property
16. reflexive property
17. addition property
18. multiplication property
19. multiplication property
20. addition property
21. multiplication property
22. addition property
23. addition property
24. multiplication property
25. $5y$ is degree one since the exponent is 1.
26. $-2x$ is degree one since the exponent is 1.
27. $5c^3$ is degree three since the exponent is 3.
28. $-6y^2$ is degree two since the exponent is 2.
29. $3ab$ is degree two since $3ab$ can be written as $3a^1b^1$ and the sum of the exponents is $1 + 1 = 2$.
30. $\frac{1}{2}x^4y$ is degree five since $\frac{1}{2}x^4y$ can be written as $\frac{1}{2}x^4y^1$ and the sum of the exponents is $4 + 1 = 5$.
31. The degree of 6 is zero since 6 can be written as $6x^0$.
32. The degree of $-3$ is zero since $-3$ can be written as $-3x^0$.
33. $-5r$ is degree one since $-5r$ can be written as $-5r^1$.
34. $18p^2q^3$ is degree five since the sum of the exponents is $2 + 3 = 5$.
35. $5a^2b^4c$ is degree seven since $5a^2b^4c$ can be written as $5a^2b^4c^1$ and the sum of the exponents is $2 + 4 + 1 = 7$.
36. $m^4n^6$ is degree ten since the sum of the exponents is $4 + 6 = 10$.
37. $3x^5y^6z$ is degree 12 since $3x^5y^6z$ can be written as $3x^5y^6z^1$ and the sum of the exponents is $5 + 6 + 1 = 12$.
38. $-2x^4y^7z^8$ is degree nineteen since the sum of the exponents is $4 + 7 + 8 = 19$.
39. $7r + 3b - 11x + 12y$ cannot be simplified since all the terms are "unlike".
40. $3x^2 + 4x + 5$ cannot be simplified since all the terms are "unlike".
41. $-2x^2 - 5x + 7x - 3$
$= -2x^2 + 2x - 3$



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**42.** $2a^2 - 4ab + 5ab - 10b^2$
$= 2a^2 + ab - 10b^2$

**43.** $10.6c^2 - 2.3c + 5.9c - 1.9c^2$
$= 10.6c^2 - 1.9c^2 - 2.3c + 59.c$
$= 8.7c^2 + 3.6c$

**44.** $4.3 - 3.2x - 2(x - 2)$
$= 4.3 - 3.2x - 2x + 4$
$= -3.2x - 2x + 4.3 + 4$
$= -5.2x + 8.3$

**45.** $w^3 + w^2 - w + 1$ cannot be further simplified since all of the terms are "unlike".

**46.** $7x^3y^2 + 11y^3x^2$ cannot be simplified since all of the terms are "unlike".

**47.** $8pq - 9pq + p + q$
$= -pq + p + q$

**48.** $b + b^2 - 4b + b^2 + 3b$
$= b^2 + b^2 + b - 4b + 3b$
$= 2b^2 + 0b$
$= 2b^2$

**49.** $12\left(\frac{1}{6} + \frac{d}{4}\right) + 5d$
$= 12 \cdot \frac{1}{6} + 12 \cdot \frac{d}{4} + 5d$
$= \frac{12}{6} + \frac{12d}{4} + 5d$
$= 2 + 3d + 5d$
$= 2 + 8d = 8d + 2$

**50.** $60\left(\frac{7}{15}x - \frac{3}{4}\right) - 2x = 60 \cdot \frac{7}{15}x - 60 \cdot \frac{3}{4} - 2x$
$= \frac{420}{15}x - \frac{180}{4} - 2x$
$= 28x - 45 - 2x$
$= 28x - 2x - 45$
$= 26x - 45$

**51.** $8\left(\frac{7}{8}x + 3\right) + 5x - 7 = 8 \cdot \frac{7}{8}x + 8 \cdot 3 + 5x - 7$
$= \frac{56}{8}x + 24 + 5x - 7$
$= 7x + 24 + 5x - 7$
$= 7x + 5x + 24 - 7$
$= 12x + 17$

**52.** $-4\left(\frac{3}{4}x - 5\right) + 7x - 1 = (-4)\frac{3}{4}x - (-4)5 + 7x - 1$
$= \frac{-12}{4}x + 20 + 7x - 1$
$= -3x + 20 + 7x - 1$
$= -3x + 7x + 20 - 1$
$= 4x + 19$

**53.** $4 - [6(3x + 2) - x] + 4$
$= 4 - [18x + 12 - x] + 4$
$= 4 - [17x - 12] + 4$
$= 4 - 17x - 12 + 4$
$= 4 - 12 + 4 - 17x$
$= -4 - 17x$
$= -17x - 4$

**54.** $-9 + 3\left[4(2x - 3) - 5x\right] + 2x$
$= -9 + 3\left[8x - 12 - 5x\right] + 2x$
$= -9 + 3\left[3x - 12\right] + 2x$
$= -9 + 9x - 36 + 2x$
$= 9x + 2x - 36 - 9$
$= 11x - 45$

**55.** $9x - \left[3x - (5x - 4y)\right] - 2y$
$= 9x - \left[3x - 5x + 4y\right] - 2y$
$= 9x - \left[-2x + 4y\right] - 2y$
$= 9x + 2x - 4y - 2y$
$= 11x - 6y$

**56.** $-2[3x - (2y - 1) - 5x] + y$
$= -2[3x - 2y + 1 - 5x] + y$
$= -2[3x - 5x - 2y + 1] + y$
$= -2[-2x - 2y + 1] + y$
$= 4x + 4y - 2 + y$
$= 4x + 4y + y - 2$
$= 4x + 5y - 2$



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**57.** $5b-\{7[2(3b-2)-(4b+9)]-2\}$
$=5b-\{7[6b-4-4b-9]-2\}$
$=5b-\{7[6b-4b-4-9]-2\}$
$=5b-[7(2b-13)-2]$
$=5b-[14b-91-2]$
$=5b-(14b-93)$
$=5b-14b+93$
$=-9b+93$

**58.** $2\{[3a-(2b-5a)]-3(2a-b)\}$
$=2\{[3a-2b+5a]-6a+3b\}$
$=2\{8a-2b-6a+3b\}$
$=2\{2a+b\}$
$=4a+2b$

**59.** $-\{[2rs-3(r+2s)]-2(2r^2-s)\}$
$=-\{[2rs-3r-6s]-4r^2+2s\}$
$=-\{2rs-3r-6s-4r^2+2s\}$
$=-\{2rs-3r-4s-4r^2\}$
$=-2rs+3r+4s+4r^2$
$=4r^2-2rs+3r+4s$

**60.** $p^2q+4pq-[-(pq+4p^2q)+pq]$
$=p^2q+4pq-[-pq-4p^2q+pq]$
$=p^2q+4pq-[-pq+pq-4p^2q]$
$=p^2q+4pq-[-4p^2q]$
$=p^2q+4pq+4p^2q$
$=p^2q+4p^2q+4pq$
$=5p^2q+4pq$

**61.** $5a-1=14$
$5a-1+1=14+1$
$5a=15$
$\frac{5a}{5}=\frac{15}{5}$
$a=3$

**62.** $-7x+3=17$
$-7x+3-3=17-3$
$-7x=14$
$\frac{-7x}{-7}=\frac{14}{-7}$
$x=-2$

**63.** $-8x+7+3x=-3$
$-8x+3x+7-=-3$
$-5x+7=-3$
$-5x+7-7=-3-7$
$-5x=-10$
$\frac{-5x}{-5}=\frac{-10}{-5}$
$x=2$

**64.** $7x-6-5x=-8$
$2x-6=-8$
$2x-6+6=-8+6$
$2x=-2$
$\frac{2x}{2}=\frac{-2}{2}$
$x=-1$

**65.** $5s-3=2s+6$
$5s-3-2s=2s+6-2s$
$3s-3=6$
$3s-3+3=6+3$
$3s=9$
$\frac{3s}{3}=\frac{9}{3}$
$s=3$

**66.** $8w+7=-3w-15$
$8w+7+3w=-3w-15+3w$
$11w+7=-15$
$11w+7-7=-15-7$
$11w=-22$
$\frac{11w}{11}=\frac{-22}{11}$
$w=-2$

**67.** $4x-5=2(x+5)$
$4x-5=2x+10$
$4x-5+5=2x+10+5$
$4x=2x+15$
$4x-2x=2x+15-2x$
$2x=15$
$\frac{2x}{2}=\frac{15}{2}$
$x=\frac{15}{2}$



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**68.** $4x-8=-4(2x-3)+4$
$4x-8=-8x+12+4$
$4x-8=-8x+16$
$4x-8+8x=-8x+16+8x$
$12x-8=16$
$12x-8+8=16+8$
$12x=24$
$\frac{12x}{12}=\frac{24}{12}$
$x=2$

**69.** $-3(t-5)=2(t-5)$
$-3t+15=2t-10$
$-3t+15-2t=2t-10-2t$
$-5t+15=-10$
$-5t+15-15=-10-15$
$-5t=-25$
$\frac{-5t}{-5}=\frac{-25}{-5}$
$t=5$

**70.** $4(2x-4)=-2(x+3)$
$8x-16=-2x-6$
$8x-16+2x=-2x-6+2x$
$10x-16=-6$
$10x-16+16=-6+16$
$10x=10$
$\frac{10x}{10}=\frac{10}{10}$
$x=1$

**71.** $3x+4(2-x)=4x+5$
$3x+8-4x=4x+5$
$-x+8=4x+5$
$-x+8-4x=4x+5-4x$
$-5x+8=5$
$-5x+8-8=5-8$
$-5x=-3$
$\frac{-5x}{-5}=\frac{-3}{-5}$
$x=\frac{3}{5}$

**72.** $4x-2(3x-7)=2x-6$
$4x-6x+14=2x-6$
$-2x+14=2x-6$
$-2x+14-2x=2x-6-2x$
$-4x+14=-6$
$-4x+14-14=-6-14$
$-4x=-20$
$\frac{-4x}{-4}=\frac{-20}{-4}$
$x=5$

**73.** $2-(x+5)=4x-8$
$2-x-5=4x-8$
$-x-3=4x-8$
$-x-3-4x=4x-8-4x$
$-5x-3=-8$
$-5x-3+3=-8+3$
$-5x=-5$
$\frac{-5x}{-5}=\frac{-5}{-5}$
$x=1$

**74.** $3k+7=4-(9-k)$
$3k+7=4-9+k$
$3k+7=-5+k$
$3k-k+7=-5+k-k$
$2k+7=-5$
$2k+7-7=-5-7$
$2k=-12$
$\frac{2k}{2}=\frac{-12}{2}$
$k=-6$

**75.** $p-(p+4)=4(p-1)+2p$
$p-p-4=4p-4+2p$
$-4=6p-4$
$-4+4=6p-4+4$
$0=6p$
$\frac{0}{6}=\frac{6p}{6}$
$0=p$



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**76.** $q-(-3q+4)=-2(q-3)+14$
$q+3q-4=-2q+6+14$
$4q-4=-2q+20$
$4q+2q-4=-2q+2q+20$
$6q-4=20$
$6q-4+4=20+4$
$6q=24$
$\frac{6q}{6}=\frac{24}{6}$
$q=4$

**77.** $-3(y-1)+2y=4(y-3)$
$-3y+3+2y=4y-12$
$-y+3=4y-12$
$-y+3+y=4y-12+y$
$3=5y-12$
$3+12=5y-12+12$
$15=5y$
$\frac{15}{5}=\frac{5y}{5}$
$3=y$

**78.** $5r-13-6r=3(r+5)-16$
$5r-13-6r=3r+15-16$
$-r-13=3r-1$
$-r-13+r=3r-1+r$
$-13=4r-1$
$-13+1=4r-1+1$
$-12=4r$
$\frac{-12}{4}=\frac{4r}{4}$
$-3=r$

**79.** $6-(n+3)=3n+5-2n$
$6-n-3=3n+5-2n$
$3-n=n+5$
$3-n+n=n+5+n$
$3=2n+5$
$3-5=2n+5-5$
$-2=2n$
$\frac{-2}{2}=\frac{2n}{2}$
$-1=n$
$n=-1$

**80.** $8-3(2a-4)=5+3a-4a$
$8-6a+12=5+3a-4a$
$-6a+20=5-a$
$-6a+20+a=5-a+a$
$-5a+20=5$
$-5a+20-20=5-20$
$-5a=-15$
$\frac{-5a}{-5}=\frac{-15}{-5}$
$a=3$

**81.** $4(2x-2)-3(x+7)=-4$
$8x-8-3x-21=-4$
$5x-29=-4$
$5x-29+29=-4+29$
$5x=25$
$\frac{5x}{5}=\frac{25}{5}$
$x=5$

**82.** $-2(3w+6)-(4w-3)=21$
$-6w-12-4w+3=21$
$-10w-9=21$
$-10w-9+9=21+9$
$-10w=30$
$\frac{-10w}{-10}=\frac{30}{-10}$
$w=-3$

**83.** $-4(3-4x)-2(x-1)=12x$
$-12+16x-2x+2=12x$
$14x-10=12x$
$14x-10-14x=12x-14x$
$-10=-2x$
$\frac{-10}{-2}=\frac{-2x}{-2}$
$5=x$
$x=5$



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**84.** $-4(2z-6)=-3(z-4)+z$

$-8z+24=-3z+12+z$

$-8z+24=-2z+12$

$-8z+24+8z=-2z+12+8z$

$24=12+6z$

$24-12=12+6z-12$

$12=6z$

$\frac{12}{6}=\frac{6z}{6}$

$2=z$

$z=2$

**85.** $5(a+3)-a=-(4a-6)+1$

$5a+15-a=-4a+6+1$

$4a+15=-4a+7$

$4a+15+4a=-4a+7+4a$

$8a+15=7$

$8a+15-15=7-15$

$8a=-8$

$\frac{8a}{8}=\frac{-8}{8}$

$a=-1$

**86.** $3(2x-4)+3(x+1)=9$

$6x-12+3x+3=9$

$9x-9=9$

$9x-9+9=9+9$

$9x=18$

$\frac{9x}{9}=\frac{18}{9}$

$x=2$

**87.** $-2\left[8-(4-w)\right]-8=4(w+5)$

$-2[8-4+w]-8=4w+20$

$-2[4+w]-8=4w+20$

$-8+2w-8=4w+20$

$-16-2w=4w+20$

$-16+16-2w=4w+20+16$

$-2w=4w+36$

$-2w-4w=4w-4w+36$

$-6w=36$

$\frac{-6w}{-6}=\frac{36}{-6}$

$w=-6$

**88.** $3\left[6-(h+2)\right]-6=4(-h+7)$

$3[6-h-2]-6=-4h+28$

$3[4-h]-6=-4h+28$

$12-3h-6=-4h+28$

$-3h+6=-4h+28$

$-3h+6+4h=-4h+28+4h$

$h+6=28$

$h+6-6=28-6$

$h=22$

**89.** $2[3x-(4x-6)]=5(x-6)$

$2(3x-4x+6)=5x-30$

$6x-8x+12=5x-30$

$-2x+12=5x-30$

$-2x+12+2x=5x-30+2x$

$12=7x-30$

$12+30=7x \quad 30+30$

$42=7x$

$\frac{42}{7}=\frac{7x}{7}$

$6=x$

$x=6$

**90.** $-z-6z+3=4-[6-z-(3-2z)]$

$-7z+3=4-(6-z-3+2z)$

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

$-7z+3=4-3-z$

$-7z+3=1-z$

$-7z+3+7z=1-z+7z$

$3=1+6z$

$3-1=1+6z-1$

$2=6z$

$\frac{2}{6}=\frac{6z}{6}$

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

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



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**91.** $4\{2-[3(c+1)-2(c+1)]\}=-2c$

$4\{2-[3c+3-2c-2]\}=-2c$

$4\{2-[c+1]\}=-2c$

$4\{2-c-1\}=-2c$

$4\{1-c\}=-2c$

$4-4c=-2c$

$4-4c+2c=-2c+2c$

$-2c+4=0$

$-2c+4-4=0-4$

$-2c=-4$

$\frac{-2c}{-2}=\frac{-4}{-2}$

$c=2$

**92.** $3\{[(x-2)+4x]-(x-3)\}=4-(x-12)$

$3[(x-2+4x)-(x-3)]=4-x+12$

$3(5x-2-x+3)=16-x$

$3(4x+1)=16-x$

$12x+3=16-x$

$12+3+x=16-x+x$

$13x+3=16$

$13x+3-3=16-3$

$13x=13$

$\frac{13x}{3}=\frac{13}{3}$

$x=1$

**93.** $-\{4(d+3)-5[3d-2(2d+7)]-8\}=-10d-6$

$-\{4(d+3)-5[-d-14]-8\}=-10d-6$

$-\{4d+12+5d+70-8\}=-10d-6$

$-\{9d+74\}=-10d-6$

$-9d-74=-10d-6$

$-9d-74+10d=-10d-6+10d$

$d-74=-6$

$d-74+74=-6+74$

$d=68$

**94.** $-3(6-4x)=4-\{5x-[6x-(4x-(3x+2))]\}$

$-18+12x=4-\{5x-[6x-(x-2)]\}$

$-18+12x=4-\{5x-[6x-x+2)]\}$

$-18+12x=4-[5x-(5x+2)]$

$-18+12x=4-[5x-5x-2]$

$-18+12x=4-(-2)$

$-18+12x=6$

$-18+18+12x=6+18$

$12x=24$

$\frac{12x}{12}=\frac{24}{12}$

$x=2$

**95.** $\frac{d}{5}=-7$

$5\left(\frac{d}{5}\right)=5(-7)$

$d=-35$

**96.** $-\frac{q}{8}=5$

$-8\left(-\frac{q}{8}\right)=-8(5)$

$q=-40$

**97.** $\frac{4x-2}{3}=-6$

$3\left(\frac{4x-2}{3}\right)=3(-6)$

$4x-2=-18$

$4x-2+2=-18+2$

$4x=-16$

$\frac{4x}{4}=\frac{-16}{4}$

$x=-4$



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**98.** $\dfrac{7m+9}{6}=5$

$6\left(\dfrac{7m+9}{6}\right)=6(5)$

$7m+9=30$

$7m+9-9=30-9$

$7m=21$

$\dfrac{7m}{7}=\dfrac{21}{7}$

$m=3$

**99.** $4-\dfrac{3}{4}a=7$

$4-\dfrac{3}{4}a-4=7-4$

$-\dfrac{3}{4}a=3$

$-4\left(-\dfrac{3}{4}a\right)=-4(3)$

$3a=-12$

$\dfrac{3a}{3}=\dfrac{-12}{3}$

$a=-4$

**100.** $-2=-\dfrac{1}{3}x+4$

$-2-4=-\dfrac{1}{3}x+4-4$

$-6=-\dfrac{1}{3}x$

$-3(-6)=-3\left(-\dfrac{1}{3}x\right)$

$18=x$

**101.** $\dfrac{3}{4}t+\dfrac{7}{8}t=39$

$8\left(\dfrac{3}{4}t+\dfrac{7}{8}t\right)=8(39)$

$6t+7t=312$

$13t=312$

$\dfrac{13t}{13}=\dfrac{312}{13}$

$t=24$

**102.** $\dfrac{1}{3}x+\dfrac{5}{6}=2x$

$6\left[\dfrac{1}{3}x+\dfrac{5}{6}\right]=6(2x)$

$2x+5=12x$

$2x+5-2x=12x-2x$

$5=10x$

$\dfrac{5}{10}=\dfrac{10x}{10}$

$\dfrac{1}{2}=x \quad \text{or} \quad x=\dfrac{1}{2}$

**103.** $\dfrac{2}{3}z-5=\dfrac{z}{6}+1$

$\dfrac{2}{3}z-5+5=\dfrac{z}{6}+1+5$

$\dfrac{2}{3}z=\dfrac{z}{6}+6$

$\dfrac{2}{3}z-\dfrac{z}{6}=\dfrac{z}{6}+6-\dfrac{z}{6}$

$\dfrac{2}{3}z-\dfrac{z}{6}=6$

$6\left(\dfrac{2}{3}z-\dfrac{z}{6}\right)=6(6)$

$4z-z=36$

$3z=36$

$\dfrac{3z}{3}=\dfrac{36}{3}$

$z=12$

**104.** $\dfrac{1}{2}x+2-\dfrac{1}{8}x-1$

$8\left[\dfrac{1}{2}x+2\right]=8\left[\dfrac{1}{8}x-1\right]$

$4x+16=x-8$

$4x+16-x=x-8-x$

$3x+16=-8$

$3x+16-16=-8-16$

$3x=-24$

$\dfrac{3x}{3}=\dfrac{-24}{3}$

$x=-8$



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**105.**
$$\frac{1}{2}=\frac{4}{5}x-\frac{1}{4}$$
$$20\left(\frac{1}{2}\right)=20\left(\frac{4}{5}x-\frac{1}{4}\right)$$
$$10=16x-5$$
$$10+5=16x-5+5$$
$$15=16x$$
$$\frac{15}{16}=\frac{16x}{16}$$
$$\frac{15}{16}=x$$

**106.**
$$\frac{5}{6}m-\frac{5}{12}=\frac{7}{8}m+\frac{2}{3}$$
$$24\left(\frac{5}{6}m-\frac{5}{12}\right)=24\left(\frac{7}{8}m+\frac{2}{3}\right)$$
$$20m-10=21m+16$$
$$20m-10-20m=21m+16-20m$$
$$-10=m+16$$
$$-10-16=m+16-16$$
$$-26=m \quad \text{or} \quad m=-26$$

**107.**
$$x+6=-\frac{2}{3}(x+1)$$
$$x+6=-\frac{2}{3}x-\frac{2}{3}$$
$$3(x+6)=3\left(-\frac{2}{3}x-\frac{2}{3}\right)$$
$$3x+18=-2x-2$$
$$3x+18-18=-2x-2-18$$
$$3x=-2x-20$$
$$3x+2x=-2x-20+2x$$
$$5x=-20$$
$$\frac{5x}{5}=\frac{-20}{5}$$
$$x=-4$$

**108.**
$$x-2=\frac{3}{4}(x+4)$$
$$4(x-2)=4\left[\frac{3}{4}(x+4)\right]$$
$$4(x-2)=3(x+4)$$
$$4x-8=3x+12$$
$$4x-8-3x=3x+12-3x$$
$$x-8=12$$
$$x-8+8=12+8$$
$$x=20$$

**109.**
$$\frac{1}{2}(x-2)=\frac{1}{3}(x+2)$$
$$6\left[\frac{1}{2}(x-2)\right]=6\left[\frac{1}{3}(x+2)\right]$$
$$3(x-2)=2(x+2)$$
$$3x-6=2x+4$$
$$3x-6-2x-2x+4-2x$$
$$x-6=4$$
$$x-6+6=4+6$$
$$x=10$$

**110.**
$$\frac{1}{4}(x+3)=\frac{1}{3}(x-2)+1$$
$$12\left[\frac{1}{4}(x+3)\right]=12\left[\frac{1}{3}(x-2)+1\right]$$
$$3(x+3)=4(x-2)+12$$
$$3x+9=4x-8+12$$
$$3x+9=4x+4$$
$$3x+9-4x=4x+4-4x$$
$$-x+9=4$$
$$-x+9-9=4-9$$
$$-x=-5$$
$$x=5$$

**111.**
$$0.4n+4.7=5.1n$$
$$0.4n+4.7-0.4n=5.1n-0.4n$$
$$4.7=4.7n$$
$$\frac{4.7}{4.7}=\frac{4.7n}{4.7}$$
$$1.00=n \quad \text{or} \quad n=1.00$$



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**112.**
$$0.8x-4=2.1x+3.2$$
$$0.8x-4+4-2.1x+3.2+4$$
$$0.8x=2.1x+7.2$$
$$0.8x-2.1x=2.1x+7.2-2.1x$$
$$-1.3x=7.2$$
$$\frac{-1.3x}{-1.3}=\frac{7.2}{-1.3}$$
$$x\approx -5.54$$

**113.**
$$1.69x-3.1=0.05-5.9x$$
$$1.69x-3.1+3.1=0.05-5.9x+3.1$$
$$1.69x=3.15-5.9x$$
$$1.69x+5.9x=3.15-5.9x+5.9x$$
$$7.59x=3.15$$
$$\frac{7.59x}{7.59}=\frac{3.15}{7.59}$$
$$x\approx 0.42$$

**114.**
$$4.2x+9.7=-3.95x-6.8$$
$$4.2x+9.7-9.7=-3.95x-6.8-9.7$$
$$4.2x=-3.95x-16.5$$
$$4.2x+3.95x=-3.95x-16.5+3.95x$$
$$8.15x=-16.5$$
$$\frac{8.15x}{8.15}=\frac{-16.5}{8.15}$$
$$x\approx -2.02$$

**115.**
$$4.7x-3.6(x-1)=4.9$$
$$4.7x-3.6x+3.6=4.9$$
$$1.1x+3.6=4.9$$
$$1.1x+3.6-3.6=4.9-3.6$$
$$1.1x=1.3$$
$$\frac{1.1x}{1.1}=\frac{1.3}{1.1}$$
$$x\approx 1.18$$

**116.**
$$6.1p-4.5(3-2p)=15.7$$
$$6.1p-13.5+9p=15.7$$
$$15.1p-13.5=15.7$$
$$15.1p-13.5+13.5=15.7+13.5$$
$$15.1p=29.2$$
$$\frac{15.1p}{15.1}=\frac{29.2}{15.1}$$
$$p\approx 1.93$$

**117.**
$$0.6(500-2.4x)=3.6(2x-4000)$$
$$300\quad 1.44x=7.2x\quad 14,400$$
$$300-1.44x+1.44x=7.2x-14,400+1.44x$$
$$300=8.64x-14,400$$
$$300+14,400=8.64x-14,400+14,400$$
$$14,700=8.64x$$
$$\frac{14,700}{8.64}=\frac{8.64x}{8.64}$$
$$1701.39\approx x$$
$$x\approx 1701.39$$

**118.**
$$0.6(14x-8000)=-0.4(20x+12,000)+20.6x$$
$$8.4x-4800=-8x-4800+20.6x$$
$$8.4x-4800=12.6x-4800$$
$$8.4x-4800-8.4x=12.6x-4800-8.4x$$
$$-4800=4.2x-4800$$
$$-4800+4800=4.2x-4800+4800$$
$$0=4.2x$$
$$\frac{0}{4.2}=\frac{4.2x}{4.2}$$
$$x=0.00$$

**119.**
$$3(y+3)-4(2y-7)=-5y+2$$
$$3y+9-8y+28=-5y+2$$
$$-5y+37=-5y+2$$
$$-5y+37+5y=-5y+2+5y$$
$$37=2$$
The solution set is $\varnothing$.
The equation is a contradiction.

**120.**
$$7x+5-5(x-3)=5(x+4)-3x$$
$$7x+5-5x+15=5x+20-3x$$
$$2x+20=2x+20$$
$$2x+20-2x=2x+20-2x$$
$$20=20$$
The solution set is $\mathbb{R}$.
The equation is an identity.



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**121.** $7+3(x-2)+8x=6(x+1)+2x-9$

$7+3x-6+8x=6x+6+2x-9$

$11x+1=8x-3$

$11x+1-1=8x-3-1$

$11x=8x-4$

$11x-8x=8x-4-8x$

$3x=-4$

$x=-\frac{4}{3}$

The solution set is $\left\{-\frac{4}{3}\right\}$.

The equation is conditional.

**122.** $-5(c+3)+4(c-2)=2(c+2)$

$-5c-15+4c-8=2c+4$

$-c-23=2c+4$

$-c-23+c=2c+4+c$

$-23=3c+4$

$-23-4=3c+4-4$

$-27=3c$

$\frac{-27}{3}=\frac{3c}{3}$

$-9=c$

The solution set is $\{-9\}$.

The equation is conditional.

**123.** $6(x-1)=-3(2-x)+3x$

$6x-6=-6+3x+3x$

$6x-6=-6+6x$

$6x-6-6x=-6+6x-6x$

$-6=-6$

The solution set is $\mathbb{R}$.

The equation is an identity.

**124.** $4(2-3x)=-[6x-(8-6x)]$

$8-12x=-(6x-8+6x)$

$8-12x=-(12x-8)$

$8-12x=-12x+8$

$8-12x+12x=-12x+8+12x$

$8=8$

The solution set is $\mathbb{R}$.

The equation is an identity.

**125.** $4-\left(\frac{2}{3}x+2\right)=2\left(-\frac{1}{3}x+1\right)$

$4-\frac{2}{3}x-2=-\frac{2}{3}x+2$

$-\frac{2}{3}x+2=-\frac{2}{3}x+2$

$-\frac{2}{3}x+2+\frac{2}{3}x=-\frac{2}{3}x+2+\frac{2}{3}x$

$2=2$

The solution set is $\mathbb{R}$.

The equation is an identity.

**126.** $7-\left(\frac{1}{2}x+4\right)=3\left(-\frac{1}{6}x+2\right)$

$7-\frac{1}{2}x-4=-\frac{1}{2}x+6$

$-\frac{1}{2}x+3=-\frac{1}{2}x+6$

$-\frac{1}{2}x+3+\frac{1}{2}x=-\frac{1}{2}x+6+\frac{1}{2}x$

$3=6$

The solution set is $\varnothing$.

The equation is a contradiction.

**127.** $0.8z-0.3(z+10)=0.5(z+1)$

$0.8z-0.3z-3.0=0.5z+0.5$

$0.5z-3.0=0.5z+0.5$

$0.5z-3.0-0.5z=0.5z+0.5-0.5z$

$-3.0=0.5$

The solution set is $\varnothing$.

The equation is a contradiction.

**128.** $0.6(z+5)-0.5(z+2)=0.1(z-23)$

$0.6z+3.0-0.5z-1.0=0.1z-2.3$

$0.1z+3.0=0.1z-2.3$

$0.1z+3.0-0.1z=0.1z-2.3-0.1z$

$3.0=-2.3$

The solution set is $\varnothing$.

The equation is contradiction.

**129. a.** For 2018, substitute 18 for $t$.

$P-0.82t+78.5$

$P=0.82(18)+78.5$

$P=14.76+78.5$

$P=93.26$

$P\approx 93$

In 2018, the population density will be about 93 people per square mile.



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**b.** Substitute 100 for $P$ and solve for $t$.

$$P = 0.82t + 78.5$$
$$100 = 0.82t + 78.5$$
$$100 - 78.5 = 0.82t + 78.5 - 78.5$$
$$21.5 = 0.82t$$
$$\frac{21.5}{0.82} = \frac{0.82t}{0.82}$$
$$26.22 \approx t$$

The population density should reach 100 people per square mile during the year 2026.

**130. a.** For first night, substitute 1 for $n$.

$$W = 5n + 5$$
$$W = 5(1) + 5$$
$$W = 10$$

Wait 10 minutes the first night.

**b.** For fourth night, substitute 4 for $n$.

$$W = 5n + 5$$
$$W = 5(4) + 5$$
$$W = 25$$

Wait 25 minutes the fourth night.

**c.** Substitute 30 for $W$ and solve for $n$.

$$W = 5n + 5$$
$$30 = 5n + 5$$
$$30 - 5 = 5n + 5 - 5$$
$$25 = 5n$$
$$\frac{25}{5} = \frac{5n}{5}$$
$$5 = n$$

Wait 30 minutes the fifth night.

**d.** Substitute 40 for $W$ and solve for $n$.

$$W = 5n + 5$$
$$40 = 5n + 5$$
$$40 - 5 = 5n + 5 - 5$$
$$35 = 5n$$
$$\frac{35}{5} = \frac{5n}{5}$$
$$7 = n$$

Wait 40 minutes the seventh night.

**131. a.** For 20 jars of salsa, substitute 20 for $j$

$$C = 2.75j + 40$$
$$= 2.75(20) + 40$$
$$= 55 + 40$$
$$= 95$$

The weekly cost for making 20 jars of salsa is \$95.

**b.** For 50 jars of salsa, substitute 50 for $j$.

$$C = 2.75j + 40$$
$$= 2.75(50) + 40$$
$$= 137.50 + 40$$
$$= 177.50$$

The weekly cost for making 50 jars of salsa is \$177.50.

**c.** Substitute \$205 for $C$ and solve for $j$.

$$C = 2.75j + 40$$
$$205 = 2.75j + 40$$
$$205 - 40 = 2.75j + 40 - 40$$
$$165 = 2.75j$$
$$\frac{165}{2.75} = j$$
$$60 = j$$

For the cost to be \$205, he would need to make 60 jars of salsa.

**132. a.** Substitute 50 for $x$.

$$P = 3.75x - 33.75$$
$$= 3.75(50) - 33.75$$
$$= 187.5 - 33.75$$
$$= 153.75$$

If she sells 50 pies, Janet's weekly profit is \$153.75.

**b.** Substitute 0 for $P$.

$$P = 3.75x - 33.75$$
$$0 = 3.75x - 33.75$$
$$0 + 33.75 = 3.75x - 33.75 + 33.75$$
$$33.75 = 3.75x$$
$$\frac{33.75}{3.75} = \frac{3.75x}{3.75}$$
$$9 = x$$

Janet would have to sell 9 pies in one week in order to break even.



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**c.** Substitute 300 for $P$.

$$P = 3.75x - 33.75$$
$$300 = 3.75x - 33.75$$
$$300 + 33.75 = 3.75x - 33.75 + 33.75$$
$$333.75 = 3.75x$$
$$\frac{333.75}{3.75} = \frac{3.75x}{3.75}$$
$$89 = x$$

Janet would have to sell 89 pies in one week in order to have a profit of \$300.

**133.** $* \Delta - \square = \odot$ for $\Delta$

$$* \Delta - \square + \square = \odot + \square$$
$$* \Delta = \odot + \square$$
$$\frac{* \Delta}{*} = \frac{\odot + \square}{*}$$
$$\Delta = \frac{\odot + \square}{*}$$

**134.** $\Delta(\odot + \square) = \otimes$ for $\Delta$

$$\frac{\Delta(\odot + \square)}{\odot + \square} = \frac{\otimes}{\odot + \square}$$
$$\Delta = \frac{\otimes}{\odot + \square}$$

**135.** $\odot\square + \Delta = \otimes$ for $\odot$

$$\odot\square + \Delta - \Delta = \otimes - \Delta$$
$$\odot\square = \otimes - \Delta$$
$$\frac{\odot\square}{\square} = \frac{\otimes - \Delta}{\square}$$
$$\odot = \frac{\otimes - \Delta}{\square}$$

**136.** $\Delta(\odot + \square) = \otimes$ for $\square$

$$\Delta\odot + \Delta\square = \otimes$$
$$\Delta\odot + \Delta\square - \Delta\odot = \otimes - \Delta\odot$$
$$\Delta\square = \otimes - \Delta\odot$$
$$\frac{\Delta\square}{\Delta} = \frac{\otimes - \Delta\odot}{\Delta}$$
$$\square = \frac{\otimes - \Delta\odot}{\Delta}$$

**137.** Answers may vary. Possible answer:
$2x + 3 = 8$
$14x = 35$
$x = \frac{5}{2}$

All three equations can be written in the form $2x = 5$.

**138.** Answers may vary. Possible answer:
$2x = 8$
$x + 3 = 7$
$x - 2 = 2$
All three equations, when simplified are equivalent to $x = 4$.

**139.** Answers may vary. One possible answer is $x + 5 = x + 3$. Make sure that the variable terms "cancel" and leave a false statement.

**140.** Answers may vary. One possible answer is $x + 5 = x + 5$. Make sure that the expressions on either side of the equal sign are equivalent.

