CHAPTER 1

Section 1.1 Solutions --

1.
$$5x = 35$$
$$\frac{1}{5} \cdot 5x = \frac{1}{5} \cdot 35$$
$$\boxed{x = 7}$$

2.
$$4t = 32$$
$$\frac{1}{4} \cdot 4t = \frac{1}{4} \cdot 32$$
$$\boxed{t = 8}$$

3.
$$-3 + n = 12$$
$$3 + -3 + n = 3 + 12$$
$$\boxed{n = 15}$$

4.
$$4 = -5 + y$$
$$5 + 4 = 5 + -5 + y$$
$$\boxed{9 = y}$$

5.
$$24 = -3x$$
$$-\frac{1}{3} \cdot 24 = -\frac{1}{3} \cdot (-3x)$$
$$\boxed{-8 = x}$$

6.
$$-50 = -5t$$
$$-\frac{1}{5} \cdot (-50) = -\frac{1}{5} \cdot (-5t)$$
$$\boxed{10 = t}$$

7.
$$\frac{1}{5}n = 3$$
$$5 \cdot \frac{1}{5}n = 5 \cdot 3$$
$$\boxed{n = 15}$$

8.
$$6 = \frac{1}{3}p$$
$$3 \cdot 6 = 3 \cdot \left(\frac{1}{3}p\right)$$
$$\boxed{18 = p}$$

9.
$$3x - 5 = 7$$
$$3x = 12$$
$$\boxed{x = 4}$$

10.
$$4p + 5 = 9$$
$$4p = 4$$
$$\boxed{p = 1}$$

11.
$$9m - 7 = 11$$
$$9m = 18$$
$$\boxed{m = 2}$$

12.
$$2x + 4 = 5$$
$$2x = 1$$
$$\boxed{x = 1/2}$$

13.
$$5t + 11 = 18$$
$$5t = 7$$
$$\boxed{t = 7/5}$$

14.
$$7x + 4 = 21 + 24x$$
$$7x = 17 + 24x$$
$$-17x = 17$$
$$\boxed{x = -1}$$

15.
$$3x - 5 = 25 + 6x$$
$$3x = 30 + 6x$$
$$-3x = 30$$
$$\boxed{x = -10}$$

16.
$$5x + 10 = 25 + 2x$$
$$5x = 15 + 2x$$
$$3x = 15$$
$$\boxed{x = 5}$$

17. $20n - 30 = 20 - 5n$ $20n = 50 - 5n$ $25n = 50$ $\boxed{n = 2}$	**18.** $14c + 15 = 43 + 7c$ $14c = 28 + 7c$ $7c = 28$ $\boxed{c = 4}$	**19.** $4(x - 3) = 2(x + 6)$ $4x - 12 = 2x + 12$ $2x = 24$ $\boxed{x = 12}$
20. $5(2y - 1) = 2(4y - 3)$ $10y - 5 = 8y - 6$ $2y = -1$ $\boxed{y = -\tfrac{1}{2}}$		**21.** $-3(4t - 5) = 5(6 - 2t)$ $-12t + 15 = 30 - 10t$ $-15 = 2t$ $\boxed{-\tfrac{15}{2} = t}$
22. $2(3n + 4) = -(n + 2)$ $6n + 8 = -n - 2$ $7n = -10$ $\boxed{n = -\tfrac{10}{7}}$		**23.** $2(x - 1) + 3 = x - 3(x + 1)$ $2x - 2 + 3 = x - 3x - 3$ $2x + 1 = -2x - 3$ $4x = -4$ $\boxed{x = -1}$
24. $4(y + 6) - 8 = 2y - 4(y + 2)$ $4y + 24 - 8 = 2y - 4y - 8$ $4y + 16 = -2y - 8$ $6y = -24$ $\boxed{y = -4}$		**25.** $5p + 6(p + 7) = 3(p + 2)$ $5p + 6p + 42 = 3p + 6$ $11p + 42 = 3p + 6$ $8p = -36$ $\boxed{p = -\dfrac{36}{8} = -\dfrac{9}{2}}$
26. $3(z + 5) - 5 = 4z + 7(z - 2)$ $3z + 15 - 5 = 4z + 7z - 14$ $3z + 10 = 11z - 14$ $-8z = -24$ $\boxed{z = 3}$		**27.** $7x - (2x + 3) = x - 2$ $7x - 2x - 3 = x - 2$ $5x - 3 = x - 2$ $4x = 1$ $\boxed{x = \tfrac{1}{4}}$
28. $3x - (4x + 2) = x - 5$ $3x - 4x - 2 = x - 5$ $-x - 2 = x - 5$ $3 = 2x$ $\boxed{\tfrac{3}{2} = x}$		**29.** $2 - (4x + 1) = 3 - (2x - 1)$ $2 - 4x - 1 = 3 - 2x + 1$ $1 - 4x = 4 - 2x$ $-3 = 2x$ $\boxed{-\tfrac{3}{2} = x}$

30. $5-(2x-3)=7-(3x+5)$ $5-2x+3=7-3x-5$ $8-2x=2-3x$ $\boxed{x=-6}$	**31.** $2a-9(a+6)=6(a+3)-4a$ $-7a-54=6a+18-4a$ $-7a-54=2a+18$ $-9a=72$ $\boxed{a=-8}$

32.
$$25-\left[2+5y-3(y+2)\right]=-3(2y-5)-\left[5(y-1)-3y+3\right]$$
$$25-\left[2+5y-3y-6\right]=-6y+15-\left[5y-5-3y+3\right]$$
$$25-2-5y+3y+6=-6y+15-5y+5+3y-3$$
$$29-2y=-8y+17$$
$$6y=-12$$
$$\boxed{y=-2}$$

33.
$$32-\left[4+6x-5(x+4)\right]=4(3x+4)-\left[6(3x-4)+7-4x\right]$$
$$32-\left[4+6x-5x-20\right]=12x+16-\left[18x-24+7-4x\right]$$
$$32-4-6x+5x+20=12x+16-18x+24-7+4x$$
$$48-x=-2x+33$$
$$\boxed{x=-15}$$

34.
$$12-\left[3+4m-6(3m-2)\right]=-7(2m-8)-3\left[(m-2)+3m-5\right]$$
$$12-\left[3+4m-18m+12\right]=-14m+56-3\left[m-2+3m-5\right]$$
$$12-3-4m+18m-12=-14m+56-3m+6-9m+15$$
$$-3+14m=-26m+77$$
$$40m=80$$
$$\boxed{m=2}$$

35.
$$20-4\left[c-3-6(2c+3)\right]=5(3c-2)-\left[2(7c-8)-4c+7\right]$$
$$20-4\left[c-3-12c-18\right]=15c-10-\left[14c-16-4c+7\right]$$
$$20-4c+12+48c+72=15c-10-14c+16+4c-7$$
$$44c+104=5c-1$$
$$39c=-105$$
$$\boxed{c=\frac{-105}{39}=\frac{-35}{13}}$$

36.	$46 - \left[7 - 8y + 9(6y - 2)\right] = -7(4y - 7) - 2\left[6(2y - 3) - 4 + 6y\right]$ $46 - \left[7 - 8y + 54y - 18\right] = -28y + 49 - 2\left[12y - 18 - 4 + 6y\right]$ $46 - 7 + 8y - 54y + 18 = -28y + 49 - 24y + 36 + 8 - 12y$ $-46y + 57 = -64y + 93$ $18y = 36$ $\boxed{y = 2}$		

37.	$60\left(\dfrac{1}{5}m\right) = 60\left(\dfrac{1}{60}m + 1\right)$ $12m = m + 60$ $11m = 60$ $\boxed{m = \dfrac{60}{11}}$	**38.**	$24\left(\dfrac{1}{12}z\right) = 24\left(\dfrac{1}{24}z + 3\right)$ $2z = z + 72$ $\boxed{z = 72}$
39.	$63\left(\dfrac{x}{7}\right) = 63\left(\dfrac{2x}{63} + 4\right)$ $9x = 2x + 252$ $7x = 252$ $\boxed{x = 36}$	**40.**	$22\left(\dfrac{a}{11}\right) = 22\left(\dfrac{a}{22} + 9\right)$ $2a = a + 198$ $\boxed{a = 198}$
41.	$24\left(\dfrac{1}{3}p\right) = 24\left(3 - \dfrac{1}{24}p\right)$ $8p = 72 - p$ $9p = 72$ $\boxed{p = 8}$	**42.**	$10\left(\dfrac{3x}{5} - x\right) = 10\left(\dfrac{x}{10} - \dfrac{5}{2}\right)$ $6x - 10x = x - 25$ $-5x = -25$ $\boxed{x = 5}$
43.	$84\left(\dfrac{5y}{3} - 2y\right) = 84\left(\dfrac{2y}{84} + \dfrac{5}{7}\right)$ $140y - 168y = 2y + 60$ $-30y = 60$ $\boxed{y = \dfrac{60}{-30} = -2}$	**44.**	$72\left(2m - \dfrac{5m}{8}\right) = 72\left(\dfrac{3m}{72} + \dfrac{4}{3}\right)$ $144m - 45m = 3m + 96$ $96m = 96$ $\boxed{m = 1}$

45. $$8\left(p+\frac{p}{4}\right)=8\left(\frac{5}{2}\right)$$ $$8p+2p=20$$ $$10p=20$$ $$\boxed{p=2}$$	**46.** $$4\left(\frac{c}{4}-2c\right)=4\left(\frac{5}{4}-\frac{c}{2}\right)$$ $$c-8c=5-2c$$ $$-5c=5$$ $$\boxed{c=-1}$$
47. $$\frac{x-3}{3}-\frac{x-4}{2}=1-\frac{x-6}{6}$$ $$6\cdot\left[\frac{x-3}{3}-\frac{x-4}{2}\right]=6\cdot\left[1-\frac{x-6}{6}\right]$$ $$2(x-3)-3(x-4)=6-(x-6)$$ $$2x-6-3x+12=6-x+6$$ $$-x+6=-x+12$$ $$6=12,\text{ which is false.}$$ Hence, $\boxed{\text{no solution}}$.	**48.** $$1-\frac{x-5}{3}=\frac{x+2}{5}-\frac{6x-1}{15}$$ $$15\cdot\left[1-\frac{x-5}{3}\right]=15\cdot\left[\frac{x+2}{5}-\frac{6x-1}{15}\right]$$ $$15-5(x-5)=3(x+2)-(6x-1)$$ $$15-5x+25=3x+6-6x+1$$ $$40-5x=-3x+7$$ $$33=2x$$ $$\boxed{^{33}\!/_2=x}$$
49. $$2y\left(\frac{4}{y}-5\right)=2y\left(\frac{5}{2y}\right)\qquad\boxed{y\neq0}$$ $$8-10y=5$$ $$-10y=-3$$ $$\boxed{y=\frac{3}{10}}$$	**50.** $$3x\left(\frac{4}{x}+10\right)=3x\left(\frac{2}{3x}\right)\qquad\boxed{x\neq0}$$ $$12+30x=2$$ $$30x=-10$$ $$\boxed{x=-\tfrac{1}{3}}$$
51. $$6x\left(7-\frac{1}{6x}\right)=6x\left(\frac{10}{3x}\right)\qquad\boxed{x\neq0}$$ $$42x-1=20$$ $$42x=21$$ $$\boxed{x=\frac{1}{2}}$$	**52.** $$6t\left(\frac{7}{6t}\right)=6t\left(2+\frac{5}{3t}\right)\qquad\boxed{t\neq0}$$ $$7=12t+10$$ $$-12t=3$$ $$\boxed{t=\frac{3}{-12}=\frac{-1}{4}}$$
53. $$3a\left(\frac{2}{a}-4\right)=3a\left(\frac{4}{3a}\right)\qquad\boxed{a\neq0}$$ $$6-12a=4$$ $$-12a=-2$$ $$\boxed{a=\frac{1}{6}}$$	**54.** $$x\left(\frac{4}{x}-2\right)=x\left(\frac{5}{2x}\right)\qquad\boxed{x\neq0}$$ $$4-2x=\tfrac{5}{2}$$ $$2x=4-\tfrac{5}{2}=\tfrac{3}{2}$$ $$\boxed{x=\tfrac{3}{4}}$$

55. $(x-2)\left(\dfrac{x}{x-2}+5\right)=(x-2)\left(\dfrac{2}{x-2}\right)$ $\boxed{x\neq 2}$ $$x+5(x-2)=2$$ $$x+5x-10=2$$ $$6x=12$$ $$x=2$$ $\boxed{\text{No solution}}$ since 2 was excluded from the solution set.	**56.** $(n-5)\left(\dfrac{n}{n-5}+2\right)=(n-5)\left(\dfrac{n}{n-5}\right)$ $\boxed{n\neq 5}$ $$n+2(n-5)=n$$ $$3n-10=n$$ $$2n=10$$ $$n=5$$ $\boxed{\text{No solution}}$ since 5 was excluded from the solution set.
57. $(p-1)\left(\dfrac{2p}{p-1}\right)=(p-1)\left(3+\dfrac{2}{p-1}\right)$ $\boxed{p\neq 1}$ $$2p=3(p-1)+2$$ $$2p=3p-3+2$$ $$2p=3p-1$$ $$p=1$$ $\boxed{\text{No solution}}$ since 1 was excluded from the solution set.	**58.** $(t+2)\left(\dfrac{4t}{t+2}\right)=(t+2)\left(3-\dfrac{8}{t+2}\right)$ $\boxed{t\neq -2}$ $$4t=3(t+2)-8$$ $$4t=3t+6-8$$ $$t=-2$$ $\boxed{\text{No solution}}$ since -2 was excluded from the solution set.
59. $(x+2)\left(\dfrac{3x}{x+2}-4\right)=(x+2)\left(\dfrac{2}{x+2}\right)$ $\boxed{x\neq -2}$ $$3x-4(x+2)=2$$ $$-x-8=2$$ $$\boxed{x=-10}$$	**60.** $(2y-1)\left(\dfrac{5y}{2y-1}-3\right)=(2y-1)\left(\dfrac{12}{2y-1}\right)$ $\boxed{y\neq \frac{1}{2}}$ $$5y-3(2y-1)=12$$ $$5y-6y+3=12$$ $$-y+3=12$$ $$\boxed{y=-9}$$
61. $\dfrac{1}{n}+\dfrac{1}{n+1}=\dfrac{-1}{n(n+1)}$ $\boxed{n\neq -1,0}$ LCD is $n(n+1)$. So, $$(n+1)+n=-1$$ $$n+1+n=-1$$ $$2n=-2$$ $$n=-1$$ But since we have already stipulated that $n\neq -1$, there is $\boxed{\text{no solution.}}$	**62.** $x(x-1)\left(\dfrac{1}{x}+\dfrac{1}{x-1}\right)=x(x-1)\left(\dfrac{1}{x(x-1)}\right)$ First notice that $\boxed{x\neq 0,1}$ $$(x-1)+x=1$$ $$2x=2$$ $$x=1$$ But since we have already stipulated that $x\neq 1$, there is $\boxed{\text{no solution.}}$

63. $\dfrac{3}{a}-\dfrac{2}{a+3}=\dfrac{9}{a(a+3)}$ $\boxed{a \neq 0,-3}$

LCD is $a(a+3)$. So,

$$3(a+3)-2a=9$$
$$3a+9-2a=9$$
$$a=0$$

But since we have already stipulated that $a \neq 0$, there is $\boxed{\text{no solution.}}$

64. $\dfrac{1}{c-2}+\dfrac{1}{c}=\dfrac{2}{c(c-2)}$ $\boxed{c \neq 0,2}$

LCD is $c(c-2)$. So,

$$c+(c-2)=2$$
$$2c-2=2$$
$$2c=4$$
$$c=2$$

But since we have already stipulated that $c \neq 2$, there is $\boxed{\text{no solution.}}$

65. $\dfrac{n-5}{6(n-1)}=\dfrac{1}{9}-\dfrac{n-3}{4(n-1)}$ $\boxed{n \neq 1}$

LCD is $36(n-1)$. So,

$$\frac{(n-5)(36)(n-1)}{6(n-1)}=\frac{36(n-1)}{9}-\frac{(n-3)(36)(n-1)}{4(n-1)}$$
$$6(n-5)=4(n-1)-9(n-3)$$
$$6n-30=4n-4-9n+27$$
$$6n-30=-5n+23$$
$$11n=53$$

So, the final solution is: $\boxed{n=\dfrac{53}{11}}$

66. $\dfrac{5}{m}+\dfrac{3}{m-2}=\dfrac{6}{m(m-2)}$ $\boxed{m \neq 0,2}$

LCD is $m(m-2)$. So,

$$5(m-2)+3(m)=6$$
$$5m-10+3m=6$$
$$8m-10=6$$
$$8m=16$$
$$m=2$$

Hence, $\boxed{\text{no solution}}$ since we have already stipulated that $m \neq 2$.

67. $\dfrac{2}{5x+1}=\dfrac{1}{2x-1}$ $\boxed{x \neq -\frac{1}{5}, \frac{1}{2}}$ $2(2x-1)=1(5x+1)$ $4x-2=5x+1$ $\boxed{x=-3}$	**68.** $\dfrac{3}{4n-1}=\dfrac{2}{2n-5}$ $\boxed{n \neq \frac{1}{4}, \frac{5}{2}}$ $3(2n-5)=2(4n-1)$ $6n-15=8n-2$ $-13=2n$ $\boxed{n=-\frac{13}{2}}$
69. $\dfrac{t-1}{1-t}=\dfrac{3}{2}$ $\boxed{t \neq 1}$ $3(1-t)=2(t-1)$ $3-3t=2t-2$ $-5t=-5$ $t=1$ $\boxed{\text{No solution}}$ since 1 was excluded from the solution set.	**70.** $\dfrac{2-x}{x-2}=\dfrac{3}{4}$ $\boxed{x \neq 2}$ $4(2-x)=3(x-2)$ $8-4x=3x-6$ $14=7x$ $x=2$ $\boxed{\text{No solution}}$ since 2 is excluded from the solution set.
71. $F=\dfrac{9}{5}C+32$ $F-32=\dfrac{9}{5}C$ $\dfrac{5}{9}(F-32)=C$ $\boxed{C=\dfrac{5}{9}F-\dfrac{160}{9}}$	**72.** $P=2L+2W$ $P-2L=2W$ $\boxed{W=\dfrac{P-2L}{2}}$
73. Let x = number of minutes you use the cell phone. Solve: $25.08=15+0.12x$ $10.08=0.12x$ $84=\dfrac{10.08}{0.12}=x$ So, you used your cell phone for $\boxed{84 \text{ min.}}$	**74.** Let x = number of miles she drove the car. Solve: $185=25(5)+0.10x$ $185=125+0.10x$ $60=0.10x$ $600=x$ She drove the car $\boxed{600 \text{ miles.}}$

75. Let x = number of minutes logged on Solve: $$2+0.10x=3.70$$ $$0.10x=1.70$$ $$x=17$$ So, logged on for $\boxed{17 \text{ min.}}$	**76.** Let x = number of subscriptions sold. Solve: $$20(25)+1.00x=645$$ $$500+1.00x=645$$ $$x=145$$ So, sold $\boxed{145 \text{ subscriptions}}$.
77. **a.** $C(x)=15,000+2,500x$ **b.** Solve for x: $$15,000+2,500x=5,515,000$$ $$2,500x=5,500,000$$ $$x=2,200$$ So, 2,200 days.	**78.** **a.** $R(x)=5,000+0.75x$ **b.** Solve for x: $$5,000+0.75x=98,750$$ $$0.75x=93,750$$ $$x=125,000$$ So, 125,000 minutes.
79. Using $a=\dfrac{d}{c}$ with $d=600$mg and $c=125$mg/ 5mL = 25mg/mL, we see that $$a=\frac{600mg}{25mg/mL}=24mL.$$	**80.** Using $a=\dfrac{d}{c}$ with $d=600$mg and $c=100$mg/ 5mL = 20mg/mL, we see that $$a=\frac{600mg}{20mg/mL}=30mL.$$
81. $$f=\frac{c}{\lambda}$$ $$\boxed{\lambda \neq 0}$$	**82.** $$\frac{1}{f}=\frac{1}{d_0}+\frac{1}{d_i}$$ LCD is $d_0 d_i f$. So, $$d_0 d_i = d_i f + d_0 f$$ $$d_0 d_i - d_0 f = d_i f$$ $$d_0(d_i - f)=d_i f$$ $$\boxed{d_0 = \frac{d_i f}{d_i - f}}$$
83. Should have subtracted $4x$ and added 7 to both sides. The correct answer is $x=5$.	**84.** Forgot to distribute the negative sign through the parentheses.