**141.** Answers may vary. One possible answer is $\frac{5}{2}p + 7 = 6 + 2p + 4$.

**142.** Answers may vary. One possible answer is $4 + 4m + 1 = 2m + 9$.

**143.** $2(a + 5) + n = 4a - 8$
Substitute $-2$ for $a$ and solve for $n$.

$$2(-2 + 5) + n = 4(-2) - 8$$
$$2(3) + n = -8 - 8$$
$$6 + n = -16$$
$$6 + n - 6 = -16 - 6$$
$$n = -22$$

**144.** $-3(x + 2) + 5x + 12 = n$
Substitute 6 for $x$ and solve for $n$.

$$-3(6 + 2) + 5(6) + 12 = n$$
$$-3(8) + 30 + 12 = n$$
$$-24 + 30 + 12 = n$$
$$18 = n$$

**145. a.** Answers will vary.

**b.** The definition of absolute value is

$$|a| = \begin{cases} a \text{ if } a \geq 0 \\ -a \text{ if } a < 0 \end{cases}$$

**146. a.** $-3^2 = -(3 \cdot 3) = -9$

**b.** $(-3)^2 = (-3)(-3) = 9$

**147.** $\sqrt[3]{-125} = -5$ since $(-5)^3 = -125$

**148.** $\left(-\frac{2}{7}\right)^2 = \left(-\frac{2}{7}\right)\left(-\frac{2}{7}\right) = \frac{4}{49}$



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## Exercise Set 2.2

**1.** To express a problem using mathematical symbols is to create a mathematical model.

**2.** A number or variable placed below and to the right of a variable is a subscript.

**3.** To express a problem algebraically is to translate the problem into mathematical language.

**4.** The first step in our problem-solving procedure is to understand the problem.

**5.** To check an answer we first ask, "Does the answer make sense?"

**6.** A formula is an equation that is a mathematical model of a real-life situation.

**7.** $F = ma$
$= 79(32)$
$= 2528$

**8.** $A = bh$
$= 13(21)$
$= 273$

**9.** $A = P + Prt$
$= 160 + 160(0.05)(2)$
$= 160 + 16$
$= 176$

**10.** $S = 2lw + 2wh + 2lh$
$= 2(7)(4) + 2(4)(3) + 2(7)(3)$
$= 56 + 24 + 42$
$= 122$

**11.** $A = \pi r^2$
$= \pi(8)^2$
$= \pi(64)$
$\approx 201.06$

**12.** $V = \pi r^2 h$
$= \pi(3)^2(5)$
$= \pi \cdot 9 \cdot 5$
$\approx 141.37$

**13.** $A = \frac{1}{2}bh$
$= \frac{1}{2}(7)(6)$
$= \frac{1}{2}(42)$
$= 21$

**14.** $A = \frac{1}{2}h(b_1 + b_2)$
$= \frac{1}{2}(15)(20 + 28)$
$= \frac{1}{2}(15)(48)$
$= 24(15)$
$= 360$

**15.** $Z = \frac{x - \overline{x}}{s}$
$= \frac{130 - 100}{15}$
$= \frac{30}{15}$
$= 2$

**16.** $E = a_1p_1 + a_2p_2$
$= 10(0.2) + 100(0.3)$
$= 2 + 30$
$= 32$

**17.** $m = \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{4 - (-3)}{-2 - (-6)}$
$= \frac{4 + 3}{-2 + 6}$
$= \frac{7}{4}$

**18.** $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(5 - (-3))^2 + (-6 - 3)^2}$
$= \sqrt{(5 + 3)^2 + (-6 - 3)^2}$
$= \sqrt{8^2 + (-9)^2}$
$= \sqrt{64 + 81}$
$= \sqrt{145} \approx 12.04$



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**19.** $R_T = \dfrac{R_1 R_2}{R_1 + R_2}$

$= \dfrac{100 \cdot 200}{100 + 200}$

$= \dfrac{20,000}{300}$

$\approx 66.67$

**20.** $s_n = \dfrac{n(a_1 + a_n)}{2}$

$= \dfrac{50(-4 + 339)}{2}$

$= \dfrac{50(335)}{2}$

$= \dfrac{16,750}{2}$

$= 8375$

**21.** $x = \dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$

$= \dfrac{-(-5) + \sqrt{(-5)^2 - 4(2)(-12)}}{2(2)}$

$= \dfrac{5 + \sqrt{25 + 96}}{4}$

$= \dfrac{5 + \sqrt{121}}{4}$

$= \dfrac{5 + 11}{4}$

$= \dfrac{16}{4}$

$= 4$

**22.** $x = \dfrac{-b - \sqrt{b^2 - 4ac}}{2a}$

$= \dfrac{-9 - \sqrt{(9)^2 - 4(2)(-5)}}{2(2)}$

$= \dfrac{-9 - \sqrt{81 + 40}}{4}$

$= \dfrac{-9 - \sqrt{121}}{4}$

$= \dfrac{-9 - 11}{4}$

$= \dfrac{-20}{4}$

$= -5$

**23.** $A = p\left(1 + \dfrac{r}{n}\right)^{nt}$

$= 100\left(1 + \dfrac{0.06}{1}\right)^{1 \cdot 3}$

$= 100(1.06)^3$

$= 100(1.191016)$

$\approx 119.10$

**24.** $A = p\left(1 + \dfrac{r}{n}\right)^{nt}$

$= 7000\left(1 + \dfrac{0.02}{4}\right)^{4 \cdot 5}$

$= 7000(1 + 0.005)^{20}$

$= 7000(1.005)^{20}$

$\approx 7000(1.10489558)$

$\approx 7734.27$

**25.** $3x + y = 5$

$3x + y - 3x = 5 - 3x$

$y = 5 - 3x$

or

$y = -3x + 5$

**26.** $6x - 2y = 16$

$6x - 2y - 6x = -6x + 16$

$-2y = -6x + 16$

$\dfrac{-2y}{-2} = \dfrac{-6x + 16}{-2}$

$y = 3x - 8$

**27.** $3x + 2y = 6$

$3x + 2y - 3x = 6 - 3x$

$2y = -3x + 6$

$\dfrac{2y}{2} = \dfrac{-3x + 6}{2}$

$y = -\dfrac{3}{2}x + 3$

**28.** $-6x + 5y = 25$

$-6x + 5y + 6x = 6x + 25$

$5y = 6x + 25$

$\dfrac{5y}{5} = \dfrac{6x + 25}{5}$

$y = \dfrac{6}{5}x + 5$



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**29.**
$$7x = 3y - 2$$
$$7x - 3y - 3y - 2 - 3y$$
$$7x - 3y = -2$$
$$7x - 3y - 7x = -2 - 7x$$
$$-3y = -7x - 2$$
$$\frac{-3y}{-3} = \frac{-7x-2}{-3}$$
$$y = \frac{7}{3}x + \frac{2}{3}$$

**30.**
$$9x = 7y + 23$$
$$9x - 23 = 7y + 23 - 23$$
$$9x - 23 = 7y$$
$$\frac{9x-23}{7} = \frac{7y}{7}$$
$$\frac{9}{7}x - \frac{23}{7} = y$$
$$y = \frac{9}{7}x - \frac{23}{7}$$

**31.**
$$\frac{x}{5} + \frac{y}{2} = 1$$
$$\frac{x}{5} - \frac{y}{2} - \frac{x}{5} = 1 - \frac{x}{5}$$
$$\frac{y}{2} = 1 - \frac{x}{5}$$
$$2\left(\frac{y}{2}\right) = 2\left(-\frac{x}{5} + 1\right)$$
$$y = -\frac{2}{5}x + 2$$

**32.**
$$\frac{x}{4} - \frac{y}{6} = 2$$
$$12\left(\frac{x}{4} - \frac{y}{6}\right) = 12 \cdot 2$$
$$3x - 2y = 24$$
$$3x - 2y - 3x = -3x + 24$$
$$-2y = -3x + 24$$
$$\frac{-2y}{-2} = \frac{-3x+24}{-2}$$
$$y = \frac{3}{2}x - 12$$

**33.**
$$y + 1 = -\frac{4}{3}(x - 9)$$
$$3[y+1] = 3\left[-\frac{4}{3}(x-9)\right]$$
$$3y + 3 = -4(x - 9)$$
$$3y + 3 = -4x + 36$$
$$3y + 3 - 3 = -4x + 36 - 3$$
$$3y =$$
$$\frac{3y}{3} = \frac{-4x+33}{3}$$
$$y = -\frac{4}{3} + 11$$

**34.**
$$y - 4 = \frac{2}{3}(x + 6)$$
$$3[y-4] = 3\left[\frac{2}{3}(x+6)\right]$$
$$3y - 12 = 2(x + 6)$$
$$3y - 12 = 2x + 12$$
$$3y - 12 + 12 = 2x + 12 + 12$$
$$3y = 2x + 24$$
$$\frac{3y}{3} = \frac{2x+24}{3}$$
$$y = \frac{2}{3}x + 8$$

**35.**
$$y - 3 = \frac{2}{3}(x + 2)$$
$$3[y-3] = 3\left[\frac{2}{3}(x+2)\right]$$
$$3y - 9 = 2(x + 2)$$
$$3y - 9 = 2x + 4$$
$$3y - 9 + 9 = 2x + 4 + 9$$
$$3y = 2x + 13$$
$$\frac{3y}{3} = \frac{2x+13}{3}$$
$$y = \frac{2}{3}x + \frac{13}{3}$$



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**36.** $y+5=-\frac{3}{2}(x-1)$

$2[y+5]=2\left[-\frac{3}{2}(x-1)\right]$

$2y+10=-3(x-1)$

$2y+10=-3x+3$

$2y+10-10=-3x+3-10$

$2y=-3x-7$

$\frac{2y}{2}=\frac{-3x-7}{2}$

$y=-\frac{3}{2}x-\frac{7}{2}$

**37.** $E=IR$

$\frac{E}{R}=\frac{IR}{R}$

$\frac{E}{R}=I$ or $I=\frac{E}{R}$

**38.** $C=2\pi r$

$\frac{C}{2\pi}=\frac{2\pi r}{2\pi}$

$\frac{C}{2\pi}=r$ or $r=\frac{C}{2\pi}$

**39.** $C=\pi d$

$\frac{C}{\pi}=\frac{\pi d}{\pi}$

$\frac{C}{\pi}=d$ or $d=\frac{C}{\pi}$

**40.** $A=lw$

$\frac{A}{w}=\frac{lw}{w}$

$\frac{A}{w}=l$ or $l=\frac{A}{w}$

**41.** $P=2l+2w$

$P-2w=2l+2w-2w$

$P-2w=2l$

$\frac{P-2w}{2}=\frac{2l}{2}$

$\frac{P-2w}{2}=l$ or $l=\frac{P-2w}{2}$

**42.** $ax+b=y$

$ax+b-b=y-b$

$ax=y-b$

$\frac{ax}{x}=\frac{y-b}{x}$

$a=\frac{y-b}{x}$

**43.** $V=lwh$

$\frac{V}{lw}=\frac{lwh}{lw}$

$\frac{V}{lw}=h$ or $h=\frac{V}{lw}$

**44.** $V=\pi r^2h$

$\frac{V}{\pi r^2}=\frac{\pi r^2h}{\pi r^2}$

$\frac{V}{\pi r^2}=h$ or $h=\frac{V}{\pi r^2}$

**45.** $A=P+Prt$

$A-P=P+Prt-P$

$A-P=Prt$

$\frac{A-P}{Pt}=\frac{Prt}{Pt}$

$\frac{A-P}{Pt}=r$ or $r=\frac{A-P}{Pt}$

**46.** $Ax+By=C$

$Ax+By-Ax=C-Ax$

$By=C-Ax$

$\frac{By}{B}=\frac{C-Ax}{B}$

$y=\frac{C-Ax}{B}$

**47.** $V=\frac{1}{3}lwh$

$3V=3\left(\frac{1}{3}lwh\right)$

$3V=lwh$

$\frac{3V}{wh}=\frac{lwh}{wh}$

$\frac{3V}{wh}=l$ or $l=\frac{3V}{wh}$



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**48.** $A = \frac{1}{2}bh$

$2A = 2 \cdot \frac{1}{2}bh$

$2A = bh$

$\frac{2A}{h} = \frac{bh}{h}$

$\frac{2A}{h} = b$ or $b = \frac{2A}{h}$

**49.** $y = mx + b$

$y - b = mx + b - b$

$y - b = mx$

$\frac{y-b}{x} = \frac{mx}{x}$

$\frac{y-b}{x} = m$ or $m = \frac{y-b}{x}$

**50.** $IR + Ir = E$

$IR + Ir - Ir = E - Ir$

$IR = E - Ir$

$\frac{IR}{I} = \frac{E-Ir}{I}$

$R = \frac{E-Ir}{I}$

**51.** $y - y_1 = m(x - x_1)$

$\frac{y-y_1}{x-x_1} = \frac{m(x-x_1)}{x-x_1}$

$\frac{y-y_1}{x-x_1} = m$ or $m = \frac{y-y_1}{x-x_1}$

**52.** $a_n = a_1 + (n-1)d$

$a_n - a_1 = a_1 + (n-1)d - a_1$

$a_n - a_1 = (n-1)d$

$\frac{a_n - a_1}{n-1} = \frac{(n-1)d}{n-1}$

$d = \frac{a_n - a_1}{n-1}$

**53.** $z = \frac{x-\overline{x}}{s}$

$sz = s\left(\frac{x-\overline{x}}{s}\right)$

$sz = x - \overline{x}$

$\frac{sz}{z} = \frac{x-\overline{x}}{z}$

$s = \frac{x-\overline{x}}{z}$

**54.** $z = \frac{x-\mu}{\sigma}$

$\sigma z = \sigma\left(\frac{x-\mu}{\sigma}\right)$

$\sigma z = x - \mu$

$\frac{\sigma z}{z} = \frac{x-\mu}{\sigma}$

$\sigma = \frac{x-\mu}{z}$

**55.** $P_1 = \frac{T_1 P_2}{T_2}$

$T_2 P_1 - T_2\left(\frac{T_1 P_2}{T_2}\right)$

$T_2 P_1 = T_1 P_2$

$\frac{T_2 P_1}{P_1} = \frac{T_1 P_2}{P_1}$

$T_2 = \frac{T_1 P_2}{P_1}$

**56.** $y = \frac{kx}{z}$

$zy = z\left(\frac{kx}{z}\right)$

$zy = kx$

$\frac{zy}{y} = \frac{kx}{y}$

$z = \frac{kx}{y}$



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**57.** $A = \frac{1}{2}h(b_1 + b_2)$

$2A = 2\left[\frac{1}{2}h(b_1 + b_2)\right]$

$2A = h(b_1 + b_2)$

$\frac{2A}{b_1 + b_2} = \frac{h(b_1 + b_2)}{b_1 + b_2}$

$\frac{2A}{b_1 + b_2} = h$ or $h = \frac{2A}{b_1 + b_2}$

**58.** $S = \frac{n}{2}(f + l)$

$2S = 2\left[\frac{n}{2}(f + l)\right]$

$2S = n(f + l)$

$\frac{2S}{f + l} = \frac{n(f + l)}{f + l}$

$\frac{2S}{f + l} = n$ or $n = \frac{2S}{f + l}$

**59.** $S = 2\pi r^2 + 2\pi rh$

$S - 2\pi r^2 = 2\pi r^2 + 2\pi rh - 2\pi r^2$

$S - 2\pi r^2 = 2\pi rh$

$\frac{S - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$

$h = \frac{S - 2\pi r^2}{2\pi r}$

**60.** $S = bh + 3bl$

$S - bh = bh + 3bl - bh$

$S - bh = 3bl$

$\frac{S - bh}{3b} = \frac{3bl}{3b}$

$\frac{S - bh}{3b} = l$

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

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

$\frac{9}{5}C = F - 32$

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

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

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

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

$F - 32 = \frac{9}{5}C$

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

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

**63.** $F = \frac{km_1m_2}{d^2}$

$Fd^2 = d^2\left(\frac{km_1m_2}{d^2}\right)$

$Fd^2 = km_1m_2$

$\frac{Fd^2}{km_2} = \frac{km_1m_2}{km_2}$

$\frac{Fd^2}{km_2} = m_1$ or $m_1 = \frac{Fd^2}{km_2}$

**64.** $F = \frac{km_1m_2}{d^2}$

$Fd^2 = d^2\left(\frac{km_1m_2}{d^2}\right)$

$Fd^2 = km_1m_2$

$\frac{Fd^2}{km_1} = \frac{km_1m_2}{km_1}$

$\frac{Fd^2}{km_1} = m_2$ or $m_2 = \frac{Fd^2}{km_1}$

**65. a.** Let $m$ = miles and $k$ = kilometers. Since each mile is approximately 1.6 kilometers, you would need to multiply the number of miles by 1.6 to get the number of kilometers. Therefore, $k = 1.6m$.

**b.** Since $k = 1.6m$

Then $\frac{k}{1.6} = \frac{1.6m}{1.6}$

$\frac{k}{1.6} = m$.



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**66. a.** Let $i$ = inches and $c$ = centimeters.

$$c = 2.54i$$
$$\frac{c}{2.54} = \frac{2.54i}{2.54}.$$
$$\frac{c}{2.54} = i$$

**b.** $c = 2.54i$

**67. a.** $i = prt$
$= 6000(0.03)(4)$
$= 720$
Bhagirathi must pay \$720 in simple interest.

**b.** $6000 + 720 = 6720$
Bhagirathi must pay a total of \$6720.

**68. a.** $i = prt$
$= 4500(0.0175)(2)$
$= 157.5$
Peter must pay \$157.50 in simple interest.

**b.** $4500 + 157.50 = 4657.50$
Peter must pay a total of \$4657.50.

**69.** $i = prt$
$4875 = (20,000)(.0375)t$
$4875 = 750t$
$\frac{4875}{750} = \frac{750t}{750}$
$6.5 = t$
The length of the loan was 6.5 years.

**70.** $i = prt$
$52.90 = (500) \cdot r \cdot (2)$
$52.90 = 1000r$
$\frac{52.90}{1000} = \frac{1000r}{1000}$
$0.0529 = r$
The interest rate was 5.29%.

**71.** $i = prt$
$5262.5 - 5000 = (5000) \cdot r \cdot (3)$
$262.5 = 15,000r$
$\frac{262.5}{15,000} = \frac{15,000r}{15,000}$
$0.0175 = r$
The interest rate was 1.75%.

**72.** $i = prt$
$2166 - 2000 = (2000) \cdot r \cdot (2)$
$166 = 4000r$
$\frac{166}{4000} = \frac{4000r}{4000}$
$0.0415 = r$
The interest rate was 4.15%.

**73.** First we note that the radius of the green circle is $r_1 = 25$ feet and the radius of the red circle is $r_2 = 15$ feet.

**a.** area of red circle $= \pi r^2$
$\approx 3.1416(15)^2$
$\approx 3.1416(225)$
$\approx 706.86$ square feet

**b.** Area of green circle
$= \pi r_1^2 - \pi r_2^2$
$= \pi(25)^2 - \pi(15)^2$
$= 625\pi - 225\pi$
$= 400\pi$
$\approx 1256.64$ square feet

**74. a.** Area of orange region
$= \pi r^2$
$= \pi(1)^2$
$\approx 3.14$ square inches

**b.** Area of red region
$= \pi r_1^2 - \pi r_2^2$
$= \pi(3)^2 - \pi(1)^2$
$= 9\pi - \pi$
$= 8\pi$
$\approx 25.13$ in.$^2$

**c.** Area of blue region
$= \pi r_1^2 - \pi r_2^2$
$- \pi(5)^2 - \pi(3)^2$
$= 25\pi - 9\pi$
$= 16\pi$
$\approx 50.27$ in.$^2$



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**75.a.** 6 inches is 0.5 feet.

$$V = lwh$$
$$= 15(10)(0.5)$$
$$= 75 \text{ cubic feet}$$

**b.** $\frac{75}{27} \approx 2.78$ cubic yards

**c.** To get 2.78 cubic yards of concrete, 3 cubic yards must be purchased.
$3(\$35) = \$105$

**76. a.** 4 inches $= \frac{1}{3}$ ft

$$V = lwh$$
$$= (108)(56)\left(\frac{1}{3}\right)$$
$$= 2016 \text{ ft}^3$$

**b.** $\left(2016 \text{ ft}^3\right)\left(\frac{1 \text{ yd}^3}{27 \text{ ft}^3}\right) \approx 74.67 \text{ yd}^3$

**c.** $\left(75 \text{ yd}^3\right)\left(\frac{\$40}{\text{yd}^3}\right) = \$3000$

**77. a.** The volume of a cylinder is given by $V = \pi r^2 h$. Note that the radius is half the diameter so the radius is 2.5 inches.

$$V = \pi r^2 h$$
$$= \pi(2.5)^2(6.25)$$
$$\approx 122.72 \text{ cubic inches}$$

**b.** For the volume of the box:

$$V = lwh$$
$$= (7)(5)(3.5)$$
$$= 122.5 \text{ cubic inches}$$

**c.** The cylinder has greater volume by about $122.72 - 122.5 = 0.22$ cubic inches.

**78. a.**

$$V = \pi r^2 h$$
$$= \pi(4.5)^2(10.5)$$
$$\approx 667.98 \text{ cubic inches}$$

**b.** $\frac{667.98}{231} \approx 2.89$ gallons

**c.** 2.89 gallons requires 2.89 ounces

**79.**

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 10{,}000\left(1 + \frac{0.06}{4}\right)^{4 \cdot 2}$$
$$= 10{,}000(1.015)^8$$
$$= 11{,}264.93$$

Beth will have \$11,264.93 in her account.

**80.**

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 8500\left(1 + \frac{0.032}{12}\right)^{12 \cdot 4}$$
$$\approx 8500\left(1.0026666667\right)^{48}$$
$$\approx 9659.05$$

Vigay will have \$9659.05 in his account.

**81. a.** Note that 36 months is 3 years so $t = 3$.

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 4390\left(1 + \frac{0.041}{2}\right)^{(2)(3)}$$
$$= 4390(1 + 0.0205)^6$$
$$= 4390(1.0205)^6$$
$$\approx 4958.41$$

The certificate will be worth \$4958.41 after 36 months.

**b.** $4958.41 - 4390 = 568.41$
Heather earned \$568.41 in interest.

**82. a.** 30 months = 2.5 years

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 12{,}000\left(1 + \frac{0.015}{12}\right)^{(12)(2.5)}$$
$$= 12{,}000\left(1.00125\right)^{30}$$
$$\approx 12{,}458.25$$

The certificate will be worth \$12,458.25 after 30 months.

**b.** $12{,}458.25 - 12{,}000 = 458.25$
Linda will earn \$458.25 in interest.



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**83. a.** $A = p\left(1+\frac{r}{n}\right)^{nt}$

$= 50,000\left(1+\frac{0.021}{12}\right)^{(12)(10)}$

$= 50,000(1.00175)^{120}$

$\approx 61,672.58$

The certificate will be worth \$61,672.58 in 10 years.

**b.** $61,672.58 - 50,000 = 11,672.58$

Jon will earn \$11,672.58 in interest.

**84. a.** $A = p\left(1+\frac{r}{n}\right)^{nt}$

$= 25,000\left(1+\frac{0.015}{12}\right)^{12\cdot 7}$

$= 25,000(1+0.00125)^{84}$

$= 25,000(1.00125)^{84}$

$= 27,765.94$

The CD will be worth \$27,765.94 in 7 years.

**b.** Anna will earn

\$27,765.94 − \$25,000 = \$2765.94 in interest.

**85.** $h = -16t^2 + v_0 t + h_0$

**a.** $h = -16(1)^2 + 55(1) + 4$

$= 43$

The height of the baseball after 1 second is 43 feet.

**b.** $h = -16(2)^2 + 55(2) + 4$

$= 50$

The height of the baseball after 2 seconds is 50 feet.

**c.** $h = -16(3.5)^2 + 55(3.5) + 4$

$= 0.5$

The height of the baseball after 3.5 seconds is 0.5 feet.

**86.** $h = -16t^2 + v_0 t + h_0$

**a.** $h = -16(1)^2 + 147(1)$

$= 131$

The height after 1 second is 131 feet.

**b.** $h = -16(4)^2 + 147(4)$

$= 332$

The height after 4 seconds is 332 feet.

**c.** $h = -16(9)^2 + 147(9)$

$= 27$

The height after 4 seconds is 27 feet.

**87. a.** $r = 220 - a$

**b.** $r = 220 - a$

$= 220 - 58$

$= 162$

Greg's recommended maximum heart rate is 162 bpm.

**c.** $157 = 220 - a$

$157 - 220 = -a$

$-63 = -a$

$63 = a$

Patrick's age is 63 years.

**88. a.** $p = 120 - a$

**b.** $p = 120 - a$

$p = 120 - 36$

$p = 84$

84% of Destine's portfolio should be stocks.

**c.** $p = 120 - a$

$79 = 120 - a$

$79 - 120 = -a$

$-41 = -a$

$41 = a$

Rachel's age is 41 years.

**89. a.** $W = 207 - 0.75n$

**b.** $W = 207 - 0.75n$

$= 207 - 0.75(8)$

$= 207 - 6$

$= 201$

After 8 weeks, Gerry weighs 201 pounds.

**c.** $W = 207 - 0.75n$

$180 = 207 - 0.75n$

$180 - 207 = 207 - 0.75n - 207$

$-27 = -0.75n$

$\frac{-27}{-0.75} = n$

$36 = n$

After 36 weeks, Gerry weighs 180 pounds.



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**90. a.** $\text{BMI} = \dfrac{w}{h^2}$

**b.** $\text{BMI} = \dfrac{705w}{h^2}$

**c.** Answers will vary.

**91.** $r = \dfrac{\frac{s}{t}}{\frac{t}{u}} = \dfrac{s}{t} \div \dfrac{t}{u} = \dfrac{s}{t} \cdot \dfrac{u}{t} = \dfrac{su}{t^2}$

In simplified form, it is $r = \dfrac{su}{t^2}$.

**a.** $r = \dfrac{su}{t^2}$

$rt^2 = t^2\left(\dfrac{su}{t^2}\right)$

$rt^2 = su$

$\dfrac{rt^2}{u} = \dfrac{su}{u}$

$\dfrac{rt^2}{u} = s$ or $s = \dfrac{rt^2}{u}$

**b.** $r = \dfrac{su}{t^2}$

$rt^2 = t^2\left(\dfrac{su}{t^2}\right)$

$rt^2 = su$

$\dfrac{rt^2}{s} = \dfrac{su}{s}$

$\dfrac{rt^2}{s} = u$ or $u = \dfrac{rt^2}{s}$

**92.** $-\sqrt{3^2+4^2} + |3-4| - 6^2 = -\sqrt{9+16} + |-1| - 36$

$= -\sqrt{25} + 1 - 36$

$= -5 + 1 - 36$

$= -40$

**93.** $\dfrac{7+9\div\left(2^3+4\div 4\right)}{|3-7|+\sqrt{5^2-3^2}} = \dfrac{7+9\div(8+4\div 4)}{|3-7|+\sqrt{25-9}}$

$= \dfrac{7+9\div(8+1)}{|-4|+\sqrt{16}} = \dfrac{7+9\div 9}{4+4}$

$= \dfrac{7+1}{4+4} = \dfrac{8}{8}$

$= 1$

**94.** $a^3 - 3a^2b + 3ab^2 - b^3$ with $a = -2$ and $b = 3$

$(-2)^3 - 3(-2)^2(3) + 3(-2)(3)^2 - (3)^3$

$-8 - 3(4)(3) + 3(-2)(9) - 27$

$-8 - (12)(3) + (-6)(9) - 27$

$-8 - 36 + -54 - 27$

$-125$

**95.** $\dfrac{1}{4}t + \dfrac{1}{2} = 1 - \dfrac{1}{8}t$

$8\left(\dfrac{1}{4}t + \dfrac{1}{2}\right) = 8\left(1 - \dfrac{1}{8}t\right)$

$2t + 4 = 8 - t$

$2t + 4 + t = 8 - t + t$

$3t + 4 = 8$

$3t + 4 - 4 = 8 - 4$

$3t = 4$

$\dfrac{3t}{3} = \dfrac{4}{3}$

$t = \dfrac{4}{3}$

## Exercise Set 2.3

**1.** The phrase "a number increased by 3" can be represented by the algebraic expression $\underline{x + 3}$.

**2.** The phrase "a number decreased by 3" can be represented by the algebraic expression $\underline{x - 3}$.

**3.** A seven foot rope is cut into two pieces. If we let $x$ = the length of the first piece, then $\underline{7 - x}$ equals the length of the second piece.

**4.** The word "$\underline{\text{is}}$" in a word problem often means "is equal to."

**5.** The phrase "6 $\underline{\text{less}}$ than a number" can be represented by the algebraic expression $x - 6$.

**6.** The phrase "5 $\underline{\text{greater}}$ than a number" can be represented by the algebraic expression $x + 5$.

**7.** $24.95x$

**8.** $11n - 7.5$

**9.** $4m - 17$

**10.** $7p + 8$

**11.** Let $x$ = the length of the first piece in feet. Then the second piece has length $12 - x$ feet.
$x;\ 12 - x$



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**12.** Let $y$ = the number of hours Robin spends on the task. Then the number of hours Tom spends is $17 - y$.

$y;\ 17 - y$

**13.** Let $w$ = the width of the rectangle in meters. Then the length is $w + 29$ meters.

$w;\ w + 29$

**14.** Let $a$ = the measure of the smaller angle in degrees. Then the larger angle measures $a + 15$ degrees.

$a;\ a + 15$

**15.** Let $t$ = the time it takes the best student to complete the test. Then Mitzi's time is $\frac{1}{4}t$.

$t;\ \frac{1}{4}t$

**16.** Let $t$ = the time it takes Jacque to mow the lawn. Then Jeff's time is $\frac{3}{4}t$.

$t;\ \frac{3}{4}t$

**17.** Let $x$ = the speed at which Joy can type a purchase order. Then Maya's speed is $3x$.

$x;\ 3x$

**18.** Let $x$ = the speed at which Jason can paint a house. Then the speed at which George can paint a house is $2x$.

$x;\ 2x$

**19.** Let $e$ = the original cost of the electricity. The increase is $0.22e$, so the new cost is the original cost plus the increase, $e + 0.22e$ or $1.22e$.

$e;\ e + 0.22e$

**20.** Let $p$ = the original price of the refrigerator. The reduction in price is $0.06p$, so the new price is the original price minus the reduction, $p - 0.06p$ or $0.94p$.

$p;\ p - 0.06p$

**21.**
$$B = 4A$$
$$A + B = 180$$
$$A + 4A = 180$$
$$5A = 180$$
$$A = 36$$
$$B = 4A = 4(36) = 144$$

The measure of angle $A$ is 36° and $B$ is 144°.

**22.** Let $x$ = measure of angle $B$

$4x$ – measure of angle $A$

measure of angle $A$ + measure of angle $B = 90^\circ$

$4x + x = 90$

$5x = 90$

$x = 18$

Angle $B$ is $18^\circ$ and angle $A$ is $4 \times 18^\circ = 72^\circ$.

**23.** Let $x$ = measure of angle C

$2x - 15$ = measure of angle $D$

measure of angle $C$ + measure of angle $D = 90^\circ$

$x + 2x - 15 = 90$

$3x - 15 = 90$

$3x - 15 + 15 = 90 + 15$

$3x = 105$

$x = 35$

Angle $C$ is $35^\circ$ and angle $D$ is $2 \times 35^\circ - 15^\circ = 55^\circ$.

**24.**
$$A = B + 30$$
$$A + B = 180$$
$$B + 30 + B = 180$$
$$2B + 30 = 180$$
$$2B = 150$$
$$B = 75$$
$$A = B + 30 = 75 + 30 = 105$$

The measure of angle $A$ is 105° and $B$ is 75°.

**25.** Let $x$=smallest angle, then

$x$+20=second angle

$2x$=third angle

$$x + x + 20 + 2x = 180$$
$$4x + 20 = 180$$
$$4x = 160$$
$$x = 40$$
$$x + 20 = 40 + 20 = 60$$
$$2x = 2(40) = 80$$

The measures of the angles are 40°, 60°, and 80°.



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**26.** Let $x$=smallest angle, then

$2x$=second angle

$x+60$=third angle

$x+2x+x+60=180$

$$4x+60=180$$
$$4x=120$$
$$x=30$$
$$2x=2(30)=60$$
$$x+60=30+60=90$$

The measures of the angles are 30°, 60°, and 90°.

**27.** Let $x$ = the regular price.

$$x-0.2x=176$$
$$0.8x=176$$
$$\frac{0.8x}{0.8}=\frac{176}{0.8}$$
$$x=220$$

The regular price is $220.

**28.** Let $p$ = regular price of suit, then

$0.25p$ = amount of reduction

$$p\ \ 0.25p=187.50$$
$$0.75p=187.50$$
$$p-250$$

The regular price of the suit is $250.

**29.** Let $x$ = number of rides.

$$1.80x=45$$
$$\frac{1.80x}{1.80}=\frac{45}{1.80}$$
$$x=25 \text{ rides}$$

Kate would need to ride the bus 25 times per month.

**30.** Let $x$ = number of weeks.

$$12.50x=940$$
$$\frac{12.50x}{12.50}=\frac{940}{12.50}$$
$$x=75.2$$

It will take 75.2 weeks for the two costs to be the same.

**31.** Let $n$ = number of miles.

$$4(60)+0.25n-300$$
$$240+0.25n=300$$
$$0.25n=300-240$$
$$0.25n=60$$
$$\frac{0.25n}{0.25}=\frac{60}{0.25}$$
$$n=240$$

Nancy can drive the truck 240 miles.

**32.** Let $x$ = total cost of food and beverages.

$$4.50(4)+0.15x=258$$
$$18+0.15x=258$$
$$0.15x=240$$
$$x=1600$$

The total cost of food and beverages served is $1600.

**33.** Let $x$ = the number of golfing trips.

The cost of a social membership:

$50x+25x+1775=75x+1775$

The cost of a golf membership:

$25x+2425$

Set these two expressions equal to each other and solve for $x$.

$$75x+1775=25x+2425$$
$$75x+1775-25x=25x+2425-25x$$
$$50x+1775=2425$$
$$50x+1775-1775=2425-1775$$
$$50x=650$$
$$x=13$$

He must go golfing 13 times per year for the two options to cost the same amount.



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**34.** Let $h$ = number of hours, then

$361+13h$ = cost for $h$ hours using the Premier membership

$281+18h$ = cost for $h$ hours using the Select membership

$$361+13h = 281+18h$$
$$361 = 281+5h$$
$$80 = 5h$$
$$\frac{80}{5} = \frac{5h}{5}$$
$$16 = h$$

The total cost for the two memberships will be the same at 16 hours.

**35.** Let $t$ = number of trips, then

$2.50t$ = cost for one trip without pass

$$0.50t+20 = 2.50t$$
$$20 = 2.00t$$
$$10 = t$$

The Morgans would have to go more than 10 times for the cost of the monthly pass to be worthwhile.

**36.** Let $t$ = number of trips

$1.06t+19.99$ = cost for $t$ trips using the Sun Pass

$1.25t$ = cost for $t$ trips using cash

$$1.06t+19.99 = 1.25t$$
$$19.99 = 1.25t-1.06t$$
$$19.99 = 0.19t$$
$$\frac{19.99}{0.19} = \frac{0.19t}{0.19}$$
$$105 \approx t$$

The total amount spent with Sun Pass will be equal to amount using cash when 105 trips are made.

**37.** Let $p$ = the price of jeans. Then

$p+0.0875p = 139.20$

$$p+0.0875p = 139.20$$
$$1.0875p = 139.20$$
$$\frac{1.0875p}{1.0875} = \frac{139.20}{1.0875}$$
$$p = 128$$

The price of the jeans before tax was \$128.

**38.** Let $x$ = the price before tax was added. Then

$$x+0.1025x = 52.92$$
$$x+0.1025x = 52.92$$
$$1.1025x = 52.92$$
$$\frac{1.1025x}{1.1025} = \frac{52.92}{1.1025}$$
$$x = 48$$

The price of the sweatshirt before the sales tax was added was \$48.

**39.** Let $s$ = sales from the northwest district (in millions of dollars), then $s+0.31$ is the sales from the southeast district (in millions of dollars).

$$s+s+0.31 = 4.6$$
$$2s+0.31 = 4.6$$
$$2s = 4.29$$
$$s = 2.145$$
$$2.145+0.31 = 2.455$$

The sales from the northwest district were \$2.145 million and the sales from the southeast district were \$2.455 million.

**40.** Let $x$ = the number of Brown Swiss cows. Then $x+29$ = the number of Holstein cows.

$$x+(x+29) = 137$$
$$2x+29 = 137$$
$$2x = 108$$
$$\frac{2x}{2} = \frac{108}{2}$$
$$x = 54$$
$$54+29 = 83$$

There are 54 Brown Swiss cows and 83 Holstein cows.

**41.** Let $f$ = fiber in a medium-sized apple. Then $1.1f$ = amount of fiber in one serving of canned blackberries.

$$1.1f = 4.4$$
$$\frac{1.1f}{1.1} = \frac{4.4}{1.1}$$
$$f = 4$$

A medium-sized apple has 4 grams of fiber.



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**42.** Let $l$ = amount of lycopene in a tablespoon of ketchup. Then $1.5l$ = the amount of lycopene in one pink grapefruit.

$$1.5l = 3$$
$$\frac{1.5l}{1.5} = \frac{3}{1.4}$$
$$l = 2$$

One tablespoon of ketchup contains 2 mg of lycopene.

**43.** Let $a$ = last year's attendance. Then $a + 0.13a = 11{,}865$

$$a + 0.13a = 11{,}865$$
$$1.13a = 11{,}865$$
$$\frac{1.13a}{1.13} = \frac{11{,}865}{1.13}$$
$$a = 10{,}500$$

Last year's attendance was 10,500.

**44.** Let $w$ = the minimum wage in 2008. Then $w + 0.1069w = 1.1069w$ is the minimum wage in 2009.

$$1.1069w = 7.25$$
$$\frac{1.1069w}{1.1069} = \frac{7.25}{1.1069}$$
$$w \approx 6.55$$

The minimum wage in 2008 was $6.55 per hour.

**45.** Let $x$ = number of grasses. Then $2x - 5$ = number of weeds and $2x + 2$ is the number of trees.

$x + (2x - 5) + (2x + 2) = 57$

$$x + (2x - 5) + (2x + 2) = 57$$
$$5x - 3 = 57$$
$$5x = 60$$
$$\frac{5x}{5} = \frac{60}{5}$$
$$x = 12$$

There are 12 grasses,
$2(12) - 5 = 24 - 5 = 19$ weeds, and
$2(12) + 2 = 24 + 2 = 26$ trees.

**46.** Let $x$ = number of cups of raisins. Then $3x$ = number of cups of peanuts and $x + 2.5$ is the number of cups of almonds.

$$x + (3x) + (x + 2.5) = 10$$
$$5x + 2.5 = 10$$
$$5x = 7.5$$
$$\frac{5x}{5} = \frac{7.5}{5}$$
$$x = 1.5$$

There are 1.5 cups of raisins,
$3(1.5) = 4.5$ cups of peanuts, and
$1.5 + 2.5 = 4$ cups of almonds.

**47.** Let $r$ = tax rate.

$$85 + 85r + 9.25 = 106.66$$
$$85r + 94.25 = 106.66$$
$$85r + 94.25 - 94.25 = 106.66 - 94.25$$
$$85r = 12.41$$
$$\frac{85r}{85} = \frac{12.41}{85}$$
$$r = 0.146$$

The tax rate is 14.6%.

**48.** Let $r$ = the sales tax rate.

$$8.25 + 8.25r + 7.95 = 16.86$$
$$8.25r + 16.2 = 16.86$$
$$8.25r = 0.66$$
$$\frac{8.25r}{8.25} = \frac{0.66}{8.25}$$
$$r = 0.08$$

The sales tax rate was 0.08, or 8%.

**49.** Let $x$ = number of hours.

$$300 + 5x = 17.5x$$
$$300 = 12.5x$$
$$\frac{300}{12.5} = \frac{12.5x}{12.5}$$
$$24 = x$$

It takes 24 or more hours per month for a membership to become advantageous.

**50.** Let $x$ = number of hours.

$$25 + 10x = 18.50x$$
$$25 = 8.50x$$
$$\frac{25}{8.50} = \frac{8.50x}{8.50}$$
$$2.9 \approx x$$

It takes 3 or more hours per month for Plan 1 to become advantageous.



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**51. a.** Let $x$ = number of months (or monthly payments) necessary for the accumulated payments under the original mortgage plan to equal the accumulated payments and closing cost under the other plan.

$$875x = 755x + 2520$$
$$120x = 2520$$
$$\frac{120x}{120} = \frac{2520}{120}$$
$$x = 21$$

In 21 months Dung will have paid the same amount on his new mortgage plus closing costs as he would on his original mortgage.