85. Cannot cross multiply- must multiply by LCD first. The correct answer is $p = \frac{6}{5}$.	86. Should have eliminated $x = 0$, $x = 1$ from the domain first.
87. False $\boxed{x \neq 0}$	88. False $\boxed{x \neq 1, -2}$
89. True	90. False $\boxed{x = 1 \text{ makes denominator} = 0}$
91. $ax + b = c \quad \boxed{a \neq 0}$ $ax = c - b$ $\boxed{x = \dfrac{c - b}{a}}$	92. $x \cdot \left(\dfrac{a}{x} - \dfrac{b}{x} \right) = x \cdot c \quad \boxed{x \neq 0,\ c \neq 0}$ $a - b = cx$ $\boxed{x = \dfrac{a - b}{c}}$

93.

$$\frac{b+c}{x+a} = \frac{b-c}{x-a} \quad \boxed{x \neq \pm a}$$

$$(b+c)(x-a) = (b-c)(x+a)$$

$$bx - ba + cx - ca = bx + ba - cx - ca$$

$$2cx = 2ba \qquad \boxed{x = \frac{ba}{c}}$$

94.

$$\frac{1}{y-a} + \frac{1}{y+a} = \frac{2}{y-1} \quad \boxed{y \neq -a, a, 1}$$

LCD is $(y-a)(y+a)(y-1)$. So,

$$(y+a)(y-1) + (y-a)(y-1) = 2(y-a)(y+a)$$

$$y^2 - y + ay - a + y^2 - y - ay + a = 2\left(y^2 + ay - ay - a^2\right)$$

$$y^2 - y + \cancel{ay} \cancel{-a} + y^2 - y \cancel{-ay} \cancel{+a} = 2y^2 \cancel{+2ay} \cancel{-2ay} - 2a^2$$

$$-2y = -2a^2$$

$$-y = -a^2$$

$$y = a^2 \boxed{y \geq 0}$$

| 95. $\dfrac{1 - \dfrac{1}{x}}{1 + \dfrac{1}{x}} = 1 \quad \boxed{x \neq -1, 0}$

 $1 - \dfrac{1}{x} = 1 + \dfrac{1}{x} \quad \Rightarrow \quad \dfrac{2}{x} = 0$
 $\boxed{\text{no solution}}$ | 96. $\dfrac{t + \dfrac{1}{t}}{\dfrac{1}{t} - 1} = 1 \quad \boxed{t \neq 0, 1}$

 $\cancel{\dfrac{1}{t}} - 1 = t + \cancel{\dfrac{1}{t}} \quad \Rightarrow \quad \boxed{t = -1}$ |

97.	98.
$y = \dfrac{a}{1 + \dfrac{b}{x} + c}$ $\boxed{x \neq 0, \ -\dfrac{b}{c+1}}$	$2 - a = 2 + 5 - 3a(2)$
$y = \dfrac{a}{\dfrac{x + b + cx}{x}}$	$2 - a = 7 - 6a$
$y = \dfrac{ax}{b + x(c+1)}$	$-5 = -5a$
$y(b + x(c+1)) = ax$	$\boxed{a = 1}$
$yb + xy(c+1) - ax = 0$	
$x[y(c+1) - a] = -yb$	
$\boxed{x = \dfrac{by}{a - y - cy}}$	
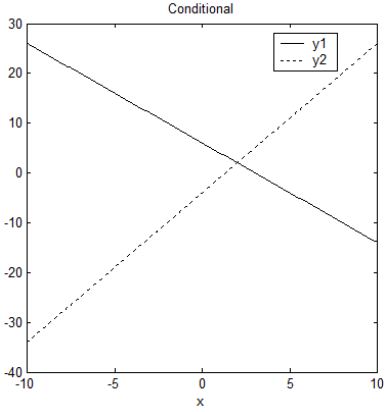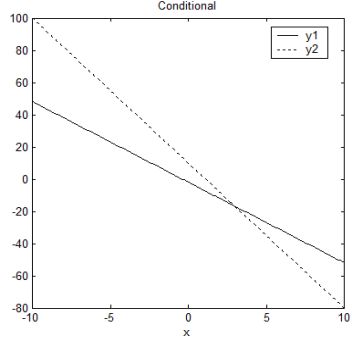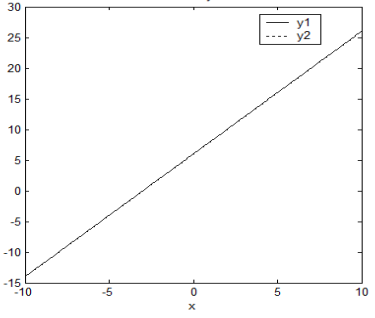
99. $y1 = 3(x+2) - 5x$ $\quad y2 = 3x - 4$	100. $y1 = -5(x-1) - 7$ $\quad y2 = 10 - 9x$
$\boxed{x = 2}$	$\boxed{x = 3}$
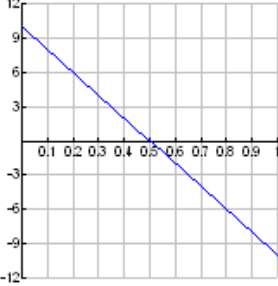
101. $y1 = 2x + 6$ $\quad y2 = 4x - 2x + 8 - 2$	102. $y1 = 10 - 20x$ $\quad y2 = 10x - 30x + 20 - 10$
All real numbers	All real numbers

45
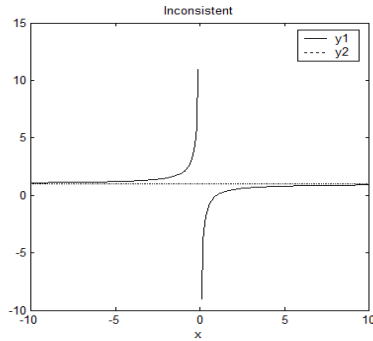
103. $y1 = \dfrac{x(x-1)}{x^2}$ $y2 = 1$ No solution	**104.** $y1 = \dfrac{2x(x+3)}{x^2}$ $y2 = 2$ No solution
105. $y1 = 0.035x + 0.029(8706 - x)$ $y2 = 285.03$ $x = 5426$	**106.** $y1 = \dfrac{1}{0.75x} - \dfrac{0.45}{x}$ $y2 = \dfrac{1}{9}$ $x = 7.95$
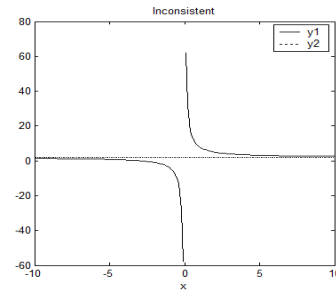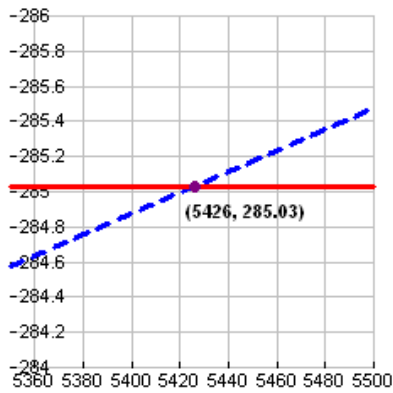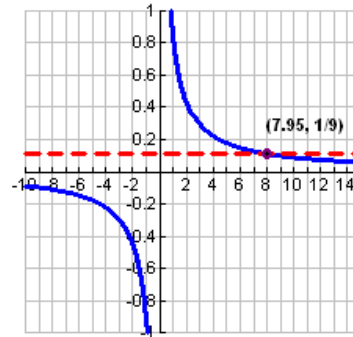
Section 1.2 Solutions ---

1. Let x = price without coupon $0.9x = 217.95$ $\boxed{x = \$242.17}$	**2.** Let x be the percentage of original price $x = \dfrac{51.80}{74} = 0.7 = 70\%$ $\boxed{30\% \text{ markdown}}$

46

3. $\quad$ Let x = cost of pizza Tom: 5.16 Chelsea: $1/8\ x$ Jeff: $1/2\ x$ $5.16 + \dfrac{1}{8}x + \dfrac{1}{2}x = x$ $41.28 + x + 4x = 8x$ $3x = 41.28$ $\boxed{x = \$13.76}$	**4.** $\quad$ Let x = take home pay Bills $= 0.5x$ Investments $= 0.2x$ Groceries $= 560$ Miscellaneous $= 0.23x$ $0.5x + 0.2x + 560 + 0.23x = x$ $0.93x + 560 = x$ $0.07x = 560$ $\boxed{x = \$8,000}$
5. $\quad$ Let x = original price $0.85x = 125,000$ $x = 147,058.82$ $\boxed{\text{Original price} \cong \$147,058.82}$ Model price $= \$125,000$ $\boxed{\text{Savings} = \$22,058.82}$	**6.** $\quad$ Let x = price paid to publisher $1.25x = 79$ $x = \dfrac{79}{1.25} = 63.2$ $\boxed{\text{Bookstore paid \$63.20}}$
7. $\quad$ Let x = distance from Angela's home to the restaurant. Home $\to$ Train station $= 1$ mile On train $\to \dfrac{3}{4}x \quad$ In taxi $\to \dfrac{1}{6}x$ $1 + \dfrac{3}{4}x + \dfrac{1}{6}x = x$ LCD $= 12$ $12 + 9x + 2x = 12x$ $12 + 11x = 12x$ $x = 12$ Angela travels $\boxed{12 \text{ miles}}$ to the restaurant.	**8.** $\quad$ Let x = distance from her house to VAB House $\to$ Park & Ride $= 7$ miles Park & Ride $\to$ H.Q. $= \dfrac{5}{6}x$ H.Q. $\to$ VAB $= \dfrac{1}{20}x$ $7 + \dfrac{5}{6}x + \dfrac{1}{20}x = x$ LCD $= 60$ $420 + 50x + 3x = 60x$ $420 = 7x$ $x = 60$ She travels $\boxed{60 \text{ miles}}$ to the VAB.

9.	**10.**
x = hours awake	Let x = calories for breakfast
Class: $\dfrac{1}{3}x$	Dinner calories $= 2x$
Eating: $\dfrac{1}{5}x$	Lunch Calories $= x + 100$
Working out: $\dfrac{1}{10}x$	Snack 1 $= 100$
Studying: 3	Snack 2 $= 150$
Other things: 2.5	$\underbrace{x}_{breakfast} + \overbrace{x+100}^{lunch} + \underbrace{2x}_{dinner} + \overbrace{100+150}^{snacks} = \underbrace{1550}_{total}$
$\dfrac{1}{3}x + \dfrac{1}{5}x + \dfrac{1}{10}x + 3 + 2.5 = x$	$4x + 350 = 1550$
$10x + 6x + 3x + 165 = 30x$	$4x = 1200$
$19x + 165 = 30x$	$x = 300$
$11x = 165$	Breakfast: 300
$x = 15$ awake	Lunch: 400
9 hours of sleep	Dinner: 600

11.	**12.**
Fixed costs $= 15,000$	Let x = number of sets of napkins
Variable costs $= 18.50x$	Fixed monthly costs $= 1329.50$
Total costs $= 20,000$	Variable costs $= 3.70x$
$18.50x + 15,000 = 20,000$	Total budget $= 1870$
$18.50x = 5000$	$1329.50 + 3.70x = 1870$
$x = 270.27$	$3.70x = 540.5$
Approximately 270 units can be produced.	$x = 146.08$
	She can afford approximately 146 sets of napkins.

13.	**14.**
$\dfrac{2}{3}x - 10 = \dfrac{1}{4}x$	$10x = 2x + 16$
$\dfrac{5}{12}x = 10$	$8x = 16$
$x = 10\left(\dfrac{12}{5}\right) = 24$	$x = 2$

15. Let the numbers be $x, x+2$	16. Let the numbers be $x, x+1, x+2$
$4(x) = 2 + 3(x+2)$ $4x = 2 + 3x + 6$ $x = 8$ The numbers are $\boxed{8, 10}$.	$x + (x+1) + (x+2) = 2\left[x + (x+1)\right]$ $3x + 3 = 2(2x+1)$ $3x + 3 = 4x + 2$ $x = 1$ The numbers are $\boxed{1, 2, 3}$.

17. Let $p = $ perimeter.	18. $w = $ width
First side $= 11$ Second side $= \dfrac{1}{5}p$ Third side $= \dfrac{1}{4}p$ $11 + \dfrac{1}{5}p + \dfrac{1}{4}p = p$ LCD = 20 $220 + 4p + 5p = 20p$ $220 = 11p$ $p = 20$ The perimeter is $\boxed{20 \text{ inches}}$.	$l = \text{length} = 2w + 1$ $p = 2l + 2w$ $20 = 2(2w+1) + 2w$ $20 = 4w + 2 + 2w$ $18 = 6w$ $w = 3$ $\boxed{\text{width} = 3 \text{ feet}}$ $\boxed{\text{length} = 7 \text{ feet}}$

19. $w = $ width	20. $w = $ width
$l = \text{length} = 2w + 40$ $p = 2l + 2w$ $260 = 2(2w + 40) + 2w$ $260 = 4w + 80 + 2w$ $180 = 6w$ $w = 30$ $\boxed{\text{width} = 30 \text{ yards}}$ $\boxed{\text{length} = 100 \text{ yards}}$	$l = \text{length} = 3w + 2$ $p = 2l + 2w$ $28 = 2(3w + 2) + 2w$ $28 = 6w + 4 + 2w$ $24 = 8w$ $w = 3$ $\boxed{\text{width} = 3 \text{ inches}}$ $\boxed{\text{length} = 11 \text{ inches}}$

21.	$r_1 = $ radius of smaller circle $r_2 = $ radius of larger circle $r_2 = r_1 + 3$ Circumference of smaller circle $= 2\pi r_1$ Circumference of larger circle $= 2\pi r_2$ Ratio of circumferences $= \dfrac{2\pi r_2}{2\pi r_1} = \dfrac{r_2}{r_1} = \dfrac{2}{1}$ $r_2 = 2r_1$ $2r_1 = r_1 + 3$ $r_1 = 3$ $\boxed{r_1 = 3 \text{ feet} \quad r_2 = 6 \text{ feet}}$	**22.**	Perimeter of semicircle is half the circumference + twice the radius. $P = \dfrac{1}{2}(2\pi r) + 2r$ $P = (\pi + 2)r$ When the radius is increased by one, the perimeter doubles, so $2P = (\pi + 2)(r + 1)$ $2(\pi + 2)r = (\pi + 2)(r + 1)$ $2r = r + 1$ $\boxed{r = 1}$
23.	$\dfrac{x}{225} = \dfrac{4}{3}$ $3x = 900$ $x = 300$ The tree is $\boxed{300 \text{ feet}}$ tall.	**24.**	$\dfrac{x}{880} = \dfrac{4}{10}$ $10x = 3520$ $x = 352$ The oak tree is $\boxed{352 \text{ feet}}$ tall.
25.	Let $x = $ length of alligator in feet. Solve: $\dfrac{3.5}{0.5} = \dfrac{x}{0.75}$ $0.5x = 2.625$ $x = 5.25$ The alligator is about $\boxed{5.25 \text{ feet}}$.	**26.**	Let $x = $ length of snake in inches. $\dfrac{\text{Fang}}{\text{Body}} = \dfrac{2}{36} = \dfrac{2.6}{x}$ Solve: $2x = 93.6$ $x = 46.8$ The snake is about 3.9 feet $= \boxed{46.8 \text{inches}}$.

27.	Let x = amount invested at 4%. $120,000 - x$ = amount invested at 7% Solve: $0.04x + 0.07(120,000 - x) = 7,800$ $0.04x + 8400 - 0.07x = 7,800$ $-0.03x = -600$ $x = 20,000$ $\boxed{\$20,000 \text{ at } 4\% \text{ and } \$100,000 \text{ at } 7\%}$	**28.**	Let x = amount invested at 10%. $13,000 - x$ = amount invested at 14% Solve: $0.10x + 0.14(13,000 - x) = 1580$ $0.10x + 1820 - 0.14x = 1580$ $-0.04x = -240$ $x = 6000$ $\boxed{\$6,000 \text{ at } 10\% \text{ and } \$7,000 \text{ at } 14\%}$
29.	Let x = amount invested at 10%. $\dfrac{14,000 - x}{2}$ = amount invested at 2% $\dfrac{14,000 - x}{2}$ = amount invested at 40% Interest earned $= 16,610 - 14,000 = 2,610$ Solve: $0.1x + 0.02\left(\dfrac{14,000 - x}{2}\right) + 0.4\left(\dfrac{14,000 - x}{2}\right) = 2610$ $0.1x + 140 - 0.01x + 2800 - 0.2x = 2610$ $-0.11x = -330$ $x = 3,000$ $\boxed{\begin{array}{l}\$3,000 \text{ at } 10\% \\ \$5,500 \text{ at } 2\% \\ \$5,500 \text{ at } 40\%\end{array}}$	**30.**	$\$2500$ in money market $(\text{rate} = x)$ $\$2500$ in stock market $(\text{rate} = 3x)$ Interest earned $= \$150$ Solve: $2500x + 2500(3x) = 150$ $2500x + 7500x = 150$ $10,000x = 150$ $x = 0.015$ $\boxed{\begin{array}{l}\text{Money market: } 1.5\% \\ \text{Stock market: } 4.5\%\end{array}}$
31.	Money for plants $= 4200 - 2400 - 1500 = 300$ Let x be the number of trees $(\$32\text{ each})$. Let $33 - x$ be the number of shrubs $(\$4\text{ each})$. Solve: $32x + 4(33 - x) = 300$ $32x + 132 - 4x = 300$ $28x = 168$ $x = 6$ $\boxed{6 \text{ trees and } 27 \text{ shrubs}}$	**32.**	Let x = lbs of turkey $(\$6.32 \text{ per lb})$ $3.2 - x$ = lbs of cheese $(\$4.27 \text{ per lb})$ Solve: $6.32x + 4.27(3.2 - x) = 17.56$ $6.32x + 13.664 - 4.27x = 17.56$ $2.05x = 3.896$ $x = 1.9$ $\boxed{1.9 \text{ lbs of turkey, } 1.3 \text{ lbs of cheese}}$

33.	Let $x =$ ml of 5% HCl Solve: $100 - x =$ ml of 15% HCl $0.05x + 0.15(100 - x) = 0.08(100)$ $0.05x + 15 - 0.15x = 8$ $-0.1x = -7$ $x = 70$ 70ml of 5% HCl 30ml of 15% HCl	**34.**	Let $x =$ gallons of 100% alcohol Solve: $0.20(5) + 1.00x = 0.50(5 + x)$ $1 + x = 2.5 + 0.50x$ $0.50x = 1.5$ $x = \dfrac{1.5}{0.5} = 3$ 3 gallons.
35.	Let $x =$ number of gallons to be drained. Solve: $0.40(5 - x) + 1.00x = 0.80(5)$ $2 - 0.40x + x = 4$ $2 + 0.60x = 4$ $0.60x = 2$ $x \approx 3.3$ About 3.3 gallons.	**36.**	Let $x = \$$ of grant with 42.5% overhead $1,170,000 - x = \$$ of grant with 26% overhead Overhead generated $= 0.39(1,170,000) = 456,300$ Solve: $0.425x + 0.26(1,170,000 - x) = 456,300$ $0.425x + 304,200 - 0.26x = 456,300$ $0.165x = 152100$ $x = 921818.\overline{18}$ On campus (42.5%) grant: $\$921,818$ Off campus (26%) grant: $\$248,182$
37.	$x =$ lbs of caramels $(\$1.50/\text{lb})$ $1.25 - x =$ lbs of gummy bears $(\$2/\text{lb})$ Solve: $1.5x + 2(1.25 - x) = 2.50$ $1.5x + 2.5 - 2x = 2.50$ $-0.5x = 0$ $x = 0$ No caramels, 1.25lb of gummy bears	**38.**	Let $x =$ lbs of Jamaican Blue Mountain Coffee Solve: $12(x) + 4.20(2 - x) = 14.25$ $12x + 8.40 - 4.20x = 14.25$ $7.80x = 5.85$ $x = 0.75$ She bought: 0.75 lbs Jamaican Blue Mountain 1.25 lbs of regular coffee beans.

39.	distance = rate · time	40.	distance = rate · time
	distance = 100,000,000 miles		distance = 0.5 miles
	rate = 670,616,629 mph		rate = 760 mph
	$\text{time} = \dfrac{\text{distance}}{\text{rate}}$		$\text{time} = \dfrac{\text{distance}}{\text{rate}}$
	$= 0.15 \text{ hours} \cong \boxed{9 \text{ minutes}}$		$= 0.0006579 \text{ hours} \cong \boxed{2.4 \text{ seconds}}$

41.	$x + 0.047x = 3.21$	42.	Let x = price in September. Then, since the price decreased by 40% by the end of Nov., the price for the TV would be 60% of the price in September. So, we solve the following equation for x:
	$1.047x = 3.21$		
	$x = 3.065$		
	So, at the beginning of November, gas was $3.07 per gallon.		$$\$299 = 0.60x$$
			$$x \approx \$498$$

43. Let x = number of mL of distilled water (which has 0% salt).
Solve for x:

$$0.03(100\,mL) + 0.00(x\,mL) = 0.009(100 + x)mL$$

$$3mL + 0mL = (0.9mL + 0.009x)$$

$$2.1mL = 0.009x$$

$$x \approx 233mL$$

44. Let x = number of mL of 20% solution.
Solve for x:

$$0.00(100\,mL) + 0.20(x\,mL) = 0.05(100 + x)mL$$

$$0.20x = (5 + 0.05x)mL$$

$$0.15x = 5mL$$

$$x \approx 33mL$$

45. rate (r) = boat speed (s) ± current speed (c) boat speed: s = 16 mph upstream: $r = s - c, t = 1/3$ hours downstream: $r = s + c, t = 1/4$ hours Distance is the same both ways $(\text{rate} \cdot \text{time})$ Solve: $(16-c)\left(\dfrac{1}{3}\right) = (16+c)\left(\dfrac{1}{4}\right)$ $4(16-c) = 3(16+c)$ $64 - 4c = 48 + 3c$ $7c = 16$ $\boxed{c = \dfrac{16}{7} \cong 2.3 \text{ mph}}$	**46.** rate (r) = plane speed (s) ± wind speed (w) plane speed: s = 130 mph upwind: $r = s - w, t = 2$ hours downwind: $r = s + w, t = 1.25$ hours Distance is the same both ways $(\text{rate} \cdot \text{time})$ Solve: $2(130 - w) = 1.25(130 + w)$ $260 - 2w = 162.5 + 1.25w$ $97.5 = 3.25w$ $\boxed{w = 30 \text{ mph}}$
47. $\begin{aligned} &\text{rate of walker} = r_w \\ &\text{rate of jogger} = r_w + 2 \\ &\text{time of walker} = 1 \text{ hour} \\ &\text{time of jogger} = \tfrac{2}{3} \text{ hour} \\ &r_w(1) = (r_w + 2)(2/3) \\ &r_w = \tfrac{2}{3}r_w + 4/3 \\ &\tfrac{1}{3}r_w = \tfrac{4}{3} \\ &r_w = 4 \end{aligned}$ $\boxed{\text{walker: 4 mph}}$ $\boxed{\text{jogger: 6 mph}}$	**48.** $\begin{aligned} &\text{dist. of Southern route} = d \\ &\text{dist. of Northern route} = d + 300 \\ &\text{time of S route} = 45 \text{ hours} \\ &\text{time of N route} = 50 \text{ hours} \\ &\dfrac{d}{45} = \dfrac{d+300}{50} \\ &50d = 45(d+300) \\ &50d = 45d + 13,500 \\ &5d = 13,500 \\ &d = 2700 \end{aligned}$ $\boxed{\text{S route} = 2,700 \text{ miles}}$ $\boxed{\text{N route} = 3,000 \text{ miles}}$

49. Let x = number of minutes it takes a rider to get to class
Using Distance = Rate × Time, and the fact that since they use the same path, their distances are the same, we must solve the equation:
$$2(12 + x) = 6(x)$$
$$24 + 2x = 6x$$
$$24 = 4x$$
$$x = 6$$
So, it takes the $\boxed{\text{bicyclist 6 minutes to get to class, and the walker 18 minutes}}$.