**b.** Let $s$ = the amount Dung would have spent on his original mortgage minus the amount he would spend on his new mortgage plus closing costs.

$$s = 875x - (755x + 2520)$$
$$s = 875(60) - [755(60) + 2520]$$
$$s = 52,500 - [45,300 + 2520]$$
$$s = 52,500 - [47,820]$$
$$s = 4680$$

Dung would save $4680.

**52. a.** Let $x$ = number of months (or monthly payments) necessary for the accumulated payments under the original loan to equal the accumulated payments and closing fee under the new loan.

$$1545x = 1275x + 5130$$
$$270x = 5130$$
$$\frac{270x}{270} = \frac{5130}{270}$$
$$x = 19$$

In 19 months after refinancing Elizabeth will have spent the same amount on her new loan plus the refinancing fee as she would have on her original loan.

**b.** Let $s$ = the amount Elizabeth would have spent on her original loan minus the amount she will spend on her new loan plus the refinancing fee.

$$s = 1545x - (1275x + 5130)$$
$$s = 1545(48) - [1275(48) + 5130]$$
$$s = 74,160 - [61,200 + 5130]$$
$$s = 74,160 - [66,330]$$
$$s = 7830$$

Elizabeth will save $7830.

**53.** Let $n$ = the number of bantams. Then $n + 10$ = the number of leghorns, and $2n - 5$ = the number of dorkings.

$$n + (n + 10) + (2n - 5) = 37$$
$$4n + 5 = 37$$
$$4n = 32$$
$$n = 8$$

There are 8 bantams, 8 + 10 = 18 leghorns, and 2(8) – 5 = 11 dorkings.

**54.** Let $x$ = the number of D's. Then $2x$ = the number of C's, $x + 2$ = the number of B's, and $2x + 2$ = the number of A's.

$$x + (x + 2) + 2x + (2x + 2) = 34$$
$$6x + 4 = 34$$
$$6x = 30$$
$$x = 5$$

There were 5 D's, $2(5) = 10$ C's, $5 + 2 = 7$ B's, and $2(5) + 2 = 12$ A's on the test.

**55.** Let $x$ = the length of the shortest side. Then $4x - 2$ = the length of the first side and $3x + 1$ is the length of the second side.

$$x + (4x - 2) + (3x + 1) = 39$$
$$8x - 1 = 39$$
$$8x - 1 + 1 = 39 + 1$$
$$8x = 40$$
$$\frac{8x}{8} = \frac{40}{8}$$
$$x = 5$$

The shortest side measures 5 meters. The first side measures 4(5) – 2 = 18 meters. The second side measures 3(5) + 1 = 16 meters.



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**56.** Let $l$ = the length of the shortest side of the triangle. Then $2l+3$ = the length of the first side of the triangle and $2l+2$ = the length of the second side of the triangle.

$$l+(2l+3)+(2l+2)=30$$
$$5l+5=30$$
$$5l+5-5=30-5$$
$$5l=25$$
$$\frac{5l}{5}=\frac{25}{5}$$
$$l=5$$

The length of the shortest side of the triangle is 5 inches, the length of the first side of the triangle is 2(5) + 3 = 13 inches, and the length of the second side of the triangle is 2(5) + 2 = 12 inches.

**57.** Let s = the length of the smaller side. The lengths of the other two sides are $(s + 3)$ and $(2s-3)$. The perimeter is the sum of the sides.

$$s+(s+3)+(2s-3)=36$$
$$4s=36$$
$$s=9$$

The length of the smaller side is 9 in. The lengths of the other two sides are $(9+3)=12$ in. and $(2(9)-3)=18-3=15$ in.

**58.** Let s = the length of the smaller side. The lengths of the other two sides are $(2s + 4)$ and $(3s-4)$. The perimeter is the sum of the sides.

$$s+(2s+4)+(3s-4)=60$$
$$6s=60$$
$$s=10$$

The length of the smaller side is 10 ft. The lengths of the other two sides are $2(10)+4=24$ ft. and $3(10)-4=26$ ft.

**59.** Let $x$ = the measure of the smallest angle in degrees. The other two angle measurements are $(x+12)$ and $(3x-27)$. The sum of the measures of the interior angles is 180º, so

$$x+(x+12)+(3x-27)=180$$
$$5x-15=180$$
$$5x=195$$
$$x=39$$

The smallest angle is 39º. The other angles are $39°+12°=51°$ and $3(39°)-27°=90°$.

**60.** Let $x$ = the measure of the smallest angle in degrees. The other two angle measurements are $(2x-20)$ and $(2x+25)$. The sum of the measures of the interior angles is 180º, so

$$x+(2x-20)+(2x+25)=180$$
$$5x+5=180$$
$$5x=175$$
$$x=35$$

The smallest angle is 35º. The other angles are $2(35°)-20°=50°$ and $2(35°)+25°=95°$.

**61.** Let $x$ = length of one side of the square. Since there are 7 sides, the total perimeter is $7x$.

$$7x=91$$
$$\frac{7x}{7}=\frac{91}{7}$$
$$x=13$$

The dimensions of each square will be 13 meters by 13 meters.

**62.** Let $x$ = the width. Then, $x + 3$ = length and since the perimeter is 22 feet, the equation is

$$P=2l+2w$$
$$22=2(x+3)+2x$$
$$22=2x+6+2x$$
$$22=4x+6$$
$$16=4x$$
$$\frac{16}{4}=\frac{4x}{4}$$
$$4=x$$

The width is 4 feet and the length is 4 + 3 = 7 feet.

**63.** Let $h$ = height of each bookshelf. Then $h + 3$ is the width.

$$2h+4(h+3)=30$$
$$2h+4h+12=30$$
$$6h=18$$
$$h=3$$
$$h+3=6$$

The width is 6 feet and the height is 3 feet.



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**64.** Let $w$ = the width of each rectangle.
Then $w + 1$ is the length. The fencing runs along 6 widths and 4 lengths.

$$6w + 4(w+1) = 114$$
$$6w + 4w + 4 = 114$$
$$10w = 110$$
$$w = 11$$
$$w + 1 = 12$$

Each rectangle has width 11 meters and length 12 meters.

**65.** Let $p$ = the original price of the calculator.

$$p - 0.10p - 5 = 49$$
$$0.90p - 5 = 49$$
$$0.90p = 54$$
$$\frac{0.90p}{0.90} = \frac{54}{0.90}$$
$$p = 60$$

The original price of the calculator was \$60.

**66.** Let $x$ = the original price of the printer.

$$x - 0.2x - 10 = 210$$
$$0.8x - 10 = 210$$
$$0.8x = 220$$
$$\frac{0.8x}{0.8} = \frac{220}{0.8}$$
$$x = 275$$

The original price was \$275.

**67. a.** Let $x$ = the retail price.

Bass Pro Shops sale price $\rightarrow x - 0.3x$

Gander Mountain sale price $\rightarrow x - 75$

These are equal, so:

$$x - 0.3x = x - 75$$
$$-0.3x = -75$$
$$\frac{-0.3x}{-0.3} = \frac{-75}{-0.3}$$
$$x = 250$$

The retail price is \$250.

**b.** The sale price is \$250 – \$75 = \$175.

**68. a.** Let $x$ = the original price of the bike.

Toys "R" Us sale price $\rightarrow x - 0.37x$

Wal-Mart sale price $\rightarrow x - 50$

These are equal, so:

$$x - 0.37x = x - 50$$
$$-0.37x = -50$$
$$\frac{-0.37x}{-0.37} = \frac{-50}{-0.37}$$
$$x \approx 135.14$$

The original price of the bike was \$135.14.

**b.** The sale price was \$135.14 – \$50 = \$85.14.

**69.** Let $a$ = the amount of land that Dale owns. Then

$\frac{1}{4}a$ = the amount of land that Lee owns and,

$\frac{1}{2}a - 60 =$ the amount of land that Marie owns.

$$a + \left(\frac{1}{4}a\right) + \left(\frac{1}{2}a - 60\right) = 640$$
$$a + \frac{1}{4}a + \frac{1}{2}a - 60 = 640$$
$$a + \frac{1}{4}a + \frac{1}{2}a = 700$$
$$4\left(a + \frac{1}{4}a + \frac{1}{2}a\right) = 4(700)$$
$$4a + a + 2a = 2800$$
$$7a = 2800$$
$$\frac{7a}{7} = \frac{2800}{7}$$
$$a = 400$$

Dale owns 400 acres, Lee owns $\frac{1}{4}(400) = 100$ acres, and Marie owns

$\frac{1}{2}(400) - 60 = 200 - 60 = 140$ acres.



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**70.** Let $x$ = bill before tax. Then

$\frac{5}{8}x$ = amount paid by the Newton family and

$\frac{3}{8}x + 0.15x$ is the amount paid by the Lee family.

The equation is

$$\frac{5}{8}x + \frac{3}{8}x + 0.15x = 184.60$$
$$1.15x = 184.60$$
$$\frac{1.15x}{1.15} = \frac{184.60}{1.15}$$
$$x \approx 160.52$$

The amount paid by the Newton family is $\frac{5}{8}(160.52) = \$100.33$ and the amount paid by the Lee family is \$184.60 – \$100.33 = \$84.27.

**71.** Let $x$ = the fifth score. Then

$$\frac{76+91+97+87+x}{5} = 90$$
$$\frac{351+x}{5} = 90$$
$$5\left(\frac{351+x}{5}\right) = 5(90)$$
$$351 + x = 450$$
$$x = 450 - 351$$
$$x = 99$$

Grant needs a score of 99 on the fifth test.

**72.** Let $x$ = the fifth score. Then

$$\frac{71+79+83+89+x}{5} = 80$$
$$\frac{322+x}{5} = 80$$
$$5\left(\frac{322+x}{5}\right) = 5(80)$$
$$322 + x = 400$$
$$x = 400 - 322$$
$$x = 78$$

Lily needs a score of 78 on the fifth test.

**73.** The final test counts for 2 regular tests, a total of 5 + 2 = 7 tests. To average 90, Shelby must score a total of $7 \times 90 = 630$ points. Let $x$ represent Shelby's score on the final test.

$$2x + 93 + 92 + 91 + 84 + 86 = 630$$
$$2x + 446 = 630$$
$$2x + 446 - 446 = 630 - 446$$
$$2x = 184$$
$$\frac{2x}{2} = \frac{184}{2}$$
$$x = 92$$

Shelby must score 92 on the final test.

**74.** The final test counts for 3 regular tests, a total of 4 + 3 = 7 tests. To average 80, Racail must score a total of $7 \times 80 = 560$ points. Let $x$ represent Racail's score on the final test.

$$3x + 73 + 72 + 71 + 89 = 560$$
$$3x + 305 = 560$$
$$3x + 305 - 305 = 560 - 305$$
$$3x = 255$$
$$\frac{3x}{3} = \frac{255}{3}$$
$$x = 85$$

Racail must score 85 on the final test.

**75.** Let $x$ = number of miles driven.

$$3(28) + 0.15x + 0.04\left[3(28) + 0.15x\right] = 121.68$$

Original Charge 4% Sales Tax

$$84 + 0.15x + 0.04(84 + 0.15x) = 121.68$$
$$84 + 0.15x + 3.36 + 0.006x = 121.68$$
$$87.36 + 0.156x = 121.68$$
$$0.156x = 34.32$$
$$\frac{0.156x}{0.156} = \frac{34.32}{0.156}$$
$$x = 220$$

Martina drove a total of 220 miles during the three days.



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**76.** Let $x$ = original value (price) of the stock.
The value of the stock on Tuesday is $x + 5\%$ of $x$ or $x + 0.05x = 1.05x$.
The value on Wednesday is $1.05x - 0.05(1.05x)$.

$$1.05x - 0.05(1.05x) = 59.85$$
$$1.05x - 0.0525x = 59.85$$
$$0.9975x = 59.85$$
$$\frac{0.9975x}{0.9975} = \frac{59.85}{0.9975}$$
$$x = 60$$

The original value of the stock was \$60.

**77. a., b., and c.** Answers will vary.

**78.** $7 - \left|-\frac{3}{5}\right| = 7 - \frac{3}{5} = \frac{35}{5} - \frac{3}{5} = \frac{32}{5}$

**79.** $6.4 \quad (-3.7) = 6.4 + 3.7 = 2.7$

**80.** $\left|-\frac{5}{8}\right| \div |-4| = \frac{5}{8} \div 4 = \frac{5}{8} \cdot \frac{1}{4} = \frac{5}{32}$

**81.** $5 - |-3| - |12| = 5 - 3 - 12 = 2 - 12 = -10$

**82.** $\left(2x^4 y^{-6}\right)^{-3} = 2^{-3}\left(x^4\right)^{-3}\left(y^{-6}\right)^{-3}$
$$= \frac{1}{8}x^{-12}y^{18}$$
$$= \frac{y^{18}}{8x^{12}}$$

## Mid-Chapter Test: 2.1 – 2.3

**1.** The degree of $6x^5y^7$ is 12 because the sum of the exponents is $5 + 7 = 12$.

**2.** $3x^2 + 7x - 9x + 2x^2 - 11$
$= 3x^2 + 2x^2 + 7x - 9x - 11$
$= 5x^2 - 2x - 11$

**3.** $2(a - 1.3) + 4(1.1a - 6) + 17$
$= 2a - 2.6 + 4.4a - 24 + 17$
$= 2a + 4.4a - 2.6 - 24 + 17$
$= 6.4a - 9.6$

**4.** $7x - 9 = 5x - 21$
$7x - 9 - 5x - 5x - 21 - 5x$
$2x - 9 = -21$
$2x - 9 + 9 = -21 + 9$
$2x = -12$
$\frac{2x}{2} = \frac{-12}{2}$
$x = -6$

**5.** $\frac{3}{4}y + \frac{1}{2} = \frac{7}{8}y - \frac{5}{4}$
$\frac{3}{4}y + \frac{1}{2} - \frac{7}{8}y = \frac{7}{8}y - \frac{5}{4} - \frac{7}{8}y$
$\frac{6}{8}y + \frac{1}{2} - \frac{7}{8}y = -\frac{5}{4}$
$-\frac{1}{8}y + \frac{1}{2} = -\frac{5}{4}$
$-\frac{1}{8}y + \frac{1}{2} - \frac{1}{2} = -\frac{5}{4} - \frac{1}{2}$
$-\frac{1}{8}y = -\frac{5}{4} - \frac{2}{4}$
$-\frac{1}{8}y = -\frac{7}{4}$
$-8\left(-\frac{1}{8}y\right) = -8\left(-\frac{7}{4}\right)$
$y = 14$

**6.** $3p - 2(p + 6) = 4(p + 1) - 5$
$3p - 2p - 12 = 4p + 4 - 5$
$p - 12 = 4p - 1$
$p - 12 - p = 4p - 1 - p$
$-12 = 3p - 1$
$-12 + 1 = 3p - 1 + 1$
$-11 = 3p$
$\frac{-11}{3} = \frac{3p}{3}$
$-\frac{11}{3} = p$



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**7.** $0.6(a-3)-3(0.4a+2)=-0.2(5a+9)-4$

$0.6a-1.8-1.2a-6=-a-1.8-4$

$-0.6a-7.8=-a-5.8$

$-0.6a-7.8+a=-a-5.8+a$

$0.4a-7.8=-5.8$

$0.4a-7.8+7.8=-5.8+7.8$

$0.4a=2$

$\frac{0.4a}{0.4}=\frac{2}{0.4}$

$a=5$

**8.** $4x+15-9x=-7(x-2)+2x+1$

$4x+15-9x=-7x+14+2x+1$

$-5x+15=-5x+15$

$-5x+15+5x=-5x+15+5x$

$15=15$

The equation is an identity. The solution set is $\mathbb{R}$, the set of all real numbers.

**9.** $-3(3x+1)=-\left[4x+(6x-5)\right]+x+7$

$-9x-3=-\left[4x+6x-5\right]+x+7$

$-9x-3=-\left[10x-5\right]+x+7$

$-9x-3=-10x+5+x+7$

$-9x-3=-9x+12$

$-9x-3+9x=-9x+12+9x$

$-3=12$

The equation is a contradiction. The solution set is $\varnothing$, the empty set.

**10.** $A=\frac{1}{2}hb$

$A=\frac{1}{2}(10)(16)$

$=5(16)$

$=80$

**11.** $R_T=\frac{R_1R_2}{R_1+R_2}$

$R_T=\frac{(100)(50)}{100+50}$

$=\frac{5000}{150}$

$=\frac{100}{3}$

**12.** $y=7x+13$

$y-13-7x+13-13$

$y-13=7x$

$\frac{y-13}{7}=\frac{7x}{7}$

$\frac{y-13}{7}=x$ or $x=\frac{y-13}{7}$

**13.** $A=\frac{2x_1+x_2+x_3}{n}$

$nA=n\left(\frac{2x_1+x_2+x_3}{n}\right)$

$nA=2x_1+x_2+x_3$

$nA-2x_1-x_2=2x_1+x_2+x_3-2x_1-x$

$nA-2x_1-x_2=x_3$

or

$x_3=nA-2x_1-x_2$

**14.** $A=P\left(1+\frac{r}{n}\right)^{nt}$

$=700\left(1+\frac{0.06}{4}\right)^{4\cdot5}$

$=700(1.015)^{20}$

$=942.80$

The certificate of deposit will be worth \$942.80 after 5 years.

**15.** $A=2B+6$

$A+B=90$

$2B+6+B=90$

$3B+6=90$

$3B=84$

$B=28$

Angle $A$ measures $2(28)+6=62°$ and angle $B$ measures $28°$.

**16.** Let $d$ = the number of days.

$15+1.75d=32.50$

$15+1.75d-15=32.50-15$

$1.75d=17.5$

$\frac{1.75d}{1.75}=\frac{17.5}{1.75}$

$d=10$

Tom rented the ladder for 10 days.



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**17.** Let $x$ = the length of the shortest side. Then the length of the longest side is $2x$ and the length of the last side is $x+20$.

$$x+2x+x+20=100$$
$$4x+20=100$$
$$4x=80$$
$$x=20$$

The sides of the triangle have lengths of 20 feet, $20+20=40$ feet, and $2(20)=40$ feet.

**18.** Let $r$ = the tax rate (as a decimal). Then the total tax is given by $36r$.

$$36+36r=37.62$$
$$36r=1.62$$
$$r=\frac{1.62}{36}=0.45$$

The sales tax rate was 4.5%.

**19.** Let $n$ = the number of months, then $52n$ is the total increase in population.

$$3613+52n=5693$$
$$52n=2080$$
$$n=\frac{2080}{52}=40$$

40 months ago the population was 3613.

**20.** Mary is incorrect. To obtain an equivalent equation, both sides of the equation must be multiplied by the *same* non-zero constant. She should multiply both sides of the equation by the least common multiple of the denominators, 12.

$$\frac{1}{2}x+\frac{1}{3}=\frac{1}{4}x-\frac{1}{2}$$
$$12\left(\frac{1}{2}x+\frac{1}{3}\right)=12\left(\frac{1}{4}x-\frac{1}{2}\right)$$
$$6x+4=3x-6$$
$$3x+4=-6$$
$$3x=-10$$
$$x=-\frac{10}{3}$$

## Exercise Set 2.4

**1.** Let $t$ = time in hours.

| Balloon | Rate | Time | Distance |
|---|---|---|---|
| 1 | 14 | $t$ | $14t$ |
| 2 | 11 | $t$ | $11t$ |

distance apart = balloon 1 dist.–balloon 2 dist.

$$12=14t-11t$$
$$12=3t$$
$$4=t$$

It will take 4 hours for the balloons to be 12 miles apart.

**2.** Let $t$ = time in hours.

| Car | Rate | Time | Distance |
|---|---|---|---|
| 1 | 76 | $t$ | $76t$ |
| 2 | 68 | $t$ | $68t$ |

distance apart = car 1 dist. – car 2 dist.

$$20=76t-68t$$
$$12=8t$$
$$2.5=t$$

It will take 2.5 hours for the cars to be 20 miles apart.

**3.** Let $t$ = the time each is plowing.

| | Rate | Time | Distance |
|---|---|---|---|
| Scott | 2.75 | $t$ | $2.75t$ |
| Troy | 3.00 | $t$ | $3t$ |

$$2.75t+3.00t=4.6$$
$$5.75t=4.6$$
$$t=0.8$$

Scott and Troy will meet after 0.8 hour.

**4.** Let $t$ = time required for them to meet.

| | Rate | Time | Distance |
|---|---|---|---|
| Ena | 60 | $t$ | $60t$ |
| Jana | 50 | $t$ | $50t$ |

Since the distances traveled total to 385 miles,

$$60t+50t=385$$
$$110t=385$$
$$t=3.5 \text{ hours}$$

It will them 3.5 hours to meet somewhere in between their houses.



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**5.** Let $t$ = time in hours.

| Rider | Rate | Time | Distance |
|---|---|---|---|
| James | 13 | $t$ | $13t$ |
| Kathy | 15 | $t$ | $15t$ |

distance apart = bicycle 1 dist. + bicycle 2 dist.

$$21 = 13t + 15t$$
$$21 = 28t$$
$$0.75 = t$$

It will take 0.75 hours or 45 minutes for the bicycles to be 20 miles apart.

**6.** Let $t$ = time needed for them to be out of range.

| | Rate | Time | Distance |
|---|---|---|---|
| Alice | 3.8 | $t$ | $3.8t$ |
| Mary | 4.2 | $t$ | $4.2t$ |

Since the distances traveled total to 2 miles,

$$3.8t + 4.2t = 2$$
$$8t = 2$$
$$t = 0.25 \text{ hours or 15 minutes}$$

It will them 0.25 hours or 15 minutes for them to be out of range.

**7. a.** Let $r$ = Wayne's speed.

| | Rate | Time | Distance |
|---|---|---|---|
| Mary | $2r$ | 3 | $(2r)(3)$ |
| Wayne | $r$ | 3 | $3r$ |

After 3 hours, Mary is 18 miles ahead of Wayne:

$$(2r)(3) = 3r + 18$$
$$6r = 3r + 18$$
$$3r = 18$$
$$r = 6$$

Wayne's speed is 6 miles per hour.

**b.** Mary's speed is $(2)(6) = 12$ miles per hour.

**8. a.** Let $r$ = Randy's rate

| | Rate | Time | Distance |
|---|---|---|---|
| Randy | $r$ | 0.75 | $0.75r$ |
| Tony | $1.5r$ | 0.75 | $0.75(1.5r)$ |

After 0.75 hour, Tony is 3 miles ahead:

$$0.75(1.5r) - 0.75r = 3$$
$$1.125r - 0.75r = 3$$
$$0.375r = 3 \quad \text{Randy's rate is 8}$$
$$\frac{0.375r}{0.375} = \frac{3}{0.375}$$
$$r = 8$$

miles per hour.

**b.** Tony's rate is $1.5r = 1.5(8) = 12$ miles per hour.

**9. a.** Let $t$ = time needed for Kristen to catch up with Luis.

| | Rate | Time | Distance |
|---|---|---|---|
| Luis | 4 | $t + 0.75$ | $4(t + 0.75)$ |
| Kristen | 24 | $t$ | $24t$ |

$$24t = 4(t + 0.75)$$
$$24t = 4t + 3$$
$$20t = 3$$
$$t = 0.15$$
$$0.15 \text{ hours} = (0.15)(60) = 9 \text{ minutes}$$

It will take Kristen 9 minutes to catch up with Luis.

**b.** When Kristen catches up with Luis (after 0.15 hours), Kristen will have traveled a distance of $(24)(0.15) = 3.6$ miles. She will be 3.6 miles from their house.

**10. a.** Let $t$ = time needed for Rhiannon to catch up with Max.

| | Rate | Time | Distance |
|---|---|---|---|
| Max | 3 | $t + 0.5$ | $3(t + 0.5)$ |
| Rhiannon | 4 | $t$ | $4t$ |



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$$4t = 3(t + 0.5)$$
$$4t = 3t + 1.5$$
$$t = 1.5$$
$$1.5 \text{ hours} = (1.5)(60) = 90 \text{ minutes}$$

It will take Rhiannon 90 minutes, or 1.5 hours, to catch up with Max.

**b.** When Rhiannon catches up with Max (after 1.5 hours), Rhiannon will have traveled a distance of $(4)(1.5) = 6$ miles. She will be 6 miles from their beach condo.

**11.** Let $t$ = time for Lightning to finish the race.

| | Rate | Time | Amount |
|---|---|---|---|
| Zippy | 5 | $t - 0.25$ | $5(t - 0.25)$ |
| Lightning | 4 | $t$ | $4.5t$ |

**a.** Both go the same distance, so
$$5(t - 0.25) = 4.5t$$
$$5t - 1.25 = 4.5t$$
$$0.5t = 1.25$$
$$t = 2.5$$

Lightning finishes the race in 2.5 hours

**b.** Zippy takes $2.5 - 0.25 = 2.25$ hours to finish the race.

**c.** The distance covered is $5(2.25) = 11.25$ inches.

**12. a.** Let $t$ = time it takes Lily to finish the race.

| | Rate | Time | Distance |
|---|---|---|---|
| Lily | 16 | $t$ | $16t$ |
| Shawna | 18 | $t - 1$ | $18(t - 1)$ |

$$16t = 18(t - 1)$$
$$16t = 18t - 18$$
$$16t - 18t = -18$$
$$-2t = -18$$
$$t = \frac{-18}{-2}$$
$$t = 9$$

It takes Lily 9 hours to finish the race.

**b.** Shawna's time = 9 – 1 = 8 hours

**c.** Race distance = $16t$
$$= 16(9)$$
$$= 144$$

The distance of the race was 144 miles.

**13.** Let $d$ = distance from car to campsite.

| | Rate | Time | Distance |
|---|---|---|---|
| Hike to campsite | 3.5 | $t$ | $3.5t$ |
| Hike to car | 4 | $15 - t$ | $4(15 - t)$ |

**a.** $3.5t = 4(15 - t)$
$$3.5t = 60 - 4t$$
$$3.5t + 4t = 60$$
$$7.5t = 60$$
$$t = \frac{60}{7.5}$$
$$t = 8$$

The time to reach the campsite was 8 hours.

**b.** Distance = hike to campsite + hike to car
$$3.5t + 4(15 - t) = 3.5(8) + 4(15 - 8)$$
$$= 28 + 4(7)$$
$$= 28 + 28$$
$$= 56$$

The total distance was 56 miles.

**14. a.** Let $t$ = time to reach bottom of canyon.

| | Rate | Time | Distance |
|---|---|---|---|
| Trip down | 3.5 | $t$ | $3.5t$ |
| Trip up | 2.1 | $16 - t$ | $2.1(1.6 - t)$ |

distance down = distance up
$$3.5t = 2.1(16 - t)$$
$$3.5t = 33.6 - 2.1t$$
$$5.6t = 33.6$$
$$t = 6$$

It took her 6 hours to reach the bottom of the canyon.

**b.** total distance = $2(\text{distance down})$
$$= 2(3.5 \cdot 6)$$
$$= 2(21)$$
$$= 42$$

The total distance traveled is 42 miles



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**15.** Let $t$ = time of operation for smaller machine.

| | Rate | Time | Amount |
|---|---|---|---|
| Smaller machine | 400 | $t$ | $400t$ |
| Larger machine | 600 | $t+2$ | $600(t+2)$ |

$$400t + 600(t+2) = 15,000$$
$$400t + 600t + 1200 = 15,000$$
$$1000t = 13,800$$
$$t = 13.8$$

The smaller machine operated for 13.8 hours.

**16.** Let $t$ = time the slower copier takes to finish the job.

| Copier | Rate | Time | Fliers |
|---|---|---|---|
| 1 | 55 | 10 | 550 |
| 2 | 45 | $10+t$ | $45(10+t)$ |

Since the total number of fliers is 1900,

$$550 + 45(10+t) = 1900$$
$$550 + 450 + 45t = 1900$$
$$1000 + 45t = 1900$$
$$45t = 900$$
$$t = 20$$

It will take the slower copier 20 minutes to finish the job.

**17.** Let $x$ = ounces of 12% solution.

| Solution | Strength | Ounces | Acid |
|---|---|---|---|
| Mail | 12% | $x$ | $0.12x$ |
| Store | 5% | 40 | $0.05(40)$ |
| Mixture | 8% | $x+40$ | $0.08(x+40)$ |

$$0.12x + 0.05(40) = 0.08(x+40)$$
$$0.12x + 2 = 0.08x + 3.2$$
$$0.04x = 1.2$$
$$x = 30$$

She should mix 30 ounces of the 12% vinegar.



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**18.** Let $x$ = number of cups of table vinegar.

| Vinegar | % Acetic Acid | No. of Cups | Amount |
|---|---|---|---|
| Table | 0.05 | $x$ | $0.05x$ |
| Pickling | 0.15 | 2 | $0.15(2)$ |
| Mixture | 0.13 | $2+x$ | $0.13(2+x)$ |

$$0.05x+0.15(2)=0.13(2+x)$$
$$0.05x+0.3=0.26+0.13x$$
$$0.05x+0.3-0.05x=0.26+0.13x-0.05x$$
$$0.3=0.26+0.08x$$
$$0.3-0.26=0.26+0.08x-0.26$$
$$0.04=0.08x$$
$$0.08x=0.04$$
$$x=\frac{0.04}{0.08}=0.5$$

Alex will need 0.5 cup of table vinegar.

**19.** Let $x$ = ounces of distilled water added.

| Solution | Strength | Ounces | Acid |
|---|---|---|---|
| Pure hydrogen peroxide | 60% | **2500** | $0.60(2500)$ |
| Distilled water | 0% | $x$ | 0 |
| Mixture | 25% | $x+2500$ | $0.25(x+2500)$ |

Since no acid is being added to the mixture, the amount of acid in the final mixture will be the same as the amount of acid in the original 2500 gallons.

$$0.25(x+2500)=0.60(2500)$$
$$0.25x+625=1500$$
$$0.25x=875$$
$$x=3500$$

David needs to add 3500 gallons of distilled water.



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**20.** Let $x$ = number of ounces of water.

| Solution | Strength | Ounces | Acid |
|---|---|---|---|
| Sulfuric acid | 25% | 8 | $0.25(8)$ |
| Water | 0 | $x$ | $0(x)$ |
| Mixture | 5% | $8+x$ | $0.05(8+x)$ |

$$0.25(8)+0(x)=0.05(8+x)$$
$$2=0.4+0.05x$$
$$1.6=0.05x$$
$$\frac{1.6}{0.05}=\frac{0.05x}{0.05}$$
$$32=x$$

He should add 32 ounces of water.

**21.** Let $x$ = number of teaspoons of 30% sauce.

| Sauce | Strength | Teaspoons | Acid |
|---|---|---|---|
| #1 | 30% | $x$ | $0.30x$ |
| #2 | 80% | $4-x$ | $0.80(4-x)$ |
| Mixture | 45% | 4 | $0.45(4)$ |

$$0.30x+0.80(4-x)=0.45(4)$$
$$0.30x+3.2-0.80x=1.8$$
$$-0.50x=-1.4$$
$$x=2.8$$

She should use 2.8 teaspoons of the 30% sauce and $4-2.8=1.2$ teaspoons of the 80% sauce.

**22.** Let $x$ = number of ounces of 1% solution.

| Solution | Strength | Ounces | Rosemary Oil |
|---|---|---|---|
| 1 | 1% | $x$ | $0.01x$ |
| 2 | 5% | $3-x$ | $0.05(3-x)$ |
| Mixture | 2% | 3 | $0.02(3)$ |

$$0.01x+0.05(3-x)=0.02(3)$$
$$0.01x+0.15-0.05x=0.06$$
$$0.01x+0.15-0.05x=0.06$$
$$-0.04x+0.15=0.06$$
$$-0.04x=-0.09$$
$$x=2.25$$

She should use 2.25 ounces of 1% solution and $3-2.25=0.75$ ounce of 5% solution.



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**23.** Let $x$ = pounds of Kona coffee.

| Item | Cost | Pounds | Total |
|---|---|---|---|
| Kona | 6.20 | $x$ | $6.20x$ |
| Amaretto | 5.80 | 18 | $5.80(18)$ |
| Mixture | 6.10 | $18+x$ | $6.10(18+x)$ |

$$6.20x+5.80(18)=6.10(18+x)$$
$$6.2x+104.4=109.8+6.1x$$
$$0.1x=5.4$$
$$x=54$$

She should mix 54 pounds of Kona coffee with the amaretto coffee.

**24.** Let $x$ = number of pounds of walnuts.

| Item | Cost | Pounds | Total |
|---|---|---|---|
| Pecans | 9.80 | 6 | $9.80(6)$ |
| Walnuts | 4.40 | $x$ | $4.40x$ |
| Mixture | 8.00 | $6+x$ | $8(6+x)$ |

$$9.80(6)+4.40x+=8(6+x)$$
$$58.8+4.40x=48+8x$$
$$58.8-48=8x-4.40x$$
$$10.8=3.6x$$
$$\frac{10.8}{3.6}=\frac{3.6x}{3.6}$$
$$3=x$$

She should mix 3 pounds of walnuts with the pecans.

**25.** Let $x$ = gallons of 93-octane needed to add.

| Gasoline | Octane% | Gallons | Amount of Octane |
|---|---|---|---|
| 87-octane | 87% | 850 | $0.87(850)$ |
| 93-octane | 93% | $x$ | $0.93x$ |
| Mixture | 89% | $850+x$ | $0.89(850+x)$ |

$$0.87(850)+0.93x=0.89(850+x)$$
$$739.5+0.93x=756.5+0.89x$$
$$0.04x=17$$
$$x=425$$

Blake should add 425 gallons of 93-octane gasoline.



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**26.** Let $x$ = gallons of 91-octane needed to add.

| Gasoline | Octane% | Gallons | Amount of Octane |
|---|---|---|---|
| 88-octane | 88% | 575 | $0.88(575)$ |
| 91-octane | 91% | $x$ | $0.91x$ |
| Mixture | 89% | $575+x$ | $0.89(575+x)$ |

$$0.88(575)+0.91x=0.89(575+x)$$
$$506+0.91x=511.75+0.89x$$
$$0.02x=5.75$$
$$x=287.5$$

287.5 gallons of 91-octane gasoline should be added.

**27.** Let $x$ = number of pounds of the orange slices.

| Type | Cost | No. of Pounds | Amount |
|---|---|---|---|
| Orange Slices | \$1.29 | $x$ | $1.29x$ |
| Strawberry Leaves | \$1.79 | $12-x$ | $(12-x)$ |
| Mixture | $\frac{17.48}{12}=\$1.46$ | 12 | 17.48 |

$$1.29x+1.79(12-x)=17.48$$
$$1.29x+21.48-1.79x=17.48$$
$$-0.50x+21.48=17.48$$
$$-0.50x=-4$$
$$x=\frac{-4}{-0.50}=8$$

8 pounds of the orange slices should be mixed with $12-8=4$ pounds of the strawberry leaves to produce the desired mixture.

**28.** Let $x$ = pounds of almonds.

| Item | Cost | Pounds | Total |
|---|---|---|---|
| Almonds | 6.00 | $x$ | $6x$ |
| Walnuts | 5.20 | $30-x$ | $5.2(30-x)$ |

$$6x+5.2(30-x)=165$$
$$6x+156-5.2x=165$$
$$0.8x=9$$
$$x=11.25$$
$$30-x=18.75$$

The mixture should contain 11.25 pounds of almonds and 18.75 pounds of walnuts.



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**29.** Let $x$ = amount invested at 3% over a one-year period.

| Account | Principal | Rate | Time | Interest |
|---|---|---|---|---|
| 3% | $x$ | 0.03 | 1 | $0.03x$ |
| 4.1% | $30000-x$ | 0.041 | 1 | $0.041(30000-x)$ |

The total interest is \$1091.73.

$$0.03x+0.041(30000-x)=1091.73$$
$$0.03x+1230-0.041x=1091.73$$
$$-0.011x+1230=1091.73$$
$$-.011x=-138.27$$
$$x=12570$$

Thus, \$12,570 was invested at 3% and the remaining amount of \$30,000 – \$12,570 = \$17,430 was invested at 4.1%.

**30.** Let $x$ = amount invested at 3.5%.

| Account | Principal | Rate | Time | Interest |
|---|---|---|---|---|
| 3.5% | $x$ | 0.035 | 2 | $(0.035)(2)x=0.07x$ |
| 2.5% | $3000-x$ | 0.025 | 2 | $(0.025)(2)(3000-x)=0.05(3000-x)$ |

The total interest is \$190.

$$0.07x+0.05(3000-x)=190$$
$$0.07x+150-0.05x=190$$
$$0.02x+150=190$$
$$0.02x=40$$
$$x=\frac{40}{0.02}=2000$$

Thus, \$2000 was invested at 3.5% and the remaining amount of \$3000 – \$2000 = \$1000 was invested at 2.5%.

**31.** Let $x$ = amount invested in the breakfast café.

| Business | Interest Rate | Amount Invested | Interest Received |
|---|---|---|---|
| Breakfast café | 0.02 | $x$ | $2(0.02x)$ |
| Comic book store | 0.01 | $10,000-x$ | $2\left[0.01(10,000-x)\right]$ |

$$2(0.02x)+2\left[0.01(10,000-x)\right]=330$$
$$0.04x+2\left[100-0.01x\right]=330$$
$$0.04x+200-0.02=330$$
$$0.02x+200=330$$
$$0.02x=130$$
$$x=6500$$

Kelly invested \$6500 in the breakfast café and $10,000-6500=\$3500$ in the comic book store.



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**32.** Let $x$ = amount lent to Judy.

| Friend | Interest Rate | Amount Lent | Interest Received |
|---|---|---|---|
| Judy | 0.025 | $x$ | $3(0.025x)$ |
| Maryanne | 0.03 | $15,000 - x$ | $3\left[0.03(15,000 - x)\right]$ |

$$3(0.025x) + 3\left[0.03(15,000 - x)\right] = 1305$$
$$0.075x + 3\left[450 - 0.03x\right] = 1305$$
$$0.075x + 1350 - 0.09x = 1305$$
$$-0.015x + 1350 = 1305$$
$$-0.015x = -45$$
$$x = 3000$$

Kelly lent \$3000 to Judy and $15,000 - 3000 = \$12,000$ to Maryanne.

**33.** Let $t$ = time (in hours) before they meet.

| | Rate | Time | Distance |
|---|---|---|---|
| Julie | 52 | $t$ | $52t$ |
| Kamilia | 50 | $t$ | $50t$ |

Their combined distances are 2448 miles.

$$52t + 50t = 2448$$
$$102t = 2448$$
$$t = 24$$

They will meet after 24 hours.

**34. a.** Let $x$ = their speed in miles per hour. Note that 1 hr. 30 min. = 1.5 hours and that 1 hr. 15 min. = 1.25 hours.

| | Rate | Time | Distance |
|---|---|---|---|
| Mike | $x$ | 1.5 | $1.5x$ |
| Scott | $x$ | 1.25 | $1.25x$ |

The total distance traveled is 110 miles.

$$1.5x + 1.25x = 110$$
$$2.75x = 110$$
$$x = 40$$

They are each traveling at a speed of 40 mph.

**b.** The restaurant is $(1.25 \text{ hr})(40 \text{ mph}) = 50$ miles away from Scott's house.



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**35.** Let $x$ = time needed for both pumps to empty the pool.

| Pump | Rate | Time | Amount Pumped |
|---|---|---|---|
| 1 | 10 | $t$ | $10t$ |
| 2 | 20 | $t$ | $20t$ |

The total amount of water pumped is 15,000 gallons.

$$10t + 20t = 15,000$$
$$30t = 15,000$$
$$t = \frac{15,000}{30} = 500 \text{ minutes}$$

It will take the pumps 500 minutes or $\frac{500}{60} = 8\frac{1}{3}$ hours to empty the pool.

**36.** Let $x$ = time it takes the two machines to bottle 2750 bottles of ketchup.

| Machine | Rate | Time | Bottles |
|---|---|---|---|
| Older | 25 | $x$ | $25x$ |
| Newer | 30 | $x$ | $30x$ |

$$25x + 30x = 2750$$
$$55x = 2750$$
$$x = 50$$

It will take 50 minutes.

**37.** Let $x$ = amount of 32% solution that Marcia should add.

| Type | Strength of Solution | No. of Ounces | Amount |
|---|---|---|---|
| 32% | 0.32 | $x$ | $0.32x$ |
| 17% | 0.17 | 32 | $0.17(32)$ |
| Mixture | 0.20 | $x + 32$ | $0.20(x+32)$ |

$$0.32x + 0.17(32) = 0.20(x+32)$$
$$0.32x + 5.44 = 0.20x + 6.4$$
$$0.12x + 5.44 = 6.4$$
$$0.12x = 0.96$$
$$x = 8$$

Marcia should add 8 ounces.



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**38.** Let $x$ = amount of 1.5% butterfat milk needed.

| Type | Strength | Quarts | Amount of Butterfat |
|---|---|---|---|
| 6% | 0.06 | 200 | $0.06(200)$ |
| 1.5% | 0.015 | $x$ | $0.015x$ |
| 2.4% | 0.024 | $200+x$ | $0.024(200+x)$ |

$$0.06(200)+0.015x=0.024(200+x)$$
$$12+0.015x=4.8+0.024x$$
$$12=4.8+0.009x$$
$$7.2=0.009x$$
$$800=x$$

Sundance Dairy should combine 800 quarts of 1.5% butterfat milk with 200 quarts of 6% butterfat milk to produce 1000 quarts of 2.4% butterfat milk.

**39. a.** Let $t$ = time before the jets meet.

| | Rate | Time | Distance |
|---|---|---|---|
| Jet | 780 | $t$ | $780t$ |
| Refueling Plane | 520 | $t+2$ | $520(t+2)$ |

The distances traveled are equal.

$$780t=520(t+2)$$
$$780t=520t+1040$$
$$260t=1040$$
$$t=4$$

The two planes will meet in 4 hours.

**b.** $780t=780(4)=3120$

The refueling will take place 3120 miles from the base.



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**40. a.** Let $t$ = time before Kimberly catches up.

| | Rate | Time | Distance |
|---|---|---|---|
| Shannon | 3 | $\frac{1}{3}+t$ | $3\left(\frac{1}{3}+t\right)$ |
| Kimberly | 15 | $t$ | $15t$ |

The distances traveled are equal.

$$15t = 3\left(\frac{1}{3}+t\right)$$

$$15t = 1+3t$$

$$12t = 1$$

$$t = \frac{1}{12} \text{ hour or 5 minutes}$$

It will take $\frac{1}{12}$ hour or 5 minutes.

**b.** $15t = 15\left(\frac{1}{12}\right) = 1.25$

The meeting will take place 1.25 miles from the dock.

**41.** Let $x$ = amount of 80% solution needed.

| Solution | Strength of Solution | No. of Ounces | Amount of Alcohol |
|---|---|---|---|
| 80% | 0.80 | $x$ | $0.80x$ |
| Water | 0 | $128-x$ | $0(128-x)$ |
| 6% | 0.06 | 128 | $0.06(128)$ |

$$0.80x + 0(128-x) = 0.06(128)$$

$$0.80x = 7.68$$

$$x = \frac{7.68}{0.80} = 9.6$$

Herb should combine 9.6 ounces of the 80% solution with 128 – 9.6 = 118.4 ounces of water to produce the desired solution.



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**42.** Let $x$ = amount of pure antifreeze to be added.

| Type | Strength of Solution | No. of Quarts | Amount |
|---|---|---|---|
| Pure | 1.00 | $x$ | $1.00x$ |
| 20% | 0.20 | 10 | $0.20(10)$ |
| Mixture | 0.50 | $x+10$ | $0.50(x+10)$ |

$$1.00x+0.20(10)=0.50(x+10)$$
$$1.00x+2=0.50x+5$$
$$0.50x=3$$
$$x=\frac{3}{0.50}=6$$

Doreen Kelly should add 6 quarts of pure antifreeze to 10 quarts of 20% antifreeze to produce a mixture (solution) of 16 quarts of 50% antifreeze.

**43.** Let $r$ = Vince's speed in construction areas. Note that 15 minutes is $\frac{1}{4}$ hour and that 45 minutes is $\frac{3}{4}$ hour.

| | Rate | Time | Distance |
|---|---|---|---|
| Road work | $r$ | $\frac{1}{4}$hr | $\frac{1}{4}r$ |
| Rest of trip | $r+10$ | $\frac{1}{2}$hr | $\frac{1}{2}(r+10)$ |

The total trip distance is 35 miles.

$$\frac{1}{4}r+\frac{1}{2}(r+10)=35$$
$$4\left(\frac{1}{4}r+\frac{1}{2}(r+10)\right)=4(35)$$
$$r+2(r+10)=140$$
$$r+2r+20=140$$
$$3r=120$$
$$r=40$$

Vince's speed in construction areas is 40 mph and his speed elsewhere is $40+10=50$ mph.



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**44.** Let $t$ = time he mowed in second gear.

| Gear | Rate | Time | Distance |
|---|---|---|---|
| Second | 4.2 | $t$ | $4.2t$ |
| Third | 7.8 | $2-t$ | $7.8(2-t)$ |

The total distance is 13.8 miles.

$$4.2t+7.8(2-t)=13.8$$
$$4.2t+15.6-7.8t=13.8$$
$$-3.6t=-1.8$$
$$t=\frac{-1.8}{-3.6}=0.5$$

Richard mowed 0.5 hour in second gear and $2-0.5=1.5$ hours in third gear.

**45. a.** Let $t$ = number of full-price tickets sold.

| Tickets | Rate | No. of Tickets | Total |
|---|---|---|---|
| Full-price | 56.5 | $t$ | $56.5t$ |
| Student | 49.5 | $3250-t$ | $49.5(3250-t)$ |

Total concert ticket sales were \$162,611.

$$56.5t+49.5(3250-t)=162,611$$
$$56.5t+160,875-49.5t=162,611$$
$$7t+160,875=162,611$$
$$7t+160,875-160,875=162,611-160,875$$
$$7t=1736$$
$$\frac{7t}{7}=\frac{1736}{7}$$
$$t=248$$

There were 248 full-price tickets sold.

**b.** $3250-248=3002$

There were 3002 student tickets sold.



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**46.** Let $t$ = number of tickets sold online.

| | Rate | No. of Tickets | Total |
|---|---|---|---|
| Online | 7.5 | $t$ | $7.5t$ |
| In person | 9 | $270-t$ | $9(270-t)$ |

$$7.5t+9(270-t)=2359.5$$
$$7.5t+2430-9t=2359.5$$
$$-1.5t+2430=2359.5$$
$$-1.5t+2430=2359.5$$
$$-1.5t=-70.5$$
$$\frac{-1.5t}{-1.5}=\frac{-70.5}{-1.5}$$
$$t=47$$

There were 47 online tickets sold and $270-47=223$ tickets sold at the box office.

**47.** Let $x$ = amount of 2% solution needed.

| Solution | Strength of Solution | No. of ml | Amount of Acid |
|---|---|---|---|
| 2% | 0.02 | $x$ | $0.02x$ |
| 14% | 0.14 | $45-x$ | $0.14(45-x)$ |
| 6% | 0.06 | 45 | $0.06(45)$ |

$$0.02x+0.14(45-x)=0.06(45)$$
$$0.02x+6.3-0.14x=2.7$$
$$0.02x+6.3-0.14x=2.7$$
$$-0.12x+6.3=2.7$$
$$-0.12x=-3.6$$
$$\frac{-0.12x}{-0.12}=\frac{-3.6}{-0.12}$$
$$x=30$$

Catherine should mix 30 ml of the 2% solution with 45 – 30 = 15 ml of the 14% solution.



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**48.** Let $x$ = amount of 2% solution needed.

| Solution | Strength of Solution | No. of Liters | Amount of Acid |
|---|---|---|---|
| 10% | 0.1 | $x$ | $0.01x$ |
| 48% | 0.48 | $950-x$ | $0.48(950-x)$ |
| 30% | 0.3 | 950 | $0.3(950)$ |

$$0.1x+0.48(950-x)=0.3(950)$$
$$0.1x+456-0.48x=285$$
$$-0.38x+456=285$$
$$-0.38x=-171$$
$$\frac{-0.38x}{-0.38}=\frac{-171}{-0.38}$$
$$x=450$$

Kathy should mix 450 liters of the 10% solution with 950 – 450 = 500 liters of the 48% solution.

**49.** It is possible to determine the times for the 2nd and 3rd parts of the trip.

2nd Part: $t=\frac{d}{r}=\frac{31}{90}\approx 0.344$ hour

3rd Part: $t=\frac{d}{r}=\frac{68}{45}\approx 1.511$ hours

The time for the first part (Paris to Calais) is $3.000-0.344-1.511=1.145$ hours. The distance is $(130 \text{ mph})(1.145 \text{ hours})\approx 149$ miles

**50. a.** Car $A$ has completed half the race which is 250 laps. Since each lap is 1 mile, Car $A$ has traveled 250 miles. To find the time use $t=\frac{d}{r}=\frac{250}{125}=2$ hours. The cars have been racing for 2 hours. Now, Car $B$ is 6.2 laps or 6.2 miles behind Car $A$. Thus, Car $B$ has traveled $250-6.2=243.8$ miles. To find the rate use $r=\frac{d}{t}=\frac{243.8}{2}=121.9$ mph.

The rate for Car $B$ is 121.9 mph.

**b.** To catch up to Car $A$, Car $B$ must travel 6.2 miles. The time required to do this is $t=\frac{d}{r}=\frac{6.2}{121.9}\approx 0.0509$ hour or

$$0.0509 \text{ hour} \times \frac{3600 \text{ seconds}}{1 \text{ hour}}$$

= 183.2 seconds.



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**51.** Let $x$ be the amount of 20% solution which must be drained. Then, $16-x$ is the amount remaining.

$$0.20(16-x)+1.00x=0.50(16)$$
$$3.2-0.20x+1.00x=8$$
$$3.2+0.80x=8$$
$$0.80x=4.8$$
$$x=\frac{4.8}{0.80}=6$$

Thus, 6 quarts must be drained before adding the same amount of antifreeze.

**52.**
$$\frac{2.16\times10^5}{3.6\times10^8}=\frac{2.16}{3.6}\times\frac{10^5}{10^8}$$
$$=0.6\times10^{5-8}$$
$$=0.6\times10^{-3}$$
$$=6.0\times10^{-3}\times10^{-1}$$
$$=6.0\times10^{-3-1}$$
$$=6.0\times10^{-4}$$

**53.**
$$0.6x+0.22=0.4(x-2.3)$$
$$0.6x+0.22=0.4x-0.92$$
$$0.6x-0.4x+0.22=0.4x-0.4x-0.92$$
$$0.2x+0.22=-0.92$$
$$0.2x+0.22-0.22=-0.92-0.22$$
$$0.2x=-1.14$$
$$\frac{0.2x}{0.2}=\frac{-1.14}{0.2}$$
$$x=-5.7$$

**54.**
$$\frac{2}{3}x+8=x+\frac{25}{4}$$
$$12\left(\frac{2}{3}x\right)+12(8)=12(x)+12\left(\frac{25}{4}\right)$$
$$8x+96=12x+75$$
$$8x-8x+96=12x-8x+75$$
$$96=4x+75$$
$$96-75=4x+75-75$$
$$21=4x$$
$$\frac{21}{4}=\frac{4x}{4}$$
$$\frac{21}{4}=x$$

**55.**
$$\frac{3}{5}(x-2)=\frac{2}{7}(2x+3y)$$
$$35\left[\frac{3}{5}(x-2)\right]=35\left[\frac{2}{7}(2x+3y)\right]$$
$$21(x-2)=10(2x+3y)$$
$$21x-42=20x+30y$$
$$21x-20x-42=20x-20x+30y$$
$$x-42=30y$$
$$\frac{x-42}{30}=\frac{30y}{30}$$
$$\frac{x-42}{30}=y \text{ or } y=\frac{x-42}{30}$$

**56.** Let $x$ be the distance driven in one day.

$$35+0.75x=20+0.80x$$
$$35=20+0.05x$$
$$15=0.05x$$
$$\frac{15}{0.05}=x$$
$$x=300 \text{ miles}$$

The costs are the same when 300 miles are driven per day.



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## Exercise Set 2.5

1. A compound inequality is formed by joining two inequalities with the word *and* or *or*.

2. A(n) open circle on the number line indicates that the endpoint is not part of the solution.

3. A(n) closed circle on the number line indicates that the endpoint is part of the solution.

4. To find the solution set of an inequality containing the word *and*, take the intersection of the solution sets of the two inequalities.

5. To find the solution set of an inequality containing the word *or*, take the union of the solution sets of the two inequalities.

6. Whenever you multiply or divide both sides of an inequality by a negative number, you must change the direction of the inequality symbol.

7. a. 


   b. $(-3, \infty)$

   c. $\{x \mid x > -3\}$

8. a. 


   b. $(-\infty, 2)$

   c. $\{x \mid x < 2\}$

9. a. 


   b. $(-\infty, 1]$

   c. $\{x \mid x \le 1\}$

10. a. 


    b. $\left[-\frac{6}{5}, \infty\right)$

    c. $\left\{x \middle| x \ge -\frac{6}{5}\right\}$

11. a. 

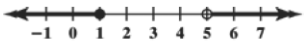

    b. $(-7, -4]$

    c. $\{x \mid -7 < x \le -4\}$

12. a. 

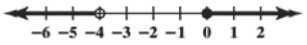

    b. $(-4, 3)$

    c. $\{x \mid -4 < x < 3\}$

13. a. 


    b. $(-\infty, 1] \cup (5, \infty)$

    c. $\{k \mid k \le 1 \text{ or } > 5\}$

14. a. 


    b. $(-\infty, -4) \cup [0, \infty)$

    c. $\{c \mid c < -4 \text{ or } c \ge 0\}$

15. a. 


    b. $(0,3]$

    c. $\{a \mid 0 < a \le 3\}$

16. a. 


    b. $[-4,1)$

    c. $\{b \mid -4 \le b < 1\}$

17. $3x + 2 \le 8$

    $3x \le 6$

    $\frac{3x}{3} \le \frac{6}{3}$

    $x \le 2$




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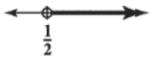
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**18.** $2x+3>4$

$2x>1$

$\frac{2x}{2}>\frac{1}{2}$

$x>\frac{1}{2}$



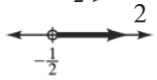

**19.** $-2z+3<4$

$-2z<4-3$

$-2z<1$

$\frac{-2z}{-2}<\frac{1}{-2}$

$z>-\frac{1}{2}$



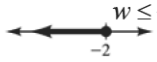

**20.** $-3w+7\geq 13$

$-3w+7-7\geq 13-7$

$-3w\geq 6$

$\frac{-3w}{-3}\leq\frac{6}{-3}$

$w\leq -2$




**21.** $-3(2x+1)>-4x+3$

$-6x-3>-4x+3$

$-6x+4x-3>-4x+4x+3$

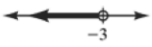
$-2x-3>3$

$-2x-3+3>3+3$

$-2x>6$

$\frac{-2x}{-2}<\frac{6}{-2}$

$x<-3$




**22.** $-5(7h+1)\leq -4(8h+2)$

$-35h-5\leq -32h-8$

$-35h+35h-5\leq -32h+35h-8$

$-5\leq 3h-8$

$-5+8\leq 3h$

$3\leq 3h$

$\frac{3}{3}\leq\frac{3h}{3}$

$1\leq h$

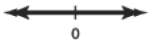



**23.** $2y-6y+8\leq 2(-2y+9)$

$-4y+8\leq -4y+18$

$8\leq 18$

Since this is a true statement, the solution is all real numbers.



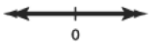

**24.** $-6(d+2)<-9d+3(d-1)$

$-6d-12<-9d+3d-3$

$-6d-12<-6d-3$

$-12<-3$

Since this is a true statement, the solution is all real numbers.



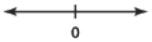

**25.** $5b-6\geq 3(b+3)+2b$

$5b-6\geq 3b+9+2b$

$5b-6\geq 5b+9$

$-6\geq 9$

Since this is a false statement, there is no solution.

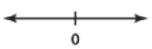



**26.** $8(2x+3)\leq 4(4x-7)$

$16x+24\leq 16x-28$

$24\leq -28$

Since this is a false statement, there is no solution.






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**27.**
$$\frac{7}{15}x-\frac{1}{3}\ge\frac{3}{5}$$
$$15\left(\frac{7}{15}x-\frac{1}{3}\right)\ge 15\left(\frac{3}{5}\right)$$
$$7x-5\ge 9$$
$$7x\ge 9+5$$
$$7x\ge 14$$
$$\frac{7x}{7}\ge\frac{14}{7}$$
$$x\ge 2$$




**28.**
$$\frac{5}{14}x+\frac{1}{2}<\frac{1}{7}x+\frac{1}{14}$$
$$14\left(\frac{5}{14}x+\frac{1}{2}\right)<14\left(\frac{1}{7}x+\frac{1}{14}\right)$$
$$5x+7<2x+1$$
$$5x-2x<1-7$$
$$3x<-6$$
$$\frac{3x}{3}<\frac{-6}{3}$$
$$x<-2$$




**29.**
$$5-2z+8\ge 5z-8$$
$$13-2z\ge 5z-8$$
$$13\ge 7z-8$$
$$21\ge 7z$$
$$\frac{21}{7}\ge\frac{7z}{7}$$
$$3\ge z$$
$$(-\infty,\ 3]$$

**30.**
$$5-7x<12+3x+13$$
$$5-7x<25+3x$$
$$5-25<3x+7x$$
$$-20<10x$$
$$\frac{-20}{10}<\frac{10x}{10}$$
$$-2<x\to(-2,\infty)$$

**31.**
$$\frac{1}{3}k-\frac{7}{9}<\frac{5}{9}k+1$$
$$9\left(\frac{1}{3}k-\frac{7}{9}\right)<9\left(\frac{5}{9}k+1\right)$$
$$3k-7<5k+9$$
$$-7-9<5k-3k$$
$$-16<2k$$
$$\frac{-16}{2}<\frac{2k}{2}$$
$$-8<k\to(-8,\infty)$$

**32.**
$$\frac{4}{21}d+\frac{3}{7}\le\frac{3}{7}d-1$$
$$21\left(\frac{4}{21}d+\frac{3}{7}\right)\le 21\left(\frac{3}{7}d-1\right)$$
$$4d+9\le 9d-21$$
$$9+21\le 9d-4d$$
$$30\le 5d$$
$$\frac{30}{5}\le\frac{5d}{5}$$
$$6\le d\to[6,\infty)$$

**33.**
$$-\frac{3}{4}(2x-1)\le\frac{15}{8}(x+4)$$
$$-\frac{6x}{4}+\frac{3}{4}\le\frac{15x}{8}+\frac{15}{2}$$
$$8\left(-\frac{6x}{4}+\frac{3}{4}\right)\le 8\left(\frac{15x}{8}+\frac{15}{2}\right)$$
$$-12x+6\le 15x+60$$
$$6\le 27x+60$$
$$-54\le 27x$$
$$\frac{-54}{27}\le\frac{27x}{27}$$
$$-2\le x$$
$$[-2,\ \infty)$$



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**34.** $\frac{6(x-2)}{5} > \frac{10(2-x)}{3}$

$15\left[\frac{6(x-2)}{5}\right] > 15\left[\frac{10(2-x)}{3}\right]$

$18(x-2) > 50(2-x)$

$18x-36 > 100-50x$

$68x-36 > 100$

$68x > 136$

$\frac{68x}{68} > \frac{136}{68}$

$x > 2$

$(2, \infty)$

**35.** $-3x+1 < 3[(x+2)-2x]-1$

$-3x+1 < 3[x+2-2x]-1$

$-3x+1 < 3[2-x]-1$

$-3x+1 < 6-3x-1$

$-3x+1 < 5-3x$

$1 < 5$

Since this is a true statement, the solution is all real numbers.

$(-\infty, \infty)$

**36.** $-2[x+3(x-4)] \geq 5(x+3)-13(x+1)$

$-2[x+3x-12] \geq 5x+15-13x-13$

$-2[4x-12] \geq -8x+2$

$-8x+24 \geq -8x+2$

$24 \geq 2$

Since this is a true statement, the solution is all real numbers.

$(-\infty, \infty)$

**37.** $-2 \leq t+3 < 4$

$-2-3 \leq t+3-3 < 4-3$

$-5 \leq t < 1$

$[-5, 1)$

**38.** $-7 < p-6 \leq -5$

$-7+6 < p-6+6 \leq -5+6$

$-1 < p \leq 1$

$(-1, 1]$

**39.** $-15 \leq -3z \leq 12$

Divide by –3 and reverse inequalities.

$\frac{-15}{-3} \geq \frac{-3z}{-3} \geq \frac{12}{-3}$

$5 \geq z \geq -4$

$-4 \leq z \leq 5$

$[-4, 5]$

**40.** $-45 < -5x \leq 15$

Divide by –5 and reverse the inequalities.

$\frac{-45}{-5} > \frac{-5x}{-5} \geq \frac{15}{-5}$

$9 > x \geq -3$

$[-3, 9)$

**41.** $5 \leq 2x-3 < 9$

$5+3 \leq 2x-3+3 < 9+3$

$8 \leq 2x < 12$

$\frac{8}{2} \leq \frac{2x}{2} < \frac{12}{2}$

$4 \leq x < 6 \rightarrow [4,6)$

**42.** $2 \leq 3x-1 < 5$

$2+1 \leq 3x-1+1 < 5+1$

$3 \leq 3x < 6$

$\frac{3}{3} \leq \frac{3x}{3} < \frac{6}{3}$

$1 \leq x < 2 \rightarrow [1,2)$



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**43.** $14 \le 2-3g < 15$

$14-2 \le 2-3g-2 < 15-2$

$12 \le -3g < 13$

Divide by –3 and reverse inequalities.

$\frac{12}{-3} \ge \frac{-3g}{-3} > \frac{13}{-3}$

$-4 \ge g > -\frac{13}{3}$

$-\frac{13}{3} < g \le -4$

$\left(-\frac{13}{3},\ -4\right]$

**44.** $-16 < 5-3n \le 13$

$-16-5 < 5-3n-5 \le 13-5$

$-21 < -3n \le 8$

Divide by –3 and reverse the inequalities.

$\frac{-21}{-3} > \frac{-3n}{-3} \ge \frac{8}{-3}$

$7 > n \ge -\frac{8}{3}$

$-\frac{8}{3} \le n < 7$

$\left[-\frac{8}{3},\ 7\right)$

**45.** $-6 \le -3(2x-4) < 12$

$-6 \le -6x+12 < 12$

$-6-12 \le -6x+12-12 < 12-12$

$-18 \le -6x < 0$

Divide by $-6$ and reverse inequalities.

$\frac{-18}{-6} \ge \frac{-6x}{-6} > \frac{0}{-6}$

$3 \ge x > 0$

$0 < x \le 3$

$\{x \mid 0 < x \le 3\}$

**46.** $2 < -2(2x-1) \le 10$

$2 < -4x+2 \le 10$

$2-2 < -4x+2-2 \le 10-2$

$0 < -4x \le 8$

Divide by –4 and reverse inequalities.

$\frac{0}{-4} > \frac{-4x}{-4} \ge \frac{8}{-4}$

$0 > x \ge -2 \rightarrow \{x \mid -2 \le x < 0\}$

**47.** $5 \le \frac{3x+1}{2} < 11$

$2(5) \le 2\left(\frac{3x+1}{2}\right) < 2(11)$

$10 \le 3x+1 < 22$

$10-1 \le 3x+1-1 < 22-1$

$9 \le 3x < 21$

$\frac{9}{3} \le \frac{3x}{3} < \frac{21}{3}$

$3 \le x < 7$

$\{x \mid 3 \le x < 7\}$

**48.** $0 \le \frac{3(t-5)}{2} \le 6$

$2(0) \le 2\left(\frac{3(t-5)}{2}\right) \le 2(6)$

$0 \le 3(t-5) \le 12$

$0 \le 3t-15 \le 12$

$0+15 \le 3x-15+15 \le 12+15$

$15 \le 3x \le 27$

$\frac{15}{3} \le \frac{3x}{3} \le \frac{27}{3}$

$5 \le x < 9 \rightarrow \{x \mid 5 \le x \le 9\}$



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**49.** $\frac{3}{5} < \frac{-x-5}{3} < 2$

$15\left(\frac{3}{5}\right) < 15\left(\frac{-x-5}{3}\right) < 15(2)$

$9 < 5(-x-5) < 30$

$9 < -5x - 25 < 30$

$9 + 25 < -5x - 25 + 25 < 30 + 25$

$34 < -5x < 55$

Divide by –5 and reverse inequalities.

$\frac{34}{-5} > \frac{-5x}{-5} > \frac{55}{-5}$

$-\frac{34}{5} > x > -11$

$-11 < x < -\frac{34}{5}$

$\left\{x \mid -11 < x < -\frac{34}{5}\right\}$

**50.** $-6 < \frac{4-3x}{2} < \frac{2}{3}$

$6(-6) < 6\left(\frac{4-3x}{2}\right) < 6\left(\frac{2}{3}\right)$

$-36 < 3(4-3x) < 2(2)$

$-36 < 12 - 9x < 4$

$-36 - 12 < 12 - 9x - 12 < 4 - 12$

$-48 < -9x < -8$

Divide by – 9 and reverse inequalities.

$\frac{-48}{-9} > \frac{-9x}{-9} > \frac{-8}{-9}$

$\frac{16}{3} > x > \frac{8}{9}$

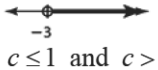
$\frac{8}{9} < x < \frac{16}{3}$

$\left\{x \middle| \frac{8}{9} < x < \frac{16}{3}\right\}$

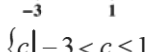
**51.** $c \le 1$




$c > -3$




$c \le 1$ and $c > -3 \quad \Rightarrow \quad -3 < c \le 1$

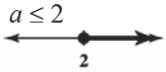



$\{c \mid -3 < c \le 1\}$

**52.** $a > -5$




$a \le 2$

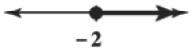



$a > -5$ and $a \le 2$

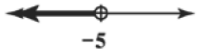



$\{a \mid -5 < a \le 2\}$

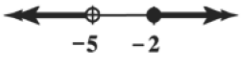
**53.** $p \ge -2$




$p < -5$

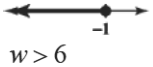



$p \ge -2$ or $p < -5$

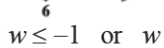



$\{p \mid p < -5 \text{ or } p \ge -2\}$

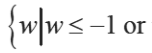
**54.** $w \le -1$




$w > 6$

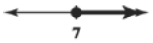



$w \le -1$ or $w > 6$

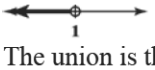



$\{w \mid w \le -1 \text{ or } w > 6\}$

**55.** $q \ge -7$




$q < 1$




The union is the entire real number line.
Therefore, the solution set is all real numbers, or $\mathbb{R}$.

**56.** $d > 0$




$d \le 8$



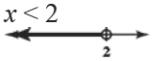

The union is the entire real number line.
Therefore, the solution set is all real numbers, or $\mathbb{R}$.



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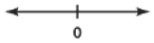
**57.** $x < 2$




$x > 4$

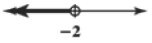



$x < 2$ and $x > 4$




There is no overlap so the solution is the empty set, $\varnothing$.

**58.** $r < -2$




$r > 4$




There is no overlap so the solution is the empty set, $\varnothing$.

**59.** $2s + 3 < 7$ or $-3s + 4 \le -17$

$2s < 4$ or $-3s \le -21$

$\frac{2s}{2} < \frac{4}{2}$ or $\frac{-3s}{-3} \ge \frac{-21}{-3}$

$s < 2$ $\quad s \ge 7$

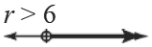
$s < 2$ or $s \ge 7$ which is $(-\infty, 2) \cup [7, \infty)$.

**60.** $4 - r < -2$ or $3r - 1 < -1$

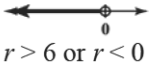
$-r < -6$ $\quad 3r < 0$

$r > 6$ $\quad r < 0$

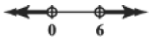
$r > 6$




$r < 0$




$r > 6$ or $r < 0$



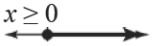

In interval notation: $(-\infty, 0) \cup (6, \infty)$

**61.** $4x + 5 \ge 5$ and $3x - 7 \le -1$

$4x \ge 0$ and $3x \le 6$

$x \ge 0$ and $x \le 2$

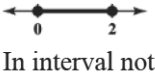
$x \ge 0$




$x \le 2$




$x \ge 0$ and $x \le 2$ which is $0 \le x \le 2$




In interval notation: $[0, 2]$

**62.** $7x - 9 > -23$ and $5x + 8 < 23$

$7x > -14$ and $5x < 15$

$x > -2$ and $x < 3$

$(-2, 3)$

**63.** $-3y + 8 > -4$ and $-2y - 5 \le 3$

$-3y > -12$ and $-2y \le 8$

$y < 4$ and $y \ge -4$

$[-4, 4)$

**64.** $-4z - 7 \le 5$ and $2z - 7 < 7$

$-4z \le 12$ and $2z < 14$

$z \ge -3$ and $z < 7$

$[-3, 7)$

**65.** $-2v + 5 \le -7$ or $-3v - 8 \ge 16$

$-2v \le -12$ or $-3v \ge 24$

$v \ge 6$ or $v \le -8$

$(-\infty, -8] \cup [6, \infty)$

**66.** $-5u + 6 > 21$ or $-7u - 5 < 9$

$-5u \ge 15$ or $-7u < 14$

$u \le -3$ or $u > -2$

$(-\infty, -3] \cup (-2, \infty)$

**67.** $5t - 3 < 12$ or $-3t + 4 \ge 16$

$5t < 15$ or $-3t \ge 12$

$t < 3$ or $t \le -4$

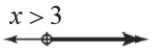
$(-\infty, -3]$

**68.** $-x + 3 < 0$ or $2x - 5 \ge 3$

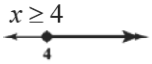
$-x < -3$ or $2x \ge 8$

$x > 3$ or $x \ge 4$

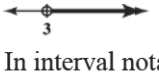
$x > 3$




$x \ge 4$




$x > 3$ or $x \ge 4$ which is $x > 3$




In interval notation: $(3, \infty)$



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**69.** $4s+3>9$ or $2s-7\le 12$

$4s>6$ or $2s\le 19$

$s>\frac{3}{2}$ or $s\le\frac{19}{2}$

$(-\infty,\infty)$

**70.** $2q-11\le -7$ or $2-3q<11$

$2q\le 4$ $\quad -3q<9$

$\frac{2q}{2}\le\frac{4}{2}$ $\quad \frac{-3q}{-3}>\frac{9}{-3}$

$q\le 2$ $\quad q>-3$

$q\le 2$ or $q>-3 \Rightarrow (-\infty,\infty)$

**71.** $-2r+8<5$ or $-5r-6\ge 17$

$-2r<-3$ or $-5r\ge 23$

$r>\frac{3}{2}$ or $r\le -\frac{23}{5}$

There is no overlap so the solution is the empty set, $\varnothing$.

**72.** $3r+5\le -17$ or $-4r+1<13$

$3r\le -22$ or $-4r<12$

$r\le -\frac{22}{3}$ or $r>-3$

There is no overlap so the solution is the empty set, $\varnothing$.]

**73. a.** $l+g\le 165$

**b.** $g=2w+2h$

$l+g\le 165$

$l+2w+2h\le 165$

**c.** $l=40,\ w=20.5$

$l+2w+2h\le 165$

$40+2(20.5)+2h\le 165$

$40+41+2h\le 165$

$81+2h\le 165$

$2h\le 84$

$h\le 42$

The maximum height is 42 inches.

**74. a.** $l+w+d\le 45$

**b.** Substitute 23 for $l$, and 12 for $w$, then solve for $d$.

$l+w+d\le 45$

$23+12+d\le 45$

$35+d\le 45$

$d\le 10$

The maximum depth is 10 inches.

**75. a.** The tax on income of \$36,200 is \$932.50 plus 15% of the taxable income over \$9325.
The tax is:

$932.50+0.15(36,200-9325)$

$=932.50+0.15(26,875)$

$=932.50+4031.25$

$=4963.75$

Ting will owe \$4963.75 in taxes.

**b.** The tax on income of \$38,600 is \$5226.25 plus 15% of the taxable income over \$37,950.
The tax is:

$5226.25+0.25(38,600-37,950)$

$=5226.25+0.25(650)$

$=5226.25+162.50$

$=5388.75$

Ting will owe \$5388.75 in taxes.

**76.a.** The tax on income of \$197,500 is \$46,643.75 plus 33% of the taxable income over \$191,650
The tax is:

$46,643.75+0.33(197,500-191,650)$

$=46,643.75+0.33(5850)$

$=46,643.75+1930.5$

$=48,574.25$

Dalton will owe \$48,574.25 in taxes.

**b.** The tax on income of \$423,600 is \$121,505.25 plus 39.6% of the taxable income over \$418,400.
The tax is:

$121,505.25+0.396(423,600-418,400)$

$=121,505.25+0.396(5200)$

$=121,505.25+2059.20$

$=123,564.45$

Dalton will owe \$123,564.45 in taxes.



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**77.** Let $x$ be the maximum number of boxes.

$$70x < 800$$
$$x \le \frac{800}{70}$$
$$x \le 11.43$$

The maximum number of boxes is 11.

**78.** Let $x$ be the maximum number of boxes.

$$70x + 195 \le 800$$
$$70x \le 605$$
$$x \le \frac{605}{70} = \frac{121}{14} \approx 8.64$$

The maximum number of boxes is 8.

**79.** Let $x$ be the number ofadditional hours to rent the bicycle.

$$5 + 1.75x < 15$$
$$1.75x < 15 - 5$$
$$1.75x < 10$$
$$x < \frac{10}{1.75}$$
$$x < 5.714$$

The number of additional hours Jose can rent the bicycle is 5 hours. So, he can rent the bicycle for a total of 6 hours.

**80.** Let $x$ be the additional hours to park in the garage.

$$1.25 + 0.75x \le 3.75$$
$$0.75x \le 2.5$$
$$x \le \frac{2.5}{0.75}$$
$$x \le 3.\overline{3}$$

You can park in the garage for the first (initial) hour plus 3 additional hours for a total of 4 hours.

**81.** To make a profit, the cost must be less than the revenue: cost < revenue.

$$10,025 + 1.09x < 6.42x$$
$$10,025 < 5.33x$$
$$\frac{10,025}{5.33} < x$$
$$1880.86 < x$$

She needs to sell a minimum of 1881 books to make a profit.

**82.** To make a profit, the cost must be less than the revenue: cost < revenue.

$$8000 + 0.08x < 1.85x$$
$$8000 < 1.77x$$
$$\frac{8000}{1.77} < x$$
$$4519.77 < x$$

He must clean a minimum of 4520 garments to make a profit.

**83.** Let $x$ = the minimum number of pieces of mail.

$$0.37x + 215 < 0.49x$$
$$215 < 0.12x$$
$$\frac{215}{0.12} < \frac{0.12x}{0.12}$$
$$1791.6 < x$$

The minimum number of pieces of mail is 1792.

**84.** Let $x$ = the minimum number of pieces of mail.

$$0.453x + 215 < 0.49x$$
$$215 < 0.037x$$
$$\frac{215}{0.037} < \frac{0.037x}{0.037}$$
$$5810.8 < x$$

The minimum number of pieces of mail is 5811.

**85.** Let $x$ be the minimum score for the sixth exam.

$$\frac{66 + 72 + 90 + 49 + 59 + x}{6} \ge 60$$
$$\frac{336 + x}{6} \ge 60$$
$$6\left(\frac{336 + x}{6}\right) \ge 6(60)$$
$$336 + x \ge 360$$
$$x \ge 24$$

She must make a 24 or higher on the sixth exam to pass the course.



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**86.** Let $x$ be the grade on the fifth exam. The average of the five grades must be greater than or equal to 90.

$$\frac{92+87+96+77+x}{5} \geq 90$$

$$\frac{352+x}{5} \geq 90$$

$$5\left(\frac{352+x}{5}\right) \geq 5(90)$$

$$352+x \geq 450$$

$$x \geq 98$$

Stephen must make a 98 or higher on the fifth exam to earn a final grade of A in the course.

**87.** Let $x$ be the score on the fifth exam.

$$80 \leq \frac{85+92+72+75+x}{5} < 90$$

$$80 \leq \frac{324+x}{5} < 90$$

$$5(80) \leq 5\left(\frac{324+x}{5}\right) < 5(90)$$

$$400 \leq 324+x < 450$$

$$76 \leq x < 126$$

To receive a final grade of B, Calisha must score 76 or higher on the fifth exam. That is, the score must be

$76 \leq x \leq 100$ (maximum grade is 100).