50. Let x = number of minutes a car travels before catching the truck
When it catches the truck, the car and truck will have traveled the same distance.
So, we must solve:

$$70x = 50(x+30)$$
$$70x = 50x+1500$$
$$x = 75$$

It takes the car 75 minutes to catch the truck.

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51. Let x = hours it takes Cynthia to paint house alone. Christopher can paint 1/15 house per hour. Cynthia can paint $1/x$ house per hour.

Together they paint $\left(\dfrac{1}{15}+\dfrac{1}{x}\right)$ house per hour.

$$\frac{1}{15}+\frac{1}{x}=\frac{1}{9}$$
$$3x+45 = 5x$$
$$2x = 45$$
$$x = 22.5$$

Cynthia can paint the house alone in 22.5 hours.

---

52. Let x = number of hours it takes Morgan to complete the yard alone.
Jay: 1/3 of the yard per hour
Morgan: $1/x$ of the yard per hour
Together: 1 hour for entire yard
Solve:

$$\frac{1}{3}+\frac{1}{x}=1$$
$$3x\cdot\left(\frac{1}{3}+\frac{1}{x}\right)=3x$$
$$x+3 = 3x$$
$$x = 1.5$$

It takes 1.5 hours for Morgan to do the yard herself.

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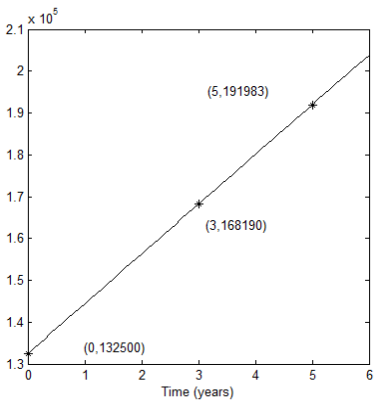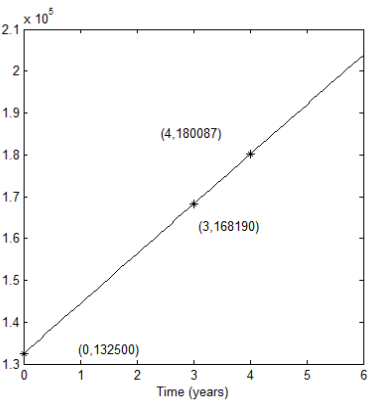
53. Tracey can do 1/4 of a delivery per hour, and Robin can do 1/6 of a delivery per hour. Together, they complete 1/4 + 1/6 = 1/(12/5) of the delivery in an hour. So, together, they complete the job in 2.4 hours.

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54. Joshua can do the job at a rate of 1/30 job per minute. Amber can do it in 1/20 job per minute. Together, they work at $(1/30+1/20)=1/12$ job per minute. They will finish in 12 minutes

55.

$$\frac{4}{5}=\frac{264}{x_1}$$
$$4x_1 = 264(5)$$
$$4x_1 = 1320$$
$$x_1 = 330 \text{ hertz}$$

$$\frac{4}{6}=\frac{264}{x_2}$$
$$4x_2 = 264(6)$$
$$4x_2 = 1584$$
$$x_2 = 396 \text{ hertz}$$

56.	$\dfrac{10}{12}=\dfrac{220}{x_1}$ $\dfrac{10}{15}=\dfrac{220}{x_2}$ $10x_1=220(12)$ $10x_2=220(15)$ $10x_1=2640$ $10x_2=3300$ $\boxed{x_1=264 \text{ hertz}}$ $\boxed{x_2=330 \text{ hertz}}$	**57.**	Let $x=$ exam grade needed Test average $=\dfrac{86+80+84+90}{4}=85$ To earn a "B": To earn an "A": $\dfrac{1}{3}(85)+\dfrac{2}{3}x=80$ $\dfrac{1}{3}(85)+\dfrac{2}{3}x=90$ $\text{LCD}=3$ $\text{LCD}=3$ $85+2x=240$ $85+2x=270$ $2x=155$ $2x=185$ $\boxed{x=77.5}$ $\boxed{x=92.5}$

58.	Let $x=$ exam grade needed $\text{Avg}=\dfrac{80+83+71+61+95+x+x}{7}=80$ $\dfrac{2x+390}{7}=80$ $2x+390=560$ $2x=170$ $\boxed{x=85}$	**59.**	Let $x=$ # field goals $8-x=$ # touchdowns $3x+7(8-x)=48$ $3x+56-7x=48$ $-4x=-8$ $x=2$ $\boxed{2 \text{ field goals, 6 touchdowns}}$

60.	TE: $\dfrac{100\text{yds}}{12\text{secs}}$ DB: $\dfrac{100\text{yds}}{10\text{secs}}$ Let d be the distance the TE runs. Then $d+5$ is the distance the DB runs. Time spent running is the same for both. dist=rate·time, time=dist/rate TE: $t=\dfrac{d}{100/12}$ DB: $t=\dfrac{d+5}{100/10}$	$\dfrac{d}{100/12}=\dfrac{d+5}{100/10}$ $\dfrac{12}{100}d=\dfrac{10}{100}(d+5)$ $12d=10d+50$ $2d=50$ $d=25$ $\boxed{\text{TE catches ball at 20 yard line and is tackled 25 yards later at the 45.}}$

61.	$(42)(5)=(60)(x)$ $210=60x$ $x=3.5$ $\boxed{\text{Maria should sit 3.5 feet from the center.}}$	**62.**	$(33+42)(4)=60x$ $(75)(4)=60x$ $x=5$ $\boxed{\text{Maria should sit 5 feet from the center.}}$

63. Let the board be 1 unit long.

Let x = distance from Maria to fulcrum.

$1 - x$ = distance from Max to fulcrum.

$60x = 42(1-x)$

$60x = 42 - 42x$

$102x = 42$

$x \cong 0.4$

Fulcrum is 0.4 units from Maria and 0.6 units from Max.

64. Let the board be 1 unit long.

Let x = distance from Maria to fulcrum.

$1 - x$ = distance from Max/Martin to fulcrum.

$60x = (42+33)(1-x)$

$60x = 75 - 75x$

$135x = 75$

$x = 0.5\overline{5}$

Fulcrum is 0.56 units from Maria and 0.44 units from Max/Martin.

65.
$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$f = 3, \ d_i = 5$

$$\frac{1}{3} = \frac{1}{d_0} + \frac{1}{5}$$

$LCD = 15d_0$

$5d_0 = 15 + 3d_0$

$2d_0 = 15$

Object is $\boxed{d_0 = 7.5}$ cm from lens.

66.
$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$f = 8, \ d_i = 2$

$$\frac{1}{8} = \frac{1}{d_0} + \frac{1}{2}$$

$LCD = 8d_0$

$d_0 = 8 + 4d_0$

$-3d_0 = 8$

$$d_0 = \frac{-8}{3} \approx -2.67$$

Object is $\boxed{2.67 \text{ cm behind lens}}$.

67.
$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$f = 2, \ d_i = \frac{1}{2}d_0$

$$\frac{1}{2} = \frac{1}{d_0} + \frac{1}{\frac{1}{2}d_0}$$

Since $\dfrac{1}{\frac{1}{2}d_0} = \dfrac{2}{d_0}$,

$$\frac{1}{2} = \frac{1}{d_0} + \frac{2}{d_0} = \frac{3}{d_0} \ \Rightarrow \ d_0 = 6$$

$\boxed{\text{Object distance} = 6\,\text{cm}}$

68.
$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$f = 8, \ d_i = \dfrac{1}{2}d_0$

$$\frac{1}{8} = \frac{1}{d_0} + \frac{1}{\left(\frac{1}{2}d_0\right)}$$

$$\frac{1}{8} = \frac{1}{d_0} + \frac{2}{d_0}$$

$$\frac{1}{8} = \frac{3}{d_0}$$

$\boxed{d_0 = 24 \text{ cm}}$

69.	70.	71.	72.
$P = 2l + 2w$ $P - 2l = 2w$ $\dfrac{P - 2l}{2} = w$	$P = 2l + 2w$ $P - 2w = 2l$ $\dfrac{P - 2w}{2} = l$	$A = \frac{1}{2}bh$ $2A = bh$ $\dfrac{2A}{b} = h$	$C = 2\pi r$ $\dfrac{C}{2\pi} = r$
73.	74.	75.	76.
$A = lw$ $\dfrac{A}{l} = w$	$d = rt$ $\dfrac{d}{r} = t$	$V = lwh$ $\dfrac{V}{lw} = h$	$V = \pi r^2 h$ $\dfrac{V}{\pi r^2} = h$

77. Let x = Janine's average speed (in mph).
Then, Tricia's speed = $(12 + x)$ mph. We must solve the equation:
$$2.5(12 + x) + 2.5x = 320$$
$$30 + 2.5x + 2.5x = 320$$
$$5x = 290$$
$$x = 58$$
So, Janine's average speed is 58 mph and Tricia's average speed is 70 mph.

78. Let x = Rick's average speed (in mph).
Then, Mike's speed = $(8 + x)$ mph. We must solve the equation:
$$1.5(8 + x) + 1.5x = 210$$
$$12 + 1.5x + 1.5x = 210$$
$$3x = 198$$
$$x = 66$$
So, Rick's average speed is 66 mph and Mike's average speed is 74 mph.

79. $y = 11896.67x + 132500$

$\boxed{\$191{,}983.35}$

80. $y = 11896.67x + 132500$

$\boxed{\$144{,}397}$

81. Let $x =$ number of times you play.

Option A: $y_1 = 300 + 15x$

Option B: $y_2 = 150 + 42x$

| Option B is better if you play about 5 times or less per month. Option A is better if you play 6 times or more per month. | .
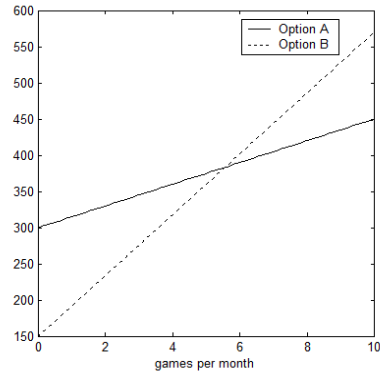
82. Let $x =$ number of minutes used.

Plan A: $y_1 = 30 + 0.1x$

Plan B: $y_2 = 50 + 0.03x$

| Plan A is better if you use about 285 minutes or less per month. Plan B is better if you use more than 285 minutes per month. | .

Section 1.3 Solutions --

1.	$x^2 - 5x + 6 = 0$ $(x-3)(x-2) = 0$ $x - 3 = 0$ or $x - 2 = 0$ $\boxed{x = 3 \text{ or } x = 2}$	**2.**	$v^2 + 7v + 6 = 0$ $(v+6)(v+1) = 0$ $v + 6 = 0$ or $v + 1 = 0$ $\boxed{v = -6 \text{ or } v = -1}$
3.	$p^2 - 8p + 15 = 0$ $(p-5)(p-3) = 0$ $\boxed{p = 5 \text{ or } p = 3}$	**4.**	$u^2 - 2u - 24 = 0$ $(u-6)(u+4) = 0$ $\boxed{u = 6 \text{ or } u = -4}$

5.	$x^2 = 12 - x$ $x^2 + x - 12 = 0$ $(x+4)(x-3) = 0$ $x + 4 = 0$ or $x - 3 = 0$ $\boxed{x = -4 \text{ or } x = 3}$	**6.**	$11x = 2x^2 + 12$ $2x^2 - 11x + 12 = 0$ $(2x-3)(x-4) = 0$ $2x - 3 = 0$ or $x - 4 = 0$ $\boxed{x = \frac{3}{2} \text{ or } x = 4}$
7.	$16x^2 + 8x = -1$ $16x^2 + 8x + 1 = 0$ $(4x+1)(4x+1) = 0$ $4x + 1 = 0$ $\boxed{x = -1/4}$	**8.**	$3x^2 + 10x - 8 = 0$ $(3x-2)(x+4) = 0$ $3x - 2 = 0$ or $x + 4 = 0$ $\boxed{x = \frac{2}{3} \text{ or } x = -4}$
9.	$9y^2 + 1 = 6y$ $9y^2 - 6y + 1 = 0$ $(3y-1)(3y-1) = 0$ $\boxed{y = \frac{1}{3}}$	**10.**	$4x = 4x^2 + 1$ $4x^2 - 4x + 1 = 0$ $(2x-1)(2x-1) = 0$ $\boxed{x = \frac{1}{2}}$
11.	$8y^2 - 16y = 0$ $8y(y-2) = 0$ $8y = 0$ or $y - 2 = 0$ $\boxed{y = 0 \text{ or } y = 2}$	**12.**	$3A^2 = -12A$ $3A^2 + 12A = 0$ $3A(A+4) = 0$ $3A = 0$ or $A + 4 = 0$ $\boxed{A = 0 \text{ or } A = -4}$
13.	$9p^2 = 12p - 4$ $9p^2 - 12p + 4 = 0$ $(3p-2)(3p-2) = 0$ $3p - 2 = 0$ $\boxed{p = \frac{2}{3}}$	**14.**	$4u^2 = 20u - 25$ $4u^2 - 20u + 25 = 0$ $(2u-5)(2u-5) = 0$ $\boxed{u = \frac{5}{2}}$
15.	$x^2 - 9 = 0$ $(x+3)(x-3) = 0$ $x + 3 = 0$ or $x - 3 = 0$ $\boxed{x = -3 \text{ or } x = 3}$	**16.**	$16v^2 - 25 = 0$ $(4v-5)(4v+5) = 0$ $\boxed{v = \frac{5}{4} \text{ or } v = -\frac{5}{4}}$

17. $x(x+4)=12$ $x^2+4x=12$ $x^2+4x-12=0$ $(x+6)(x-2)=0$ $x+6=0$ or $x-2=0$ $\boxed{x=-6 \text{ or } x=2}$	**18.** $3t^2-48=0$ $3(t^2-16)=0$ $3(t+4)(t-4)=0$ $t+4=0$ or $t-4=0$ $\boxed{t=-4 \text{ or } t=4}$
19. $2p^2-50=0$ $2(p^2-25)=0$ $2(p-5)(p+5)=0$ $\boxed{p=-5 \text{ or } p=5}$	**20.** $5y^2-45=0$ $5(y^2-9)=0$ $5(y-3)(y+3)=0$ $\boxed{y=-3 \text{ or } y=3}$
21. $3x^2=12$ $3x^2-12=0$ $3(x^2-4)=0$ $3(x-2)(x+2)=0$ $\boxed{x=-2 \text{ or } x=2}$	**22.** $7v^2=28$ $7v^2-28=0$ $7(v^2-4)=0$ $7(v-2)(v+2)=0$ $\boxed{v=-2 \text{ or } v=2}$
23. $p^2-8=0$ $p^2=8$ $p=\pm\sqrt{8}$ $\boxed{p=\pm2\sqrt{2}}$	**24.** $y^2-72=0$ $y^2=72$ $y=\pm\sqrt{72}$ $\left(72=2^3\cdot3^2\right)$ $\boxed{y=\pm6\sqrt{2}}$
25. $x^2+9=0$ $x^2=-9$ $\boxed{x=\pm3i}$	**26.** $v^2+16=0$ $v^2=-16$ $\boxed{v=\pm4i}$
27. $(x-3)^2=36$ $x-3=\pm6$ $x=3\pm6$ $\boxed{x=-3,\,9}$	**28.** $(x-1)^2=25$ $x-1=\pm5$ $x=\pm5+1$ $\boxed{x=-4,\,6}$

29.		30.	
	$(2x+3)^2 = -4$		$(4x-1)^2 = -16$
	$2x+3 = \pm 2i$		$4x-1 = \pm 4i$
	$2x = -3 \pm 2i$		$4x = 1 \pm 4i$
	$\boxed{x = \frac{-3 \pm 2i}{2}}$		$\boxed{x = \frac{1}{4} \pm i}$
31.		32.	
	$(5x-2)^2 = 27$		$(3x+8)^2 = 12$
	$5x-2 = \pm\sqrt{27}$		$3x+8 = \pm\sqrt{12}$
	$5x = 2 \pm 3\sqrt{3}$		$3x = -8 \pm 2\sqrt{3}$
	$\boxed{x = \frac{2 \pm 3\sqrt{3}}{5}}$		$\boxed{x = \frac{-8 \pm 2\sqrt{3}}{3}}$
33.		34.	
	$(1-x)^2 = 9$		$(1-x)^2 = -9$
	$1-x = \pm 3$		$1-x = \pm 3i$
	$-x = -1 \pm 3$		$-x = -1 \pm 3i$
	$\boxed{x = 1 \pm 3 = -2,\ 4}$		$\boxed{x = 1 \pm 3i}$
35.		36.	
	$x^2 + 6x$		$x^2 - 8x$
	$\left(\frac{1}{2} \cdot 6\right)^2 = 3^2 = 9$		$\left(\frac{1}{2} \cdot 8\right)^2 = 4^2 = 16$
	$x^2 + 6x + \boxed{9}$		$x^2 - 8x + \boxed{16}$
37.		38.	
	$x^2 - 12x$		$x^2 + 20x$
	$\left(\frac{1}{2} \cdot 12\right)^2 = 6^2 = 36$		$\left(\frac{1}{2} \cdot 20\right)^2 = 10^2 = 100$
	$x^2 - 12x + \boxed{36}$		$x^2 + 20x + \boxed{100}$
39.		40.	
	$x^2 - \frac{1}{2}x$		$x^2 - \frac{1}{3}x$
	$\left(\frac{1}{2} \cdot \frac{1}{2}\right)^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$		$\left(\frac{1}{3} \cdot \frac{1}{2}\right)^2 = \left(\frac{1}{6}\right)^2 = \frac{1}{36}$
	$x^2 - \frac{1}{2}x + \boxed{\frac{1}{16}}$		$x^2 - \frac{1}{3}x + \boxed{\frac{1}{36}}$

41.	42.
$x^2 + \dfrac{2}{5}x$ $\left(\dfrac{1}{2}\cdot\dfrac{2}{5}\right)^2 = \left(\dfrac{1}{5}\right)^2 = \dfrac{1}{25}$ $x^2 + \dfrac{2}{5}x + \boxed{\dfrac{1}{25}}$	$x^2 + \dfrac{4}{5}x$ $\left(\dfrac{1}{2}\cdot\dfrac{4}{5}\right)^2 = \left(\dfrac{2}{5}\right)^2 = \dfrac{4}{25}$ $x^2 + \dfrac{4}{5}x + \boxed{\dfrac{4}{25}}$
43.	44.
$x^2 - 2.4x$ $\left(\dfrac{1}{2}\cdot 2.4\right)^2 = 1.2^2 = 1.44$ $x^2 - 2.4 + \boxed{1.44}$	$x^2 + 1.6x$ $\left(\dfrac{1}{2}\cdot 1.6\right)^2 = 0.8^2 = 0.64$ $x^2 + 1.6x + \boxed{0.64}$
45.	46.
$x^2 + 2x = 3$ $x^2 + 2x + 1 = 3 + 1$ $(x+1)^2 = 4$ $x + 1 = \pm 2$ $x = -1 \pm 2$ $\boxed{x = -3, 1}$	$y^2 + 8y - 2 = 0$ $y^2 + 8y + 16 = 2 + 16$ $(y+4)^2 = 18$ $y + 4 = \pm\sqrt{18}$ $\boxed{y = -4 \pm 3\sqrt{2}}$
47.	48.
$t^2 - 6t = -5$ $t^2 - 6t + 9 = -5 + 9$ $(t-3)^2 = 4$ $t - 3 = \pm 2$ $\boxed{t = 3 \pm 2 = 1, 5}$	$x^2 + 10x = -21$ $x^2 + 10x + 25 = -21 + 25$ $(x+5)^2 = 4$ $x + 5 = \pm 2$ $\boxed{x = -5 \pm 2 = -7, -3}$
49.	50.
$y^2 - 4y = -3$ $y^2 - 4y + 4 = -3 + 4$ $(y-2)^2 = 1$ $y - 2 = \pm 1$ $\boxed{y = \pm 1 + 2 = 1, 3}$	$x^2 - 7x = -12$ $x^2 - 7x + \left(\dfrac{7}{2}\right)^2 = -12 + \left(\dfrac{7}{2}\right)^2$ $\left(x - \dfrac{7}{2}\right)^2 = -12 + \dfrac{49}{4} = \dfrac{1}{4}$ $x - \dfrac{7}{2} = \pm\dfrac{1}{2}$ $\boxed{x = \dfrac{7}{2} \pm \dfrac{1}{2} = 3, 4}$