**88.** Let $x$ be Tammy's grade on the final test.

$$85 \leq \frac{87+96+94+89+x}{5} < 93$$

$$85 \leq \frac{366+x}{5} < 93$$

$$5(85) \leq 5\left(\frac{366+x}{5}\right) < 5(93)$$

$$425 \leq 366+x < 465$$

$$59 \leq x < 99$$

She must score greater than or equal to 59 and less than 99 to earn a B.

**89.** Let $x$ be the value of the third reading.

$$7.2 < \frac{7.48+7.15+x}{3} < 7.8$$

$$7.2 < \frac{14.63+x}{3} < 7.8$$

$$3(7.2) < 3\left(\frac{14.63+x}{3}\right) < 3(7.8)$$

$$21.6 < 14.63+x < 23.4$$

$$6.97 < x < 8.77$$

Any value between 6.97 and 8.77 would result in a normal pH reading.

**90.** Let $x$ be the value of the third reading.

$$7.2 < \frac{7.06+7.31+x}{3} < 7.8$$

$$7.2 < \frac{14.37+x}{3} < 7.8$$

$$3(7.2) < 3\left(\frac{14.37+x}{3}\right) < 3(7.8)$$

$$21.6 < 14.37+x < 23.4$$

$$7.23 < x < 9.03$$

Any value between 7.23 and 9.03 would result in a normal pH reading.

**91. a.**

$$v > 0$$

$$-32t+96 > 0$$

$$-32t > -96$$

$$t < 3$$

The object is traveling upward on the interval $[0,\ 3)$.

**b.**

$$v < 0$$

$$-32t+96 < 0$$

$$-32t < -96$$

$$t > 3$$

The object is traveling downward on the interval $(3,\ 10]$.

**92. a.**

$$v > 0$$

$$-32t+172.8 > 0$$

$$-32t > -172.8$$

$$t < 5.4$$

The object is traveling upward on the interval $[0,\ 5.4)$.



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**b.**
$$v < 0$$
$$-32t + 172.8 < 0$$
$$-32t < -172.8$$
$$t > 5.4$$
The object is traveling downward on the interval $(5.4,\ 12]$.

**93. a.**
$$v > 0$$
$$-9.8t + 49 > 0$$
$$-9.8t > -49$$
$$t < 5$$
The object is traveling upward on the interval $[0,\ 5)$.

**b.**
$$v < 0$$
$$-9.8t + 49 < 0$$
$$-9.8t < -49$$
$$t > 5$$
The object is traveling downward on the interval $(5,\ 13]$.

**94. a.**
$$v > 0$$
$$-9.8t + 31.36 > 0$$
$$-9.8t > -31.36$$
$$t < 3.2$$
The object is traveling upward on the interval $[0,\ 3.2)$.

**b.**
$$v < 0$$
$$-9.8t + 31.36 < 0$$
$$-9.8t < -31.36$$
$$t > 3.2$$
The object is traveling downward on the interval $(3.2,\ 6]$.

**95. a.** The 10th percentile is approximately 17.5 pounds and the 90th percentile is approximately 23.5 pounds. Therefore, 80% of the weights for 9 month old boys are in the interval $[17.5,\ 23.5]$ (in pounds).

**b.** The 10th percentile is approximately 23.5 pounds and the 90th percentile is approximately 31 pounds. Therefore, 80% of the weights for 21 month old boys are in the interval $[23.5,\ 31]$ (in pounds).

**c.** The 10th percentile is approximately 27.2 pounds and the 90th percentile is approximately 36.5 pounds. Therefore, 80% of the weights for 36 month old boys are in the interval $[27.2,\ 36.5]$ (in pounds).

**96. a.** From the chart, the 10th percentile is approximately 16.2 pounds and the 90th percentile is approximately 21.5 pounds. Therefore, 80% of the weights for 9 month old girls are in the interval $[16.2,\ 21.5]$ (in pounds).

**b.** From the chart, the 10th percentile is approximately 22.4 pounds and the 90th percentile is approximately 29.4 pounds. Therefore, 80% of the weights for 21 month old girls are in the interval $[22.4,\ 29.4]$ (in pounds).

**c.** From the chart, the 10th percentile is approximately 26.5 pounds and the 90th percentile is approximately 36 pounds. Therefore, 80% of the weights for 36 month old girls are in the interval $[26.5,\ 36]$ (in pounds).

**97.** No, $-1 > -2$ but $(-1)^2 < (-2)^2$.

**98.** The solution will involve dividing through by $b$. The direction of the inequalities will need to be changed if we divide by a negative number, but not if we divide by a positive number. Therefore, one needs to know whether $b > 0$ or $b < 0$.



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**99.** First find the average of 82, 90, 74, 76, and 68.

$$\frac{82+90+74+76+68}{5}=\frac{390}{5}=78$$

This represents $\frac{2}{3}$ of the final grade.

Let $x$ be the score from the final exam. Since this represents $\frac{1}{3}$ of the final grade, the inequality is

$$80 \le \frac{2}{3}(78)+\frac{1}{3}x < 90$$

$$3(80) \le 3\left[\frac{2}{3}(78)+\frac{1}{3}x\right] \le 3(90)$$

$$240 \le 2(78)+x \le 270$$

$$240 \le 156+x \le 270$$

$$84 \le x \le 114$$

Stephen must score at least 84 points on the final exam to have a final grade of B. The range is $84 \le x \le 100$.

**100.** Answers may vary. One possible answer is:
Write $x < 3x - 10 < 2x$ as
$x < 3x - 10$ and $3x - 10 < 2x$
Solve each of the inequalities.

| $x < 3x - 10$ | and | $3x - 10 < 2x$ |
|---|---|---|
| $-2x < -10$ | | $-10 < -x$ |
| $x > 5$ | | $10 > x$ |

The final answer is $x > 5$ and $10 > x$ which is $5 < x < 10$ or $(5, 10)$.

**101.** Answers may vary. One possible answer is:
Write $x < 2x + 3 < 2x + 5$ as $x < 2x + 3$ and $2x + 3 < 2x + 5$
Solve each of the inequalities.

| $x < 2x + 3$ | and | $2x + 3 < 2x + 5$ |
|---|---|---|
| $-x < 3$ | | $3 < 5$ |
| $x > -3$ | | All real numbers |

The final answer is $x > -3$ or $(-3, \infty)$.

**102.** Answers may vary. One possible answer is:
Write $x + 5 < x + 3 < 2x + 2$ as
$x + 5 < x + 3$ and $x + 3 < 2x + 2$
Solve each of the inequalities

| $x + 5 < x + 3$ | and | $x + 3 < 2x + 2$ |
|---|---|---|
| $5 < 3$ | | $1 < x$ |
| False | | $x > 1$ |

The solution is the empty set or $\varnothing$.

**103.a.** $A \cup B = \{1, 2, 3, 4, 5, 6, 8, 9\}$

**b.** $A \cap B = \{1, 8\}$

**104.** **a.** 4 is a counting number.

**b.** 0 and 4 are whole numbers.

**c.** $-3, 4, \frac{5}{2}, 0$, and $-\frac{13}{29}$ are rational numbers.

**d.** $-3, 4, \frac{5}{2}, \sqrt{7}, 0$, and $-\frac{13}{29}$ are real numbers.

**105.** associative property of addition.

**106.** commutative property of addition

**107.**

$$R = L + (V - D)r$$

$$R = L + Vr - Dr$$

$$R - L + Dr = Vr$$

$$\frac{R-L+Dr}{r} = V \text{ or } V = \frac{R-L+Dr}{r}$$

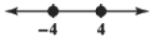
## Exercise Set 2.6

**1.** The graph of the solution to $|x| \le 4$ on the number line is 

.

**2.** The graph of the solution to $|x| \ge 4$ on the number line is 

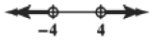
.

**3.** The graph of the solution to $|x| = 4$ on the number line is 

.

**4.** The graph of the solution to $|x| < 4$ on the number line is 

.

**5.** The graph of the solution to $|x| > 4$ on the number line is 

.

**6.** The solution set of $|x| \le 5$ is $\{x \mid -5 \le x \le 5\}$.

**7.** The solution set of $|x| \ge 5$ is $\{x \mid x \le -5 \text{ or } x \ge 5\}$.



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**8.** The solution set of $|x| = 5$ is $\{-5, 5\}$.

**9.** The solution set of $|x| < 5$ is $\{x \mid -5 < x < 5\}$.

**10.** The solution set of $|x| > 5$ is $\{x \mid x < -5 \text{ or } x > 5\}$.

**11.** The solution set of $|x| > -6$ is $\mathbb{R}$.

**12.** The solution set of $|x| < -6$ is $\varnothing$.

**13.** $|x| = 9$
$x = 9$ or $x = -9$
The solution set is $\{-9, 9\}$.

**14.** $|y| = 11$
$y = 11$ or $y = -11$
The solution set is $\{-11, 11\}$.

**15.** $|w| - 0$
$w = 0$
The solution set is $\{0\}$.

**16.** $|z| = 0$
$z = 0$
The solution set is $\{0\}$.

**17.** $|p| = -13$
There is no solution since the right side is a negative number and the absolute value can never be equal to a negative number. The solution set $\varnothing$.

**18.** $|q| = -19$
There is no solution since the right side is a negative number and the absolute value can never be equal to a negative number. The solution set $\varnothing$.

**19.** $|x + 5| = 8$
$x + 5 = 8 \qquad x + 5 = -8$
$x = 3 \quad \text{or} \quad x = -13$
The solution set is $\{-13, 13\}$.

**20.** $|l + 4| = 6$
$l + 4 = 6 \qquad l + 4 = -6$
$x = 2 \quad \text{or} \quad x = -10$
The solution set is $\{-10, 2\}$.

**21.** $|2x - 3| = 9$
$2x - 3 = 9 \quad \text{or} \quad 2x - 3 = -9$
$2x = 12 \qquad 2x = -6$
$x = 6 \qquad x = -3$
The solution set is $\{-3, 6\}$.

**22.** $|3x - 2| = 8$
$3x - 2 = 8 \quad \text{or} \quad 3x - 2 = -8$
$3x = 10 \qquad 3x = -6$
$x = \frac{10}{3} \qquad x = -2$
The solution set is $\left\{-2, \frac{10}{3}\right\}$.

**23.** $|3x - 8| + 5 = 9$
$|3x - 8| = 4$
$3x - 8 = 4 \quad \text{or} \quad 3x - 8 = -4$
$3x = 12 \qquad 3x = 4$
$x = 4 \qquad x = \frac{4}{3}$
The solution set is $\left\{\frac{4}{3}, 4\right\}$.

**24.** $|5x - 1| + 3 = 12$
$|5x - 1| = 9$
$5x - 1 = 9 \quad \text{or} \quad 5x - 1 = -9$
$5x = 10 \qquad 5x = -8$
$x = 2 \qquad x = -\frac{8}{5}$
The solution set is $\left\{-\frac{8}{5}, 2\right\}$.



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**25.** $\left|\frac{x-3}{4}\right|=5$

$\frac{x-3}{4}=5$ or $\frac{x-3}{4}=-5$

$4\left(\frac{x-3}{4}\right)=4(5)$ $\quad 4\left(\frac{x-3}{4}\right)=4(-5)$

$x-3=20$ $\quad x-3=-20$

$x=23$ $\quad x=-17$

The solution set is $\{-17,\ 23\}$.

**26.** $\left|\frac{c-2}{5}\right|=1$

$\frac{c-2}{5}=1$ or $\frac{c-2}{5}=-1$

$5\left(\frac{c-2}{5}\right)=5(1)$ $\quad 5\left(\frac{c-2}{5}\right)=5(-1)$

$c-2=5$ $\quad c-2=-5$

$c=7$ $\quad c=-3$

The solution set is $\{-3, 7\}$.

**27.** $\left|\frac{x\ \ 3}{4}\right|+8=8$

$\left|\frac{x-3}{4}\right|=0$

$\frac{x-3}{4}=0$

$4\left(\frac{x-3}{4}\right)=4(0)$

$x-3=0$

$x=3$

The solution set is $\{3\}$.

**28.** $\left|\frac{3x-4}{2}\right|-3=-3$

$\left|\frac{3x-4}{2}\right|=0$

$\frac{3x-4}{2}=0$

$3x-4=0$

$3x=4$

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

The solution set is $\left\{\frac{4}{3}\right\}$.

**29.** $|x-5|+4=3$

$|x-5|=-1$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

**30.** $|2x+3|-5=-8$

$|2x+3|=-3$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

**31.** $|a|<5$

$-5<a<5$

The solution set is $\{a\,|\,-5<a<5\}$.

**32.** $|b|\le 7$

$-7\le b\le 7$

The solution set is $\{b\,|\,-7\le b\le 7\}$.

**33.** $|q+5|\le 8$

$8\le q+5\le 8$

$-8-5\le q+5-5\le 8-5$

$-13\le q\le 3$

The solution set is $\{q\,|\,-13\le q\le 3\}$.



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**34.** $|r-2|<7$

$-7<r-2<7$

$-5<r<9$

The solution set is $\{r\mid -5<r<9\}$.

**35.** $|a+7|-5\le -3$

$|a+7|\le 2$

$-2\le a+7\le 2$

$-9\le a\le -5$

The solution set is $\{a\mid -9\le a\le -5\}$.

**36.** $|x-3|-7<-2$

$|x-3|<5$

$-5<x-3<5$

$-5+3<x-3+3<5+3$

$-2<x<8$

The solution set is $\{x\mid -2<x<8\}$.

**37.** $|2x+3|-5\le 10$

$|2x+3|\le 15$

$-15\le 2x+3\le 15$

$-15-3\le 2x+3-3\le 15-3$

$-18\le 2x\le 12$

$\frac{-18}{2}\le\frac{2x}{2}\le\frac{12}{2}$

$-9\le x\le 6$

The solution set is $\{x\mid -9\le x\le 6\}$.

**38.** $|2y-7|+3<12$

$|2y-7|<9$

$-9<2y-7<9$

$-2<2y<16$

$-1<y<8$

The solution set is $\{y\mid -1<y<8\}$.

**39.** $|3x-7|+8<14$

$|3x-7|<6$

$-6<3x-7<6$

$-6+7<3x-7+7<6+7$

$1<3x<13$

$\frac{1}{3}<\frac{3x}{3}<\frac{13}{3}$

$\frac{1}{3}<x<\frac{13}{3}$

The solution set is $\left\{x\mid \frac{1}{3}<x<\frac{13}{3}\right\}$.

**40.** $|5x+3|-11\le -3$

$|5x+3|\le 8$

$-8\le 5x+3\le 8$

$-11\le 5x\le 5$

$-\frac{11}{5}\le x\le 1$

The solution set is $\left\{x\mid -\frac{11}{5}\le x\le 1\right\}$.

**41.** $|2x-6|+5\le 1$

$|2x-6|\le -4$

There is no solution since the right side is negative whereas the left side is non-negative; zero or a positive number is never less than a negative number. The solution set is $\varnothing$.

**42.** $|7x-9|-3<-11$

$|7x-9|<-8$

There is no solution since the right side is negative whereas the left side is positive or zero, hence, never less than a negative number. The solution set is $\varnothing$.



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**43.** $\left|\frac{m}{3}-\frac{7}{9}\right| \le \frac{7}{27}$

$$-\frac{7}{27} \le \frac{m}{3}-\frac{7}{9} \le \frac{7}{27}$$
$$27\left(-\frac{7}{27}\right) \le 27\left(\frac{m}{3}-\frac{7}{9}\right) \le 27\left(\frac{7}{27}\right)$$
$$-7 \le 9m-21 \le 7$$
$$14 \le 9m \le 28$$
$$\frac{14}{9} \le m \le \frac{28}{9}$$

The solution set is $\left\{m \middle| \frac{14}{9} \le m \le \frac{28}{9}\right\}$.

**44.** $\left|\frac{k}{4}-\frac{3}{8}\right| < \frac{7}{16}$

$$-\frac{7}{16} < \frac{k}{4}-\frac{3}{8} < \frac{7}{16}$$
$$16\left(-\frac{7}{16}\right) < 16\left(\frac{k}{4}-\frac{3}{8}\right) < 16\left(\frac{7}{16}\right)$$
$$-7 < 4k-6 < 7$$
$$-7+6 < 4k-6+6 < 7+6$$
$$-1 < 4k < 13$$
$$-\frac{1}{4} < k < \frac{13}{4}$$

The solution is $\left\{k \middle| -\frac{1}{4} < k < \frac{13}{4}\right\}$.

**45.** $\left|\frac{x-3}{2}\right| - 4 \le -2$

$$\left|\frac{x-3}{2}\right| \le 2$$
$$-2 \le \frac{x-3}{2} \le 2$$
$$2(-2) \le 2\left(\frac{x-3}{2}\right) \le 2(2)$$
$$-4 \le x-3 \le 4$$
$$-4+3 \le x-3+3 \le 4+3$$
$$-1 \le x \le 7$$

The solution set is $\{x \mid -1 \le x \le 7\}$.

**46.** $\left|\frac{y+3}{5}\right| + 2 < 7$

$$\left|\frac{y+3}{5}\right| < 5$$
$$-5 < \frac{y+3}{5} < 5$$
$$5(-5) < 5\left(\frac{y+3}{5}\right) < 5(5)$$
$$-25 < y+3 < 25$$
$$-28 < y < 22$$

The solution set is $\{y \mid -28 < y < 22\}$.

**47.** $|a| \ge 5$

$a \le -5$ or $a \ge 5$

The solution set is $\{a \mid a \le -5 \text{ or } a \ge 5\}$.

**48.** $|b| > 7$

$b < -7$ or $b > 7$

The solution set is $\{b \mid b < -7 \text{ or } b > 7\}$.

**49.** $|x+4| > 5$

$x+4 < -5$ or $x+4 > 5$

$x < -9$ $\qquad$ $x > 1$

The solution set is $\{x \mid x < -9 \text{ or } x > 1\}$.

**50.** $|x-5| > 3$

$x-5 > 3$ or $x-5 < -3$

$x > 8$ $\qquad$ $x < 2$

The solution set is $\{x \mid x < 2 \text{ or } x > 8\}$.

**51.** $|2b-7| > 3$

$2b-7 < -3$ or $2b-7 > 3$

$2b < 4$ $\qquad$ $2b > 10$

$b < \frac{4}{2}$ $\qquad$ $b > \frac{10}{2}$

$b < 2$ $\qquad$ $b > 5$

The solution set is $\{b \mid b < 2 \text{ or } b > 5\}$.



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**52.** $|2b+5| \geq 7$

$2b+5 \geq 7$ or $2b+5 \leq -7$

$2b \geq 2$ $\quad$ $2b \leq -12$

$b \geq 1$ $\quad$ $b \leq -6$

The solution set is $\{b \mid b \leq -6 \text{ or } b \geq 1\}$.

**53.** $|3d-8| > 5$

$3d-8 > 5$ or $3d-8 < -5$

$3d > 13$ $\quad$ $3d < 3$

$d > \frac{13}{3}$ $\quad$ $d < 1$

The solution set is $\left\{d \mid d < 1 \text{ or } d > \frac{13}{3}\right\}$.

**54.** $|2x-1| \geq 12$

$2x-1 \leq -12$ or $2x-1 \geq 12$

$2x \leq -11$ or $2x \geq 13$

$x \leq -\frac{11}{2}$ $\quad$ $x \geq \frac{13}{2}$

The solution set is $\left\{x \mid x \leq -\frac{11}{2} \text{ or } x \geq \frac{13}{2}\right\}$.

**55.** $|0.1x-0.4|+0.4 > 0.6$

$|0.1x-0.4| > 0.2$

$0.1x-0.4 < -0.2$ or $0.1x-0.4 > 0.2$

$0.1x < 0.2$ $\quad$ $0.1x > 0.6$

$x < \frac{0.2}{0.1}$ $\quad$ $x > \frac{0.6}{0.1}$

$x < 2$ $\quad$ $x > 6$

The solution set is $\{x \mid x < 2 \text{ or } x > 6\}$.

**56.** $|0.2x+0.5|-0.3 \geq 0.8$

$|0.2x+0.5| \geq 1.1$

$0.2x+0.5 \geq 1.1$ or $0.2x+0.5 \leq -1.1$

$0.2x \geq 0.6$ $\quad$ $0.2x \leq -1.6$

$\frac{0.2x}{0.2} \geq \frac{0.6}{0.2}$ $\quad$ $\frac{0.2x}{0.2} \leq \frac{-1.6}{0.2}$

$x \geq 0.3$ $\quad$ $x \leq -0.8$

The solution set is $\{x \mid x \leq -8 \text{ or } x \geq 3\}$.

**57.** $\left|\frac{x}{2}+4\right| \geq 5$

$\frac{x}{2}+4 \leq -5$ $\quad$ or $\quad$ $\frac{x}{2}+4 \geq 5$

$2\left(\frac{x}{2}+4\right) \leq 2(-5)$ $\quad$ $2\left(\frac{x}{2}+4\right) \geq 2(5)$

$x+8 \leq -10$ $\quad$ $x+8 \geq 10$

$x \leq -18$ $\quad$ $x \geq 2$

The solution set is $\{x \mid x < -18 \text{ or } x > 2\}$.

**58.** $\left|4-\frac{3x}{5}\right| \geq 9$

$4-\frac{3x}{5} \leq -9$ $\quad$ or $\quad$ $4-\frac{3x}{5} \geq 9$

$-\frac{3x}{5} \leq -13$ $\quad$ $-\frac{3x}{5} \geq 5$

$-\frac{5}{3}\left(-\frac{3x}{5}\right) \geq -\frac{5}{3}(-13)$ $\quad$ $-\frac{5}{3}\left(-\frac{3x}{5}\right) \leq -\frac{5}{3}(5)$

$x \geq \frac{65}{3}$ $\quad$ $x \leq -\frac{25}{3}$

The solution set is $\left\{x \mid x < -\frac{25}{3} \text{ or } x > \frac{65}{3}\right\}$.

**59.** $|7w+3|-12 \geq -12$

$|7w+3| \geq 0$

Observe that the absolute value of a number is always greater than or equal to 0. Thus, the solution is the set of real numbers, or $\mathbb{R}$.

**60.** $|13d-6|+7 > 7$

$|13d-6| > 0$

Since the right side is 0 whereas the left side is positive or zero and always greater than or equal to 0, the solution is the entire real number line. Thus, the solution is all real numbers, or $\frown$.

**61.** $|4-2x| > 0$

$4-2x < 0$ or $4-2x > 0$

$-2x < -4$ $\quad$ $-2x > -4$

$x > \frac{-4}{-2}$ $\quad$ $x < \frac{-4}{-2}$

$x > 2$ $\quad$ $x < 2$

The solution set is $\{x \mid x < 2 \text{ or } x > 2\}$.



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**62.** $|9-3m|>0$

$9-3m<0$ or $9-3m>0$

$9<3m$ $\quad$ $9>3m$

$\frac{9}{3}<\frac{3m}{3}$ $\quad$ $\frac{9}{3}>\frac{3m}{3}$

$3<m$ $\quad$ $3>m$

The solution set is $\{m \mid m<3 \text{ or } m>3\}$.

**63.** $|3p-5|=|2p+10|$

$3p-5=-(2p+10)$ or $3p-5=2p+10$

$3p-5=-2p-10$ $\quad$ $p-5=10$

$5p-5=-10$ $\quad$ $p=15$

$5p=-5$

$p=-1$

The solution set is $\{-1,\ 15\}$.

**64.** $|6n+3|=|4n-13|$

$6n+3=-(4n-13)$ $\quad$ $6n+3=(4n-13)$

$6n+3=-4n+13$ or $6n+3=4n-13$

$10n+3=13$ $\quad$ $2n+3=-13$

$10n=10$ $\quad$ $2n+-16$

$n=1$ $\quad$ $n=-8$

The solution set is $\{-8,\ 1\}$.

**65.** $|7-3k|=|3k+19|$

$7-3k=-(3k+19)$ or $7-3k=3k+19$

$7-3k=-3k-19$ $\quad$ $7-3k=3k+19$

$7=-19$ False $\quad$ $-12=6k$

$-2=k$

The solution set is $\{-2\}$.

**66.** $|5-2m|=|2m+13|$

$5-2m=-(2m+13)$ or $5-2m=2m+13$

$5-2m=-2m-13$ $\quad$ $5=4m+13$

$5=-13$ False $\quad$ $-8=4m$

$-2=m$

The solution set is $\{-2\}$.

**67.** $|5t-10|=|10-5t|$

$|5t-10|=|-(5t-10)|$

Since the $5t-10$ and $-(5t-10)$ are opposites, the absolute value of each are equivalent. Therefore, the solution is all real numbers or $\frown$.

**68.** $|4d-9|=|9-4d|$

$|4d-9|=|-(9-4d)|$

Since $4d-9$ and $-(9-4d)$ are opposites, the absolute value of each are equivalent. Therefore, the solution is all real numbers or $\frown$.

**69.** $\left|\frac{2r}{3}+\frac{5}{6}\right|=\left|\frac{r}{2}-3\right|$

$\frac{2r}{3}+\frac{5}{6}=-\left(\frac{r}{2}-3\right)$ or $\frac{2r}{3}+\frac{5}{6}=\frac{r}{2}-3$

$\frac{2r}{3}+\frac{5}{6}=-\frac{r}{2}+3$ $\quad$ $6\left(\frac{2r}{3}+\frac{5}{6}\right)=6\left(\frac{r}{2}-3\right)$

$6\left(\frac{2r}{3}+\frac{5}{6}\right)=6\left(-\frac{r}{2}+3\right)$ $\quad$ $4r+5=3r-18$

$4r+5=-3r+18$ $\quad$ $r+5=-18$

$7r+5=18$ $\quad$ $r=-23$

$7r=13$

$r=\frac{13}{7}$

The solution set is $\left\{-23,\ \frac{13}{7}\right\}$.



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**70.** $\left|\frac{3r}{4}+\frac{1}{8}\right|=\left|\frac{r}{2}-\frac{3}{8}\right|$

$\frac{3r}{4}+\frac{1}{8}=\frac{r}{2}-\frac{3}{8}$ or $\frac{3r}{4}+\frac{1}{8}=-\left(\frac{r}{2}-\frac{3}{8}\right)$

$8\left(\frac{3r}{4}+\frac{1}{8}\right)=8\left(\frac{r}{2}-\frac{3}{8}\right)$ $\frac{3r}{4}+\frac{1}{8}=-\frac{r}{2}+\frac{3}{8}$

$6r+1=4r-3$ $8\left(\frac{3r}{4}+\frac{1}{8}\right)=8\left(-\frac{r}{2}+\frac{3}{8}\right)$

$2r+1=-3$ $6r+1=-4r+3$

$2r=-4$ $10r+1=3$

$r=-2$ $10r=2$

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

The solution set is $\left\{-2,\ \frac{1}{5}\right\}$.

**71.** $|j|=15$

$j=15$ or $h=-15$

The solution set is $\{-15,\ 15\}$.

**72.** $|y|\le 8$

$-8\le y\le 8$

The solution set is $\{y\,|\,-8\le y\le 8\}$.

**73.** $|q+6|>2$

$q+6<-2$ or $q+6>2$

$q<-8$ $q>-4$

The solution set is $\{q\,|\,q<-8 \text{ or } q>-4\}$.

**74.** $|9d+7|\le -9$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

**75.** $|2w-7|\le 9$

$-9\le 2w-7\le 9$

$-9+7\le 2w-7+7\le 9+7$

$-2\le 2w\le 16$

$\frac{-2}{2}\le\frac{2w}{2}\le\frac{16}{2}$

$-1\le w\le 8$

The solution set is $\{w\,|\,-1\le w\le 8\}$.

**76.** $|2z-7|+5>8$

$|2z-7|>3$

$2z-7<-3$ or $2z-7>3$

$2z<4$ $2z>10$

$z<2$ $z>5$

The solution set is $\{z\,|\,z<2 \text{ or } z>5\}$.

**77.** $|5a-1|=9$

$5a-1=-9$ or $5a-1=9$

$5a=-8$ $5a=10$

$a=-\frac{8}{5}$ $a=2$

The solution set is $\left\{-\frac{8}{5},\ 2\right\}$.

**78.** $|2x-4|+5=13$

$|2x-4|=8$

$2x-4=-8$ or $2x-4=8$

$2x=-4$ $2x=12$

$x=-2$ $x=6$

The solution set is $\{-2,\ 6\}$.

**79.** $|5x+2|>0$

$5+2x<0$ or $5+2x>0$

$2x<-5$ $2x>-5$

$x<-\frac{5}{2}$ $x>-\frac{5}{2}$

The solution set is $\left\{x\,\middle|\,x<-\frac{5}{2} \text{ or } x>-\frac{5}{2}\right\}$.



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**80.** $|7-3b|=|5b+15|$

$7-3b=-(5b+15)$ or $7-3b=5b+15$

$7-3b=-5b-15$ $\quad -8b=8$

$2b=-22$ $\quad b=-1$

$b=-11$

The solution set is $\{-11,\ -1\}$.

**81.** $|4+3x|\le 9$

$-9\le 4+3x\le 9$

$-13\le 3x\le 5$

$-\frac{13}{3}\le x\le\frac{5}{3}$

The solution set is $\left\{x\left|-\frac{13}{3}\le x\le\frac{5}{3}\right.\right\}$.

**82.** $|2.4x+4|+4.9>3.9$

$|2.4x+4|>-1.0$

Since the right side is negative whereas the left side is non-negative and always greater than a negative number, the solution is the entire real number line. Thus, the solution is the set of all real numbers or $\mathbb{R}$.

**83.** $|3n+8|-4=-10$

$|3n+8|=-6$

Since the right side is negative and the left side is non-negative, there is no solution since the absolute value can never equal a negative number. The solution set is $\varnothing$.

**84.** $|4-2x|-3=7$

$|4-2x|=10$

$4-2x=-10$ or $4-2x=10$

$-2x=-14$ $\quad -2x=6$

$x=7$ $\quad x=-3$

The solution set is $\{-3,\ 7\}$.

**85.** $\left|\frac{w+4}{3}\right|+5<9$

$\left|\frac{w+4}{3}\right|<4$

$-4<\frac{w+4}{3}<4$

$3(-4)<3\left(\frac{w+4}{3}\right)<3(4)$

$-12<w+4<12$

$-16<w<8$

The solution set is $\{w\,|\,-16<w<8\}$.

**86.** $\left|\frac{5t-10}{6}\right|>\frac{5}{3}$

$\frac{5t-10}{6}<-\frac{5}{3}$ or $\frac{5t-10}{6}>\frac{5}{3}$

$6\left(\frac{5t-10}{6}\right)<6\left(-\frac{5}{3}\right)$ $\quad 6\left(\frac{5t-10}{6}\right)>6\left(\frac{5}{3}\right)$

$5t-10<-10$ $\quad 5t-10>10$

$5t<0$ $\quad 5t>20$

$t<0$ $\quad t>4$

The solution set is $\{t\,|\,t<0 \text{ or } t>4\}$.

**87.** $\left|\frac{3x-2}{4}\right|-\frac{1}{3}\ge-\frac{1}{3}$

$\left|\frac{3x-2}{4}\right|\ge 0$

Since the absolute value of a number is always greater than or equal to zero, the solution is the set of all real numbers or $\mathbb{R}$.

**88.** $\left|\frac{2x-4}{5}\right|=14$

$\frac{2x-4}{5}=-14$ or $\frac{2x-4}{5}=14$

$5\left(\frac{2x-4}{5}\right)=5(-14)$ $\quad 5\left(\frac{2x-4}{5}\right)=5(14)$

$2x-4=-70$ $\quad 2x-4=70$

$2x=-66$ $\quad 2x=74$

$x=-33$ $\quad x=37$

The solution set is $\{-33,\ 37\}$.



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**89.** $\left|2x-8\right|=\left|\frac{1}{2}x+3\right|$

$2x-8=-\left(\frac{1}{2}x+3\right)$ or $2x-8=\frac{1}{2}x+3$

$2x-8=-\frac{1}{2}x-3$ $\quad\quad$ $\frac{3}{2}x-8=3$

$\frac{5}{2}x-8=-3$ $\quad\quad$ $\frac{3}{2}x=11$

$\frac{5}{2}x=5$ $\quad\quad$ $\frac{2}{3}\left(\frac{3}{2}x\right)=\frac{2}{3}(11)$

$\frac{2}{5}\left(\frac{5}{2}x\right)=\frac{2}{5}(5)$ $\quad\quad$ $x=\frac{22}{3}$

$x=2$

The solution set is $\left\{2,\ \frac{22}{3}\right\}$.

**90.** $\left|\frac{1}{3}y+3\right|=\left|\frac{2}{3}y-1\right|$ $\quad$ $\frac{1}{3}y+3=\frac{2}{3}y-1$ or $\frac{1}{3}y+3=-\left(\frac{2}{3}y-1\right)$

$3=\frac{1}{3}y-1$ $\quad\quad$ $\frac{1}{3}y+3=-\frac{2}{3}y+1$

$4=\frac{1}{3}y$ $\quad\quad$ $y+3=1$

$3(4)=3\left(\frac{1}{3}y\right)$ $\quad\quad$ $y=-2$

$12=y$

The solution set is $\left\{-2,\ 12\right\}$.

**91.** $\left|2-3x\right|=\left|4-\frac{5}{3}x\right|$

$2-3x=-\left(4-\frac{5}{3}x\right)$ or $2-3x=4-\frac{5}{3}x$

$2-3x=-4+\frac{5}{3}x$ $\quad\quad$ $-3x=2-\frac{5}{3}x$

$-3x=-6+\frac{5}{3}x$ $\quad\quad$ $-\frac{4}{3}x=2$

$-\frac{14}{3}x=-6$ $\quad\quad$ $-\frac{3}{4}\left(-\frac{4}{3}x\right)=-\frac{3}{2}(2)$

$\left(-\frac{3}{14}\right)\left(-\frac{14}{3}\right)x=\left(-\frac{3}{14}\right)(-6)$ $\quad\quad$ $x=-\frac{3}{2}$

$x=\frac{9}{7}$

The solution set is $\left\{-\frac{3}{2},\ \frac{9}{7}\right\}$.

**92.** $\left|\frac{-2u+3}{7}\right|\le 5$

$-5\le\frac{-2u+3}{7}\le 5$

$21(5)\le 21\left(\frac{-2u+3}{7}\right)\le 21(5)$

$-105\le -6u+9\le 105$

$-105-9\le -6u+9-9\le 105-9$

$-114\le -6u\le 96$

$\frac{-114}{-6}\ge\frac{-6u}{-6}\ge\frac{96}{-6}$

$19\ge u\ge -16$

$-16\le u\le 19$

The solution set is $\left\{u\middle|-16\le u\le 19\right\}$.



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**93. a.** $|t-0.089| \le 0.004$

$-0.004 \le t-0.089 \le 0.004$

$-0.004+0.089 \le t-0.089+0.089 \le 0.004+0.089$

$0.085 \le t \le 0.093$

The solution is $[0.085, 0.093]$.

**b.** 0.085 inches

**c.** 0.093 inches

**94. a.** $\left|t-\frac{5}{8}\right| \le \frac{1}{56}$

$-\frac{1}{56} \le t-\frac{5}{8} \le \frac{1}{56}$

$56\left(-\frac{1}{56}\right) \le 56\left(t-\frac{5}{8}\right) \le 56\left(\frac{1}{56}\right)$

$-1 \le 56t-35 \le 1$

$-1+35 \le 56t-35+35 \le 1+35$

$34 \le 56t \le 36$

$\frac{34}{56} \le \frac{56t}{56} \le \frac{36}{56}$

$\frac{17}{28} \le t \le \frac{9}{14}$

The solution is $\left[\frac{17}{28}, \frac{9}{14}\right]$.

**b.** $\frac{17}{28}$ inches

**c.** $\frac{9}{14}$ inches

**95. a.** $|d-160| \le 28$

$-28 \le d-160 \le 28$

$-28+160 \le d-160+160 \le 28+160$

$132 \le d \le 188$

The solution is $[132, 188]$.

**b.** The submarine can move between 132 feet and 188 feet below sea level, inclusive.

**96. a.** $|d-4| \le \frac{1}{2}$

$-\frac{1}{2} \le d-4 \le \frac{1}{2}$

$-\frac{1}{2}+4 \le d-4+4 \le \frac{1}{2}+4$

$\frac{7}{2} \le d \le \frac{9}{2}$

The solution is $\left[\frac{7}{2}, \frac{9}{2}\right]$ or $[3.5, 4.5]$.

**b.** The spring will oscillate between 3.5 feet and 4.5 feet, inclusive.

**97.** If $a \ne 0$, and $k > 0$,

**a.** $|ax+b| = k$ has 2 solutions.

**b.** $|ax+b| < k$ has an infinite number of solutions.

**c.** $|ax+b| > k$ has an infinite number of solutions.

**98. a.** $x > y$

**b.** One example is $x = -1$ and $y = -2$. Note that $|-1| < |-2|$, but $-1 > -2$.

**99. a.** $|ax+b| = k, a \ne 0$

If $k < 0$, there are no solutions.

**b.** $|ax+b| = k, a \ne 0$

If $k = 0$, there is one solution.

**c.** $|ax+b| = k, a \ne 0$

If $k > 0$, there are two solutions.

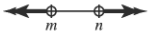
**100. a.** $|ax+b| < c$

The solution is $m < x < n$ or




**b.** $|ax+b| > c$

The solution is $x < m$ or $x > n$ or






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**101.** $|ax+b| \le 0$

$0 \le ax+b \le 0$

which is the same as

$ax+b=0$

$ax=-b$

$x=-\dfrac{b}{a}$

**102.** $|ax+b|>0$ is not true when $|ax+b|=0$

$ax+b=0$

$ax=-b$

$x=-\dfrac{b}{a}$

**103. a.** Set $ax+b=-c$ or $ax+b=c$ and solve each equation for $x$.

**b.**

$ax+b=-c$ or $ax+b=c$

$ax=-c-b$ $\qquad$ $ax=c-b$

$x=\dfrac{-c-b}{a}$ $\qquad$ $x=\dfrac{c-b}{a}$

The solution is $x=\dfrac{-c-b}{a}$ or $x=\dfrac{c-b}{a}$.

**104. a.** Write the inequality as $-c < ax+b < c$ and then solve for $x$.

**b.**

$-c < ax+b < c$

$-c-b < ax+b-b < c-b$

$-c-b < ax < c-b$

$\dfrac{-c-b}{a} < \dfrac{ax}{a} < \dfrac{c-b}{a}$

$\dfrac{-c-b}{a} < x < \dfrac{c-b}{a}$

The solution is $\dfrac{-c-b}{a} < x < \dfrac{c-b}{a}$.

**105. a.** Write $ax+b=-c$ or $ax+b=c$ and solve each inequality for $x$.

**b.**

$ax+b<-c$ or $ax+b>c$

$ax<-c-b$ $\qquad$ $ax>c-b$

$x<\dfrac{-c-b}{a}$ $\qquad$ $x>\dfrac{c-b}{a}$

The solution is $x<\dfrac{-c-b}{a}$ or $x>\dfrac{c-b}{a}$.

**106. a.** Divide both sides by –4 and change the direction of the inequality.

**b.**

$-4|3x-5| \le -12$

$\dfrac{-4|3x-5|}{-4} \ge \dfrac{-12}{-4}$

$|3x-5| \ge 3$

$3x-5 \le -3$ or $3x-5 \ge 3$

$3x \le 2$ $\qquad$ $3x \ge 8$

$x \le \dfrac{2}{3}$ $\qquad$ $x \ge \dfrac{8}{3}$

The solution set is $\left\{x \middle| x \le \dfrac{2}{3} \text{ or } x \ge \dfrac{8}{3}\right\}$ or $\left(-\infty, \dfrac{2}{3}\right] \cup \left[\dfrac{8}{3}, \infty\right)$.

**107.** $|x-4| = |4-x|$

$x-4 = -(4-x)$ or $x-4 = 4-x$

$x-4 = -4+x$ $\qquad$ $2x-4=4$

$0=0$ $\qquad$ $2x=8$

True $\qquad$ $x=4$

Since the first statement is always true all real values work. The solution set is $\mathbb{R}$.

**108.** $|x-4| = -|x-4|$

This occurs only if $|x-4|=0$.

$x-4=0$

$x=4$

The solution set is $\{4\}$.

**109.** $|x| = x$

By definition $|x| = \begin{cases} x, & x \ge 0 \\ -x, & x<0 \end{cases}$

Thus, $|x|=x$ when $x \ge 0$.

The solution set is $\{x|x \ge 0\}$.



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**110.** $|x+2| = x+2$

By definition, $|x+2| = \begin{cases} x+2, & x+2 \geq 0 \\ -(x+2), & x+2 < 0 \end{cases}$

$= \begin{cases} x+2, & x \geq -2 \\ -(x+2), & x < -2 \end{cases}$

Thus, $|x+2| = x+2$ when $x \geq -2$.

The solution set is $\{x \mid x \geq -2\}$.

**111.** $|x+1| = 2x-1$

$x+1 = -(2x-1)$ or $x+1 = 2x-1$

$x+1 = -2x+1$ $\quad 1 = x-1$

$3x+1 = 1$ $\quad 2 = x$

$3x = 0$

$x = 0$

Checking both possible solutions, only $x = 2$ checks. The solution set is $\{2\}$.

**112.** $|3x+1| = x-3$

$3x+1 = x-3$ or $3x+1 = -(x-3)$

$2x+1 = -3$ $\quad 3x+1 = -x+3$

$2x = -4$ $\quad 4x+1 = 3$

$x = -2$ $\quad 4x = 2$

$x = \frac{2}{4} = \frac{1}{2}$

Neither possible solution checks.
Thus, there are no values for $x$ that make the equation true. The solution set is $\varnothing$.

**113.** $|x-4| = -(x-4)$

By the definition, $|x-4| = \begin{cases} x-4, & x-4 \geq 0 \\ -(x-4), & x-4 \leq 0 \end{cases}$

$= \begin{cases} x-4, & x \geq 4 \\ -(x-4), & x \leq 4 \end{cases}$

Thus, $|x-4| = -(x-4)$ for $x \leq 4$.

The solution set is $\{x \mid x \leq 4\}$.

**114.** $|x| + x = 8$

For $x \geq 0$: $|x| + x = 8$

$x + x = 8$

$2x = 8$

$x = 4$

For $x < 0$: $|x| + x = 8$

$-x + x = 8$

$0 = 8$ False

The solution set is $\{4\}$.

**115.** $x + |-x| = 8$

For $x \geq 0$, $x + |-x| = 8$

$x + x = 8$

$2x = 8$

$x = 4$

For $x < 0$, $x + |-x| = 8$

$x - x = 8$

$0 = 8$ False

The solution set is $\{4\}$.

**116.** $|x| - x = 8$

For $x \geq 0$, $|x| - x = 8$

$x - x = 8$

$0 = 8$ False

For $x < 0$, $|x| - x = 8$

$-x - x = 8$

$-2x = 8$

$x = -4$

The solution set is $\{-4\}$.

**117.** $x - |x| = 8$

For $x \geq 0$, $x - |x| = 8$

$x - x = 8$

$0 = 8$ False

For $x < 0$, $x - |x| = 8$

$x - (-x) = 8$

$x + x = 8$

$2x = 8$

$x = 4$ Contradicts $x < 0$

There are no values of $x$, so the solution set is $\varnothing$.



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**118.** **a.** Answers will vary.

**b.** All real numbers $x$ and $y$.

**c.** Only when $x = y$.

**119.** $$\frac{1}{3}+\frac{1}{4}\div\frac{2}{5}\left(\frac{1}{3}\right)^2=\frac{1}{3}+\frac{1}{4}\div\frac{2}{5}\cdot\frac{1}{9}$$
$$=\frac{1}{3}+\frac{1}{4}\cdot\frac{5}{2}\cdot\frac{1}{9}$$
$$=\frac{1}{3}+\frac{5}{72}$$
$$=\frac{1}{3}\cdot\frac{24}{24}+\frac{5}{72}$$
$$=\frac{24}{72}+\frac{5}{72}$$
$$=\frac{29}{72}$$

**120.** Substitute 1 for $x$ and 3 for $y$.
$$4(x+3y)-5xy=4(1+3\cdot3)-5(1)(3)$$
$$=4(1+9)-5(1)(3)$$
$$=4(10)-5(1)(3)$$
$$=40-15$$
$$=25$$

**121.** Let $x$ be the time needed to swim across the lake. Then $1.5-x$ is the time needed to make the return trip.

| | Rate | Time | Distance |
|---|---|---|---|
| First Trip | 2 | $x$ | $2x$ |
| Return Trip | 1.6 | $1.5-x$ | $1.6(1.5-x)$ |

The distances are the same.
$$2x=1.6(1.5-x)$$
$$2x=2.4-1.6x$$
$$3.6x=2.4$$
$$x=\frac{2.4}{3.6}=\frac{2}{3}$$
The total distance across the lake is
$2x=2\left(\frac{2}{3}\right)=\frac{4}{3}$ or 1.33 miles.

**122.** $$-7(x-3)+5(x+1)\ge20$$
$$-7x+21+5x+5\ge20$$
$$-2x+26\ge20$$
$$-2x+26-26\ge20-26$$
$$-2x\ge-6$$
$$\frac{-2x}{-2}\le\frac{-6}{-2}$$
$$x\le3$$
The solution set is $\{x\,|\,x\le3\}$.

## Chapter 2 Review Exercises

**1.** $9a^2b^6$ has degree eight since the sum of the exponents is $2+6=8$.

**2.** $2y$ has degree one since $2y$ can be written as $2y^1$ and the only exponent is 1.

**3.** $-21xyz^5$ has degree seven since $-21xyz^5$ can be written as $-21x^1y^1z^5$ and the sum of the exponents is $1+1+5=7$.

**4.** $$7(z+3)-2(z+4)$$
$$=7z+21-2z-8$$
$$=5z+13$$

**5.** $$x^2+2xy+6x^2-13=x^2+6x^2+2xy-13$$
$$=7x^2+2xy-13$$

**6.** $b^2+b-9$ cannot be simplified since there are no like terms.

**7.** $$2\left[-(x-y)+3x\right]-5y+10$$
$$=2\left[-x+y+3x\right]-5y+10$$
$$=2\left[2x+y\right]-5y+10$$
$$=4x+2y-5y+10$$
$$=4x-3y+10$$

**8.** $$4(a+3)-6=2(a+1)$$
$$4a+12-6=2a+2$$
$$4a+6=2a+2$$
$$4a=2a-4$$
$$2a=-4$$
$$a=-2$$



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**9.** $3(x+1)-3=4(x-5)$

$3x+3-3=4x-20$

$3x+0=4x-20$

$3x=4x-20$

$3x-4x=4x-4x-20$

$-x=-20$

$\frac{-1x}{-1}=\frac{-20}{-1}$

$x=20$

**10.** $3+\frac{x}{2}=\frac{5}{6}$

$6(3)+6\left(\frac{x}{2}\right)=6\left(\frac{5}{6}\right)$

$18+3x=5$

$18-18+3x=5-18$

$3x=-13$

$\frac{3x}{3}=\frac{-13}{3}$

$x=-\frac{13}{3}$

**11.** $\frac{1}{2}(3t+4)=\frac{1}{3}(4t+1)$

$6\left(\frac{1}{2}(3t+4)\right)=6\left(\frac{1}{3}(4t+1)\right)$

$3(3t+4)=2(4t+1)$

$9t+12-8t=8t+2-8t$

$t+12=2$

$t+12-12=2-12$

$t=-10$

**12.** $2\left(\frac{x}{2}-4\right)=3\left(x+\frac{1}{3}\right)$

$x-8=3x+1$

$x-8+8=3x+1+8$

$x=3x+9$

$x-3x=3x-3x+9$

$-2x=9$

$\frac{-2x}{-2}=\frac{9}{-2}$

$x=-\frac{9}{2}$

**13.** $3x-7=9x+8-6x$

$3x-7-3x+8$

$3x-3x-7=3x-3x+8$

$-7=8$

This is a false statement which means there is no solution, or $\varnothing$.

**14.** $2(x-6)=5-\{2x-[4(x-2)-9]\}$

$2x-12=5-\{2x-[4x-8-9]\}$

$2x-12=5-\{2x-[4x-17]\}$

$2x-12=5-\{2x-4x+17\}$

$2x-12=5-\{-2x+17\}$

$2x-12=5+2x-17$

$2x-12=2x-12$

$2x-12-2x=2x-12-2x$

$12=12$

Since this is a true statement, the solution set is all real numbers, or $\mathbb{R}$.

**15.** $r=\sqrt{x^2+y^2}$

$=\sqrt{3^2+4^2}$

$=\sqrt{9+16}$

$=\sqrt{25}$

$=5$

**16.** $x=\frac{-b+\sqrt{b^2-4ac}}{2a}$

$=\frac{-10+\sqrt{(10)^2-4(8)(-3)}}{2(8)}$

$=\frac{-10+\sqrt{100+96}}{16}$

$=\frac{-10+\sqrt{196}}{16}$

$=\frac{-10+14}{16}$

$=\frac{4}{16}$

$=\frac{1}{4}$



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**17.** $h = \frac{1}{2}at^2 + v_0t + h_0$

$= \frac{1}{2}(-32)(1)^2 + 0(2) + 85$

$= \frac{1}{2}(-32)(1) + 0 + 85$

$= -16(1) + 0 + 85$

$= -16 + 0 + 85$

$= 69$

**18.** $z = \frac{\overline{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{50-54}{\frac{5}{\sqrt{25}}} = \frac{50-54}{\frac{5}{5}} = \frac{50-54}{1} = -4$

**19.** $D = r \cdot t$

$\frac{D}{r} = \frac{r \cdot t}{t}$

$\frac{D}{r} = t$ or $t = \frac{D}{r}$

**20.** $P = 2l + 2w$

$P - 2l = 2l - 2l + 2w$

$P - 2l = 2w$

$\frac{P-2l}{2} = \frac{2w}{2}$

$\frac{P-2l}{2} = w$ or $w = \frac{P-2l}{2}$

**21.** $A = \pi r^2 h$

$\frac{A}{\pi r^2} = \frac{\pi r^2}{\pi r^2}$

$\frac{A}{\pi r^2} = h$ or $h = \frac{A}{\pi r^2}$

**22.** $A = \frac{1}{2}bh$

$2(A) = 2\left(\frac{1}{2}bh\right)$

$2A = bh$

$\frac{2A}{b} = \frac{bh}{b}$

$\frac{2A}{b} = h$ or $h = \frac{2A}{b}$

**23.** $y = mx + b$

$y - b - mx + b - b$

$y - b = mx$

$\frac{y-b}{x} = \frac{mx}{x}$

$\frac{y-b}{x} = m$ or $m = \frac{y-b}{x}$

**24.** $2x - 3y = 5$

$2x - 2x - 3y - -2x + 5$

$-3y = -2x + 5$

$\frac{-3y}{-3} = \frac{-2x+5}{-3}$

$y = \frac{-2x+5}{-3}$ or $y = \frac{2x-5}{3}$

**25.** $R_T = R_1 + R_2 + R_3$

$R_T - R_1 - R_3 = R_1 + R_2 + R_3 - R_1 - R_3$

$R_T - R_1 - R_3 = R_2$

or $R_2 = R_T - R_1 - R_3$

**26.** $S = \frac{3a+b}{2}$

$2(S) = 2\left(\frac{3a+b}{2}\right)$

$2S = 3a + b$

$2S - b = 3a + b - b$

$2S - b = 3a$

$\frac{2S-b}{3} = \frac{3a}{3}$

$\frac{2S-b}{3} = a$ or $a = \frac{2S-b}{3}$

**27.** $K = 2(d + l)$

$K = 2d + 2l$

$K - 2d = 2d - 2d + 2l$

$K - 2d = 2l$

$\frac{K-2d}{2} = \frac{2l}{2}$

$\frac{D-2d}{2} = l$ or $l = \frac{K-2d}{2}$



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**28.** Let $x$ be the original price.

$$x - 0.1x = 630$$
$$0.9x = 630$$
$$\frac{0.9x}{0.9} = \frac{630}{0.9}$$
$$x = 700$$

The original price was \$700.

**29.** Let $x$ be the number of years for the population to reach 5800.

$$4750 + 350x = 7200$$
$$350x = 2450$$
$$x = \frac{2450}{350}$$
$$x = 7$$

It will take 7 years for the population to grow from 4750 people to 7200 people.

**30.** Let $x$ be the amount of sales.

$$300 + 0.06x = 708$$
$$0.06x = 408$$
$$\frac{0.06x}{0.06} = \frac{408}{0.06}$$
$$x = 6800$$

Celeste's sales must be \$6800 to earn \$708 in a week.

**31.** Let $x$ be the number of miles she drives.

$$3(24.99) = 3(19.99) + 0.10x$$
$$74.97 = 59.97 + 0.10x$$
$$15.00 = 0.10x$$
$$\frac{15.00}{0.10} = \frac{0.10x}{0.10}$$
$$150 = x$$

The cost would be the same if she drives 150 miles.

**32.** Let $x$ be the regular price.

$$x - 0.40x - 20 = 136$$
$$0.60x - 20 = 136$$
$$0.60x = 156$$
$$\frac{0.60x}{0.60} = \frac{156}{0.60}$$
$$x = 260$$

The regular price was \$260.



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**33.** Let $x$ = the amount invested at 3.5%. Then $5000-x$ is the amount invested at 4.0%.

| Account | Principal | Rate | Time | Interest |
|---|---|---|---|---|
| 3.5% | $x$ | 0.035 | 1 | $0.035x$ |
| 4.0% | $5000-x$ | 0.04 | 1 | $0.04(5000-x)$ |

$$0.035x+0.04(5000-x)=187.15$$
$$0.035x+200-0.04x=187.15$$
$$-0.005x+200=187.15$$
$$-0.005x=-12.85$$
$$x=\frac{-12.85}{-0.005}$$
$$x=2570$$

Thus, Mr. Olden invested \$2570 at 3.5% and \$5000 – \$2570 = \$2430 at 4.0%.

**34.** Let $x$ = the amount of 20% solution.

| Solution | Strength of Solution | No. of Gallons | Amount |
|---|---|---|---|
| 20% | 0.20 | $x$ | $0.20x$ |
| 60% | 0.06 | $250-x$ | $0.60(250-x)$ |
| Mixture | 0.30 | 250 | $0.30(250)$ |

$$0.20x+0.60(250-x)=0.30(250)$$
$$0.20x+150-0.60x=75$$
$$-0.40x+150=75$$
$$-0.40x=-75$$
$$x=\frac{-75}{-0.40}$$
$$x=187.5$$

Dale must combine 187.5 gallons of the 20% solution with $250-187.5=62.5$ gallons of the 60% solution to obtain the 30% solution.

**35.** Let $t$ be the amount of time needed.

| Type | Rate | Time | Distance |
|---|---|---|---|
| One Train | 60 | $t$ | $60t$ |
| Other Train | 80 | $t$ | $80t$ |

The total distance is 910 miles.

$$60t+80t=910$$
$$140t=910$$
$$t=\frac{910}{140}=\frac{13}{2}=6\frac{1}{2}$$

In $6\frac{1}{2}$ hours, the trains are 910 miles apart.



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**36. a.** Let $x$ be the speed of Shuttle 1. Then $x + 300$ is the speed of Shuttle 2.

| Type | Rate | Time | Distance |
|---|---|---|---|
| Shuttle 1 | $x$ | 5.5 | $5.5x$ |
| Shuttle 2 | $x+300$ | 5.0 | $5.0(x+300)$ |

The distances are the same.

$$5.5x = 5.0(x+300)$$
$$5.5x = 5.0x + 1500$$
$$0.5x = 1500$$
$$x = \frac{1500}{0.5} = 3000$$

The speed of Shuttle 1 is 3000 mph.

**b.** The distance is $5.5(3000) = 16{,}500$ miles.

**37.** Let $x$ be the amount of \$6.00 coffee needed. Then $40 - x$ is the amount of \$6.80 coffee needed.

| Item | Cost per Pound | No. of Pounds | Total Value |
|---|---|---|---|
| \$6.00 Coffee | \$6.00 | $x$ | $6.00x$ |
| \$6.80 Coffee | \$6.80 | $40-x$ | $6.80(40-x)$ |
| Mixture | \$6.50 | 40 | $6.50(40)$ |

$$6.00x + 6.80(40-x) = 6.50(40)$$
$$6.00x + 272 - 6.80x = 260$$
$$-0.80x + 272 = 260$$
$$-0.80x = -12$$
$$x = \frac{-12}{-0.80} = 15$$

Mr. Tomlins needs to combine 15 pounds of \$6.00 coffee with 40 – 15 = 25 pounds of \$6.80 coffee to produce the mixture.

**38.** Let $x$ = the original price of the telephone.

$$x - 0.20x = 28.80$$
$$0.80x = 28.80$$
$$x = \frac{28.80}{0.80} = 36$$

The original price of the telephone was \$36.

**39.** Let $x$ be the time spent jogging. Then $4 - x$ is the time spent walking.

| Trip | Rate | Time | Distance |
|---|---|---|---|
| Jogging | 7.2 | $x$ | $7.2x$ |
| Walking | 2.4 | $4-x$ | $2.4(4-x)$ |

**a.** The distances are the same.

$$7.2x = 2.4(4-x)$$
$$7.2x = 9.6 - 2.4x$$
$$9.6x = 9.6$$
$$x = \frac{9.6}{9.6} = 1$$

Nicolle jogged for 1 hour.

**b.** The distance one-way is 7.2(1) = 7.2 miles. The total distance is twice this value or 2(7.2) = 14.4 miles.



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**40.** Let $x$ be the measure of the smallest angle. The measure of the other two angles are $x+25$ and $2x-5$.

$$x+(x+25)+(2x-5)=180$$
$$4x+20=180$$
$$4x=160$$
$$x=\frac{160}{4}=40$$

The measures of the angles are $40°$, $40+25=65°$, and $2(40)-5=80-5=75°$.

**41.** Let $x$ be the flow rate of the smaller hose.

| Type | Rate | Time | Amount (No. of Gallons) |
|---|---|---|---|
| Smaller | $r$ | 3 | $3r$ |
| Larger | $1.5r$ | 5 | $5(1.5r)$ |

The total number of gallons of water is 3150 gallons.

$$3r+5(1.5r)=3150$$
$$3r+7.5r=3150$$
$$10.5r=3150$$
$$r=\frac{3150}{10.5}=300$$

The flow rate for the smaller hose is 300 gallons per hour and the flow rate for the larger hose is $1.5(300)=450$ gallons per hour.

**42.** Let $x$ = measure of one of the angles. Then the other angle measure is $2x-30$. The sum of the measures of complementary angles is 90°.

$$x+(2x-30)=90$$
$$3x-30=90$$
$$3x=120$$
$$x=\frac{120}{3}$$
$$x=40$$

The measures of the angles are 40° and $2(40°)-30°=50°$.

**43.** Let $x$ be the amount of 20% solution.

| Solution | Strength of Solution | No. of Ounces | Amount |
|---|---|---|---|
| 20% | 0.20 | $x$ | $0.20x$ |
| 6% | 0.06 | 10 | $0.06(10)$ |
| Mixture | 0.12 | $x+10$ | $0.12(x+10)$ |

$$0.20x+0.06(10)=0.12(x+10)$$
$$0.20x+0.6=0.12x+1.2$$
$$0.08x+0.6=1.2$$
$$0.08x=0.6$$
$$x=\frac{0.6}{0.08}=7.5$$

The clothier must combine 7.5 ounces of the 20% solution with 10 ounces of the 6% solution to obtain the 12% solution.

**44.** Let $x$ be the amount invested at 10%. Then $12,000-x$ is the amount invested at 6%.

| Acct | Principal | Rate | Time | Interest |
|---|---|---|---|---|
| 10% | $x$ | 0.10 | 1 | $0.10x$ |
| 6% | $12,000-x$ | 0.06 | 1 | $0.06(12,000-x)$ |

$$0.10x=0.06(12,000-x)$$
$$0.10x=720-0.06x$$
$$0.16x=720$$
$$x=\frac{720}{0.16}=4500$$

Thus, David invested \$4500 at 10% and $12,000-4500=\$7500$ at 6%.

**45.** Let $x$ be the number of visits. The cost of the first plan = cost of second plan gives the equation

$$40+1(x)=25+4(x)$$
$$40+x=25+4x$$
$$15+x=4x$$
$$15=3x$$
$$\frac{15}{3}=x \text{ or } x=5$$

Jeff needs to make more than 5 visits for the first plan to be advantageous.



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**46.** Let $x$ be the speed of the faster train. Then $x - 10$ is the speed of the slower train.

| Train | Rate | Time | Distance |
|---|---|---|---|
| Faster | $x$ | 3 | $3x$ |
| Slower | $x-10$ | 3 | $3(x-10)$ |

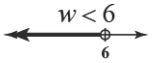
$$3x + 3(x-10) = 270$$
$$3x + 3x - 30 = 270$$
$$6x - 30 = 270$$
$$6x = 300$$
$$x = \frac{300}{6} = 50$$

The speed of the faster train is 50 mph and the speed of the slower train is 40 mph.

**47.** $3z + 9 \le 15$
$$3z \le 6$$
$$z \le 2$$



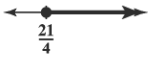

**48.** $8 - 2w > -4$
$$-2w > -12$$
$$\frac{-2w}{-2} < \frac{-12}{-2}$$
$$w < 6$$



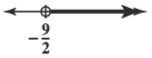

**49.** $2x + 1 > 6$
$$2x > 5$$
$$x > \frac{5}{2}$$




**50.** $26 \le 4x + 5$
$$21 \le 4x$$
$$\frac{21}{4} \le x$$




**51.** $\frac{4x+3}{3} > -5$
$$3\left(\frac{4x+3}{3}\right) > 3(-5)$$
$$4x + 3 > -15$$
$$4x > -18$$
$$x > \frac{-18}{4}$$
$$x > -\frac{9}{2}$$

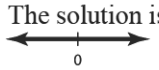



**52.** $2(x-1) > 3x + 8$
$$2x - 2 > 3x + 8$$
$$2x - 10 > 3x$$
$$-10 > x$$



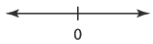

**53.** $-4(x-2) \ge 6x + 8 - 10x$
$$-4x + 8 \ge -4x + 8$$
$$8 \ge 8 \quad \text{a true statement}$$

The solution is all real numbers.




**54.** $\frac{x}{2} + \frac{3}{4} > x - \frac{x}{2} + 1$
$$4\left(\frac{x}{2} + \frac{3}{4}\right) > 4\left(x - \frac{x}{2} + 1\right)$$
$$2x + 3 > 4x - 2x + 4$$
$$2x + 3 > 2x + 4$$
$$3 > 4$$

This is a contradiction, so the solution is $\{\ \}$.




**55.** Let $x$ be the maximum number of 40-pound boxes. Since the maximum load is 560 pounds, the total weight of Bob, Kathy, and the boxes must be less than or equal to 560 pounds.
$$300 + 40x \le 560$$
$$40x \le 260$$
$$x \le \frac{260}{40}$$
$$x \le 6.5$$

The maximum number of boxes that Bob and Kathy can carry in the canoe is 6.



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**56.** Let $x$ be the number of additional hours (beyond the first hour) of the bike rental.

$14+7x \le 63$

$7x \le 4.15$

$x \le \frac{49}{7}$

$x \le 7$

The Wetters can rent the bike for 7 hours plus the first hour for a total of 8 hours.

**57.** Let $x$ be the number of weeks (after the first week) needed to lose 27 pounds.

$5+1.5x \ge 27$

$1.5x \ge 22$

$x \ge \frac{22}{1.5}$

$x \ge 14\frac{2}{3} \approx 14.67$

The number of weeks is about 14.67 plus the initial week for a total of 15.67 weeks.

**58.** Let $x$ be the grade from the 5th exam. The inequality is

$80 \le \frac{94+73+72+80+x}{5} < 90$

$80 \le \frac{319+x}{5} < 90$

$5(80) \le 5\left(\frac{319+x}{5}\right) < 5(90)$

$400 \le 319+x < 450$

$400-319 \le 319+x-319 < 450-319$

$81 \le x < 131$

(We must use 100 here since it is not possible to score 131.)

Thus, Patrice needs to score 81 or higher on the 5th exam to receive a B.

$\{x \mid 81 \le x \le 100\}$

**59.** $-2 < z-5 < 3$

$-2+5 < z-5+5 < 3+5$

$3 < z < 8$

$(3,\ 8)$

**60.** $8 < p+11 \le 16$

$8-11 < p+11-11 \le 16-11$

$-3 < p \le 5$

$(-3,\ 5]$

**61.** $3 < 2x-4 < 12$

$3+4 < 2x-4+4 < 12+4$

$7 < 2x < 16$

$\frac{7}{2} < \frac{2x}{2} < \frac{16}{2}$

$\frac{7}{2} < x < 8$

$\left(\frac{7}{2}, 8\right)$

**62.** $-12 < 6-3x < -2$

$-12-6 < 6-3x-6 < -2-6$

$-18 < -3x < -8$

$\frac{-18}{-3} > \frac{-3x}{-3} > \frac{-8}{-3}$

$6 > x > \frac{8}{3}$

$\frac{8}{3} < x < 6$

$\left(\frac{8}{3}, 6\right)$

**63.** $-1 < \frac{5}{9}x+\frac{2}{3} \le \frac{11}{9}$

$9(-1) < 9\left(\frac{5}{9}x+\frac{2}{3}\right) \le 9\left(\frac{11}{9}\right)$

$-9 < 5x+6 \le 11$

$-9-6 < 5x+6-6 \le 11-6$

$-15 < 5x \le 5$

$\frac{-15}{5} < \frac{5x}{5} \le \frac{5}{5}$

$-3 < x \le 1$

$(-3,\ 1]$



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**64.** $-8 < \dfrac{4-2x}{3} < 0$

$3(-8) < 3\left(\dfrac{4-2x}{3}\right) < 3(0)$

$-24 < 4-2x < 0$

$-24-4 < 4-4-2x < 0-4$

$-28 < -2x < -4$

$\dfrac{-28}{-2} > \dfrac{-2x}{-2} > \dfrac{-4}{-2}$

$14 > x > 2$

$2 < x < 14$

$(2, 14)$

**65.** $2x+1 \le 7$ and $7x-3 > 11$

$2x \le 6$ and $7x > 14$

$x \le 3$ and $x > 2$

$x \le 3$




$x > 2$




$x > 2$ and $x \le 3$ which is $2 < x \le 3$.



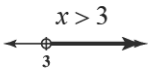

The solution set is $\{x \mid 2 < x \le 3\}$.

**66.** $2x-1 > 5$ or $3x-2 \le 10$

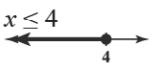
$2x > 6$ or $3x \le 12$

$x > 3$ or $x \le 4$

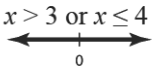
$x > 3$




$x \le 4$




$x > 3$ or $x \le 4$



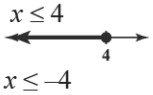

which is the entire real number line or $\mathbb{R}$.

**67.** $4x-5 < 11$ and $-3x-4 \ge 8$

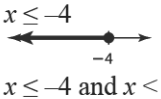
$4x < 16$ and $-3x \ge 12$

$x < 4$ and $x \le -4$

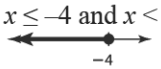
$x \le 4$




$x \le -4$




$x \le -4$ and $x < 4$ which is $x \le -4$




$\{x \mid x \le -4\}$

**68.** $\dfrac{7-2g}{3} \le -5$ or $\dfrac{3-g}{9} > 1$

$7-2g \le -15$ or $3-g > 9$

$-2g \le -22$ or $-g > 6$

$g \ge 11$ or $g < -6$

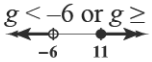
$g < -6$




$g \ge 11$




$g < -6$ or $g \ge 11$




$\{g \mid g < -6 \text{ or } g \ge 11\}$

**69.** $|h| = 4$

$h = 4$ or $h = -4$

The solution set is $\{-4, 4\}$.

**70.** $|x| < 8$

$-8 < x < 8$

The solution set is $\{x \mid -8 < x < 8\}$.

**71.** $|x| \ge 9$

$x \le -9$ or $x \ge 9$

The solution set is $\{x \mid x \le -9 \text{ or } x \ge 9\}$.

**72.** $|l+5| = 13$

$l+5 = -13$ or $l+5 = 13$

$l = -18$ $\quad$ $l = 8$

The solution set is $\{-18, 8\}$.

**73.** $|x-2| \ge 5$

$x-2 \le -5$ or $x-2 \ge 5$

$x \le -3$ $\quad$ $x \ge 7$

The solution set is $\{x \mid x \le -3 \text{ or } x \ge 7\}$.



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**74.** $|4-2x|=5$

$4-2x=5$ or $4-2x=-5$

$-2x=1$ $-2x=-9$

$x=\frac{1}{-2}$ $x=\frac{-9}{-2}$

$x=-\frac{1}{2}$ $x=\frac{9}{2}$

The solution set is $\left\{-\frac{1}{2},\frac{9}{2}\right\}$.

**75.** $|-2q+9|<7$

$-7<-2q+9<7$

$-7-9<-2q+9-9<7-9$

$-16<-2q<-2$

$\frac{-16}{-2}>\frac{-2q}{-2}>\frac{-2}{-2}$

$8>q>1$

$1<q<8$

The solution set is $\{q\,|\,1<q<8\}$.

**76.** $\left|\frac{2x-3}{5}\right|=1$

$\frac{2x-3}{5}=1$ or $\frac{2x-3}{5}=-1$

$2x-3=5$ $2x-3=-5$

$2x=8$ $2x=-2$

$x=4$ $x=-1$

The solution set is $\{-1,\ 4\}$.

**77.** $\left|\frac{x-4}{3}\right|<6$

$-6<\frac{x-4}{3}<6$

$3(-6)<3\left(\frac{x-4}{3}\right)<3(6)$

$-18<x-4<18$

$-14<x<22$

The solution set is $\{x\,|\,-14<x<22\}$.

**78.** $|4d-1|=|6d+9|$

$4d-1=-(6d+9)$ or $4d-1=6d+9$

$4d-1=-6d-9$ $4d-10=6d$

$10d-1=-9$ $-10=2d$

$10d=-8$ $-5=d$

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

The solution set is $\left\{-5,-\frac{4}{5}\right\}$.

**79.** $|2x-3|+4\geq -17$

$|2x-3|\geq -21$

Since the right side is negative and the left side is non-negative, the solution is the entire real number line since the absolute value of a number is always greater than a negative number. The solution set is all real numbers, or $\mathbb{R}$.

**80.** $|2x-3|\geq 5$

$2x-3\geq 5$ or $2x-3\leq -5$

$2x\geq 8$ or $2x\leq -2$

$x\geq 4$ or $x\leq -1$

The solution set is $(-\infty,-1]\cup[4,\infty)$.

**81.** $3<2x-5\leq 11$

$3+5<2x-5+5\leq 11+5$

$8<2x\leq 16$

$\frac{8}{2}<\frac{2x}{2}\leq\frac{16}{2}$

$4<x\leq 8$

The solution is $(4,\ 8]$.



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**82.** $-6 \le \dfrac{3-2x}{4} < 5$

$4(-6) \le 4\left(\dfrac{3-2x}{4}\right) < 4(5)$

$-24 \le 3-2x < 20$

$-27 \le -2x < 17$

$\dfrac{-27}{-2} \ge \dfrac{-2x}{-2} > \dfrac{17}{-2}$

$\dfrac{27}{2} \ge x > -\dfrac{17}{2}$

$-\dfrac{17}{2} < x \le \dfrac{27}{2}$

The solution is $\left(-\dfrac{17}{2}, \dfrac{27}{2}\right]$.

**83.** $2p-5<7$ or $9-3p \le 15$

$2p<12$ or $-3p \le 6$

$p<6$ or $p \ge -2$

$-2 \le p < 6$

The solution is $[-2, 6)$.

**84.** $x-3 \le 4$ or $2x-5>7$

$x-3+3 \le 4+3$ $2x-5+5>7+5$

$x \le 7$ $2x>12$

$x>6$

The solution is $(-\infty, \infty)$.

**85.** $-10 < 3(x-4) \le 18$

$-10 < 3x-12 \le 18$

$-10+12 < 3x-12+12 \le 18+121$

$2 < 3x < 30$

$\dfrac{2}{3} < \dfrac{3x}{3} < \dfrac{30}{3}$

$\dfrac{2}{3} < x \le 10$

The solution is $\left(\dfrac{2}{3}, 10\right]$.

## Chapter 2 Practice Test

**1.** $-3a^2bc^4$ is degree seven since $-3a^2bc^4$ can be written as $-3a^2b^1c^4$ and the sum of the exponents is $2+1+4=7$.

**2.** $2p-3q+2pq-6p(q-3)-4p$

$2p-3q+2pq-6pq+18p-4p$

$(2p+18p-4p)-3q+(2pq-6pq)$

$16p-3q-4pq$

**3.** $7q-\{2[3-4(q+7)]+5q\}-8$

$=7q-\{2[3-4q-28]+5q\}-8$

$=7q-\{2(-25-4q)+5q\}-8$

$=7q-(-50-8q+5q)-8$

$=7q-(-3q-50)-8$

$=7q+3q+50-8$

$=10q+42$

**4.** $7(d+2)=3(2d-4)$

$7d+14=6d-12$

$7d+14-6d=6d-12-6d$

$d+14=-12$

$d+14-14=-12-14$

$d=-26$

**5.** $\dfrac{r}{12}+\dfrac{1}{3}=\dfrac{4}{9}$

$36\left(\dfrac{r}{12}+\dfrac{1}{3}\right)=36\left(\dfrac{4}{9}\right)$

$3r+12=16$

$3r+12-12=16-12$

$3r=4$

$\dfrac{3r}{3}=\dfrac{4}{3}$

$r=\dfrac{4}{3}$



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**6.**
$$\begin{aligned}-2(x+3)&=4\{3[x-(3x+7)]+2\}\\-2x-6&=4\{3[x-3x-7]+2\}\\-2x-6&=4\{3[-2x-7]+2\}\\-2x-6&=4\{-6x-21+2\}\\-2x-6&=4\{-6x-19\}\\-2x-6&=-24x-76\\-2x-6+24x&=-24x-76+24x\\22x-6&=-76\\22x-6+6&=-76+6\\22x&=-70\\\frac{22x}{22}&=\frac{-70}{22}\\x&=-\frac{35}{11}\end{aligned}$$

**7.**
$$\begin{aligned}7x-6(2x-4)&=3-(5x-6)\\7x-12x+24&=3-5x+6\\-5x+24&=-5x+9\\-5x+24+5x&=-5x+9+5x\\24&=9\end{aligned}$$
This is a false statement which means there is no solution. $\varnothing$

**8.**
$$\begin{aligned}-\frac{1}{2}(4x-6)&=\frac{1}{3}(3-6x)+2\\-2x+3&=1-2x+2\\-2x+3&=-2x+3\\2x+3-2x&=2x+3-2x\\3&=3\end{aligned}$$
This is always true which means the solution is any real number or $\mathbb{R}$.

**9.**
$$S_n=\frac{a_1(1-r^n)}{1-r}$$
$$S_3=\frac{3\left[1-\left(\frac{1}{3}\right)^3\right]}{1-\frac{1}{3}}=\frac{3\left[1-\frac{1}{27}\right]}{1-\frac{1}{3}}=\frac{3\left(\frac{26}{27}\right)}{\frac{2}{3}}$$
$$=\frac{\frac{26}{9}}{\frac{2}{3}}=\frac{26}{9}\cdot\frac{3}{2}=\frac{13}{3}$$

**10.**
$$c=\frac{a-5b}{2}$$
$$\begin{aligned}2(c)&=2\left(\frac{a-5b}{2}\right)\\2c&=a-5b\\2c-a&=a-a-5b\\2c-a&=-5b\\\frac{2c-a}{-5}&=\frac{-5b}{-5}\\\frac{2c-a}{-5}&=b \text{ or } b=\frac{a-2c}{5}\end{aligned}$$

**11.**
$$\begin{aligned}A&=\frac{1}{2}h(b_1+b_2)\\2(A)&=2\left[\frac{1}{2}h(b_1+b_2)\right]\\2A&=h(b_1+b_2)\\2A&=hb_1+hb_2\\2A-hb_1&=hb_1-hb_1+hb_2\\2A-hb_1&=hb_2\\\frac{2A-hb_1}{h}&=\frac{hb_2}{h}\\\frac{2A-hb_1}{h}&=b_2 \text{ or } b_2=\frac{2A-hb_1}{h}\end{aligned}$$

**12.** Let $x$ be the cost of the clubs before tax, then $0.07x$ is the tax.
$$\begin{aligned}x+0.07x&=668.75\\1.07x&=668.75\\x&=\frac{668.75}{1.07}\\x&=625\end{aligned}$$
The cost of the clubs before tax is \$625.