51. $2p^2 + 8p = -3$ $2(p^2 + 4p) = -3$ $2(p^2 + 4p + 4) = -3 + 8$ $2(p+2)^2 = 5$ $(p+2)^2 = \dfrac{5}{2}$ $p + 2 = \pm\sqrt{\dfrac{5}{2}}$ $\boxed{p = -2 \pm \sqrt{\dfrac{5}{2}} = \dfrac{-4 \pm \sqrt{10}}{2}}$	**52.** $2x^2 - 4x = -3$ $2(x^2 - 2x) = -3$ $2(x^2 - 2x + 1) = -3 + 2$ $2(x-1)^2 = -1$ $(x-1)^2 = \dfrac{-1}{2}$ $x - 1 = \pm i\dfrac{1}{\sqrt{2}}$ $\boxed{x = 1 \pm i\dfrac{\sqrt{2}}{2}}$
53. $2x^2 - 7x = -3$ $2\left(x^2 - \dfrac{7}{2}x\right) = -3$ $2\left(x^2 - \dfrac{7}{2}x + \left(\dfrac{7}{4}\right)^2\right) = -3 + 2\left(\dfrac{7}{4}\right)^2$ $2\left(x - \dfrac{7}{4}\right)^2 = -3 + 2\left(\dfrac{49}{16}\right)$ $\left(x - \dfrac{7}{4}\right)^2 = \dfrac{-3}{2} + \dfrac{49}{16} = \dfrac{25}{16}$ $x - \dfrac{7}{4} = \pm\dfrac{5}{4}$ $\boxed{x = \dfrac{7}{4} \pm \dfrac{5}{4} = \dfrac{1}{2}, 3}$	**54.** $3x^2 - 5x = 10$ $3\left(x^2 - \dfrac{5}{3}x\right) = 10$ $3\left(x^2 - \dfrac{5}{3}x + \left(\dfrac{5}{6}\right)^2\right) = 10 + 3\left(\dfrac{5}{6}\right)^2$ $3\left(x - \dfrac{5}{6}\right)^2 = 10 + 3\left(\dfrac{25}{36}\right)$ $\left(x - \dfrac{5}{6}\right)^2 = \dfrac{10}{3} + \dfrac{25}{36} = \dfrac{145}{36}$ $x - \dfrac{5}{6} = \pm\sqrt{\dfrac{145}{36}} = \pm\dfrac{\sqrt{145}}{6}$ $(145 = 5 \cdot 29)$ so the radical can't be reduced. $\boxed{x = \dfrac{5}{6} \pm \dfrac{\sqrt{145}}{6} = \dfrac{5 \pm \sqrt{145}}{6}}$

55.	$\dfrac{x^2}{2} - 2x = \dfrac{1}{4}$ $x^2 - 4x = \dfrac{1}{2}$ $x^2 - 4x + 4 = \dfrac{1}{2} + 4$ $(x-2)^2 = \dfrac{9}{2}$ $x - 2 = \pm \dfrac{3}{\sqrt{2}}$ $\boxed{x = 2 \pm \dfrac{3}{\sqrt{2}} = \dfrac{4 \pm 3\sqrt{2}}{2}}$	**56.**	$\dfrac{t^2}{3} + \dfrac{2t}{3} + \dfrac{5}{6} = 0$ $t^2 + 2t = -\dfrac{5}{2}$ $t^2 + 2t + 1 = -\dfrac{5}{2} + 1$ $(t+1)^2 = \dfrac{-3}{2}$ $t + 1 = \pm i \sqrt{\dfrac{3}{2}}$ $\boxed{t = -1 \pm i \sqrt{\dfrac{3}{2}} = -1 \pm i \dfrac{\sqrt{6}}{2}}$
57.	$t^2 + 3t - 1 = 0$ $t = \dfrac{-3 \pm \sqrt{9 + 4}}{2}$ $\boxed{t = \dfrac{-3 \pm \sqrt{13}}{2}}$	**58.**	$t^2 + 2t - 1 = 0$ $t = \dfrac{-2 \pm \sqrt{4 + 4}}{2} = -1 \pm \dfrac{1}{2}\sqrt{8}$ $\boxed{t = -1 \pm \sqrt{2}}$
59.	$s^2 + s + 1 = 0$ $s = \dfrac{-1 \pm \sqrt{1 - 4}}{2} = \dfrac{-1 \pm \sqrt{-3}}{2}$ $\boxed{s = \dfrac{-1 \pm i\sqrt{3}}{2}}$	**60.**	$2s^2 + 5s + 2 = 0$ $s = \dfrac{-5 \pm \sqrt{25 - 16}}{4} = \dfrac{-5 \pm \sqrt{9}}{4}$ $\boxed{s = \dfrac{-5 \pm 3}{4} = -2, \dfrac{-1}{2}}$
61.	$3x^2 - 3x - 4 = 0$ $x = \dfrac{3 \pm \sqrt{9 + 48}}{6} = \dfrac{1}{2} \pm \dfrac{\sqrt{57}}{6}$ $\boxed{x = \dfrac{3 \pm \sqrt{57}}{6}}$	**62.**	$4x^2 - 2x - 7 = 0$ $x = \dfrac{2 \pm \sqrt{4 + 4 \cdot 28}}{8} = \dfrac{2 \pm \sqrt{116}}{8}$ $\left(116 = 2^2 \cdot 29\right)$ $\boxed{x = \dfrac{2 \pm 2\sqrt{29}}{8} = \dfrac{1 \pm \sqrt{29}}{4}}$

63. $x^2 - 2x + 17 = 0$ $x = \dfrac{2 \pm \sqrt{4 - 4 \cdot 17}}{2} = \dfrac{2 \pm \sqrt{-64}}{2}$ $\boxed{x = \dfrac{2 \pm 8i}{2} = 1 \pm 4i}$	**64.** $4m^2 + 7m + 8 = 0$ $m = \dfrac{-7 \pm \sqrt{49 - 4 \cdot 32}}{8} = \dfrac{-7 \pm \sqrt{-79}}{8}$ $\boxed{m = -\dfrac{7}{8} \pm i\dfrac{\sqrt{79}}{8}}$
65. $5x^2 + 7x - 3 = 0$ $x = \dfrac{-7 \pm \sqrt{49 + 60}}{10}$ $\boxed{x = \dfrac{-7 \pm \sqrt{109}}{10}}$	**66.** $3x^2 + 5x + 11 = 0$ $x = \dfrac{-5 \pm \sqrt{25 - 132}}{6} = \dfrac{-5 \pm \sqrt{-107}}{6}$ $\boxed{x = -\dfrac{5}{6} \pm i\dfrac{\sqrt{107}}{6}}$
67. $\frac{1}{4}x^2 + \frac{2}{3}x - \frac{1}{2} = 0$ $3x^2 + 8x - 6 = 0$ $x = \dfrac{-8 \pm \sqrt{64 - 4(3)(-6)}}{2(3)} = \dfrac{-8 \pm 2\sqrt{34}}{2(3)}$ $\boxed{x = \dfrac{-4 \pm \sqrt{34}}{3}}$	**68.** $\frac{1}{4}x^2 - \frac{2}{3}x - \frac{1}{3} = 0$ $3x^2 - 8x - 4 = 0$ $x = \dfrac{8 \pm \sqrt{64 - 4(3)(-4)}}{2(3)} = \dfrac{8 \pm 4\sqrt{7}}{2(3)}$ $\boxed{x = \dfrac{4 \pm 2\sqrt{7}}{3}}$
69. $(-22)^2 - 4(1)(121) = 484 - 484 = \boxed{0}$ $\boxed{1 \text{ real solution}}$ (repeated root)	**70.** $(-28)^2 - 4(1)(196) = 784 - 784 = \boxed{0}$ $\boxed{1 \text{ real solution}}$ (repeated root)
71. $(-30)^2 - 4(2)(68) = 900 - 544 = \boxed{356}$ $\boxed{2 \text{ real solutions}}$ (distinct)	**72.** $(27)^2 - 4(-3)(66) = 729 + 792 = \boxed{1521}$ $\boxed{2 \text{ real solutions}}$ (distinct)
73. $(-7)^2 - 4(9)(8) = 49 - 288 = \boxed{-239}$ $\boxed{2 \text{ complex solutions}}$ (complex conjugate)	**74.** $(5)^2 - 4(-3)(-7) = 25 - 84 = \boxed{-59}$ $\boxed{2 \text{ complex solutions}}$ (complex conjugate)
75. $v^2 - 8v - 20 = 0$ $(v - 10)(v + 2) = 0$ $\boxed{v = -2, 10}$	**76.** $v^2 - 8v + 20 = 0$ $v = \dfrac{8 \pm \sqrt{64 - 80}}{2} = \dfrac{8 \pm \sqrt{-16}}{2}$ $\boxed{v = \dfrac{8 \pm 4i}{2} = 4 \pm 2i}$

77.	$t^2 + 5t - 6 = 0$	78.	$t^2 + 5t + 6 = 0$
	$(t+6)(t-1) = 0$		$(t+2)(t+3) = 0$
	$\boxed{t = -6, 1}$		$\boxed{t = -2, -3}$
79.	$(x+3)^2 = 16$	80.	$(x+3)^2 = -16$
	$x + 3 = \pm 4$		$x + 3 = \pm 4i$
	$\boxed{x = -3 \pm 4 = -7, 1}$		$\boxed{x = -3 \pm 4i}$
81.	$(p-2)^2 = 4p$	82.	$(u+5)^2 = 16u$
	$p^2 - 4p + 4 = 4p$		$u^2 + 10u + 25 = 16u$
	$p^2 - 8p + 4 = 0$		$u^2 - 6u + 25 = 0$
	$p = \dfrac{8 \pm \sqrt{64 - 4(1)(4)}}{2(1)} = \dfrac{8 \pm 4\sqrt{3}}{2}$		$u = \dfrac{6 \pm \sqrt{36 - 4(25)}}{2} = \dfrac{6 \pm 8i}{2}$
	$\boxed{p = 4 \pm 2\sqrt{3}}$		$\boxed{u = 3 \pm 4i}$
83.	$8w^2 + 2w + 21 = 0$	84.	$8w^2 + 2w - 21 = 0$
	$w = \dfrac{-2 \pm \sqrt{4 - 4 \cdot 8 \cdot 21}}{16}$		$(4w+7)(2w-3) = 0$
	$w = \dfrac{-2 \pm \sqrt{-668}}{16} = \dfrac{-2 \pm 2i\sqrt{167}}{16}$		$4w + 7 = 0 \text{ or } 2w - 3 = 0$
	$\boxed{w = \dfrac{-1 \pm i\sqrt{167}}{8}}$		$\boxed{w = \dfrac{-7}{4}, \dfrac{3}{2}}$
85.	$3p^2 - 9p + 1 = 0$	86.	$3p^2 - 9p - 1 = 0$
	$p = \dfrac{9 \pm \sqrt{81 - 12}}{6}$		$p = \dfrac{9 \pm \sqrt{81 + 12}}{6}$
	$\boxed{p = \dfrac{9 \pm \sqrt{69}}{6}}$		$\boxed{p = \dfrac{9 \pm \sqrt{93}}{6}}$

87. $\dfrac{2}{3}t^2 - \dfrac{4}{3}t - \dfrac{1}{5} = 0$ $LCD = 15$ $10t^2 - 20t - 3 = 0$ $t = \dfrac{20 \pm \sqrt{400 + 120}}{20}$ $t = \dfrac{20 \pm \sqrt{520}}{20} = \dfrac{20 \pm 2\sqrt{130}}{20}$ $\boxed{t = \dfrac{10 \pm \sqrt{130}}{10}}$	**88.** $\dfrac{1}{2}x^2 + \dfrac{2}{3}x - \dfrac{2}{5} = 0$ $LCD = 30$ $15x^2 + 20x - 12 = 0$ $x = \dfrac{-20 \pm \sqrt{400 + 4 \cdot 15 \cdot 12}}{30}$ $x = \dfrac{-20 \pm \sqrt{1120}}{30}$ $x = \dfrac{-20 \pm 4\sqrt{70}}{30}$ $\boxed{x = \dfrac{-10 \pm 2\sqrt{70}}{15}}$
89. $x + \dfrac{12}{x} = 7 \quad \boxed{x \neq 0}$ $x^2 + 12 = 7x$ $x^2 - 7x + 12 = 0$ $(x - 3)(x - 4) = 0$ $x - 3 = 0$ or $x - 4 = 0$ $\boxed{x = 3 \text{ or } x = 4}$	**90.** $x - \dfrac{10}{x} = -3 \quad \boxed{x \neq 0}$ $x^2 - 10 = -3x$ $x^2 + 3x - 10 = 0$ $(x + 5)(x - 2) = 0$ $x + 5 = 0$ or $x - 2 = 0$ $\boxed{x = -5 \text{ or } x = 2}$
91. $\dfrac{4(x - 2)}{x - 3} + \dfrac{3}{x} = \dfrac{-3}{x(x - 3)} \quad \boxed{x \neq 0, 3}$ $LCD = x(x - 3)$ $4x(x - 2) + 3(x - 3) = -3$ $4x^2 - 8x + 3x - 9 = -3$ $4x^2 - 5x - 6 = 0$ $(4x + 3)(x - 2) = 0$ $4x + 3 = 0$ or $x - 2 = 0$ $\boxed{x = -3/4 \text{ or } x = 2}$	**92.** $\dfrac{5}{y + 4} = 4 + \dfrac{3}{y - 2} \quad \boxed{y \neq -4, 2}$ $LCD = (y + 4)(y - 2)$ $5(y - 2) = 4(y + 4)(y - 2) + 3(y + 4)$ $5y - 10 = 4(y^2 + 2y - 8) + 3y + 12$ $5y - 10 = 4y^2 + 8y - 32 + 3y + 12$ $-4y^2 - 6y + 10 = 0$ $2y^2 + 3y - 5 = 0$ $(2y + 5)(y - 1) = 0$ $2y + 5 = 0$ or $y - 1 = 0$ $\boxed{y = -\frac{5}{2} \text{ or } y = 1}$

93. $x^2 - 0.1x - 0.12 = 0$	94. $y^2 - 0.5y + 0.06 = 0$

93.

$$x^2 - 0.1x - 0.12 = 0$$
$$(x - 0.4)(x + 0.3) = 0$$
$$\boxed{x = -0.3,\ 0.4}$$

94.

$$y^2 - 0.5y + 0.06 = 0$$
$$(y - 0.2)(y - 0.3) = 0$$
$$\boxed{y = 0.2,\ 0.3}$$

95.

$$6.25t^2 - 35t + 360 = 310$$
$$6.25t^2 - 35t + 50 = 0$$
$$625t^2 - 3500t + 5000 = 0$$
$$625\left(t^2 - 6t + 8\right) = 0$$
$$625(t - 4)(t - 2) = 0$$
$$\boxed{\begin{aligned} t = 4 \text{ (March 2015) and} \\ 2\,(\text{January 2015}) \end{aligned}}$$

96.

$$-0.39t^2 + 4.29t + 120.1 = 124$$
$$-0.39t^2 + 4.29t - 3.9 = 0$$
$$39t^2 - 429t + 390 = 0$$
$$39\left(t^2 - 11t + 10\right) = 0$$
$$39(t - 1)(t - 10) = 0$$
$$\boxed{\begin{aligned} t = 1 \text{ (Dec. 2014) and} \\ 10 \text{ (Sept. 2015)} \end{aligned}}$$

97. Solve $P(q) = 0$:

$$-100 + (0.2q - 3)q = 0$$
$$-100 + 0.2q^2 - 3q = 0$$
$$0.2q^2 - 3q - 100 = 0$$
$$q^2 - 15q - 500 = 0$$
$$q = \frac{15 \pm \sqrt{(-15)^2 - 4(1)(-500)}}{2(1)}$$
$$= \frac{15 \pm \sqrt{2,225}}{2} = \frac{15 \pm 47.17}{2}$$
$$= 31.085,\ \cancel{-16.09}$$

So, approximately 31,000 units must be sold to break even.

98. Solve $P(q) = 40$:

$$-100 + (0.2q - 3)q = 40$$
$$-100 + 0.2q^2 - 3q = 40$$
$$0.2q^2 - 3q - 140 = 0$$
$$q^2 - 15q - 700 = 0$$
$$(q - 35)(q + 20) = 0$$
$$q = 35,\ \cancel{-20}$$

So, 35,000 units must be sold to achieve this profit level.

99. Solve $P(x) = 460$:

$$-5(x + 3)(x - 24) = 460$$
$$-5x^2 + 105x + 360 = 460$$
$$-5x^2 + 105x - 100 = 0$$
$$x^2 - 21x + 20 = 0$$
$$(x - 20)(x - 1) = 0$$
$$x = 1,\ 20$$

So, the smallest price increase that will produce a weekly profit of $460 is $1 per bottle.

100. Solve $P(x) = 630$:

$$-5(x + 3)(x - 24) = 630$$
$$-5x^2 + 105x + 360 = 630$$
$$-5x^2 + 105x - 270 = 0$$
$$x^2 - 21x + 54 = 0$$
$$(x - 18)(x - 3) = 0$$
$$x = 3,\ 18$$

So, the smallest price increase that will produce a weekly profit of $630 is $3 per bottle.

101. Solve $P(t) = 160$, $1 \leq t \leq 6$:	**102.** Solve $P(t) = 172$, $1 \leq t \leq 6$:
$-t^2 + 13t + 130 = 160$	$-t^2 + 13t + 130 = 172$
$-t^2 + 13t - 30 = 0$	$-t^2 + 13t - 42 = 0$
$t^2 - 13t + 30 = 0$	$t^2 - 13t + 42 = 0$
$(t - 10)(t - 3) = 0$	$(t - 6)(t - 7) = 0$
$t = 3, \cancel{10}$	$t = 6, \cancel{7}$
So, 160 people would have contracted the flu after 3 days.	So, 172 people would have contracted the flu after 6 days.
103. a.	**104. a.**
<u>The width of useable space =</u> $(8.5 - 2(1))$ inches = 6.5 inches	<u>The width of useable space =</u> $(8.5 - 2(1))$ inches = 6.5 inches
<u>The length of useable space =</u> $(11 - 2(1.25))$ inches = 8.5 inches	<u>The length of useable space =</u> $(11 - 2(1))$ inches = 9 inches
So, the amount of useable space is the area, namely (6.5 in)(8.5 in) = 55.25 in².	So, the amount of useable space is the area, namely (6.5 in)(9 in) = 58.5 in².
b. Let x = amount of margin reduction (in inches)	**b.** Let x = amount of margin reduction (in inches)
<u>Width of useable space =</u> $8.5 - 2(1) + 2x = 6.5 + 2x$	<u>Width of useable space =</u> $8.5 - 2(1) + 2x = 6.5 + 2x$
<u>Length of useable space =</u> $11 - 2(1.25) + 2x = 8.5 + 2x$	<u>Length of useable space =</u> $11 - 2(1) + 2x = 9 + 2x$
So, the useable area is $(6.5 + 2x)(8.5 + 2x) = 55.25 + 30x + 4x^2$	So, the useable area is $(6.5 + 2x)(9 + 2x) = 58.5 + 31x + 4x^2$
c. $55.25 + 30x + 4x^2$ - 55.25 = $4x^2 + 30x$	**c.** $58.5 + 31x + 4x^2$ - 58.5 = $4x^2 + 31x$
This represents the increase in useable area of the paper.	This represents the increase in useable area of the paper.
d. Find x such that $10\left(55.25 + 30x + 4x^2\right) = 11(55.25)$.	**d.** Find x such that $15\left(58.5 + 31x + 4x^2\right) = 16(58.5)$.
Solving for x yields:	Solving for x yields:
$552.5 + 300x + 40x^2 = 607.75$	$60x^2 + 465x - 58.5 = 0$
$40x^2 + 300x - 55.25 = 0$	$12x^2 + 93x - 11.7 = 0$
$8x^2 + 60x - 11.05 = 0$	**Continued onto next page.**
Continued onto next page.	