**13.** Let $x$ = the number of visits Jay can make.
$$\begin{aligned}240+2x&=400\\2x&=160\\x&=80\end{aligned}$$
Bill can visit the health club 80 times.



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**14.** Let $x$ = the number of hours in which the will be 147 miles apart.

| Person | Rate | Time | Distance |
|---|---|---|---|
| Jeffrey | 15 | $x$ | $15x$ |
| Roberto | 20 | $x$ | $20x$ |

The total distance is the sum of the distances they traveled.

$$15x + 20x = 147$$
$$35x = 147$$
$$x = \frac{147}{35}$$
$$x = 4.2$$

In 4.2 hours, the cyclists will be 147 miles apart.

**15.** Let $x$ be the amount of 12% solution.

| Solution | Strength of Solution | No. of Liters | Amount of Salt |
|---|---|---|---|
| 12% | 0.12 | $x$ | $0.12x$ |
| 25% | 0.25 | 10 | $0.25(10)$ |
| 20% | 0.20 | $x+10$ | $0.20(x+10)$ |

$$0.12x + 0.25(10) = 0.20(x+10)$$
$$0.12x + 2.50 = 0.20x + 2.00$$
$$0.12x + 0.50 = 0.20x$$
$$0.50 = 0.08x$$
$$\frac{0.50}{0.08} = x$$
$$6.25 = x$$

Combine 6.25 liters of the 12% solution with 10 liters of the 25% solution to obtain the mixture.

**16.** Let $x$ be the amount invested at 8%. Then $12{,}000 - x$ is the amount invested at 7%.

| Account | Principal | Rate | Interest |
|---|---|---|---|
| 8% | $x$ | 0.08 | $0.08x$ |
| 7% | $12{,}000 - x$ | 0.07 | $0.07(12{,}000 - x)$ |

The total interest is \$910.

$$0.08x + 0.07(12{,}000 - x) = 910$$
$$0.08x + 840 - 0.07x = 910$$
$$0.01x + 840 = 910$$
$$0.01x = 70$$
$$x = \frac{70}{0.01}$$
$$x = 7000$$

Thus, \$7000 was invested at 8% and the remaining amount of $12{,}000 - 7000 = \$5000$ was invested at 7%.

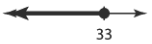
**17.** $3(2q+4) < 5(q-1) + 7$

$$6q + 12 < 5q - 5 + 7$$
$$6q + 12 < 5q + 2$$
$$q + 12 < 2$$
$$q < -10$$




**18.** $\frac{6-2x}{5} \geq -12$

$$5\left(\frac{6-2x}{5}\right) \geq 5(-12)$$
$$6 - 2x \geq -60$$
$$-2x \geq -66$$
$$\frac{-2x}{-2} \leq \frac{-66}{-2}$$
$$x \leq 33$$






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**19.** $x-3\le 4$ and $2x+1>10$

$x-3+3\le 4+3$ $\quad$ $2x+1-1>10-1$

$x\le 7$ $\quad$ $2x>9$

$x>\frac{9}{2}$

The solution is $\left(\frac{9}{2}, 7\right]$.

**20.** $7\le\frac{2u-5}{3}<9$

$3(7)\le 3\left(\frac{2u-5}{3}\right)<3(9)$

$21\le 2u-5<27$

$21+5\le 2u-5+5<27+5$

$26\le 2u<32$

$13\le u<16$

The solution is $[13, 16)$.

**21.** $|2b+5|=9$

$2b+5=-9$ or $2b+5=9$

$2b=-14$ $\quad$ $2b=4$

$b=-7$ $\quad$ $b=2$

The solution set is $\{-7, 2\}$.

**22.** $|2x-3|=\left|\frac{1}{2}x-10\right|$

$2x-3=-\left(\frac{1}{2}x-10\right)$ or $2x-3=\frac{1}{2}x-10$

$2x-3=-\frac{1}{2}x+10$ $\quad$ $\frac{3}{2}x-3=-10$

$\frac{5}{2}x-3=10$ $\quad$ $\frac{3}{2}x=-7$

$\frac{5}{2}x=13$ $\quad$ $\frac{2}{3}\left(\frac{3}{2}x\right)=\frac{2}{3}(-7)$

$\frac{2}{5}\left(\frac{5}{2}x\right)=\frac{2}{5}(13)$ $\quad$ $x=-\frac{14}{3}$

$x=\frac{26}{5}$

The solution set is $\left\{-\frac{14}{3}, \frac{26}{5}\right\}$.

**23.** $|4z+12|=0$

$4z+12=0$

$4z=-12$

$z=-3$

The solution set is $\{-3\}$.

**24.** $|2x-3|+6>11$

$|2x-3|>5$

$2x-3<-5$ or $2x-3>5$

$2x<-2$ $\quad$ $2x>8$

$x<-1$ $\quad$ $x>4$

The solution set is $\{x|x<-1 \text{ or } x>4\}$.

**25.** $\left|\frac{2x-3}{8}\right|\le\frac{1}{4}$

$-\frac{1}{4}\le\frac{2x-3}{8}\le\frac{1}{4}$

$8\left(-\frac{1}{4}\right)\le 8\left(\frac{2x-3}{8}\right)\le 8\left(\frac{1}{4}\right)$

$-2\le 2x-3\le 2$

$1\le 2x\le 5$

$\frac{1}{2}\le x\le\frac{5}{2}$

The solution set is $\left\{x\left|\frac{1}{2}\le x\le\frac{5}{2}\right.\right\}$.

## Chapter 2 Cumulative Review Test

**1. a.** $A\cup B=\{1, 2, 3, 5, 7, 9, 11, 13, 15\}$

**b.** $A\cap B=\{3, 5, 7, 11, 13\}$

**2. a.** commutative property of addition

**b.** associative property of multiplication

**c.** distributive property

**3.** $-4^3+(-6)^2\div(2^3-2)^2$

$=-4^3+(-6)^2\div(8-2)^2$

$=-4^3+(-6)^2\div(6)^2$

$=-64+36\div 36$

$=-64+1$

$=-63$



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**4.** Substitute –1 for $a$ and –2 for $b$.

$$\begin{aligned}
&a^2b^3+ab^2-3b\\
&=(-1)^2(-2)^3+(-1)(-2)^2-3(-2)\\
&=(1)(-8)+(-1)(4)-3(-2)\\
&=-8+(-4)-(-6)\\
&=-8+(-4)+6\\
&=-12+6\\
&=-6
\end{aligned}$$

**5.**
$$\begin{aligned}
\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-\left[5-(12\div 4)\right]^2}&=\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-\left[5-3\right]^2}\\
&=\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-2^2}\\
&=\frac{8-3\cdot 3\div 9}{5-4}\\
&=\frac{8-9\div 9}{5-4}\\
&=\frac{8-1}{5-4}\\
&=\frac{7}{1}\\
&=7
\end{aligned}$$

**6.**
$$\begin{aligned}
\left(5x^4y^3\right)^{-2}&=\left(\frac{1}{5x^4y^3}\right)^2\\
&=\frac{1^2}{5^2x^{4\cdot 2}y^{3\cdot 2}}\\
&=\frac{1}{25x^8y^6}
\end{aligned}$$

**7.**
$$\begin{aligned}
\left(\frac{4m^2n^{-4}}{m^{-3}n^2}\right)^2&=\left(\frac{4m^{2-(-3)}}{n^{2-(-4)}}\right)^2\\
&=\left(\frac{4m^5}{n^6}\right)^2\\
&=\frac{4^2m^{5\cdot 2}}{n^{6\cdot 2}}\\
&=\frac{16m^{10}}{n^{12}}
\end{aligned}$$

**8.**
$$\begin{aligned}
\frac{5.704\times 10^5}{1.045\times 10^3}&=\frac{5.704}{1.045}\times 10^{5-3}\\
&\approx 5.458\times 10^2\\
&\approx 545.8
\end{aligned}$$

The land area of Alaska is about 545.8 times larger than that of Rhode Island.

**9.**
$$\begin{aligned}
-3(y+7)&=2(-2y-8)\\
-3y-21&=-4y-16\\
y-21&=-16\\
y&=5
\end{aligned}$$

**10.**
$$\begin{aligned}
1.2(x-3)&=2.4x-4.98\\
1.2x-3.6&=2.4x-4.98\\
1.2x&=2.4x-1.38\\
-1.2x&=-1.38\\
x&=\frac{-1.38}{-1.2}\\
x&=1.15
\end{aligned}$$

**11.**
$$\begin{aligned}
\frac{2m}{3}-\frac{1}{6}&=\frac{4}{9}m\\
18\left(\frac{2m}{3}-\frac{1}{6}\right)&=18\left(\frac{4}{9}m\right)\\
12m-3&=8m\\
4m-3&=0\\
4m&=3\\
m&=\frac{3}{4}
\end{aligned}$$

**12.** A conditional equation is true only under specific conditions. An identity is true for an infinite number of values of the variable. A contradiction is never true. Answers may vary. One possible answer is:

$3x+4=13$ is a conditional linear equation.

$3(x+7)=2(x+10)+x+1$ is an identity.

$3x+4=3x+8$ is a contradiction.



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**13.** $x = \dfrac{-b+\sqrt{b^2-4ac}}{2a}$

$= \dfrac{-(-8)+\sqrt{(-8)^2-4(3)(-3)}}{2(3)}$

$= \dfrac{-(-8)+\sqrt{64+36}}{6} = \dfrac{-(-8)+\sqrt{100}}{6}$

$= \dfrac{8+10}{6} = \dfrac{18}{6} = 3$

**14.** $y - y_1 = m(x - x_1)$

$\dfrac{y-y_1}{m} = \dfrac{m(x-x_1)}{m}$

$\dfrac{y-y_1}{m} = x - x_1$

$\dfrac{y-y_1}{m} + x_1 = x$

$x = \dfrac{y-y_1}{m} + x_1$ or $x = \dfrac{y-y_1+mx_1}{m}$

**15. a.** $-4 < \dfrac{5x-2}{3} < 2$

$3(-4) < 3\left(\dfrac{5x-2}{3}\right) < 3(2)$

$-12 < 5x - 2 < 6$

$-12+2 < 5x-2+2 < 6+2$

$-10 < 5x < 8$

$3(-4) < 3\left(\dfrac{5x-2}{3}\right) < 3(2)$

$-12 < 5x - 2 < 6$

$-12+2 < 5x-2+2 < 6+2$

$-10 < 5x < 8$

$\dfrac{-10}{5} < \dfrac{5x}{5} < \dfrac{8}{5}$

$-2 < x < \dfrac{8}{5}$




**b.** $\left\{x \middle| -2 < x < \dfrac{8}{5}\right\}$

**c.** $\left(-2, \dfrac{8}{5}\right)$

**16.** $|3h-1| = 8$

$3h - 1 = -8$ or $3h - 1 = 8$

$3h = -7$ $\quad$ $3h = 9$

$h = -\dfrac{7}{3}$ $\quad$ $h = 3$

Solution is $\left\{-\dfrac{7}{3}, 3\right\}$.

**17.** $|2x-4| - 6 \geq 18$

$|2x-4| \geq 24$

$2x - 4 \leq -24$ or $2x - 4 \geq 24$

$2x \leq -20$ $\quad$ $2x \geq 28$

$x \leq -10$ $\quad$ $x \geq 14$

The solution set is $\{x \mid x \leq -10 \text{ or } x \geq 14\}$.

**18.** Let $x$ be the original price.

$x - 0.40x = 21$

$0.60x = 21$

$x = \dfrac{21}{0.60}$

$x = 35$

The original price was \$35.

**19.** Let $x$ be the speed of the car traveling south. Then $x + 20$ is the speed of the car traveling north.

| Car | Rate | Time | Distance |
|---|---|---|---|
| South | $x$ | 3 | $3x$ |
| North | $x+20$ | 3 | $3(x+20)$ |

The total distance is 300 miles.

$3x + 3(x+20) = 300$

$3x + 3x + 60 = 300$

$6x + 60 = 300$

$6x = 240$

$x = \dfrac{240}{6}$

$x = 40$

The speed of the car traveling south is 40 mph and the speed of the car traveling north is $40 + 20 = 60$ mph.



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**20.** Let $x$ = the number of pounds of cashews. Then $40 - x$ is the number of pounds of peanuts.

| | Cost | Pounds | Cost |
|---|---|---|---|
| cashews | 6.50 | $x$ | $6.50x$ |
| peanuts | 2.50 | $40 - x$ | $2.50(40 - x)$ |
| mixture | 4.00 | 40 | 4.00(40) |

$$6.50x + 2.50(40 - x) = 4.00(40)$$
$$6.50x + 100 - 2.50x = 160$$
$$4.00x + 100 = 160$$
$$4.00x = 60$$
$$x = 15$$

Molly should combine 15 pounds of cashews with 40 lbs – 15 lbs = 25 lbs of peanuts.



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# Chapter 2 Pretest Form A *(cont.)*

Name:_____

**20.** Determine the solution set to the inequality. $|x+1|>4$

**20.** _____



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Name:_____

Date:_____

# Chapter 2 Pretest Form B

State the degree of each term.

**1.** $4x^6$ **1.** _____

**2.** $-8x^2yz$ **2.** _____

Simplify.

**3.** $10a - 6b - 7a$ **3.** _____

**4.** $17 - 3(x + 2) - 4x$ **4.** _____

**5.** $8x - [1 - (x - 3)] + 11$ **5.** _____

Solve each equation.

**6.** $7x - 4 = 24$ **6.** _____

**7.** $3(x - 5) + x = -23$ **7.** _____

**8.** $\frac{2}{5} - \frac{x}{10} = 1$ **8.** _____

**9.** $-\frac{1}{6}(18x - 24) = \frac{1}{2}(8 - 6x)$ **9.** _____

**10.** $9x - 5(2x + 6) = 7x - (8x + 3)$ **10.** _____

**11.** Determine the value of $A$ for $h = 8$, $b_1 = 3$, and $b_2 = 9$. **11.** _____

$$A = \frac{1}{2}h(b_1 + b_2)$$

**12.** Solve $y = mx + b$ for $x$. **12.** _____

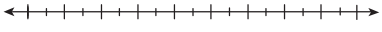
Use an equation to solve.

**13.** The cost of a movie ticket is \$6 after a 6% tax. Determine the cost before tax. **13.** _____

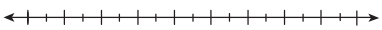
**14.** Train A leaves a station traveling at 20 mph. Two hours later, train B leaves the same station traveling in the same direction at 30 mph. How long does it take for train B to catch up to train A? **14.** _____

Solve each inequality and graph the solution on the number line.

**15.** $3x - 11 \le 16$ **15.** _____



**16.** $-4 - 5x < -9$ **16.** _____



**17.** Write $-4 \le x < 5$ in interval notation. **17.** _____

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# Chapter 2 Pretest Form B *(cont.)*

Name:_____

**18.** Solve the inequality and write the solution in interval notation.
$x - 5 < 12$ and $2x + 9 \geq 3$

**18.** _____

**19.** Determine the solution set to the equation.
$|x - 3| = 7$

**19.** _____

**20.** Determine the solution set to the inequality.
$|x + 4| \leq 6$

**20.** _____


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# Mini-Lecture 2.1

Solving Linear Equations

**Learning Objectives:**

1. Identify the reflexive, symmetric, and transitive properties.
2. Combine like terms.
3. Solve linear equations.
4. Solve equations containing fractions.
5. Identify conditional equations, contradictions, and identities.
6. Understand the concepts to solve equations.
7. Key vocabulary: *terms, (numerical) coefficient, constant, degree of a term, like/unlike terms, simplify an expression, equation, solutions, solution set, equivalent equations, linear equations in one variable, least common denominator (LCD), conditional equations, contradictions, identities*

**Examples:**

1. Name each indicated property.
   a) If $x-4=8$, then $x-4+4=8+4$.  b) If $4=-7+5y$, then $-7+5y=4$.
   c) If $3x=8y$ and $8y=20$, then $3x=20$.  d) $-7+5y=-7+5y$

2. Simplify each expression if possible.
   a) $3x-4y-x-5y$  b) $4n^2-n+2$  c) $3(2y+3)-4[6-(y+2)]$

3. Solve the following linear equations.
   a) $6-4x=38$  b) $6x+19=3x-8$  c) $5-4(3x-8)=21-8x$

4. Solve each equation. Leave your answer as a fraction if it is not an integer.
   a) $\frac{1}{4}x-\frac{1}{3}=\frac{5}{12}$  b) $\frac{1}{3}(2-5x)=-11$

5. Solve. Then indicate whether the equation is conditional, an identity, or a contradiction.
   a) $2x-(3x-6)+4x=3x-6$  b) $3(2x-8)-5(15-6x)=9(4x-11)$

6. Solve $\odot\square-\triangle=*$ for $\square$.

**Teaching Notes:**

Some students make the mistake of leaving the variable out of their answer when they subtract like terms. For instance, they write $7x-x$ as 6, instead of $6x$.

Caution students not to add exponents when adding like terms.

When solving multi-step equations, many students start to isolate the variable on one side of the equation before first simplifying each side of the equation.

*Answers: 1a) addition property; 1b) symmetric property; 1c) transitive property; 1d) reflexive property; 2a)* $2x-9y$*; 2b) cannot be simplified; 2c)* $10y-7$*; 3a) –8; 3b) –9; 3c) 4; 4a) 3; 4b) 7; 5a)* $\varnothing$*, contradiction; 5b)* $\mathbb{R}$*, identity; 6)* $\square=\frac{*+\triangle}{\odot}$

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# Mini-Lecture 2.2

Problem Solving and Using Formulas

**Learning Objectives:**

1. Use the problem-solving procedure.
2. Solve for a variable in an equation or formula.
3. Key vocabulary: *mathematical model, formula, simple interest formula, compound interest formula, subscripts*

**Examples:**

1. How much simple interest is earned when $5000 is invested at 4.25% for 3 years?

2. a) Frank invests $3500 into a money market account that earns 3.75% compounded monthly. How much money will be in Frank's money market account in 4 years, assuming that he makes no other deposits or withdrawals?
   b) How much interest will Frank's account earn over this 4-year period?

3. a) When an object is projected directly upward, its height at a particular time can be found using the formula $h = -16t^2 + v_0t + h_0$, where $h$ is the height in feet, $t$ is the time in seconds, $v_0$ is the initial velocity of the object, and $h_0$ is the initial height of the object. A baseball is projected directly upward with an initial velocity of 65 feet per second from an initial height of 4 feet. What is the height of the baseball after 2 seconds?
   b) What is the height of the baseball after 3.5 seconds?

4. Solve each equation for the variable $y$.
   a) $3x + y = 7$ b) $12x + 4y = -20$
   c) $3x - 5y = 7$ d) $y + 2 = \frac{1}{3}(x - 8)$

5. Solve each equation for the indicated variable.
   a) $A = 2\pi rh$ for $r$ b) $a_n = a_1 + (n-1)d$ for $a_1$ c) $S = \frac{n}{2}(a_1 + a_n)$ for $a_n$

**Teaching Notes:**

Remind students that when solving a formula for a particular variable, this variable should eventually be isolated on one side of the equation and should not occur anywhere on the other side of the equation.

With interest problems, students may forget to convert percents into decimals.

Emphasize that both the simple interest formula and compound interest formula require time to be expressed in years.

*Answers: 1) $637.50; 2a) $4065.47; 2b) $565.47; 3a) 70 feet; 3b) 35.5 feet; 4a)* $y = -3x + 7$; *4b)* $y = -3x - 5$; *c)* $y = \frac{3}{5}x - \frac{7}{5}$; *d)* $y = \frac{1}{3}x - \frac{14}{3}$; *5a)* $r = \frac{A}{2\pi h}$; *5b)* $a_1 = a_n - (n-1)d$; *5c)* $a_n = \frac{2S}{n} - a_1$


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# Mini-Lecture 2.3

Applications of Algebra

**Learning Objectives:**

1. Translate a verbal statement into an algebraic expression or equation.
2. Use the problem-solving procedure.
3. Key vocabulary: *complementary angles, supplementary angles*

**Examples:**

1. Express each phrase as an algebraic expression.
   a) 6 more than a number, $n$
   b) 12 decreased by twice a number, $x$
   c) the number of cents in $n$ nickels
   d) a $7\frac{1}{2}\%$ sales tax applied to sales of $y$ dollars

2. Select one variable to represent one quantity. Express the second quantity in terms of the first.
   a) Altogether, Jim and John own 9 vehicles.
   b) Stefanie has \$5 less than Terry.
   c) The height of a triangle is 2 inches shorter than three times its base.

3. Write an equation that can be used to solve the problem. Then determine the solution.
   a) David's monthly cell phone bill is \$19 plus 20¢ per minute of non-peak usage. Trinh's monthly cell phone bill is \$13 plus 35¢ per minute of non-peak usage. For what number of non-peak minutes will David's monthly cell phone bill be exactly the same as Trinh's?
   b) The cost of membership at a country club increased by 8% from 2009 to 2010. The yearly cost for membership in 2010 was \$1350. What was the cost of membership in 2009?
   c) Determine the measures of the three angles of a triangle if one angle is $12^\circ$ more than the smallest angle and the third angle is 4 times the size of the smallest angle.
   d) Juan stayed in a hotel room one night at a rate of \$99 per night. The hotel charged him \$4 for one local phone call. If his final bill was \$120.51, determine the tax rate for the room.
   e) If two angles are complementary and the larger angle is $2^\circ$ more than 3 times the smaller angle, determine the measure of each angle.
   f) Two angles are supplements of each other and one angle is $14^\circ$ smaller than the other angle. Determine the measure of each angle.

**Teaching Notes:**

Students often have difficulty with translating expressions that involve subtraction. For instance, the phrase "less than" is often confused with the term "less." Additionally, phrases like "six less than a number" may be written as $6-x$ instead of $x-6$.

If students are having difficulty translating phrases into algebraic expressions, have them experiment with specific numbers before they try using variables.

*Answers: 1a) $n+6$; 1b) $12-2x$; 1c) $5n$; 1d) $0.075y$; 2a) $x$, $9-x$; 2b) $x$, $x-5$; 2c) $b$, $3b-2$; 3a) 40 minutes; 3b) \$1250; 3c) $28^\circ$, $40^\circ$, and $112^\circ$; 3d) 17.5%; 3e) $22^\circ$ and $68^\circ$; 3f) $83^\circ$ and $97^\circ$*

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# Mini-Lecture 2.4

Additional Application Problems

**Learning Objectives:**

1. Solve motion problems.
2. Solve mixture problems.
3. Key vocabulary: *motion formula, distance formula, mixture problem*

**Examples:**

1. Write an equation that can be used to solve the motion problem. Then solve the equation and answer the question asked.
   a) Gary and Kathy leave at the same time from their house and drive in opposite directions. Gary drives at a rate of 65 mph and Kathy drives at a rate of 55 mph. How long will it take for Gary and Kathy to be 420 miles apart from each other?
   b) Amy leaves at noon and travels north at a rate of 75 mph. Deb leaves the same place 2 hours later, also headed north. If Deb travels at a rate of 80 mph, how long will it take for Deb to catch up with Amy?
   c) Paul and his son Michael own a grass-cutting business. On average, Michael can finish twice as many lawns in a given day than his father Paul. In a recent week, Paul mowed lawns by himself for 3 days and then Michael mowed lawns for 2 days by himself. If altogether, they finishing cutting grass on 28 lawns in 5 days, determine the rate (in lawns per day) at which each of them cut grass.

2. Write an equation that can be used to solve the mixture problem. Then solve the equation and answer the question asked.
   a) One type of coffee worth \$3.20 per pound is mixed with another type worth \$2 per pound to make 20 pounds that will sell for \$2.72 per pound. How much of each type of coffee is being used?
   b) A certain money market account pays 5% simple interest, and a certain savings account pays 3% simple interest. Suppose that \$2400 was split so that some was placed in the money market account and the remaining money was placed in the savings account. At the end of one year, the total amount of interest earned from both accounts was \$108. Determine the original amount of money that was placed into each of the accounts.
   c) Nick has a total of 20 nickels and dimes worth \$1.30. How many of each type of coin does Nick have?

**Teaching Notes:**

When writing equations for mixture problems, remind students to be consistent with their units of measurement. This especially applies to percents (decimals versus whole numbers) and money (dollars versus cents).

*Answers: 1a)* $3\frac{1}{2}$ *hours; 1b) 30 hours; 1c) Paul: 4 lawns per day, Michael: 8 lawns per day; 2a) 12 lbs of first type, 8 lbs of second type; 2b) \$1800 in the money market account, \$600 in the savings account; 2c) 14 nickels and 6 dimes*


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# Mini-Lecture 2.5

Solving Linear Inequalities

**Learning Objectives:**

1. Solve inequalities.
2. Graph solutions to inequalities on a number line, interval notation, and solution sets.
3. Solve compound inequalities involving *and*.
4. Solve compound inequalities involving *or*.
5. Key vocabulary: *inequality, compound inequality, intersection, union*

**Examples:**

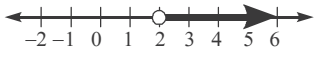
1. Solve each inequality. State the solution set and graph the solution on a number line.
   a) $2x+3>7$ b) $5x+4\ge 6x-16$ c) $-x-27>11$
2. Solve each inequality and give the solution in interval notation.
   a) $12-7x>6x-7(2x+3)$ b) $\frac{2}{3}x-\frac{2}{3}\ge\frac{3}{4}x-\frac{7}{2}$
   c) $4(x+2)<4x-10$ d) $2x+(x+4)\ge 3x+4$
3. Solve each inequality and give the solution in interval notation.
   a) $-2<3x-5\le 7$ b) $-2\le\frac{5-3x}{2}\le 2$ c) $4x-5>3$ and $4-\frac{1}{2}x<1$
4. Solve each inequality and give the solution set.
   a) $5x+3>4x$ or $3(x+2)-1<2x$ b) $-4(x+2)\ge 12$ or $3x+8<11$
5. A rental car agency charges a daily rate of \$37.50 per day plus \$0.21 per mile. Sam is budgeted \$150 per day for business expenses related to car rentals. To the nearest tenth of a mile, how far Sam can travel per day to stay within his budget?
   a) Write an inequality that could be used to solve this problem.
   b) Solve the inequality and use the solution to answer the given question.
6. Ella wants to make a B in her algebra class. The grading scale for a B is 85 to 93, inclusive. Her first four test scores were 93, 100, 88, and 87. Determine the range of grades she must score on her fifth test in order to make a B.

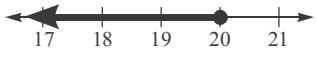
**Teaching Notes:**

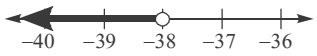
Some students reverse the direction of the inequality symbol any time the operation on the inequality somehow involves a negative number.

Encourage students to always end up with the variable on the left side of the solution. This helps prevent errors in expressing the solution graphically or with interval notation.

A common mistake with writing answers in interval notation is improper placement of the infinity symbol. For instance, the inequality $x<5$ may be incorrectly written as $(5,-\infty)$.

*Answers: 1a)* $\{x|x>2\}$ 

*1b)* $\{x|x\le 20\}$ 

*1c)* $\{x|x<-38\}$ 

*2a)* $(-33,\infty)$*; 2b)* $(-\infty,34]$*; 2c) no solution;*
2d) $(-\infty,\infty)$; 3a) $(-1,4]$; 3b) $\left[\frac{1}{3},3\right]$; 3c) $(6,\infty)$; 4a) $\{x|x<-5 \text{ or } x>-3\}$; 4b) $\{x|x<1\}$;
5a) $37.5+0.21x\le 150$; 5b) 535.7 miles; 6) 57 to 97, inclusive

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# Mini-Lecture 2.6

Solving Equations and Inequalities Containing Absolute Values

**Learning Objectives:**

1. Understand absolute value on the number line.
2. Solve equations of the form $|x| = a,\ a > 0$.
3. Solve inequalities of the form $|x| < a,\ a > 0$.
4. Solve inequalities of the form $|x| > a,\ a > 0$.
5. Solve inequalities of the form $|x| < a$ or $|x| > a,\ a < 0$.
6. Solve inequalities of the form $|x| < 0,\ |x| \le 0,\ |x| > 0$, or $|x| \ge 0$.
7. Solve equations of the form $|x| = |y|$.
8. Key vocabulary: *absolute value*

**Examples:**

1. Determine the solution set for each equation.
   a) $|x| = 7$ b) $|x| = -7$ c) $|2x - 3| = 5$

2. Determine the solution set for each inequality.
   a) $|3 - 4x| < 13$ b) $|4 - \frac{1}{3}x| + 2 < 8$ c) $|x - 2| > 4$
   d) $|3 - \frac{1}{2}x| \ge 4.5$ e) $|9 - 5x| + 6 \le 4$ f) $|7x - 6| > -1$
   g) $|x - 8| > 0$ h) $|4x - 8| \le 0$

3. Determine the solution set for each equation.
   a) $|x + 2| = |x - 3|$ b) $|5x + 3| = |3x + 25|$

**Teaching Notes:**

Some students write answers to equations having two solutions using parentheses instead of braces. Distinguish between the mathematical meanings of $\{2,6\}$ and $(2,6)$.

With absolute value equations and inequalities, students typically ignore the absolute value symbols and think of $|2x - 7| = 12$ and $2x - 7 = 12$ as the same problem.

Remind students to isolate the absolute value expression before removing the absolute value symbols and writing two equations or inequalities.

*Answers: 1a) $\{-7,7\}$; 1b) no solution; 1c) $\{-1,4\}$; 2a) $\{x|-2.5 < x < 4\}$; 2b) $\{x|-6 < x < 30\}$; 2c) $\{x|x < -2 \text{ or } x > 6\}$; 2d) $\{x|x \le -3 \text{ or } x \ge 15\}$; 2e) no solution; 2f) all real numbers; 2g) $\{x|x < 8 \text{ or } x > 8\}$; 2h) $\{2\}$; 3a) $\{\frac{1}{2}\}$; 3b) $\{-\frac{7}{2}, 11\}$*


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# Additional Exercises 2.1

Name the property indicated.

**1.** $x+3=x+3$ **1.** _____

**2.** If $y=x^2+5x+3$, then $x^2+5x+3=y$. **2.** _____

Simplify each expression.

**3.** $-8y+(-5)+4x+(-9y)-(-6x)$ **3.** _____

**4.** $-3-3(4+x)+7x$ **4.** _____

**5.** $-4x+2(3x-1)$ **5.** _____

**6.** $5x-3(x-1)$ **6.** _____

Solve each equation.

**7.** $2x-10=26$ **7.** _____

**8.** $\frac{4x}{3}-6=5+\frac{4x-7}{5}$ **8.** _____

**9.** $\frac{x}{8}-\frac{x}{9}=1$ **9.** _____

**10.** $\frac{x+5}{7}=\frac{x}{8}$ **10.** _____

**11.** $3a=2\left(2a-\left[11a+(16a-17)\right]\right)+13$ **11.** _____

**12.** $5+4(x-2)=2(x+7)+1$ **12.** _____

**13.** $\frac{x-5}{5}=\frac{5}{6}$ **13.** _____

**14.** $\frac{x+4}{2}=\frac{2}{3}$ **14.** _____

**15.** Solve the equation. Round to the nearest hundredth. **15.** _____
$1.6x+5=0.2x-7.8$

**16.** $5.8x-1.9(2x-5)=8.3$ **16.** _____

Find the solution for each exercise. Then indicate whether the equation is conditional, an identity, or a contradiction.

**17.** $6x+5=9x+5-3x$ **17.** _____

**18.** $7x+2=-1$ **18.** _____

**19.** $5x+3=2x-2$ **19.** _____

**20.** $-2+15x+10=5(3x+2)$ **20.** _____

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# Additional Exercises 2.2

**1.** If $A = \pi r^2$, $\pi = 3.14$, and $r = 4.6$, determine $A$. Round to the nearest hundredth. **1.** _____

**2.** If $S = 4\pi r^2$, $\pi = 3.14$, and $r = 7.8$, determine $S$. Round to the nearest hundredth. **2.** _____

**3.** Evaluate the formula $\frac{2}{3}x_1 + 2x_2 - 3$ for $x_1 = 1$ and $x_2 = 2\frac{2}{5}$. **3.** _____

**4.** Evaluate $\frac{6 - 5w^2}{2n}$ when $w = 2$ and $n = 7$. **4.** _____

**5.** Evaluate $\frac{xy}{x - y}$ when $x = 6$ and $y = 2$. **5.** _____

**6.** Evaluate the formula $c = \frac{6}{7}ab^2$ for $a = 3\frac{1}{3}$ and $b = 7$. **6.** _____

**7.** Evaluate the formula $W = x + yz$ for $x = 4$, $y = 2$, and $z = \frac{2}{3}$. **7.** _____

**8.** Solve the equation for $y$: $\frac{1}{5}xy - 4y = 6y + 1$ **8.** _____

**9.** Solve the equation for $b$: $-ab + 3b = 5(a + ab)$ **9.** _____

**10.** Solve for $a$ in $F = kma$. **10.** _____

**11.** Solve for $d$ in the equation $e = \frac{c - 2d}{6}$. **11.** _____

**12.** Solve $A = 2(ab + ah + bh)$ for $h$. **12.** _____

**13.** Solve for $h$ in $V = lwh$. **13.** _____

**14.** Solve for $M$ in $N = \frac{2}{3}(4 + M)$. **14.** _____

**15.** Solve for $h$ in $V = \frac{1}{3}\pi r^2 h$. **15.** _____

**16.** Solve $2 = \frac{x - \mu}{\sigma}$ for $x$. **16.** _____

**17.** Marcus jogs at a rate of 4.5 miles per hour. Write a formula that can be used to determine how far Marcus jogs in a given amount of time ($t$). **17.** _____

**18.** Use the formula from the previous problem to determine how far Marcus jogs in 45 minutes (0.75 hour). **18.** _____

**19.** Solve your formula from Exercise 17 for $t$. **19.** _____

**20.** Use the formula from Exercise 19 to determine how long it takes Marcus to jog 6.75 miles. **20.** _____



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# Additional Exercises 2.3

Express as an algebraic expression or equation.

**1.** the product of a number ($n$) and 10 **1.** _____

**2.** twice the sum of 21 and Allen's weight ($x$) **2.** _____

**3.** the difference of a number ($n$) and 5 **3.** _____

**4.** twice $q$ less 15 **4.** _____

**5.** Use $x$ for the variable: a number increased by 16% is 120 **5.** _____

**6.** Use $x$ for the variable: a number decreased by 7% is 130 **6.** _____

Solve each problem.

**7.** Determine the dimensions of a rectangle if the length is 10 feet more than the width and the perimeter is 220 feet. Use $P = 2L + 2W$ . **7.** _____

**8.** Determine the dimensions of a rectangle if the width is 20 feet less than the length and the perimeter is 260 feet. Use $P = 2L + 2W$ . **8.** _____

**9.** The sum of two consecutive integers is 147. Determine the two integers. **9.** _____

**10.** The sum of two consecutive even integers is 94. Determine the integers. **10.** _____

**11.** Shane worked 11 hours less this week than last. If he worked 39 hours this week, how many hours did he work last week? **11.** _____

**12.** A car rental company offers two rental plans. One plan is \$45 per day plus 5¢ per mile driven. The other plan offers no daily fee but 50¢ per mile driven. Determine the number of miles that must be driven in one day for both plans to cost the same **12.** _____

**13.** The median home price in a certain city is \$196,000. This represents a 2.5% increase from the previous year. What was the median home price the previous year? **13.** _____

**14.** Two angles are supplements of each other. The larger angle is $12^\circ$ more than 3 times the smaller. Determine the measure of each angle. **14.** _____

**15.** On the third day of their vacation trip the Nelson family traveled 111 miles in 3 hours. What was their average speed? **15.** _____

**16.** On the fourth day of their vacation trip the Price family traveled 258 miles in 6 hours. What was their average speed? **16.** _____

**17.** Marvin can check 12 parts per minute on an assembly line. How many parts will he be able to check in 4 hours? **17.** _____

**18.** Maria can check 15 parts per minute on an assembly line. How many parts will she be able to check in 3 hours? **18.** _____

**19.** Ken can earn a flat salary of \$812 a week in one job or \$500 a week plus 6% commission in another job. How much would he need to sell per week in the second job to equal the salary of the first job? **19.** _____

**20.** Susan bought a dress for \$45. If the total cost of the dress with tax was \$47.88, what sales tax rate did she pay? **20.** _____

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Name:_____

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# Additional Exercises 2.4

**1.** Train A leaves a station traveling at 20 mph. Four hours later, train B leaves the same station traveling in the same direction at 40 mph. How long does it take for train B to catch up to train A?

**1.** _____

**2.** Two joggers start at the same point at the same time and jog in opposite directions. Homer jogs at 5 mph, while Frances jogs at $3\frac{1}{4}$ mph. How far apart will they be in $1\frac{1}{8}$ hours? (Round your answer to the nearest hundredth.)

**2.** _____

**3.** A train traveling at 40 mph leaves for a certain town. Three hours later, a car traveling at 50 mph leaves for the same town and arrives at the same time as the train. If both the train and the car traveled in a straight line, how far is the town from where they started?

**3.** _____

**4.** Train A leaves a station traveling at 20 mph. Two hours later, train B leaves the same station traveling in the same direction at 30 mph. How long does it take for train B to catch up to train A?

**4.** _____

**5.** Cindy invested $11,000 for one year, part at 8% simple interest and part at 11% simple interest. If she earned a total of $970 in interest, how much was invested at each rate?

**5.** _____

**6.** Arlene invested $29,000 for one year, part at 9% simple interest and part at 10% simple interest. If she earned a total of $2760 in interest, how much did she invest at each rate?