$$x = \frac{-60 \pm \sqrt{60^2 - 4(8)(-11.05)}}{2(8)}$$ $$= \frac{-60 \pm \sqrt{3,953.6}}{16} \approx \frac{2.877}{16} \approx 0.2$$ So, about 0.2 inches.	$$x = \frac{-93 \pm \sqrt{93^2 - 4(12)(-11.7)}}{2(12)}$$ $$= \frac{-93 \pm \sqrt{9,210.6}}{24} \approx \frac{2.9719}{24} \approx 0.1$$ So, about 0.1 inches.
105. Form a right triangle with legs of length x and 25in. and hypotenuse of length 32in. Then, by the Pythagorean Theorem, we solve: $$x^2 + 25^2 = 32^2$$ $$x^2 = 399$$ $$x = \pm\sqrt{399} \approx \pm 20$$ So, the TV is approximately $\boxed{20 \text{ inches}}$ high.	**106.** Form a right triangle with legs of length x and 20in. and hypotenuse of length 42in. Then, by the Pythagorean Theorem, we solve: $$x^2 + 20^2 = 42^2$$ $$x^2 = 1364$$ $$x = \pm\sqrt{1364} \approx \pm 37$$ So, the TV is approximately $\boxed{37 \text{ inches}}$ wide.
107. Let the numbers be x, $x+1$. $$x + (x+1) = 35$$ $$2x = 34 \implies x = 17$$ $$x(x+1) = 306$$ $$x^2 + x = 306$$ $$x^2 + x - 306 = 0$$ $$(x+18)(x-17) = 0$$ $$x = \cancel{-18}, 17$$ So, $\boxed{\text{the numbers are 17 and 18}}$.	**108.** Let the numbers be x, $x+2$. $$x + (x+2) = 24$$ $$2x = 22 \implies x = 11$$ $$x(x+2) = 143$$ $$x^2 + 2x = 143$$ $$x^2 + 2x - 143 = 0$$ $$(x+13)(x-11) = 0$$ $$x = \cancel{-13}, 11$$ So, $\boxed{\text{the numbers are 11 and 13}}$.
109. Let l = length of the rectangle (in ft.) Then, the width $w = l - 6$ (in ft.) We must solve: $$135 = lw$$ $$135 = l(l-6)$$ $$l^2 - 6l - 135 = 0$$ $$(l-15)(l+9) = 0$$ $$l = 15, \cancel{-9}$$ So, the rectangle has: $\boxed{\text{length 15ft. and width 9ft.}}$	**110.** $$\text{Area} = \text{length} \cdot \text{width} = (2w+2)(w) = 31.5$$ $$2w^2 + 2w - 31.5 = 0$$ $$w = \frac{-2 \pm \sqrt{4 + 4 \cdot 2 \cdot 31.5}}{4}$$ $$w = \frac{-2 \pm \sqrt{256}}{4} = \frac{-2 \pm 16}{4}$$ Widths and lengths are always positive, so $$\boxed{w = \frac{14}{4} = \frac{7}{2}m, \ l = 2\left(\frac{7}{2}\right) + 2 = 9m}$$

111.	112.
$\text{Area} = \dfrac{1}{2}b \cdot h = 60$ $h = 3b + 2$ $\dfrac{1}{2}b(3b + 2) = 60$ $\dfrac{3}{2}b^2 + b = 60$ $3b^2 + 2b - 120 = 0$ $(3b + 20)(b - 6) = 0$ $\boxed{b = \dfrac{-20}{3}, \ 6; \ h = 20}$	$s^2 = A$ $(s + 3)^2 = A + 69$ $(s + 3)^2 = s^2 + 69$ $s^2 + 6s + 9 = s^2 + 69$ $6s - 60 = 0$ $\boxed{s = 10 \text{ yards}}$
113.	114.
$h = -16t^2 + 100$ $\text{Ground} \to h = 0$ $-16t^2 + 100 = 0$ $t^2 = \dfrac{100}{16}$ $t = \pm\dfrac{10}{4} \ (\text{Time must be} \geq 0)$ $\boxed{\text{Impact with ground in 2.5 sec}}$	$h = -16t^2 - 5t + 100$ $\text{Ground} \to h = 0$ $16t^2 + 5t - 100 = 0$ $t = \dfrac{-5 \pm \sqrt{25 + 4 \cdot 16 \cdot 100}}{32}$ $t = \dfrac{-5 \pm \sqrt{6425}}{32} = \dfrac{-5 \pm 5\sqrt{257}}{32}$ $\boxed{t \cong 2.3 \text{ sec}}$
115.	116.
$15^2 + 15^2 = r^2$ $r^2 = 450$ $r = \pm\sqrt{450} = \pm 15\sqrt{2}$ $\boxed{r \approx 21.2 \text{ feet}}$	$d^2 = 90^2 + 90^2$ $d^2 = 16200$ $d = \pm\sqrt{16200} = \pm 90\sqrt{2}$ $\boxed{d \cong 127 \text{ feet}}$

117.	volume $= l \cdot w \cdot h$	118.	volume $= l \cdot w \cdot h = 12$

117. volume $= l \cdot w \cdot h$

$v = (x-2)(x-2)(1)$

$9 = (x-2)^2$

$x - 2 = \pm 3$

$x = 2 \pm 3 = -1, 5$

$x = 5$

$\boxed{\text{Original square was } 5\text{ft} \times 5\text{ft}}$

118. volume $= l \cdot w \cdot h = 12$

$l = 2w, \ h = 1$

$v = (2w-2)(w-2)(1) = 12$

$(2w-2)(w-2) = 12$

$2w^2 - 6w + 4 = 12$

$2w^2 - 6w - 8 = 0$

$w^2 - 3w - 4 = 0$

$(w+1)(w-4) = 0$

$\boxed{\text{Original rectangle was } 4\text{ft} \times 8\text{ft}}$

119. Let $w =$ width of border

Total area of garden $+$ border $= (8+2w)(5+2w) = 4w^2 + 26w + 40$

Area of garden $= 8 \cdot 5 = 40$

Area of border $= \underbrace{(4w^2 + 26w + 40)}_{total} - \underbrace{40}_{garden} = 4w^2 + 26w$

Volume of border $=$ Area $\cdot$ depth $\ \left(\text{depth} = 4\,\text{in.} = 1/3\,\text{ft}\right)$

$$= (4w^2 + 26w)(1/3)$$

Volume $= 27\ \text{ft}^3$

$\dfrac{1}{3}(4w^2 + 26w) = 27$

$4w^2 + 26w = 81$

$4w^2 + 26w - 81 = 0$

$w = \dfrac{-26 \pm \sqrt{26^2 + 4 \cdot 4 \cdot 81}}{2 \cdot 4} = \dfrac{-26 \pm \sqrt{1972}}{8}$

$w \cong \cancel{-8.8}, 2.3$

$\boxed{\text{Width of border is 2.3 feet.}}$

120.	Area of Rose Garden $= \dfrac{\pi r^2}{2} = \dfrac{\pi 6^2}{2} = 18\pi$ Volume of mulch $=$ Area $\cdot$ depth $= 18\pi \cdot d$ Volume of mulch $= 54 \text{ ft}^3$ $18\pi d = 54$ $d = \dfrac{54}{18\pi} \cong 0.95$ $\boxed{\text{Mulch will be about 1 foot deep}}$
121.	Let $x =$ days for Kimmie to complete job herself. $x - 5 =$ days for Lindsey to complete job herself. $\dfrac{1}{x} = \%$ of job Kimmie can do per day. $\dfrac{1}{x-5} = \%$ of job Lindsey can do per day. $\dfrac{1}{x} + \dfrac{1}{x-5} = \dfrac{1}{6}$ (Together they can do it in 6 days.) $\text{LCD} = x(x-5)6 \quad \boxed{x \neq 0, 5}$ $6(x-5) + 6x = x(x-5)$ $6x - 30 + 6x = x^2 - 5x$ $x^2 - 17x + 30 = 0$ $(x-15)(x-2) = 0$ $x = \cancel{2}, 15$ Kimmie alone: 15 days $\boxed{\text{Lindsey alone: 10 days}}$
122.	Jack can clean $\dfrac{1}{4}$ house per hour. Ryan can clean $\dfrac{1}{6}$ house per hour. Together they can clean $\dfrac{1}{4} + \dfrac{1}{6} = \dfrac{10}{24} = \dfrac{5}{12}$ house per hour. $\boxed{\text{They can clean the house in } \dfrac{12}{5} = 2.4 \text{ hours.}}$

123. Factored incorrectly $t^2 - 5t - 6 = 0$ $(t+1)(t-6) = 0$ $\boxed{t = -1,\, 6}$	**124.** Forgot $\pm$ $(2y-3)^2 = 25$ $2y - 3 = \pm 5$ $2y = 3 \pm 5$ $y = \dfrac{3 \pm 5}{2} = -1,\, 4$
125. $\sqrt{-a}$ is imaginary for positive a $a^2 = -\dfrac{9}{16}$, so $\boxed{a = \pm\sqrt{\dfrac{9}{16}} = \pm\dfrac{3}{4}i}$	**126.** In completing the square we should add $2\,(\text{not } 1)$ to the right side. So, $2(x^2 - 2x + 1) = 3 + 2$. The solutions are $1 \pm \sqrt{\tfrac{5}{2}}$.
127. False $x = -5/3$ satisfies 1ˢᵗ equation but not 2ⁿᵈ	**128.** True
129. True	**130.** True
131. If $x = a$ is a repeated root for a quadratic equation, then $(x-a)^2 = 0$. Simplifying yields: $\boxed{x^2 - 2ax + a^2 = 0}$	**132.** If $x = bi$ is a root for a quadratic equation, then so is $x = -bi$. $$(x + bi)(x - bi) = 0$$ Then, $x^2 - b^2 i^2 = 0$ $\boxed{x^2 + b^2 = 0}$
133. $(x-2)(x-5) = 0$ $\boxed{x^2 - 7x + 10 = 0}$	**134.** $x(x+3) = 0$ $\boxed{x^2 + 3x = 0}$
135. $$s = \frac{1}{2} g t^2$$ $$t^2 = \frac{2s}{g}$$ $$\boxed{t = \pm\sqrt{\frac{2s}{g}}}$$	**136.** $$A = P(1+r)^2$$ $$\frac{A}{P} = (1+r)^2$$ $$1 + r = \pm\sqrt{\frac{A}{P}}$$ $$\boxed{r = -1 \pm \sqrt{\frac{A}{P}}}$$
137. $$a^2 + b^2 = c^2$$ $$\boxed{c = \pm\sqrt{a^2 + b^2}}$$	**138.** $$P = EI - RI^2$$ $$RI^2 - EI + P = 0$$ This equation is quadratic in I. $$\boxed{I = \frac{E \pm \sqrt{E^2 - 4RP}}{2R}}$$

139.	140.
$x^4 - 4x^2 = 0$ $\quad$ $x^2(x^2 - 4) = 0$ $\quad$ $x^2(x-2)(x+2) = 0$ $\quad$ $\boxed{x = 0, \pm 2}$	$3x - 6x^2 = 0$ $\quad$ $3x(1 - 2x) = 0$ $\quad$ $\boxed{x = 0, \tfrac{1}{2}}$

141.	142.
$x^3 + x^2 - 4x - 4 = 0$ $\quad$ $(x^3 + x^2) - 4(x+1) = 0$ $\quad$ $x^2(x+1) - 4(x+1) = 0$ $\quad$ $(x^2 - 4)(x+1) = 0$ $\quad$ $(x-2)(x+2)(x+1) = 0$ $\quad$ $\boxed{x = -1, \pm 2}$	$x^3 + 2x^2 - x - 2 = 0$ $\quad$ $(x^3 + 2x^2) - (x+2) = 0$ $\quad$ $x^2(x+2) - (x+2) = 0$ $\quad$ $(x^2 - 1)(x+2) = 0$ $\quad$ $(x-1)(x+1)(x+2) = 0$ $\quad$ $\boxed{x = \pm 1, -2}$

143.

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \qquad\qquad x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

$$x_1 + x_2 = \frac{-b}{2a} + \frac{\sqrt{b^2 - 4ac}}{2a} - \frac{b}{2a} - \frac{\sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-2b}{2a} = \boxed{\frac{-b}{a}}$$

144.

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \qquad\qquad x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

$$x_1 \cdot x_2 = \frac{\left(-b + \sqrt{b^2 - 4ac}\right)\left(-b - \sqrt{b^2 - 4ac}\right)}{2a \cdot 2a}$$

$$= \frac{b^2 - (b^2 - 4ac)}{4a^2} = \frac{4ac}{4a^2} = \boxed{\frac{c}{a}}$$

145.	146.
$\left[x-\left(3+\sqrt{5}\right)\right]\left[x-\left(3-\sqrt{5}\right)\right]=0$	$\left[x-\left(2-i\right)\right]\left[x-\left(2+i\right)\right]=0$
$\left[(x-3)-\sqrt{5}\right]\left[(x-3)+\sqrt{5}\right]=0$	$\left[(x-2)+i\right]\left[(x-2)-i\right]=0$
$(x-3)^2-5=0$	$(x-2)^2-i^2=0$
$x^2-6x+9-5=0$	$x^2-4x+4+1=0$
$\boxed{x^2-6x+4=0}$	$\boxed{x^2-4x+5=0}$

147.

Let x = speed in still air and y = time to make the trip with a tail wind.

Using Distance = Rate × Time, we obtain the following two equations:

With tail wind: $(x+50)y=600$ **(1)**

Against head wind:
$(x-50)(y+1)=600$ **(2)**

Solve **(1)** for y: $y=\dfrac{600}{x+50}$

Substitute this into **(2)** and solve for x:

$(x-50)\left(\dfrac{600}{x+50}+1\right)=600$

$(x-50)\left(\dfrac{600+x+50}{x+50}\right)=600$

$(x-50)(650+x)=600(x+50)$

$650x-32,500-50x+x^2=600x+30,000$

$x^2-62,500=0$

$(x-250)(x+250)=0$

$x=250,\ \cancel{-250}$

So, the plane in still air travels at $\boxed{250\text{mph}}$.

148.

Let c = Current rate.

Down river: rate $=10+c$ in t hours

Up river: rate $=10-c$ in $t+1$ hours.

Using Distance = Rate × Time, we obtain:

Distance down river: $d=(10+c)(t)=24$ **(1)**

Distance up river: $d=(10-c)(t+1)=24$ **(2)**

Equating **(1)** and **(2)** yields:

$(10+c)(t)=(10-c)(t+1)$

$10t+ct=10t+10-ct-c$

$2ct=10-c$

$t=\dfrac{10-c}{2c}$ **(3)**

Substitute **(3)** into **(1)** to solve for c:

$(10+c)\left(\dfrac{10-c}{2c}\right)=24$

$(10+c)(10-c)=2c(24)$

$100-c^2=48c$

$-c^2-48c+100=0$

$c^2+48c-100=0$

$c=\dfrac{-48\pm\sqrt{48^2+400}}{2}$

$=\dfrac{-48\pm\sqrt{2704}}{2}=\dfrac{-48\pm52}{2}$

The rate must be postive, so $\boxed{c=2\text{ mph}}$.

149.
2 distinct real roots of $ax^2 + bx + c = 0$ are: $x_1 = \dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$ $x_2 = \dfrac{-b - \sqrt{b^2 - 4ac}}{2a}$

If real roots are negatives of x_1, x_2, then $x_1^* = \dfrac{b - \sqrt{b^2 - 4ac}}{2a}$ $x_2^* = \dfrac{b + \sqrt{b^2 - 4ac}}{2a}$

Replace b with $-b$. So, $\boxed{ax^2 - bx + c = 0}$.

150.
$$ax^2 + bx + c = 0 \implies x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Label the roots as $x_1 = \dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$, $x_2 = \dfrac{-b - \sqrt{b^2 - 4ac}}{2a}$

$$\boxed{x_1^* = \frac{1}{x_1} = \frac{2a}{-b + \sqrt{b^2 - 4ac}} \qquad x_2^* = \frac{1}{x_2} = \frac{-2a}{b + \sqrt{b^2 - 4ac}}}$$

Using these roots in a new quadratic equation,

$$\left[x - \frac{2a}{-b + \sqrt{b^2 - 4ac}} \right]\left[x - \frac{-2a}{b + \sqrt{b^2 - 4ac}} \right] = 0$$

$$\left[x + \frac{2a}{b - \sqrt{b^2 - 4ac}} \right]\left[x + \frac{2a}{b + \sqrt{b^2 - 4ac}} \right] = 0$$

$$x^2 + x\left(\frac{2a}{b + \sqrt{b^2 - 4ac}} \right) + x\left(\frac{2a}{b - \sqrt{b^2 - 4ac}} \right) + \left(\frac{2a}{b - \sqrt{b^2 - 4ac}} \right)\left(\frac{2a}{b + \sqrt{b^2 - 4ac}} \right) = 0$$

$$x^2 + \frac{2ax\left(b + \sqrt{b^2 - 4ac}\right) + 2ax\left(b - \sqrt{b^2 - 4ac}\right)}{\left(b - \sqrt{b^2 - 4ac}\right)\left(b + \sqrt{b^2 - 4ac}\right)} + \frac{4a^2}{4ac} = x^2 + \frac{4abx + 4a^2}{4ac} = 0$$

$$x^2 + \frac{b}{c}x + \frac{a}{c} = 0$$

$$\boxed{cx^2 + bx + a = 0}$$

151. Let x = speed of small jet (in mph). Then, the speed of the 757-jet = $x+100$ (mph) Form a right triangle depicting the relative position of the jets after two hours of flight. Using Distance = Rate × time, this triangle will have legs of length $2x$ and $2(x+100)$, and hypotenuse of length 1000 miles. Using the Pythagorean Theorem then yields

$$(2x)^2 + (2(x+100))^2 = 1000^2$$

$$4x^2 + 4x^2 + 800x + 40,000 = 1,000,000$$

$$x^2 + 100x - 120,000 = 0$$

$$x = \frac{-100 \pm \sqrt{100^2 + 4(120,000)}}{2} = \frac{-100 \pm 700}{2} = \cancel{-400}, 300$$

So, $\boxed{\text{the speed of the small jet is 300mph and the speed of the 757-jet is 400mph}}$.

152. Let x = speed of small boat (in mph).

Then, the speed of the large boat = $x+10$ (mph).

Form a right triangle depicting the relative position of the jets after three hours. Using Distance = Rate × time, this triangle will have legs of length $3x$ and $3(x+10)$, and hypotenuse of length 150 miles. Using the Pythagorean Theorem then yields

$$(3x)^2 + (3(x+10))^2 = 150^2$$

$$9x^2 + 9x^2 + 180x + 900 = 22,500$$

$$x^2 + 10x - 1200 = 0$$

$$(x+40)(x-30) = 0$$

$$x = \cancel{-40}, \ 30$$

So, the speed of the small boat is 30mph and the speed of the large boat is 40mph.

153. $x^2 - x - 2 = 0$

$(x-2)(x+1) = 0$

$\boxed{x = -1, \ 2}$
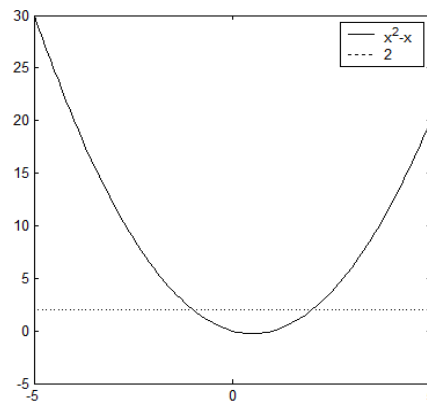
154. $x^2 - 2x + 2 = 0$

$x = \dfrac{2 \pm \sqrt{4 - 4 \cdot 2}}{2} = \dfrac{2 \pm \sqrt{-4}}{2}$

$\boxed{x = 1 \pm i}$

155. (a) Consider $x^2 - 2x - b = 0$. **(1)**

For $b = 8$, **(1)** factors as $(x-4)(x+2) = 0$, so that $x = -2, 4$.

Graphically, we let $y1 = x^2 - 2x$, $y2 = 8$ and look for the intersection points of the graphs:

Note that they intersect at precisely the *x*-values obtained algebraically. So, yes, these values agree with the points of intersections.

(b) We do the same thing now for different values of *b*.

$\underline{b = -3}$:

$$x^2 - 2x + 3 = 0$$

$$x = \frac{2 \pm \sqrt{4 - 4(3)}}{2} = 1 \pm i\sqrt{2}$$

So, we don't expect the graphs to intersect. Indeed, we have:

$\underline{b = -1}$:

$$x^2 - 2x + 1 = 0$$

$$(x-1)^2 = 0$$

$$x = 1$$

So, we expect the graphs to intersect once. Indeed, we have:

80

$\underline{b=0}$:

$$x^2 - 2x = 0$$
$$x(x-2) = 0$$
$$x = 0, 2$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

$\underline{b=5}$:

$$x^2 - 2x - 5 = 0$$
$$x = \frac{2 \pm \sqrt{4+4(5)}}{2} = 1 \pm \sqrt{6}$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

156. (a) Consider $x^2 + 2x - b = 0$. **(1)**

For $b = 8$, **(1)** factors as $(x+4)(x-2) = 0$, so that $x = 2, -4$.

Graphically, we let $y1 = x^2 + 2x$, $y2 = 8$ and look for the intersection points of the graphs:

Note that they intersect at precisely the x-values obtained algebraically. So, yes, these values agree with the points of intersections.

b) We do the same thing now for different values of b.

$\underline{b = -3}$:

$x^2 + 2x + 3 = 0$

$$x = \frac{-2 \pm \sqrt{4 - 4(3)}}{2} = -1 \pm i\sqrt{2}$$

So, we don't expect the graphs to intersect. Indeed, we have:

$\underline{b = -1}$:

$x^2 + 2x + 1 = 0$

$(x + 1)^2 = 0$

$x = -1$
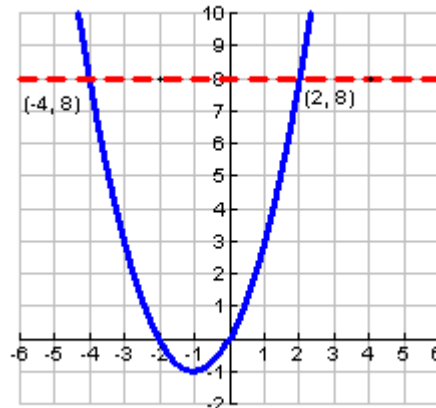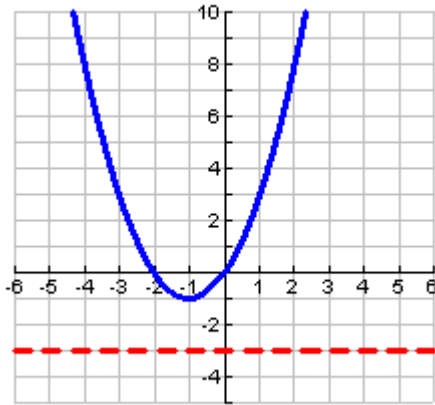
So, we expect the graphs to intersect once. Indeed, we have:

$\underline{b = 0}$:

$x^2 + 2x = 0$

$x(x + 2) = 0$

$x = 0, -2$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

$\underline{b = 5}$:
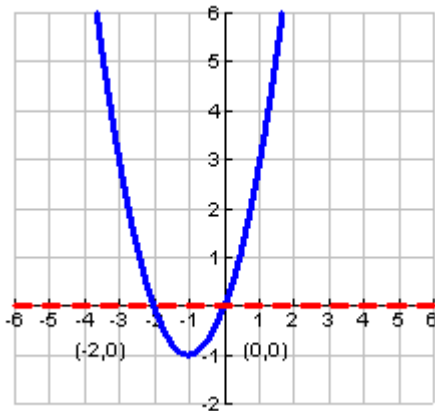
$x^2 + 2x - 5 = 0$

$$x = \frac{-2 \pm \sqrt{4 + 4(5)}}{2} = -1 \pm \sqrt{6}$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

Section 1.4 Solutions --

1.	2.	3.	4.
$\sqrt{t-5}=2$ $t-5=4$ $\boxed{t=9}$	$\sqrt{2t-7}=3$ $2t-7=9$ $2t=16$ $\boxed{t=8}$	$(4p-7)^{1/2}=5$ $4p-7=25$ $4p=32$ $\boxed{p=8}$	$11=(21-p)^{1/2}$ $121=21-p$ $\boxed{p=-100}$

5.	6.	7.	8.
$\sqrt{u+1}=-4$ $\boxed{\text{no solution}}$ $u+1=16$ $u=15$ Check: $\sqrt{15+1}$ $=\sqrt{16}=4$	$-\sqrt{3-2u}=9$ $\sqrt{3-2u}=-9$ $\boxed{\text{no solution}}$ $3-2u=81$ $2u=-78$ $u=-39$ $-\sqrt{3+2\cdot 39}=-9$	$\sqrt[3]{5x+2}=3$ $5x+2=3^3=27$ $5x=25$ $\boxed{x=5}$	$\sqrt[3]{1-x}=-2$ $1-x=-8$ $\boxed{x=9}$

9.	10.	11.	12.
$(4y+1)^{\frac{1}{3}}=-1$ $4y+1=-1$ $4y=-2$ $\boxed{y=-\dfrac{1}{2}}$	$(5x-1)^{\frac{1}{3}}=4$ $5x-1=64$ $5x=65$ $\boxed{x=13}$	$\sqrt{12+x}=x$ $12+x=x^2$ $x^2-x-12=0$ $(x+3)(x-4)=0$ $x=-3,\boxed{4}$ Check -3: $\sqrt{12-3}=\sqrt{9}\neq -3$ Check 4: $\sqrt{12+4}=\sqrt{16}=4$	$x=\sqrt{56-x}$ $x^2=56-x$ $x^2+x-56=0$ $(x+8)(x-7)=0$ $x=-8,\boxed{7}$ Check -8: $\sqrt{56+8}=\sqrt{64}\neq -8$ Check 7: $\sqrt{56-7}=\sqrt{49}=7$

13.	14.	15.	16.
$y=5\sqrt{y}$ $y^2=25y$ $y^2-25y=0$ $y(y-25)=0$ $\boxed{y=0,25}$ Check 0: $0=5\sqrt{0}$ Check 25: $25=5\sqrt{25}$	$\sqrt{y}=\dfrac{y}{4}$ $y=\dfrac{y^2}{16}$ $y^2-16y=0$ $y(y-16)=0$ $\boxed{y=0,16}$ Check 0: $\sqrt{0}=0/4$ Check 16: $\sqrt{16}=16/4$	$s=3\sqrt{s-2}$ $s^2=9(s-2)$ $s^2=9s-18$ $s^2-9s+18=0$ $(s-3)(s-6)=0$ $\boxed{s=3,6}$ Check 3: $3=3\sqrt{3-2}=3\sqrt{1}$ Check 6: $6=3\sqrt{6-2}=3\sqrt{4}$	$-2s=\sqrt{3-s}$ $4s^2=3-s$ $4s^2+s-3=0$ $(s+1)(4s-3)=0$ $s=\boxed{-1},\dfrac{3}{4}$ Check -1: $(-2)(-1)=\sqrt{3+1}$ $2=2$ Check 3/4: $-2\left(\dfrac{3}{4}\right)=\sqrt{3-\dfrac{3}{4}}$ $-\dfrac{3}{2}=\sqrt{\dfrac{9}{4}}\neq \dfrac{3}{2}$

17. $\sqrt{2x+6} = x+3$ $2x+6 = (x+3)^2$ $x^2+4x+3 = 0$ $(x+3)(x+1) = 0$ $x = \boxed{-3,-1}$ Check -3: $\sqrt{2(-3)+6} = -3+3$ $\sqrt{0} = 0$ Check -1: $\sqrt{2(-1)+6} = -1+3$ $\sqrt{4} = 2$	**18.** $\sqrt{8-2x} = 2x-2$ $8-2x = 4x^2-8x+4$ $4x^2-6x-4 = 0$ $2x^2-3x-2 = 0$ $(2x+1)(x-2) = 0$ $x = \dfrac{-1}{2}, \boxed{2}$ Check $\dfrac{-1}{2}$: $\sqrt{8-2\left(\dfrac{-1}{2}\right)} = 2\left(\dfrac{-1}{2}\right)-2$ $\sqrt{9} \neq -3$ Check 2: $\sqrt{8\text{-}4} = 2(2)-2$ $\sqrt{4} = 2$	**19.** $\sqrt{1-3x} = x+1$ $1-3x = x^2+2x+1$ $x^2+5x = 0$ $x(x+5) = 0$ $x = -5, \boxed{0}$ Check -5: $\sqrt{1+15} \neq -4$ Check 0: $\sqrt{1} = 1$
20. $\sqrt{2-x} = x-2$ $2-x = (x-2)^2$ $2-x = x^2-4x+4$ $x^2-3x+2 = 0$ $(x-2)(x-1) = 0$ $x = \cancel{1}, \boxed{2}$	**21.** $3x-6\sqrt{x-1} = 3$ $3x-3 = 6\sqrt{x-1}$ $x-1 = 2\sqrt{x-1}$ $(x-1)^2 = \left(2\sqrt{x-1}\right)^2$ $(x-1)^2-4(x-1) = 0$ $(x-1)(x-1-4) = 0$ $(x-1)(x-5) = 0$ $x = 1,5$	**22.** $5x-10\sqrt{x+2} = -10$ $x-2\sqrt{x+2} = -2$ $x+2 = 2\sqrt{x+2}$ $(x+2)^2 = \left(2\sqrt{x+2}\right)^2$ $(x+2)^2-4(x+2) = 0$ $(x+2)(x+2-4) = 0$ $(x+2)(x-2) = 0$ $x = -2,2$
23. $3x-6\sqrt{x+2} = 3$ $x-2\sqrt{x+2} = 1$ $x-1 = 2\sqrt{x+2}$ $(x-1)^2 = \left(2\sqrt{x+2}\right)^2$ $(x-1)^2 = 4(x+2)$ $x^2-2x+1 = 4x+8$ $x^2-6x-7 = 0$ $(x-7)(x+1) = 0$ $x = \cancel{-1}, 7$	**24.** $2x-4\sqrt{x+1} = 4$ $x-2\sqrt{x+1} = 2$ $x-2 = 2\sqrt{x+1}$ $(x-2)^2 = \left(2\sqrt{x+1}\right)^2$ $(x-2)^2 = 4(x+1)$ $x^2-4x+4 = 4x+4$ $x^2-8x = 0$ $x(x-8) = 0$ $x = \cancel{0}, 8$	**25.** $3\sqrt{x+4}-2x = 9$ $3\sqrt{x+4} = 2x+9$ $\left(3\sqrt{x+4}\right)^2 = (2x+9)^2$ $9(x+4) = 4x^2+36x+81$ $9x+36 = 4x^2+36x+81$ $4x^2+27x+45 = 0$ $(4x+15)(x+3) = 0$ $x = -\frac{15}{4}, -3$

26.

$2\sqrt{x+1} - 3x = -5$

$2\sqrt{x+1} = 3x - 5$

$\left(2\sqrt{x+1}\right)^2 = (3x-5)^2$

$4(x+1) = 9x^2 - 30x + 25$

$4x + 4 = 9x^2 - 30x + 25$

$9x^2 - 34x + 21 = 0$

$(9x-7)(x-3) = 0$

$x = \cancel{\tfrac{7}{9}}, 3$

27.

$\sqrt{x^2 - 4} = x - 1$

$x^2 - 4 = (x-1)^2$

$x^2 - 4 = x^2 - 2x + 1$

$2x = 5$

$\boxed{x = \dfrac{5}{2}}$

28.

$\sqrt{25 - x^2} = x + 1$

$25 - x^2 = (x+1)^2$

$25 - x^2 = x^2 + 2x + 1$

$2x^2 + 2x - 24 = 0$

$x^2 + x - 12 = 0$

$(x+4)(x-3) = 0$

$x = \cancel{-4}, \boxed{3}$

29.

$\sqrt{x^2 - 2x - 5} = x + 1$

$x^2 - 2x - 5 = (x+1)^2$ $\boxed{\text{No solution}}$.

$x^2 - 2x - 5 = x^2 + 2x + 1$

$-6 = 4x$

$\cancel{-\tfrac{3}{2}} = x$

30.

$\sqrt{2x^2 - 8x + 1} = x - 3$

$2x^2 - 8x + 1 = (x-3)^2$

$2x^2 - 8x + 1 = x^2 - 6x + 9$

$x^2 - 2x - 8 = 0$

$(x-4)(x+2) = 0$

$\boxed{x = \cancel{-2}, 4}$

31.

$$\sqrt{3x+1} - \sqrt{6x-5} = 1$$

$$\sqrt{3x+1} = \sqrt{6x-5} + 1$$

$$\left(\sqrt{3x+1}\right)^2 = \left(\sqrt{6x-5} + 1\right)^2$$

$$3x + 1 = 6x - 5 + 2\sqrt{6x-5} + 1$$

$$3x + 1 = 6x - 4 + 2\sqrt{6x-5}$$

$$(-3x+5)^2 = \left(2\sqrt{6x-5}\right)^2$$

$$9x^2 - 30x + 25 = 4(6x-5)$$

$$9x^2 - 30x + 25 = 24x - 20$$

$$9x^2 - 54x + 45 = 0$$

$$(9x-9)(x-5) = 0$$

$$x = 1, \cancel{5}$$

32.

$$\sqrt{2-x} + \sqrt{6-5x} = 6$$

$$\sqrt{2-x} = 6 - \sqrt{6-5x}$$

$$\left(\sqrt{2-x}\right)^2 = \left(6 - \sqrt{6-5x}\right)^2$$

$$2 - x = 36 - 12\sqrt{6-5x} + (6-5x)$$

$$2 - x = 42 - 5x - 12\sqrt{6-5x}$$

$$-40 + 4x = -12\sqrt{6-5x}$$

$$-10 + x = -3\sqrt{6-5x}$$

$$\left(-10 + x\right)^2 = \left(-3\sqrt{6-5x}\right)^2$$

$$100 - 20x + x^2 = 9(6-5x)$$

$$100 - 20x + x^2 = 54 - 45x$$

$$x^2 + 25x + 46 = 0$$

$$(x+23)(x+2) = 0$$

$$x = \cancel{-23}, \, -2$$

33.

$$\sqrt{x+12} + \sqrt{8-x} = 6$$

$$\sqrt{x+12} = 6 - \sqrt{8-x}$$

$$\left(\sqrt{x+12}\right)^2 = \left(6 - \sqrt{8-x}\right)^2$$

$$x + 12 = 36 - 12\sqrt{8-x} + (8-x)$$

$$2x - 32 = -12\sqrt{8-x}$$

$$x - 16 = -6\sqrt{8-x}$$

$$\left(x-16\right)^2 = \left(-6\sqrt{8-x}\right)^2$$

$$x^2 - 32x + 256 = 36(8-x)$$

$$x^2 - 32x + 256 = 288 - 36x$$

$$x^2 + 4x - 32 = 0$$

$$(x-4)(x+8) = 0$$

$$x = 4, -8$$

34.
$$\sqrt{5-x} + \sqrt{3x+1} = 4$$
$$\sqrt{5-x} = 4 - \sqrt{3x+1}$$
$$\left(\sqrt{5-x}\right)^2 = \left(4 - \sqrt{3x+1}\right)^2$$
$$5 - x = 16 - 8\sqrt{3x+1} + (3x+1)$$
$$5 - x = 17 + 3x - 8\sqrt{3x+1}$$
$$-12 - 4x = -8\sqrt{3x+1}$$
$$3 + x = 2\sqrt{3x+1}$$
$$(3+x)^2 = \left(2\sqrt{3x+1}\right)^2$$
$$9 + 6x + x^2 = 4(3x+1)$$
$$9 + 6x + x^2 = 12x + 4$$
$$x^2 - 6x + 5 = 0$$
$$(x-5)(x-1) = 0$$
$$x = 1, 5$$

35.
$$\sqrt{2x-1} = 1 + \sqrt{x-1}$$
$$2x - 1 = 1 + 2\sqrt{x-1} + x - 1$$
$$x - 1 = 2\sqrt{x-1}$$
$$x^2 - 2x + 1 = 4(x-1)$$
$$x^2 - 2x + 1 = 4x - 4$$
$$x^2 - 6x + 5 = 0$$
$$(x-5)(x-1) = 0$$
$$\boxed{x = 1, 5}$$

36.
$$\sqrt{8-x} = 2 + \sqrt{2x+3}$$
$$8 - x = 4 + 4\sqrt{2x+3} + 2x + 3$$
$$-3x + 1 = 4\sqrt{2x+3}$$
$$9x^2 - 6x + 1 = 16(2x+3)$$
$$9x^2 - 6x + 1 = 32x + 48$$
$$9x^2 - 38x - 47 = 0$$
$$(9x-47)(x+1) = 0$$
$$x = \tfrac{47}{9}, \boxed{-1}$$

37.
$$\sqrt{3x-5} = 7 - \sqrt{x+2}$$
$$3x - 5 = 49 - 14\sqrt{x+2} + x + 2$$
$$2x - 56 = -14\sqrt{x+2}$$
$$x - 28 = -7\sqrt{x+2}$$
$$x^2 - 56x + 784 = 49(x+2)$$
$$x^2 - 56x + 784 = 49x + 98$$
$$x^2 - 105x + 686 = 0$$
$$(x-98)(x-7) = 0$$
$$x = \boxed{7}, \cancel{98}$$

38.
$$\sqrt{x+5} = 1 + \sqrt{x-2}$$
$$x + 5 = 1 + 2\sqrt{x-2} + x - 2$$
$$6 = 2\sqrt{x-2}$$
$$9 = x - 2$$
$$\boxed{x = 11}$$

39. $\sqrt{2+\sqrt{x}}=\sqrt{x}$ $2+\sqrt{x}=x$ $\sqrt{x}=x-2$ $x=x^2-4x+4$ $x^2-5x+4=0$ $(x-4)(x-1)=0$ $x=\cancel{1},\boxed{4}$	**40.** $\sqrt{2-\sqrt{x}}=\sqrt{x}$ $2-\sqrt{x}=x$ $\sqrt{x}=2-x$ $x=4-4x+x^2$ $x^2-5x+4=0$ $(x-1)(x-4)=0$ $x=\boxed{1},\cancel{4}$	**41.** Let $u=x^{1/3}$ $u^2+2u=0$ $u(u+2)=0$ $u=-2,0$ $x^{1/3}=0\rightarrow\boxed{x=0}$ $x^{1/3}=-2\rightarrow\boxed{x=-8}$
42. Let $u=x^{1/4}$ $u^2-2u=0$ $u(u-2)=0$ $u=0,2$ $x^{1/4}=0\rightarrow\boxed{x=0}$ $x^{1/4}=2\rightarrow\boxed{x=16}$	**43.** Let $u=x^2$ $u^2-3u+2=0$ $(u-1)(u-2)=0$ $u=1,2$ $x^2=1\rightarrow\boxed{x=\pm1}$ $x^2=2\rightarrow\boxed{x=\pm\sqrt{2}}$	**44.** Let $u=x^2$ $u^2-8u+16=0$ $(u-4)^2=0$ $u=4$ $x^2=4$ $\boxed{x=\pm2}$
45. Let $u=x^2$ $2u^2+7u+6=0$ $(2u+3)(u+2)=0$ $u=-3/2\quad u=-2$ $x^2=-3/2\quad x^2=-2$ $x=\pm i\sqrt{3/2}\quad x=\pm i\sqrt{2}$ $\boxed{x=\dfrac{\pm i\sqrt{6}}{2}}\quad\boxed{x=\pm i\sqrt{2}}$	**46.** Let $u=x^4$ $u^2-17u+16=0$ $(u-16)(u-1)=0$ $u=1\quad u=16$ $x^4=1\quad x^4=16$ $x^2=\pm1\quad x^2=\pm4$ if $x^2=1$ if $x^2=4$ $\boxed{x=\pm1}\quad\boxed{x=\pm2}$ if $x^2=-1$ if $x^2=-4$ $\boxed{x=\pm i}\quad\boxed{x=\pm2i}$	**47.** Let $u=2x+1$ $u^2+5u+4=0$ $(u+4)(u+1)=0$ $u=-4\quad u=-1$ $2x+1=-4\quad 2x+1=-1$ $2x=-5\quad 2x=-2$ $\boxed{x=-5/2}\quad\boxed{x=-1}$

48. Let $u = x - 3$	**49.** Let $u = t - 1$	**50.** Let $u = 1 - y$
$u^2 + 6u + 8 = 0$	$4u^2 - 9u + 2 = 0$	$2u^2 + 5u - 12 = 0$
$(u + 2)(u + 4) = 0$	$(4u - 1)(u - 2) = 0$	$(2u - 3)(u + 4) = 0$
$u = -2 \qquad u = -4$	$u = 1/4 \qquad u = 2$	$u = 3/2 \qquad u = -4$
$x - 3 = -2 \quad x - 3 = -4$	$t - 1 = 1/4 \quad t - 1 = 2$	$1 - y = 3/2 \quad 1 - y = -4$
$\boxed{x = 1} \qquad \boxed{x = -1}$	$\boxed{t = 5/4} \qquad \boxed{t = 3}$	$\boxed{y = -1/2} \quad \boxed{y = 5}$

51. Let $u = x^{-4}$	**52.** Let $x = u^{-1}$	**53.** Let $u = y^{-1}$
$u^2 - 17u + 16 = 0$	$2x^2 + 5x - 12 = 0$	$3u^2 + u - 4 = 0$
$(u - 16)(u - 1) = 0$	$(2x - 3)(x + 4) = 0$	$(3u + 4)(u - 1) = 0$
$u = 1 \qquad u = 16$	$x = 3/2 \qquad x = -4$	$u = -4/3 \qquad u = 1$
$x^{-4} = 1 \qquad x^{-4} = 16$	$u^{-1} = 3/2 \quad u^{-1} = -4$	$y^{-1} = -4/3 \quad y^{-1} = 1$
$x^2 = \pm 1 \qquad x^2 = \pm 1/4$	$\boxed{u = 2/3} \qquad \boxed{u = -1/4}$	$\boxed{y = -3/4} \qquad \boxed{y = 1}$
$\boxed{x = \pm 1, \pm i} \quad \boxed{x = \pm\frac{1}{2}, \pm\frac{1}{2}i}$		

54.	**55.**
Let $u = a^{-1}$	Let $u = z^{1/5}$
$5u^2 + 11u + 2 = 0$	$u^2 - 2u + 1 = 0$
$(5u + 1)(u + 2) = 0$	$(u - 1)^2 = 0$
$u = -1/5 \ \Rightarrow \ a^{-1} = -1/5 \ \Rightarrow \ \boxed{a = -5}$	$u = 1 \ \Rightarrow \ z^{1/5} = 1 \ \Rightarrow \ \boxed{z = 1}$
$u = -2 \ \Rightarrow \ a^{-1} = -2 \ \Rightarrow \ \boxed{a = -1/2}$	

56.

$$\text{Let } u = x^{1/4}$$

$$2u^2 + u - 1 = 0 \ \Rightarrow \ (2u - 1)(u + 1) = 0 \ \Rightarrow u = -1, \tfrac{1}{2}$$

$$x^{1/4} = \tfrac{1}{2} \text{ or } \cancel{x^{1/4} = -1} \ \Rightarrow \ \boxed{x = \tfrac{1}{16}}$$

57.	**58.**
$(x + 3)^{5/3} = 32$	$(x + 2)^{4/3} = 16$
$x + 3 = 32^{3/5}$	$x + 2 = 16^{3/4}$
$x = -3 + \left(32^{1/5}\right)^3 = -3 + 2^3 = -3 + 8 = 5$	$x = -2 + \left(16^{1/4}\right)^3 = -2 + 2^3 = -2 + 8 = 6$

59.	60.
$(x+1)^{\frac{2}{3}} = 4$ $x+1 = \pm 4^{\frac{3}{2}}$ $x = -1 \pm 4^{\frac{3}{2}} = -1 \pm 8$ $x = -9 \ \text{ or } \ x = 7$	$(x-7)^{\frac{4}{3}} = 81$ $x-7 = \pm 81^{\frac{3}{4}}$ $x = 7 \pm 27$ $x = -20 \ \text{ or } \ x = 34$