**6.** _____

**7.** George invested $8000 for one year, part at 12% simple interest and part at 13% simple interest. If he earned a total interest of $980, how much did he invest at each rate?

**7.** _____

**8.** A 50% sulfuric acid solution is mixed with a 20% sulfuric acid solution. How much of each should be used to make 12 liters of a solution that is 30% acid?

**8.** _____

**9.** How many pounds of salted nuts selling for $2.40 per pound should be mixed with 7 pounds of salted nuts selling for $1.60 a pound to obtain a mixture selling for $1.84 per pound?

**9.** _____

**10.** How many pounds of cashews selling for $6 per pound should be combined with 50 lbs of walnuts selling for $9 per pound to form a mixture that can be sold for $7 per pound?

**10.** _____

**11.** Elana's garden pond holds 1200 gallons of water. One pump drains 5 gallons of water per minute while another pump drains 7 gallons of water per minute. If the pumps are turned on at the same time, how long will it take for the pond to be drained?

**11.** _____

**12.** How many gallons of a 40% alcohol solution should be mixed with 15 gallons of 80% alcohol solution to obtain a 60% alcohol solution?

**12.** _____

**13.** A water tank can be filled by a hose in 20 minutes. When a pipe is used with the hose, it only takes 12 minutes to fill the same tank. How long would it take the pipe alone to fill the tank?

**13.** _____

**14.** Paul can paint a 120-square-foot room in 4 hours. Sally can paint the same size room in 3 hours. Working together, how long would it take them to paint the room?

**14.** _____



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# Additional Exercises 2.4 *(cont.)*

Name:_____

**15.** Columbia, South Carolina and Atlanta, Georgia are about 200 miles apart. A car leaves Columbia headed toward Atlanta at 55 mph. At the same time, a truck leaves Atlanta headed toward Columbia at 45 mph. How long will it take them to meet?

**15.** _____

**16.** One week, Larissa sold 40 shirts. White ones cost $4.95 and printed ones cost $7.95. In all, she sold $282 worth of shirts. How many of each kind were sold?

**16.** _____

**17.** Five cups of mixed nuts is 20% peanuts. How many cups of peanuts should be added to produce a mixture that is 50% peanuts?

**17.** _____

**18.** The speed of a passenger train is 14 mph faster than the speed of a freight train. If they leave a station at the same time in opposite directions, they are 730 miles apart in 5 hours. Determine the speed of the freight train.

**18.** _____

**19.** Mix A is 16% sunflower seed. Mix B is 9% sunflower seed. How many pounds of each should be mixed together to get 350 pounds of birdseed that is 12% sunflower seed?

**19.** _____

**20.** Janie invested $15,000 in two accounts, one paying 9% simple interest and another paying 10% simple interest. The total interest earned in one year on the investments was $1432. How much did she invest at each rate?

**20.** _____

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Name:_____

Date:_____

# Additional Exercises 2.5

Express each inequality (a) using the number line, (b) in interval notation, and (c) as a solution set.

**1.** $x \geq 2$

**1. (a)** 

**(b)** _____

**(c)** _____

**2.** $x < -\frac{4}{3}$

**2. (a)** 

**(b)** _____

**(c)** _____

**3.** $-5 \leq x < \frac{2}{3}$

**3. (a)** 

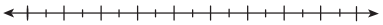
**(b)** _____

**(c)** _____

Solve each inequality and graph the solution on the number line.

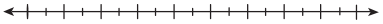
**4.** $2x < 29$

**4.** _____



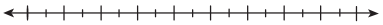
**5.** $5x - 10 \leq 10$

**5.** _____



**6.** $\frac{2x-8}{4} > 2$

**6.** _____



Solve each inequality and give the solution in interval notation.

**7.** $3x \leq 15$

**7.** _____

**8.** $6 - 4x < 14$

**8.** _____

**9.** $1 < -7 - \frac{1}{3}x < 2$

**9.** _____

**10.** $4 < \frac{7-4x}{8} \leq 6$

**10.** _____

Solve each inequality and indicate the solution set.

**11.** $-9 \leq -9x - 18 < 9$

**11.** _____

**12.** $-12 < \frac{6x+6}{3} < 5$

**12.** _____



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# Additional Exercises 2.5 *(cont.)*

Name:_____

**13.** $-6 \le \dfrac{3(x+5)}{2} < 3$ **13.** _____

**14.** $-4 \le 4x$ and $x \le 3$ **14.** _____

**15.** $x > -12$ or $x > 7$ **15.** _____

**16.** $3x + 4 > 10$ and $2x - 2 < 18$ **16.** _____

**17.** $-5x + 15 > -15$ or $3x < 24$ **17.** _____

**18.** The width of a rectangle is 39 centimeters. Determine all possible values for the length of the rectangle if the perimeter is at least 784 centimeters. **18.** _____

**19.** The width of a rectangle is 38 centimeters. Determine all possible values for the length of the rectangle if the perimeter is at least 456 centimeters. **19.** _____

**20.** Karl's grades on his first five exams are 71, 65, 72, 80, and 77. What range of scores can Karl earn on his sixth exam so that his final grade is a C? All of the exams have a maximum score of 100. A final grade of C is given when the test average is greater than or equal to 70 and less than 80. **20.** _____

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# Additional Exercises 2.6

Determine the solution set for each equation or inequality.

**1.** $|2x-6|=4$ **1.** _____

**2.** $|3x+3|=6$ **2.** _____

**3.** $|x-7|<1$ **3.** _____

**4.** $\left|\frac{8x-3}{5}\right|\le\frac{2}{5}$ **4.** _____

**5.** $|4x+2|\le 6$ **5.** _____

**6.** $|3x-4|<5$ **6.** _____

**7.** $|x-2|>8$ **7.** _____

**8.** $|2x-9|+9>10$ **8.** _____

**9.** $|3x+5|>7$ **9.** _____

**10.** $|2-5x|>6$ **10.** _____

**11.** $|x+8|\le -7$ **11.** _____

**12.** $|x-8|\ge -4$ **12.** _____

**13.** $|12x-3|\ge -5$ **13.** _____

**14.** $|3x+7|+6<2$ **14.** _____

**15.** $\left|\frac{3}{7}x+6\right|+3=8$ **15.** _____

**16.** $|x-3|=9$ **16.** _____

**17.** $|x-2|=|x-4|$ **17.** _____

**18.** $|2x-11|=|x+5|$ **18.** _____

**19.** $\left|\frac{2}{5}x+4\right|=\left|\frac{1}{4}x+2\right|$ **19.** _____

**20.** $\left|\frac{3}{5}x+2\right|=\left|\frac{1}{3}x+3\right|$ **20.** _____



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# Chapter 2 Test Form A

**1.** State the degree of the term $32xy^7$. **1.** _____

**2.** Simplify: $7-7(9+x)+5x$ **2.** _____

Solve each equation.

**3.** $\frac{1}{4}(x-2)=\frac{1}{3}(2x+6)$ **3.** _____

**4.** $\frac{x}{5}-\frac{x}{7}=2$ **4.** _____

**5.** $\frac{3x}{2}-8=2+\frac{3x-4}{7}$ **5.** _____

**6.** Evaluate $w=\frac{x+y}{z}$ for $x=4$, $y=2\frac{4}{5}$, and $z=\frac{1}{2}$. **6.** _____

Solve for the variable indicated.

**7.** $U=mgh$, for $h$ **7.** _____

**8.** $Ax+By=C$, for $y$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

**9.** Angles $A$ and $B$ are complementary. Determine the measures of $A$ and $B$ if angle $A$ is four times larger than angle $B$. **9.** _____

**10.** Two joggers start at the same point at the same time and jog in opposite directions. Homer jogs at 4 mph while Frances jogs at $4\frac{1}{4}$ mph. How far apart will they be in $1\frac{1}{7}$ hours? (Round your answer to the nearest hundredth.) **10.** _____

**11.** How many liters of 20% salt solution must be added to 68 liters of 61% salt solution to get a 37% salt solution? **11.** _____

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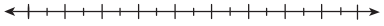
# Chapter 2 Test Form A *(cont.)*

Name:_____

Solve each inequality. Graph the solution on the real number line.

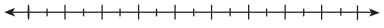
**12.** $\frac{5x-15}{5} \le 5$

**12.** _____



**13.** $3x+5>-10$ and $2x+6<12$

**13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** The width of a rectangle is 12 cm. Determine all possible values for the length of the rectangle if the perimeter is at least 416 cm.

**14.** _____

Solve the inequality. Write the solution in interval notation.

**15.** $1 \le \frac{6-2x}{9} \le 2$

**15.** _____

**16.** $x>4$ or $x \ge -4$

**16.** _____

**17.** $5x-3>10$ and $5-3x<-3$

**17.** _____

Determine the solution set to the equation or inequality.

**18.** $|x+4|=6$

**18.** _____

**19.** $\left|\frac{7x-2}{5}\right| \le \frac{4}{3}$

**19.** _____

**20.** $|3x+6|>9$

**20.** _____


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Name:_____

Date:_____

# Chapter 2 Test Form B

**1.** State the degree of the term $4xy^2z^3$. **1.** _____

**2.** Simplify: $3x-(x-2)$ **2.** _____

Solve each equation.

**3.** $x-2=\frac{3}{4}(x+4)$ **3.** _____

**4.** $3(x-3)=2(6-x)+2$ **4.** _____

**5.** $\frac{6x+5}{6}=x-4$ **5.** _____

**6.** Evaluate $\frac{ab}{a+b}$ for $a = 9$ and $b = 15$. **6.** _____

Solve for the variable indicated.

**7.** $S=\frac{n}{2}(f+l)$ for $l$ **7.** _____

**8.** $A=P+\text{Pr}t$ for $P$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

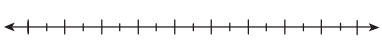
**9.** The cost of renting a truck is \$35 a day plus 20¢ per mile. How far can Tonya drive in one day if she only has \$80? **9.** _____

**10.** Train A leaves a station traveling at 20 mph. Four hours later, train B leaves the same station traveling in the same direction at 30 mph. How long does it take for train B to catch up to train A? **10.** _____

**11.** How many liters of 17% salt solution must be added to 90 liters of 52% salt solution to get a 35% salt solution? **11.** _____

Solve each inequality. Graph the solution on the real number line.

**12.** $-5x+20>-20$ **12.** _____



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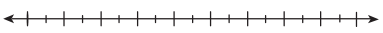


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# Chapter 2 Test Form B *(cont.)*

Name:_____

**13.** $x+3\le 6$ and $-2x<8$ **13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** An elevator can carry a maximum load of 1200 pounds. How many 70-pound boxes can Harold take on the elevator if he weighs 150 pounds? **14.** _____

Solve each inequality. Write the solution in interval notation.

**15.** $-2\le \dfrac{7-x}{7}\le 3$ **15.** _____

**16.** $4-x<-2$ or $3x-1<-1$ **16.** _____

**17.** $-2\le 2x$ and $x\le 2$ **17.** _____

Determine the solution set to the equality or inequality.

**18.** $|x+4|+5=14$ **18.** _____

**19.** $|2x-1|\le 3$ **19.** _____

**20.** $|2x-1|+4>9$ **20.** _____


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Name:_____

Date:_____

# Chapter 2 Test Form C

**1.** State the degree of the term $5y$. **1.** _____

**2.** Simplify: $7-(-3+x)+9x$ **2.** _____

Solve each equation.

**3.** $4x-2(3x-7)=2x-6$ **3.** _____

**4.** $-2+15x+10=5(3x+2)$ **4.** _____

**5.** $\frac{x-2}{6}=\frac{x}{7}$ **5.** _____

**6.** Evaluate $z=\frac{5}{6}x+2y-2$ for $x=1$ and $y=\frac{9}{4}$. **6.** _____

Solve for the variable indicated.

**7.** $f=\frac{d-5e}{6}$ for $e$ **7.** _____

**8.** $y=ab+ah+bh$ for $b$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

**9.** The sale price of a suit that was reduced by 25% is $187.50. Determine the regular price of the suit. **9.** _____

**10.** A bus traveling at 60 mph departs for a certain town. One hour later, a car traveling at 70 mph departs for the same town and arrives at the same time as the bus. How far is the town from where they started? **10.** _____

**11.** How many pounds of coffee beans selling for $1.60 per pound should be mixed with 4 pounds of decaffeinated coffee beans selling for $2.20 a pound to obtain a mixture selling for $1.84 per pound? **11.** _____

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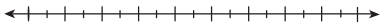
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# Chapter 2 Test Form C *(cont.)*

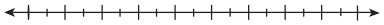
Name:_____

Solve each inequality. Graph the solution on the real number line.

**12.** $-3x-12>-6$ **12.** _____



**13.** $x+2\le 4$ and $-4x<12$ **13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** Tracy's first three exam scores are 85, 70, and 95. If an average of 80 or greater and less than 90 is needed for a B average, what score does Tracy need to have a B average? Assume a maximum score of 100. **14.** _____

Solve each inequality. Write the solution in interval notation.

**15.** $6\le -3(2x-4)<12$ **15.** _____

**16.** $x<-7$ or $x\le 6$ **16.** _____

**17.** $x\ge -1$ and $2x+1>5$ **17.** _____

Determine the solution set to each equality or inequality.

**18.** $|x-3|=7$ **18.** _____

**19.** $|x+1|\le -5$ **19.** _____

**20.** $|7-3x|>5$ **20.** _____


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Name:_____

Date:_____

# Chapter 2 Test Form D

**1.** State the degree of the term $-4x^2yz^3$. **1.** _____

**2.** Simplify: $6(3x+2)-x$ **2.** _____

Solve each equation.

**3.** $4x+3=27$ **3.** _____

**4.** $2(x-6)=5-(-2x+17)$ **4.** _____

**5.** $\frac{x}{5}-\frac{x}{6}=1$ **5.** _____

**6.** Evaluate $w=x+yz$ for $x=2$, $y=4$, and $z=\frac{3}{4}$. **6.** _____

Solve for the variable indicated.

**7.** $2x+3y=6$ for $y$ **7.** _____

**8.** $\frac{1}{5}xy-10y=5$ for $y$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

**9.** Mario can check 11 parts per minute on an assembly line. How many parts will he be able to check in 5 hours? **9.** _____

**10.** A plane leaves an airport traveling at 50 mph. One hour later, another plane leaves the same airport traveling in the same direction at 60 mph. How long does it take for the second plane to catch up to the first plane? **10.** _____

**11.** A chemist has one solution of acid and water that is 25% acid. A second solution is 50% acid. How many gallons of the 50% solution should be mixed with 4 gallons of the 25% solution to get a solution that is 40% acid? **11.** _____

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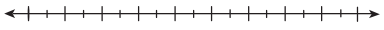
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# Chapter 2 Test Form D *(cont.)*

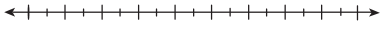
Name:_____

Solve each inequality. Graph the solution on the real number line.

**12.** $\frac{4x+4}{6} \geq -4$ **12.** _____



**13.** $x+1 \leq 4$ and $-3x < 12$ **13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** Angie can rent a car for \$40 per day plus \$0.10 per mile. If she needs the car for 5 days, how many miles can she drive without spending more than \$300 on the rental car? **14.** _____

Solve each inequality. Write the solution in interval notation.

**15.** $-3 < -3x - 9 \leq 3$ **15.** _____

**16.** $x > 3$ or $x \geq -2$ **16.** _____

**17.** $-x - 1 \leq 3$ and $2x < 6$ **17.** _____

Determine the solution set to the equality or inequality.

**18.** $|x - 5| = 2$ **18.** _____

**19.** $|2x + 3| \leq 5$ **19.** _____

**20.** $|14x - 6| \geq -2$ **20.** _____


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# Chapter 2 Test Form E

**1.** State the degree of the term $2xy^2$. **1.** _____

**2.** Simplify: $-9y+(-4)+(-6x)+(-2y)-5x$ **2.** _____

Solve each equation.

**3.** $3+2x=x+2-(4-x)$ **3.** _____

**4.** $3(7-2x)=14-8(x-1)$ **4.** _____

**5.** $\frac{x+8}{2}=\frac{6}{5}$ **5.** _____

**6.** Evaluate $\frac{nm}{n+m}$ for $n = 10$ and $m = 12$. **6.** _____

Solve for the variable indicated.

**7.** $g=\frac{e-7f}{8}$ for $f$ **7.** _____

**8.** $y=ab+ah+bh$ for $h$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

**9.** Determine the dimensions of a rectangle if the length is 35 feet more than the width and the perimeter is 250 feet. **9.** _____

**10.** Two bike riders start at the same point at the same time and bike in opposite directions. Jeri bikes at 7 mph and Fran bikes at $4\frac{1}{4}$ mph. How far apart will they be in $1\frac{1}{5}$ hours? **10.** _____

**11.** How many quarts of a 4% acid solution must be added to 10 quarts of 1% acid solution to get a 2% acid solution? **11.** _____

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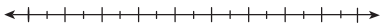
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# Chapter 2 Test Form E *(cont.)*

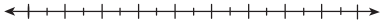
Name:_____

Solve each inequality. Graph the solution on the real number line.

**12.** $\frac{2x-8}{6} < -2$ **12.** _____



**13.** $2x + 2 > -6$ and $3x + 2 \le 11$ **13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** Carol receives a base wage of $200 per week plus 5% commission on all sales. What amount of sales does she need in order to have a weekly salary of at least $400? **14.** _____

Solve each inequality. Write the solution in interval notation.

**15.** $-1 \le \frac{3-x}{4} \le 5$ **15.** _____

**16.** $x < -5$ or $x \le 2$ **16.** _____

**17.** $4x < 16$ and $-3x \le 12$ **17.** _____

Determine the solution set to the equality or inequality.

**18.** $|2x-4| = 2$ **18.** _____

**19.** $|2x+3| \le 7$ **19.** _____

**20.** $|3x-4|+10 \ge 6$ **20.** _____


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Date:_____

# Chapter 2 Test Form F

**1.** State the degree of the term $5xyz^2$. **1.** _____

**2.** Simplify: $9y+(-6)+(-7x)+y-5x$ **2.** _____

Solve each equation.

**3.** $10x+1=11$ **3.** _____

**4.** $4-\frac{x}{2}=\frac{2(x+1)}{5}$ **4.** _____

**5.** $\frac{x-4}{2}=\frac{x}{3}$ **5.** _____

**6.** Evaluate $c=\frac{7}{8}ab^2$ for $a=\frac{4}{3}$ and $b=\frac{3}{7}$. **6.** _____

Solve for the variable indicated.

**7.** $y=\frac{7}{8}(x-10)$ for $x$ **7.** _____

**8.** $4b=6a+7ab$ for $a$ **8.** _____

Write an equation that can be used to solve the problem. Solve the problem and check your answer.

**9.** When the price of a jacket is decreased by 25%, it costs $72. Determine the original price of the jacket. **9.** _____

**10.** A train traveling at a speed of 40 mph leaves for a certain town. One hour later, a bus traveling at a speed of 50 mph leaves for the same town and arrives at the same time as the train. If the distance is the same by track or road, how far is the town from where they started? **10.** _____

**11.** How many pounds of nuts selling for $3 per pound should be mixed with 3 pounds of nuts selling for $1.20 a pound to obtain a mixture selling for $2.46 per pound? **11.** _____

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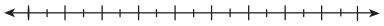
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# Chapter 2 Test Form F *(cont.)*

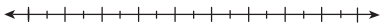
Name:_____

Solve each inequality. Graph the solution on the real number line.

**12.** $2x - 10 < 40$ **12.** _____



**13.** $-4 \le 2x$ and $x \le 3$ **13.** _____



Write an inequality that can be used to solve the problem. Solve the inequality and answer the question.

**14.** The width of a rectangle is 38 cm. Determine all possible values for the length of the rectangle if the perimeter is at least 300 cm. **14.**. _____

Solve each inequality. Write the solution in interval notation.

**15.** $1 \le \frac{9-x}{8} \le 8$ **15.** _____

**16.** $x < 3$ or $x \le -2$ **16.** _____

**17.** $5x - 3 < 7$ and $x \le 5$ **17.** _____

Determine the solution set to the equality or inequality.

**18.** $|6x - 5| = 2$ **18.** _____

**19.** $|x - 3| \le -2$ **19.** _____

**20.** $|5x + 1| \ge 9$ **20.** _____


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# Chapter 2 Test Form G

**1.** State the degree of the term $3xy$.

**(a)** first **(b)** second **(c)** third **(d)** fourth

**2.** Simplify: $4x-3(x+3)$

**(a)** $x+3$ **(b)** $x+9$ **(c)** $x-9$ **(d)** $-x-9$

Solve each equation.

**3.** $-3x-11=14$

**(a)** $-\frac{25}{3}$ **(b)** $\frac{25}{3}$ **(c)** $-1$ **(d)** 1

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

**(a)** $-8$ **(b)** 0 **(c)** $\mathbb{R}$ **(d)** $\varnothing$

**5.** $7-\frac{x}{3}=\frac{5(x+1)}{7}$

**(a)** 3 **(b)** 6 **(c)** 7 **(d)** 12

**6.** Evaluate $c=\frac{4}{5}ab^2$ for $a=\frac{16}{5}$ and $b=\frac{5}{4}$.

**(a)** $5\frac{19}{25}$ **(b)** 4 **(c)** $3\frac{1}{5}$ **(d)** $12\frac{4}{5}$

Solve for the variable indicated.

**7.** $4x+3y=1$ for $y$

**(a)** $y=-\frac{4}{3}x-\frac{1}{3}$ **(b)** $y=\frac{4}{3}x+\frac{1}{3}$ **(c)** $y=-\frac{4}{3}x+\frac{1}{3}$ **(d)** $y=\frac{4}{3}x+1$

**8.** $2b=4a+5ab$ for $a$

**(a)** $a=\frac{4b}{2-5b}$ **(b)** $a=\frac{4b}{2+5b}$ **(c)** $a=\frac{2b}{4-5b}$ **(d)** $a=\frac{2b}{4+5b}$

Solve each problem.

**9.** Determine the total cost of a \$900 sofa if the sales tax rate is 7.5%.

**(a)** \$1575 **(b)** \$907.50 **(c)** \$932.50 **(d)** \$967.50

**10.** Two friends leave school at the same time, traveling in opposite directions. Sarah travels at 65 mph and Julie travels at 55 mph. Three hours later, they arrive at home at the same time. How far apart do they live?

**(a)** 120 miles **(b)** 360 miles **(c)** 400 miles **(d)** 480 miles

**11.** George invested \$8000 for one year, part at 12% simple interest and part at 13% simple interest. If he earned a total of \$980 in interest, how much was invested at 13%?

**(a)** \$500 **(b)** \$6000 **(c)** \$2000 **(d)** \$1500

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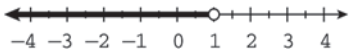
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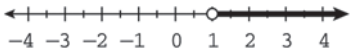
# Chapter 2 Test Form G *(cont.)*

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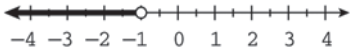
Solve each inequality. Identify the graph of the solution.

**12.** $\frac{4x+20}{3} > 8$

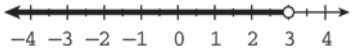
**(a)** 

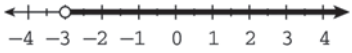

**(b)** 

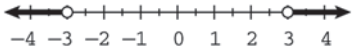

**(c)** 

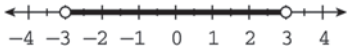

**(d)** 


**13.** $-5x-5>10$ or $2x<6$

**(a)** 


**(b)** 


**(c)** 


**(d)** 


Solve.

**14.** Fran has 300 feet of fence. She wants to build a rectangular pen with a length of at least 60 feet. What are all possible values for the width of the pen?

**(a)** $w \geq 180$ ft **(b)** $w \leq 180$ ft **(c)** $w \geq 90$ ft **(d)** $w \leq 90$ ft

**15.** $3 \leq \frac{7-2x}{9} \leq 7$

**(a)** [–10, 28] **(b)** [–28, 10] **(c)** [–28, –10] **(d)** [10,28]

**16.** $x<-1$ or $x \leq 2$

**(a)** $(-\infty, 2]$ **(b)** $(-1, 2]$ **(c)** $(-1, \infty)$ **(d)** $[2, \infty)$

**17.** $x<0$ and $x-2 \geq -5$

**(a)** $(-\infty, 0)$ **(b)** $(-\infty, -7)$ **(c)** $[-3, \infty)$ **(d)** $[-3, 0)$

**18.** $|x-7|=|x-3|$

**(a)** {–4} **(b)** {5} **(c)** {–4, 5} **(d)** {–5}

**19.** $|x-8|<5$

**(a)** $\{x|3<x<13\}$ **(b)** $\{x|-3<x<13\}$ **(c)** $\{x|x<13\}$ **(d)** $\varnothing$

**20.** $|8x-4| \geq -3$

**(a)** $\left\{x\middle|x \leq -\frac{1}{8}\right\}$ **(b)** $\left\{x\middle|x \geq \frac{1}{8}\right\}$ **(c)** $\varnothing$ **(d)** all real numbers


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Name:_____

Date:_____

# Chapter 2 Test Form H

**1.** State the degree of the term $5xyz^4$.

**(a)** second **(b)** fourth **(c)** fifth **(d)** sixth

**2.** Simplify: $5x+3(x+1)$

**(a)** $8x+3$ **(b)** $8x+1$ **(c)** $8x-3$ **(d)** $-8x+3$

Solve each equation.

**3.** $8x+2(x-4)=8x+10$

**(a)** 7 **(b)** 9 **(c)** 3 **(d)** $\varnothing$

**4.** $\frac{x}{6}-\frac{x}{7}=1$

**(a)** –42 **(b)** 1 **(c)** $3\frac{3}{13}$ **(d)** 42

**5.** $\frac{x+7}{5}=\frac{6}{11}$

**(a)** –47 **(b)** $-\frac{47}{11}$ **(c)** $-\frac{11}{47}$ **(d)** $\frac{107}{11}$

**6.** Evaluate $\frac{cd}{c+d}$ for $c=6$ and $d=12$.

**(a)** 4 **(b)** $\frac{1}{4}$ **(c)** $\frac{2}{5}$ **(d)** 40

Solve for the variable indicated.

**7.** $V=\pi r^2 h$ for $h$

**(a)** $h=\pi r^2-V$ **(b)** $h=\frac{\pi r^2}{V}$ **(c)** $h-V-\pi r^2$ **(d)** $h=\frac{V}{\pi r^2}$

**8.** $2b=3a+ab$ for $a$

**(a)** $a=\frac{3}{2+b}$ **(b)** $a=\frac{3+b}{2b}$ **(c)** $a=\frac{2b}{3+b}$ **(d)** $a=\frac{2+b}{3}$

Solve each problem.

**9.** Determine the sale price of a $250 dress during a 30% off sale.

**(a)** $75 **(b)** $175 **(c)** $220 **(d)** $238

**10.** Jet B takes off $\frac{1}{2}$ hour after Jet A takes off. If Jet B travels 100 mph faster than Jet A and overtakes Jet A exactly 4 hours later, determine the speed of Jet A.

**(a)** 500 mph **(b)** 600 mph **(c)** 800 mph **(d)** 900 mph

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# Chapter 2 Test Form H *(cont.)*

Name:_____

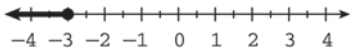
**11.** Soybean meal is 16% protein and corn meal is 10% protein. How many pounds of cornmeal should be mixed with 200 pounds of soybean meal to obtain a mixture that is 12% protein?

**(a)** 400 lb **(b)** 300 lb **(c)** 200 lb **(d)** 100 lb

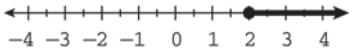
Solve each inequality. Identify the graph of the solution.

**12.** $-3x+15 \le 9$

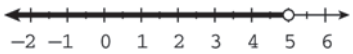
**(a)** 


**(b)** 

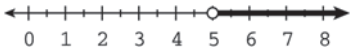

**(c)** 

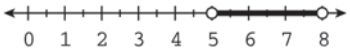

**(d)** 


**13.** $-3x+6>-9$ or $-3x<-24$

**(a)** 


**(b)** 


**(c)** 


**(d)** 


Solve.

**14.** Morgan's scores on four exams were 80, 95, 100, and 85. What range can the score for the fifth exam fall into for Morgan to have an average of 90 or above? Assume a maximum score of 100.

**(a)** $x \ge 95$ **(b)** $x \ge 85$ **(c)** $x \ge 80$ **(d)** $x \ge 90$

**15.** $0 \le \dfrac{4-2x}{3} \le 8$

**(a)** $[-10, -2]$ **(b)** $[-10, 2]$ **(c)** $[-2, 10]$ **(d)** $[2, 10]$

**16.** $x \ge -1$ or $x > 5$

**(a)** $(-\infty, -1)$ **(b)** $(5, \infty)$ **(c)** $[-1, 5)$ **(d)** $[-1, \infty)$

**17.** $x < 2$ and $2x-3 \ge -7$

**(a)** $[-2, 2)$ **(b)** $[-2, \infty)$ **(c)** $(-\infty, -2)$ **(d)** $(-\infty, 2]$

**18.** $|2x-8| = |x-6|$

**(a)** $\{-2\}$ **(b)** $\{2\}$ **(c)** $\{2, \frac{14}{3}\}$ **(d)** $\{-6, -8\}$

**19.** $|x+3|+8 \le 5$

**(a)** $\{x \mid -16 \le x \le 13\}$ **(b)** $\{x \mid x \le 10\}$ **(c)** $\varnothing$ **(d)** all real numbers

**20.** $|x+5| < 7$

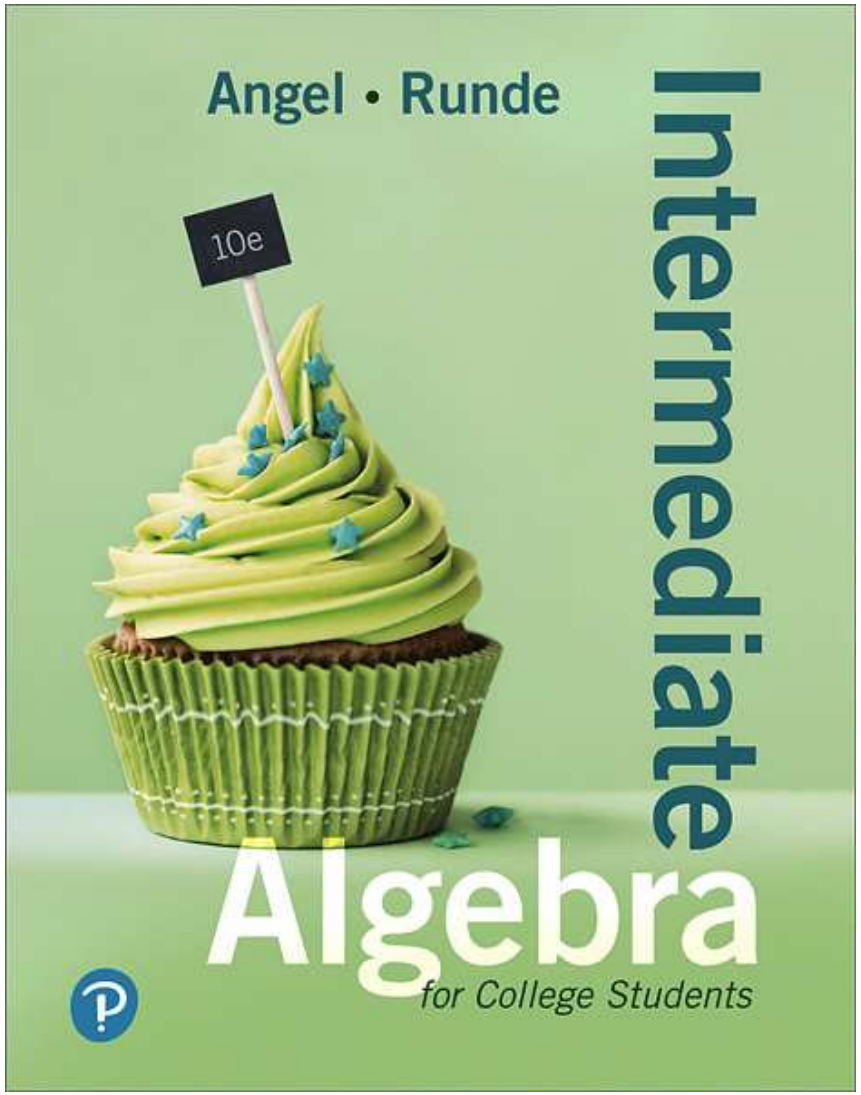
**(a)** $\{x \mid -2 < x < 12\}$ **(b)** $\{x \mid -12 < x < 2\}$ **(c)** $\{x \mid -12 < x < -2\}$ **(d)** $\varnothing$


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# Chapter 1

# Basic Concepts





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# 1.2

# Sets and Other Basic Concepts


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# Variable

When a letter is used to represent various numbers it is called a **variable**.

If a letter represents one particular value it is called a **constant**.

The term **algebraic expression**, or simply **expression**, will be used. An expression is any combination of numbers, variables, exponents, mathematical symbols (other than equals signs), and mathematical operations.


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# Identify Sets

A **set** is a collection of objects. The objects in a set are called **elements** of the set. Sets are indicated by means of braces, { }, and are named with capital letters.

**Roster form**

| Set | Number of Elements |
|---|---|
| $A = \{a, b, c\}$ | 3 |
| $B = \{\text{yellow, green, blue, red}\}$ | 4 |
| $C = \{1, 2, 3, 4, 5\}$ | 5 |


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# Identify and Use Inequalities

**Inequality Symbols**

$>$ is read “is greater than.”

$\geq$ is read “is greater than or equal to.”

$<$ is read “is less than.”

$\leq$ is read “is less than or equal to.”

$\neq$ is read “is not equal to.”


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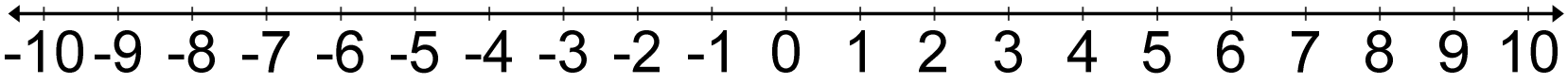
# Example 1

Insert either > or < in the ____ between the numbers to make each statement true.

a. 2 ___<___ 8

b. 1 ___>___ –7

c. –4 ___>___ –9





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# Use Set Builder Notation

A second method of describing a set is called **set builder notation**. An example is

$$E = \{x | x \text{ is a natural number greater than } 7\}$$

This is read "Set $E$ is the set of all elements $x$, such that $x$ is a natural number greater than 7."

In roster form, this set is written

$$E = \{8, 9, 10, 11, 12, \ldots\}$$


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# Set Builder Notation

The general form of set builder notation is

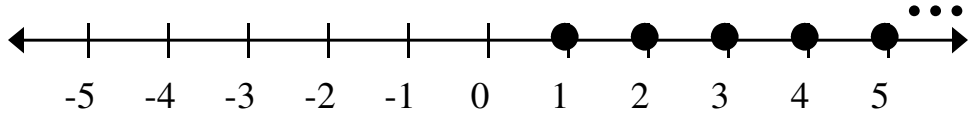
$$\{ \quad x \quad | \quad x \text{ has property } p \quad \}$$

The set of — all elements $x$ — such that — $x$ has the given property

$E = \{x | x \text{ is a natural number greater than } 1\}$

In roster form: $E = \{1, 2, 3, 4, \ldots\}$

On a number line:





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# Use Set Builder Notation

Two condensed ways of writing set
$E = \{x | x \text{ is a natural number greater than } 7\}$
in set builder notation are as follows:

$$E = \{x \mid x > 7 \text{ and } x \in \square\}$$

or

$$E = \{x \mid x \geq 8 \text{ and } x \in \square\}$$


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# Find the Union and Intersection of Sets

The **union** of set $A$ and set $B$, written $A \cup B$, is the set of elements that belong to either set $A$ *or* set $B$.

Example

$A = \{1, 2, 3, 4, 5\}, \quad B = \{3, 4, 5, 6, 7\},$

$A \cup B = \{1, 2, 3, 4, 5, 6, 7\}$


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# Find the Union and Intersection of Sets

The **intersection** of set $A$ and set $B$, written $A \cap B$, is the set of all elements that are common to both set $A$ *and* set $B$.

Example

$A = \{1, 2, 3, 4, 5\}, \quad B = \{3, 4, 5, 6, 7\},$

$A \cap B = \{3, 4, 5\}$


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# Identify Important Sets of Numbers

**Real Numbers**: The set of all numbers that can be represented on a number line.

**Natural Numbers**: {1, 2, 3, 4, 5…}

**Whole Numbers**: {0, 1, 2, 3, 4, 5,…}

**Integers**: {…,−3, −2, −1, 0, 1, 2, 3,…}

**Rational Numbers**: The set of all numbers that can be expressed as a quotient (ratio) of two integers (the denominator cannot be 0).


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# Example 2 (1 of 3)

Consider the following set:

$$\left\{-8,\ 0,\ \frac{5}{9},\ 12.25,\ \sqrt{7},\ -\sqrt{11},\ \frac{22}{7},\ 5,\ 7.1,\ -54,\ \pi\right\}$$

List the elements of the set that are

a. natural numbers

5

b. whole numbers

0, 5


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# Example 2 (2 of 3)

Consider the following set:

$$\left\{-8,\ 0,\ \frac{5}{9},\ 12.25,\ \sqrt{7},\ -\sqrt{11},\ \frac{22}{7},\ 5,\ 7.1,\ -54,\ \pi\right\}$$

List the elements of the set that are

c. integers

$-8,\ 0,\ 5,\ -54$

d. rational numbers

$$-8,\ 0,\ \frac{5}{9},\ 12.25,\ \frac{22}{7},\ 5,\ 7.1,-54$$


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# Example 2 (3 of 3)

Consider the following set:

$$\left\{-8,\ 0,\ \frac{5}{9},\ 12.25,\ \sqrt{7},\ -\sqrt{11},\ \frac{22}{7},\ 5,\ 7.1,\ -54,\ \pi\right\}$$

List the elements of the set that are

e. irrational numbers

$$\sqrt{7}, -\sqrt{11},\ \pi$$

f. real numbers

$$-8,\ 0,\ \frac{5}{9},\ 12.25,\ \sqrt{7},\ -\sqrt{11},\ \frac{22}{7},\ 5,\ 7.1, -54,\ \pi$$


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