61.	62.	63.
Let $u = t^{-1/3}$ $6u^2 - u - 1 = 0$ $(3u+1)(2u-1) = 0$ $u = -1/3 \qquad u = 1/2$ $t^{-1/3} = -1/3 \quad t^{-1/3} = 1/2$ $t = (-1/3)^{-3} \quad t = (1/2)^{-3}$ $\boxed{t = -27}$ $\boxed{t = 8}$	$u = t^{-1/3}$ $u^2 - u - 6 = 0$ $(u-3)(u+2) = 0$ $u = 3 \qquad u = -2$ $t^{-1/3} = 3 \qquad t^{-1/3} = -2$ $t = 3^{-3} \qquad t = (-2)^{-3}$ $\boxed{t = 1/27}$ $\boxed{t = -1/8}$	$3 = \dfrac{1}{(x+1)^2} + \dfrac{2}{(x+1)} \quad \boxed{x \neq -1}$ $3(x+1)^2 = 1 + 2(x+1)$ $3(x+1)^2 - 2(x+1) - 1 = 0$ Let $u = x+1$ $3u^2 - 2u - 1 = 0$ $(3u+1)(u-1) = 0$ $u = -1/3 \qquad u = 1$ $x+1 = -1/3 \qquad x+1 = 1$ $\boxed{x = -4/3} \qquad \boxed{x = 0}$

64.	65.	66.
$\dfrac{1}{(x+1)^2} + \dfrac{4}{x+1} + 4 = 0$ $\boxed{x \neq -1}$ $\text{LCD} = (x+1)^2$ $1 + 4(x+1) + 4(x+1)^2 = 0$ Let $u = x+1$ $4u^2 + 4u + 1 = 0$ $(2u+1)^2 = 0$ $u = -1/2$ $x+1 = -1/2$ $\boxed{u = -3/2}$	$\left(\dfrac{1}{2x-1}\right)^2 + \dfrac{1}{2x-1} - 12 = 0$ $\boxed{x \neq 1/2}$ Let $u = \dfrac{1}{2x-1}$ $u^2 + u - 12 = 0$ $(u+4)(u-3) = 0$ $u = -4$ $\dfrac{1}{2x-1} = -4$ $-4(2x-1) = 1$ $-8x + 4 = 1$ $-8x = -3$ $\boxed{x = 3/8}$ $u = 3$ $\dfrac{1}{2x-1} = 3$ $3(2x-1) = 1$ $6x - 3 = 1$ $6x = 4$ $\boxed{x = 2/3}$	$\dfrac{5}{(2x+1)^2} - \dfrac{3}{2x+1} = 2$ $\boxed{x \neq -1/2}$ Let $u = \dfrac{1}{2x+1}$ $5u^2 - 3u - 2 = 0$ $(5u+2)(u-1) = 0$ $u = -2/5$ $\dfrac{1}{2x+1} = \dfrac{-2}{5}$ $-2(2x+1) = 5$ $-4x - 2 = 5$ $-4x = 7$ $\boxed{x = -7/4}$ $u = 1$ $\dfrac{1}{2x+1} = 1$ $2x+1 = 1$ $2x = 0$ $\boxed{x = 0}$

67. Let $x = u^{2/3}$

$x^2 - 5x + 4 = 0$

$(x-4)(x-1) = 0$

$x = 4 \qquad x = 1$

$u^{2/3} = 4 \qquad u^{2/3} = 1$

$u = \pm 4^{3/2} \qquad u = \pm 1^{3/2}$

$\boxed{u = \pm 8} \qquad \boxed{u = \pm 1}$

68. Let $x = u^{2/3}$

$x^2 + 5x + 4 = 0$

$(x+4)(x+1) = 0$

$x = -4 \qquad\qquad x = -1$

$u^{2/3} = -4 \qquad\quad u^{2/3} = -1$

$u = (-4)^{3/2} \qquad u = (-1)^{3/2}$

$u = \left[(-4)^{1/2} \right]^3 \qquad u = \left[(-1)^{1/2} \right]^3$

$u = [2i]^3 \qquad\qquad u = (\pm i)^3$

$\boxed{u = \pm 8i} \qquad\qquad \boxed{u = \pm i}$

69. $t^4 - t^2 - 6 = 0$

Let $u = t^2$

$u^2 - u - 6 = 0$

$(u-3)(u+2) = 0$

$u = -2 \qquad u = 3$

$t^2 = -2 \qquad t^2 = 3$

$\cancel{t = \pm i \sqrt{2}} \qquad \boxed{t = \sqrt{3}, \cancel{-\sqrt{3}}}$

70.

$u = \sqrt[4]{-2u^2 - 1}$

$u^4 = -2u^2 - 1$

$u^4 + 2u^2 + 1 = 0$

Let $x = u^2$. Then, $x^2 + 2x + 1 = 0$

$(x+1)^2 = 0 \implies x = -1$

So, $u^2 = -1 \implies u = i, \cancel{-i}$

$\boxed{u = i}$

71.

$x^3 - x^2 - 12x = 0$

$x(x^2 - x - 12) = 0$

$x(x-4)(x+3) = 0$

$\boxed{x = 0, -3, 4}$

72.

$2y^3 - 11y^2 + 12y = 0$

$y(2y^2 - 11y + 12) = 0$

$y(2y - 3)(y - 4) = 0$

$\boxed{y = 0, 4, \tfrac{3}{2}}$

73.

$4p^3 - 9p = 0$

$p(4p^2 - 9) = 0$

$p(2p - 3)(2p + 3) = 0$

$\boxed{p = 0, \pm \tfrac{3}{2}}$

74.

$25x^3 = 4x$

$25x^3 - 4x = 0$

$x(25x^2 - 4) = 0$

$x(5x - 2)(5x + 2) = 0$

$\boxed{x = 0, \pm \tfrac{2}{5}}$

75.

$u^5 - 16u = 0$

$u(u^4 - 16) = 0$

$u(u^2 - 4)(u^2 + 4) = 0$

$u(u - 2)(u + 2)(u - 2i)(u + 2i) = 0$

$\boxed{u = 0, \pm 2, \pm 2i}$

76.	77.
$t^5 - 81t = 0$ $t(t^4 - 81) = 0$ $t(t^2 - 9)(t^2 + 9) = 0$ $t(t-3)(t+3)(t-3i)(t+3i) = 0$ $\boxed{t = 0, \pm 3, \pm 3i}$	$x^3 - 5x^2 - 9x + 45 = 0$ $(x^3 - 5x^2) - (9x - 45) = 0$ $x^2(x-5) - 9(x-5) = 0$ $(x^2 - 9)(x-5) = 0$ $(x-3)(x+3)(x-5) = 0$ $\boxed{x = \pm 3, \ 5}$
78.	79.
$2p^3 - 3p^2 - 8p + 12 = 0$ $(2p^3 - 3p^2) - (8p - 12) = 0$ $p^2(2p-3) - 4(2p-3) = 0$ $(p^2 - 4)(2p-3) = 0$ $(p-2)(p+2)(2p-3) = 0$ $\boxed{p = \pm 2, \ \tfrac{3}{2}}$	$y(y-5)^3 - 14(y-5)^2 = 0$ $(y-5)^2 [y(y-5) - 14] = 0$ $(y-5)^2 (y^2 - 5y - 14) = 0$ $(y-5)^2 (y-7)(y+2) = 0$ $\boxed{y = -2, 5, 7}$
80.	81.
$v(v+3)^3 - 40(v+3)^2 = 0$ $(v+3)^2 [v(v+3) - 40] = 0$ $(v+3)^2 (v^2 + 3v - 40) = 0$ $(v+3)^2 (v-5)(v+8) = 0$ $\boxed{v = -8, -3, 5}$	$x^{9/4} - 2x^{5/4} - 3x^{1/4} = 0$ $x^{1/4} [x^2 - 2x - 3] = 0$ $x^{1/4}(x-3)(x+1) = 0$ $\boxed{x = 0, 3, \cancel{-1}}$
82.	83.
$u^{7/3} + u^{4/3} - 20u^{1/3} = 0$ $u^{1/3} [u^2 + u - 20] = 0$ $u^{1/3}(u+5)(u-4) = 0$ $\boxed{u = -5, 0, 4}$	$t^{5/3} - 25t^{-1/3} = 0$ $t^{-1/3} [t^2 - 25] = 0$ $t^{-1/3}(t-5)(t+5) = 0$ $\boxed{t = \pm 5}$ (Note: $t^{-1/3} = 0$ has no solution.)

84.

$$4x^{\frac{3}{5}} - 9x^{-\frac{1}{5}} = 0$$

$$x^{-\frac{1}{5}}\left[4x^2 - 9\right] = 0$$

$$x^{-\frac{1}{5}}(2x - 3)(2x + 3) = 0$$

$$\boxed{x = \pm \tfrac{3}{2}}$$

(Note: $x^{-\frac{1}{5}} = 0$ has no solution.)

85.

$$y^{\frac{3}{2}} - 5y^{\frac{1}{2}} + 6y^{-\frac{1}{2}} = 0$$

$$y^{-\frac{1}{2}}\left[y^2 - 5y + 6\right] = 0$$

$$y^{-\frac{1}{2}}(y - 3)(y - 2) = 0$$

$$\boxed{y = 2, 3}$$

(Note: $y^{-\frac{1}{2}} = 0$ has no solution.)

86.

$$4p^{\frac{5}{3}} - 5p^{\frac{2}{3}} - 6p^{-\frac{1}{3}} = 0$$

$$p^{-\frac{1}{3}}\left(4p^2 - 5p - 6\right) = 0$$

(Note: $p^{-\frac{1}{3}} = 0$ has no solution.)

$$p^{-\frac{1}{3}}(4p + 3)(p - 2) = 0$$

$$\boxed{p = -\tfrac{3}{4}, 2}$$

87. Solve $d(t) = 3$. (Note: The right-side is 3, and not 3,000,000, because $d(t)$ is measured in millions.)

$$3\sqrt{t+1} - 0.75t = 3$$

$$3\sqrt{t+1} = 3 + 0.75t$$

$$\left(3\sqrt{t+1}\right)^2 = \left(3 + 0.75t\right)^2$$

$$9t + 9 = 9 + 4.5t + 0.5625t^2$$

$$0.5625t^2 - 4.5t = 0$$

$$t(0.5625t - 4.5) = 0$$

$$t = 0, \ \tfrac{4.5}{0.5625} = 8$$

So, this occurs in January and September.

88. Solve $d(t) = 4$. (Note: The right-side is 4, and not 4,000,000, because $d(t)$ is measured in millions.)

$$3\sqrt{t+1} - 0.75t = 4$$

$$3\sqrt{t+1} = 4 + 0.75t$$

$$\left(3\sqrt{t+1}\right)^2 = \left(4 + 0.75t\right)^2$$

$$9t + 9 = 16 + 6t + 0.5625t^2$$

$$0.5625t^2 - 3t + 7 = 0$$

$$\text{No real solutions}$$

So, this never occurs. The demand for the product is never 4,000,000 units.

89. Solve $\sqrt{\dfrac{wh}{3,600}} = BSA$ for h, when $w = 72$ and $BSA = 1.8$.

$$\sqrt{\frac{72h}{3,600}} = 1.8$$

$$\frac{\sqrt{72h}}{60} = 1.8$$

$$\sqrt{72h} = (1.8)(60)$$

$$72h = 108^2$$

$$h = \frac{11,664}{72} = 162$$

So, the height of such a female is 162 cm.

90. Solve $\sqrt{\dfrac{wh}{3,600}} = BSA$ for w, when $h = 177$ and $BSA = 2.1$.

$$\sqrt{\frac{177w}{3,600}} = 2.1$$

$$\frac{\sqrt{177w}}{60} = 2.1$$

$$\sqrt{177w} = (2.1)(60)$$

$$177w = 126^2$$

$$w = \frac{15,876}{177} \approx 90$$

So, the weight of such a male is about 90 kg.

91.

$$C = \sqrt{10 + a}$$
$$C = 9$$
$$9 = \sqrt{10 + a}$$
$$81 = 10 + a$$
$$\boxed{a = 71 \text{ years old}}$$

92.

$$C = \sqrt{5a + 1}$$
$$C = 20$$
$$20 = \sqrt{5a + 1}$$
$$400 = 5a + 1$$
$$5a = 399$$
$$a = \frac{399}{5} = 79.8$$
$$\boxed{79.8 \text{ years old}}$$

93.
$P = 5\sqrt{t^2 + 1} + 50$

$P = 85$

$85 = 5\sqrt{t^2 + 1} + 50$

$35 = 5\sqrt{t^2 + 1}$

$7 = \sqrt{t^2 + 1}$

$49 = t^2 + 1$

$t^2 = 48$

$t = \sqrt{48}$

$t = 4\sqrt{3}$ (t must be ≥ 0)

$t \cong 7$ months

March

94.
$S = 1000 + 10\sqrt{2t}$

$S = 1230$

$1230 = 1000 + 10\sqrt{2t}$

$230 = 10\sqrt{2t}$

$23 = \sqrt{2t}$

$529 = 2t$

$t = 264.5 \cong 265$

In the year 2255

95.
$T = \dfrac{\sqrt{d}}{4} + \dfrac{d}{1100}, \ T = 3$

$3 = \dfrac{\sqrt{d}}{4} + \dfrac{d}{1100}$

$LCD = 1100$

$3300 = 275\sqrt{d} + d$

$d + 275\sqrt{d} - 3300 = 0$

Let $u = \sqrt{d}$

$u^2 + 275u - 3300 = 0$

$u = \dfrac{-275 \pm \sqrt{275^2 + 4 \cdot 1 \cdot 3300}}{2(1)}$

$u = -286.5, 11.5$

$\sqrt{d} = 11.5$

$d = 132$ ft

96. $\dfrac{\sqrt{d}}{4} = 3 \ \Rightarrow \ \sqrt{d} = 12 \ \Rightarrow \ \boxed{d = 144 \text{ feet}}$

97.
$1 = 2\pi\sqrt{\dfrac{L}{9.8}}$

$\left(\dfrac{1}{2\pi}\right)^2 = \dfrac{L}{9.8}$

$0.24824\,\text{m} \approx \dfrac{9.8}{4\pi^2} = L$

Convert to centimeters:

$\dfrac{0.24824 \ \text{m} \ | \ 100 \text{ cm}}{| \ 1 \text{ m}} \approx \boxed{25\,\text{cm}}$

98.
$1 = 2\pi\sqrt{\dfrac{L}{32}}$

$\left(\dfrac{1}{2\pi}\right)^2 = \dfrac{L}{32}$

$0.81057\,\text{ft} \approx \dfrac{32}{4\pi^2} = L$

Convert to inches:

$\dfrac{0.81057 \ \text{ft} \ | \ 12 \text{ in}}{| \ 1 \text{ ft}} \approx \boxed{10\,\text{in}}$

99.
$18 = 30\sqrt{1 - \dfrac{v^2}{c^2}}$

$\dfrac{3}{5} = \dfrac{18}{30} = \sqrt{1 - \dfrac{v^2}{c^2}}$

$\left(\dfrac{3}{5}\right)^2 = 1 - \dfrac{v^2}{c^2}$

$\dfrac{16}{25} = \dfrac{v^2}{c^2}$

$v^2 = \dfrac{16}{25}c^2$

$v = \dfrac{4}{5}c$

So, 80% of the speed of light.

100.
$5 = 30\sqrt{1 - \dfrac{v^2}{c^2}}$

$\dfrac{1}{6} = \dfrac{5}{30} = \sqrt{1 - \dfrac{v^2}{c^2}}$

$\left(\dfrac{1}{6}\right)^2 = 1 - \dfrac{v^2}{c^2}$

$\dfrac{35}{36} = \dfrac{v^2}{c^2}$

$v^2 = \dfrac{35}{36}c^2$

$v = \dfrac{\sqrt{35}}{6}c$

So, about 98.6% of the speed of light.

101. $t = 5$ is extraneous; there is no solution.	102. $x = -1$ is extraneous. $\boxed{x = 2}$	103. Forgot about the substitution $u = x^{1/3}$. $x^{1/3} = -4, 5$ $\boxed{x = -64, 125}$
104. $x^2 = -1$ $x = \pm\sqrt{-i}$ $\boxed{x = \pm i}$ (not ± 1)	105. True Let $u = (2x - 1)^3$ $u^2 + 4u + 3 = 0$ (quadratic)	106. False Let $u = t^5$ $u^5 + 2u + 1 = 0$ (not quadratic)
107. False	108. False $\left(\sqrt{x+2} + \sqrt{x}\right)^2 = \left(\sqrt{x+5}\right)^2$ $x + 2 + 2\sqrt{x}\sqrt{x+2} + x = x + 5$	
109. Solve $\sqrt{x^2} = x$. If $x \geq 0$, then $\sqrt{x^2} = x$, while if $x < 0$, then $\sqrt{x^2} = -x$. So, the solution set is $\boxed{[0, \infty)}$.	110. Solve $\sqrt{x^2} = -x$. If $x \geq 0$, then $\sqrt{x^2} = x$, while if $x < 0$, then $\sqrt{x^2} = -x$. So, the solution set is $\boxed{(-\infty, 0]}$.	

111.	112.
Let $u = 3x^2 + 2x$	Factor out $x^{1/3}$
$u = \sqrt{u}$	$x^{1/3}\left(3x^{1/4} - x^{1/2} - 2\right) = 0$
$u = 0, 1$	Let $u = x^{1/4}$.
	$3u - u^2 - 2 = 0$
	$u^2 - 3u + 2 = 0$
	$(u - 2)(u - 1) = 0$
$3x^2 + 2x = 0 \qquad 3x^2 + 2x = 1$	$u = 2 \qquad u = 1 \qquad x^{1/3} = 0$
$x(3x + 2) = 0 \qquad 3x^2 + 2x - 1 = 0$	$x^{1/4} = 2 \qquad x^{1/4} = 1 \qquad \boxed{x = 0}$
$\boxed{x = 0, -2/3} \qquad (3x - 1)(x + 1) = 0$	$\boxed{x = 16} \qquad \boxed{x = 1}$
$\boxed{x = -1, 1/3}$	

113.

$\sqrt{x+6} + \sqrt{11+x} = 5\sqrt{3+x}$

$(x+6) + 2\sqrt{x+6}\sqrt{11+x} + (11+x) = 25(3+x)$

$2x + 17 + 2\sqrt{x+6}\sqrt{11+x} = 75 + 25x$

$2\sqrt{x+6}\sqrt{11+x} = 58 + 23x$

$4(x+6)(11+x) = 529x^2 + 2668x + 3364$

$4(x^2 + 17x + 66) = 529x^2 + 2668x + 3364$

$4x^2 + 68x + 264 = 529x^2 + 2668x + 3364$

$525x^2 + 2600x + 3100 = 0$

$21x^2 + 104x + 124 = 0$

$(21x + 62)(x+2) = 0$

$x = \dfrac{-62}{21}$, $\boxed{x = -2}$

114.

$\left[2x\left(x(x)^{1/2} \right)^{1/3} \right]^{1/4} = 2$

$2x\left(x(x)^{1/2} \right)^{1/3} = 2^4 = 16$

$x\left[x \cdot x^{1/2} \right]^{1/3} = 8$

$\left[x \cdot x^{1/2} \right]^{1/3} = \dfrac{8}{x} \quad \boxed{x \neq 0}$

$x \cdot x^{1/2} = x^{3/2} = \left(\dfrac{8}{x} \right)^3$

$x = \left[\left(\dfrac{8}{x} \right)^3 \right]^{2/3} = \left(\dfrac{8}{x} \right)^2 = \dfrac{64}{x^2}$

$x^3 = 64$

$\boxed{x = 4}$

115.

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

$x - 3 = 16 - 8\sqrt{x+2} + x + 2$

$-21 = -8\sqrt{x+2}$

$441 = 64(x+2) = 64x + 128$

$313 = 64x$

$\boxed{x = \dfrac{313}{64} \cong 4.891}$
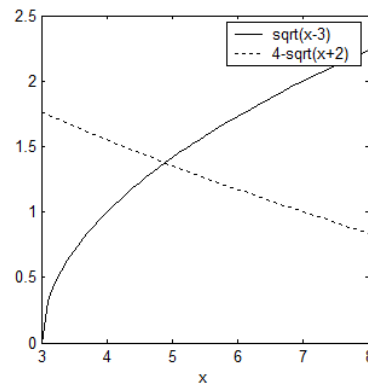
116.

$2\sqrt{x+1} = 1 + \sqrt{3-x}$

$4(x+1) = 1 + 2\sqrt{3-x} + 3 - x$

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

$5x = 2\sqrt{3-x}$

$25x^2 = 4(3-x) = 12 - 4x$

$25x^2 + 4x - 12 = 0$

$x = \dfrac{-4 \pm \sqrt{4^2 - 4(25)(-12)}}{2(25)}$

$x \cong \dfrac{-4 \pm 34.9}{50} \cong -0.778, \boxed{0.62}$

97
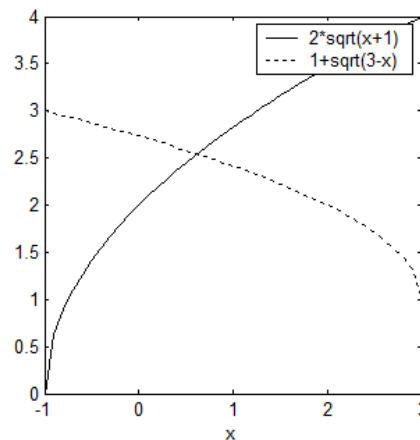
117.

$-4 = \sqrt{x+3}$

$16 = x+3$

$x = 13\,(\text{Extraneous})$

$\boxed{\text{no solution}}$
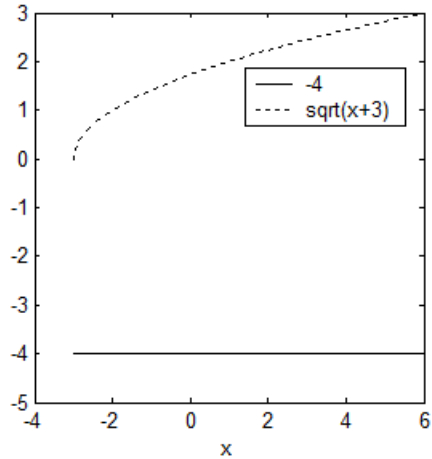
118.

$x^{1/4} = -4x^{1/2} + 21$

$4x^{1/2} + x^{1/4} - 21 = 0$

Let $u = x^{1/4}$ to obtain

$4u^2 + u - 21 = 0$

$u = \dfrac{-1 \pm \sqrt{1 - 4(4)(-21)}}{2(4)}$

$u \cong \dfrac{-1 \pm 18.4}{8} \cong -2.4,\, 2.2$

$x^{1/4} = -2.4 \qquad x^{1/4} = 2.2$

$\boxed{\text{no solution}} \qquad \boxed{x \cong 22.2}$
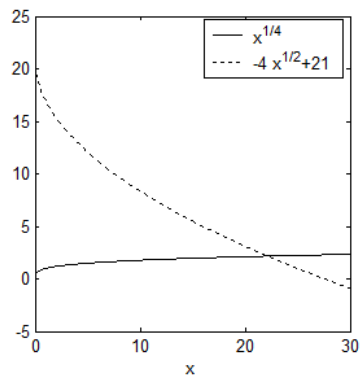
119.

$x^{1/2} = -4x^{1/4} + 21$

$x^{1/2} + 4x^{1/4} - 21 = 0$

Let $u = x^{1/4}$ to obtain

$u^2 + 4u - 21 = 0$

$(u+7)(u-3) = 0$

$u = -7, 3$

$x^{1/4} = -7 \qquad x^{1/4} = 3$

$\boxed{\text{no solution}} \quad \boxed{x = 81}$

Yes, the two solutions agree.

Graphically, let:

$y1 = x^{\frac{1}{2}}, \quad y2 = -4x^{\frac{1}{4}} + 21$.
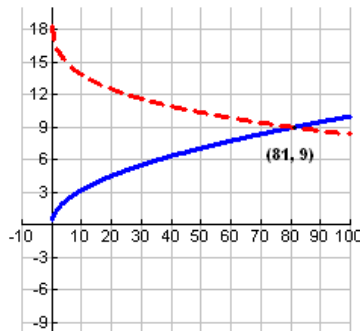
120.

$x^{-1} = 3x^{-2} - 10$

$3x^{-2} - x^{-1} - 10 = 0$

Let $u = x^{-1}$ to obtain

$3u^2 - u - 10 = 0$

$(3u + 5)(u - 2) = 0$

$u = -\frac{5}{3}, 2$

$x^{-1} = -\frac{5}{3} \quad x^{-1} = 2$

$\boxed{x = -\frac{3}{5}} \quad \boxed{x = \frac{1}{2}}$

Yes, the two solutions agree.

Graphically, let:

$y1 = x^{-1}, \quad y2 = 3x^{-2} - 10$.
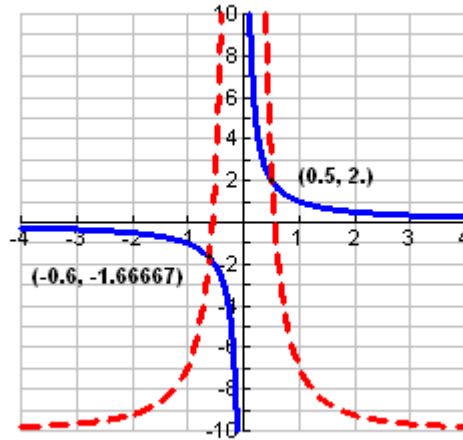
121.

$x^{-2} = 3x^{-1} - 10$

$x^{-2} - 3x^{-1} + 10 = 0$

Let $u = x^{-1}$ to obtain

$u^2 - 3u + 10 = 0$

$u = \dfrac{3 \pm \sqrt{9 - 4(10)(1)}}{2} = \dfrac{3 \pm i\sqrt{31}}{2}$

So, there are no real solutions. As such, we expect the graphs to not intersect.

Yes, the two solutions agree.

Graphically, let:

$y1 = x^{-2}, \quad y2 = 3x^{-1} - 10$.
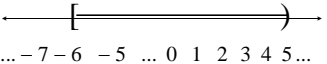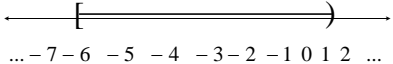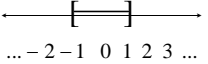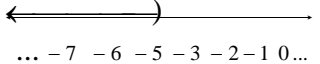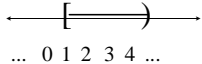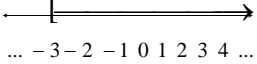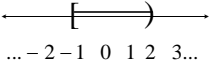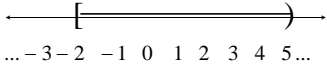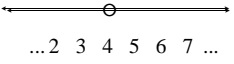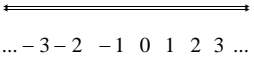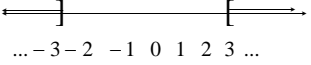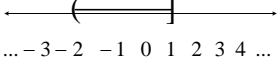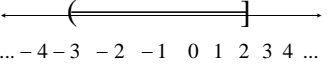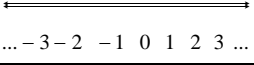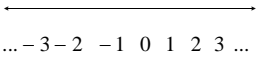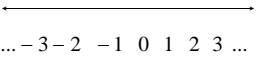
Section 1.5 Solutions ---

1. $[3, \infty)$

... 0 1 2 3 4 5 6 ...

2. $(-\infty, -2)$

... −4 −3 −2 −1 0 1 2 ...

3. $(-\infty, -5]$

... −7 −6 −5 −4 −3 −2 −1 0 ...

4. $(-7, \infty)$

... −7 −6 −5 −4 −3 −2 −1 0 1 ...

99

5. $[-2,3)$ ... −3 −2 −1 0 1 2 3 4 ...	**6.** $[-4,-1]$ ... −5 −4 −3 −2 −1 0 ...
7. $(-3,5]$ ... −3 −2 −1 0 1 2 3 4 5 ...	**8.** $(0,6)$ ... −2 −1 0 1 2 3 4 5 6 7 8 ...
9. $[0,0]$ ... −3 −2 −1 0 1 2 3 ...	**10.** $[-7,-7]$ ... −9 −8 −7 −6 −5 −4 ...
11. $[4,6]$ ... 3 4 5 6 7 ...	**12.** $(-3,2]$ ... −3 −2 −1 0 1 2 ...
13. $[-8,-6]$ ... −9 −8 −7 −6 −5 ...	**14.** $(-\infty,2)$ ... 0 1 2 3 4 ...
15. $\varnothing$ ... −3 −2 −1 0 1 2 3 ...	**16.** $\varnothing$ ... −3 −2 −1 0 1 2 3 ...
17. $\{x:0\le x<2\}$	**18.** $\{x:0<x\le 3\}$
19. $\{x:-7<x<-2\}$	**20.** $\{x:-3\le x\le 2\}$
21. $\{x:x\le 6\}$	**22.** $\{x:x>5\}$
23. $\{x:-\infty<x<\infty\}$	**24.** $\{x:4\le x\le 4\}$
25. $-3<x\le 7 \quad (-3,7]$	**26.** $-\dfrac{1}{2}\le x<\dfrac{7}{8} \quad \left[-\dfrac{1}{2},\dfrac{7}{8}\right)$
27. $3\le x<5 \quad [3,5)$	**28.** $4<x\le 8 \quad (4,8]$
29. $-2\le x \quad [-2,\infty)$	**30.** $x<-3 \quad (-\infty,-3)$
31. $-\infty<x<8 \quad (-\infty,8)$	**32.** $-2\le x<\infty \quad [-2,\infty)$
33. $(-5,3)$ ... −5 −4 −3 −2 −1 0 1 2 3 ...	**34.** $[-5,7)$ ... −5 −4 −3 −2 −1 0 ... 7 8 9 ...

35. $[-6,5)$ ...$-7-6\ -5$ ... $0\ 1\ 2\ 3\ 4\ 5$...	**36.** $[-6,1)$ ...$-7-6\ -5\ -4\ -3-2\ -1\ 0\ 1\ 2$ ...
37. $[-1,1]$ ...$-2\ -1\ 0\ 1\ 2\ 3$ ...	**38.** $(-\infty,-5)$ ...$-7\ -6\ -5\ -3\ -2-1\ 0$...
39. $[1,4)$ ...$0\ 1\ 2\ 3\ 4$ ...	**40.** $[-3,\infty)$ ...$-3-2\ -1\ 0\ 1\ 2\ 3\ 4$ ...
41. $[-1,2)$ ...$-2-1\ 0\ 1\ 2\ 3$...	**42.** $[-2,5)$ ...$-3-2\ -1\ 0\ 1\ 2\ 3\ 4\ 5$...
43. $(-\infty,4)\cup(4,\infty)$ ...$2\ 3\ 4\ 5\ 6\ 7$ ...	**44.** $(-\infty,\infty)$ ...$-3-2\ -1\ 0\ 1\ 2\ 3$ ...
45. $(-\infty,-3]\cup[3,\infty)$ ...$-3-2\ -1\ 0\ 1\ 2\ 3$ ...	**46.** $(-2,1]$ ...$-3-2\ -1\ 0\ 1\ 2\ 3\ 4$ ...
47. $(-3,2]$ ...$-4-3\ -2\ -1\ 0\ 1\ 2\ 3\ 4$ ...	**48.** $(-\infty,\infty)$ ...$-3-2\ -1\ 0\ 1\ 2\ 3$ ...
49. $\varnothing$ ...$-3-2\ -1\ 0\ 1\ 2\ 3$ ...	**50.** $\varnothing$ ...$-3-2\ -1\ 0\ 1\ 2\ 3$ ...

51. $(-\infty,2)\cup[3,5)$	**52.** $(-\infty,-5)\cup[0,2]$	**53.** $(-\infty,-4]\cup(2,5]$
54. $[-12,-5)\cup(-2,\infty)$	**55.** $[-4,-2)\cup(3,7]$	**56.** $(-\infty,-2)\cup(2,\infty)$

57. $(-6,-3]\cup[0,4)$	**58.** $(-\infty,-5]\cup[-1,\infty)$

59. $x-3<7$ $x<10$ $\boxed{(-\infty,10)}$	60. $x+4>9$ $x>5$ $\boxed{(5,\infty)}$	61. $3x-2\le 4$ $3x\le 6$ $x\le 2$ $\boxed{(-\infty,2]}$
62. $3x+7\ge -8$ $3x\ge -15$ $x\ge -5$ $\boxed{[-5,\infty)}$	63. $-5p\ge 10$ Divide by -5 and flip sign $p\le -2$ $\boxed{(-\infty,-2]}$	64. $-4u<12$ Divide by -4 and flip sign $u>-3$ $\boxed{(-3,\infty)}$
65. $3-2x\le 7$ $-2x\le 4$ $x\ge -2$ $\boxed{[-2,\infty)}$	66. $4-3x>-17$ $-3x>-21$ $x<7$ $\boxed{(-\infty,7)}$	67. $-1.8x+2.5>3.4$ $-1.8x>0.9$ $x<\dfrac{0.9}{-1.8}=-0.5$ $\boxed{(-\infty,-0.5)}$
68. $2.7x-1.3<6.8$ $2.7x<8.1$ $x<3$ $\boxed{(-\infty,3)}$	69. $3(t+1)>2t$ $3t+3>2t$ $t+3>0$ $t>-3$ $\boxed{(-3,\infty)}$	
70. $2(y+5)\le 3(y-4)$ $2y+10\le 3y-12$ $10\le y-12$ $22\le y$ $\boxed{[22,\infty)}$	71. $7-2(1-x)>5+3(x-2)$ $7-2+2x>5+3x-6$ $5+2x>3x-1$ $5>x-1$ $x<6$ $\boxed{(-\infty,6)}$	72. $4-3(2+x)<5$ $4-6-3x<5$ $-2-3x<5$ $-3x<7$ $x>-7/3$ $\boxed{(-7/3,\infty)}$

73.

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

LCD $= 6$

$$2(x+2) - 2(6) \geq x(3)$$

$$2x + 4 - 12 \geq 3x$$

$-8 \geq x$ or $x \leq -8$

$\boxed{(-\infty, -8]}$

74.

$$\frac{y-3}{5} - 2 \leq \frac{y}{4}$$

$$20 \cdot \left(\frac{y-3}{5} - 2 \right) \leq 20 \cdot \frac{y}{4}$$

$$4(y-3) - 2(20) \leq 5y$$

$$4y - 12 - 40 \leq 5y$$

$$-52 \leq y$$

$\boxed{[-52, \infty)}$

75.

$$\frac{t-5}{3} \leq -4$$

LCD $= 3$

$$t - 5 \leq -4(3)$$

$$t - 5 \leq -12$$

$$t \leq -7$$

$\boxed{(-\infty, -7]}$

76.

$$\frac{2p+1}{5} > -3$$

$$5 \cdot \left(\frac{2p+1}{5} \right) > 5 \cdot (-3)$$

$$2p + 1 > -15$$

$$2p > -16$$

$$p > -8$$

$\boxed{(-8, \infty)}$

77.

Multiply by LCD $= 6$

$$4y - 3(5-y) < 10y - 6(2+y)$$

$$4y - 15 + 3y < 10y - 12 - 6y$$

$$7y - 15 < 4y - 12$$

$$3y - 15 < -12$$

$$3y < 3$$

$$y < 1$$

$\boxed{(-\infty, 1)}$

78.

$$\frac{s}{2} - \frac{s-3}{3} > \frac{s}{4} - \frac{1}{12}$$

LCD $= 12$

$$6s - 4(s-3) > 3s - 1$$

$$6s - 4s + 12 > 3s - 1$$

$$2s + 12 > 3s - 1$$

$$s < 13$$

$\boxed{(-\infty, 13)}$

79.

$$-2 < x + 3 < 5$$

$$-5 < x < 2$$

$\boxed{(-5, 2)}$

80.

$$1 < x + 6 < 12$$

$$-5 < x < 6$$

$\boxed{(-5, 6)}$

81.	$-8 \le 4 + 2x < 8$ $-12 \le 2x < 4$ Divide by 2 $-6 \le x < 2$ $\boxed{[-6,2)}$	**82.**	$0 < 2 + x \le 5$ $-2 < x \le 3$ $\boxed{(-2,3]}$	**83.**	$-3 < 1 - x \le 9$ $-4 < -x \le 8$ Divide by -1 Flip the signs $-8 \le x < 4$ $\boxed{[-8,4)}$
84.	$3 \le -2 - 5x \le 13$ $5 \le -5x \le 15$ Divide by -5 Flip the signs $-1 \ge x \ge -3$ $\boxed{[-3,-1]}$	**85.**	$0 < 2 - \dfrac{1}{3}y < 4$ $-2 < -\dfrac{1}{3}y < 2$ Multiply by -3 Flip the signs $-6 < y < 6$ $\boxed{(-6,6)}$	**86.**	$3 < \dfrac{1}{2}A - 3 < 7$ $6 < \dfrac{1}{2}A < 10$ Multiply by 2 $12 < A < 20$ $\boxed{(12,20)}$
87.	$\dfrac{1}{2} \le \dfrac{1+y}{3} \le \dfrac{3}{4}$ Multiply by 3 $\dfrac{3}{2} \le 1 + y \le \dfrac{9}{4}$ $\dfrac{1}{2} \le y \le \dfrac{5}{4}$ $\boxed{\left[\dfrac{1}{2}, \dfrac{5}{4}\right]}$	**88.**	$-1 < \dfrac{2-z}{4} \le \dfrac{1}{5}$ Multiply by 4 $-4 < 2 - z \le \dfrac{4}{5}$ $-6 < -z \le -\dfrac{6}{5}$ Multiply by -1 Flip the signs $6 > z \ge \dfrac{6}{5}$ $\boxed{\left[\dfrac{6}{5}, 6\right)}$	**89.**	$-0.7 \le 0.4x + 1.1 \le 1.3$ $-1.8 \le 0.4x \le 0.2$ $-\dfrac{1.8}{0.4} \le x \le \dfrac{0.2}{0.4}$ $-4.5 \le x \le 0.5$ $\boxed{[-4.5,\ 0.5]}$
90.	$7.1 > 4.7 - 1.2x > 1.1$ $2.4 > -1.2x > -3.6$ $-2 < x < 3$ $\boxed{(-2,3)}$	**91.**	Low weight: $\underbrace{110}_{1^{st}\ 5\ feet} + \underbrace{2}_{2\ lbs}\underbrace{(9)}_{9\ inches} = 128$ High weight: $\underbrace{110}_{1^{st}\ 5\ feet} + \underbrace{6}_{6\ lbs}\underbrace{(9)}_{9\ inches} = 164$ $\boxed{128 \le w \le 164}$		

92. Low weight: $\underbrace{105}_{1^{st}\ 5\ feet} + \underbrace{1}_{1\ lbs}\underbrace{(9)}_{9\ inches} = 114$ High weight: $\underbrace{105}_{1^{st}\ 5\ feet} + \underbrace{5}_{5\ lbs}\underbrace{(9)}_{9\ inches} = 150$ $\boxed{114 \le w \le 150}$	**93.**	$\text{Revenue} = 100x\ (x = \#\ dresses)$ $\text{Cost} = 4000 + 20x$ $\text{Profit} = \text{Revenue} - \text{Cost}$ $= 100x - (4000 + 20x) > 0$ $100x - 4000 - 20x > 0$ $80x > 4000$ $x > 50$ $\boxed{\text{More than 50 dresses}}$
94. If champ by age 2: Revenue $= 30,000$ $2000 + 400(24) \le \text{Cost} \le 2000 + 1000(24)$ $11,600 \le \text{Cost} \le 26,000$ $\text{Profit} = \text{revenue} - \text{cost}$ $30,000 - 26,000 \le \text{profit} \le 30,000 - 11,600$ $4,000 \le \text{profit} \le 18,400$ $\boxed{\$4,000\ \text{to}\ \$18,400}$	**95.**	Solve: $5,000 + 1.75x \ge 10,000$ (Note: We changed from 10 to 10,000 on the right-side of the inequality because $R(x)$ is measured in thousands of dollars.) $1.75x \ge 5,000$ $x \ge 2,857.14$ So, must sell at least 285,700 units.

96. Solve: $5,000 + 1.75x \ge 7,500$

(Note: We changed from 7.5 to 7,500 on the right-side of the inequality because $R(x)$ is measured in thousands of dollars.)
$$1.75x \ge 2,500$$
$$x \ge 1,428.57$$
So, must sell at least 142,900 units.

97. Use the formula
$$THR = (HR_{max} - HR_{rest}) \times I + HR_{rest}$$
with $HR_{rest} = 65$, $HR_{max} = 170$.

Solve for I first when $THR = 100$ and then when $THR = 140$:

$$100 = (170 - 65)I + 65$$
$$35 = 105I$$
$$I \approx 0.33$$

So, about 33%.

$$140 = (170 - 65)I + 65$$
$$75 = 105I$$
$$I \approx 0.71$$

So, about 71%.

So, can consider workouts between 33% and 71% intensity.

98. Use the formula
$$THR = \left(HR_{\max} - HR_{rest}\right) \times I + HR_{rest}$$
with $HR_{rest} = 75$, $HR_{\max} = 175$.
Solve for I first when $THR = 110$ and then when $THR = 150$:

$$110 = (175 - 75)I + 75$$
$$35 = 100I$$
$$I \approx 0.35$$

So, about 35%.

$$150 = (175 - 75)I + 75$$
$$75 = 100I$$
$$I \approx 0.75$$

So, about 75%.

So, can consider workouts between 35% and 75% intensity.

99.

Cell Phone Charge: $50 + 0.22x$

$(x = \text{minutes over 800 used})$

$67.16 \le 50 + 0.22x \le 96.86$

$17.16 \le 0.22x \le 46.86$

$78 \le x \le 213$

Least minutes: $800 + 78 = \boxed{878}$

Most minutes: $800 + 213 = \boxed{1013}$

100. Let x = number of minutes used in excess of 1000.
Solve:
$$36.40 \le 30 + 0.08x \le 47.20$$
$$6.40 \le 0.08x \le 17.20$$
$$\frac{6.40}{0.08} \le x \le \frac{17.20}{0.08}$$
$$80 \le x \le 215$$
The least number of minutes used was 1,080, and the most used was 1,215.

101. Let x = grade on the 4th exam.
$$\frac{67 + 77 + 84 + x}{4} \ge 80$$
$$67 + 77 + 84 + x \ge 320$$
$$228 + x \ge 320$$
$$x \ge \boxed{92}$$

102. Let x = grade on the exam.
$$80 \le \frac{96 + 87 + 79 + 89 + x}{5} \le 90$$
$$400 \le 351 + x \le 450$$
$$49 \le x \le 99$$
You would need to score between 49% and 99% on the final exam.

103. Let x = invoice price.
$$\frac{27,999}{1.30} < x < \frac{27,999}{1.15}$$
$$\boxed{\$21,537.69 < x < \$24,346.96}$$

104. Let x = invoice price. $$\frac{42,599}{1.30} < x < \frac{42,599}{1.15}$$ $$\boxed{\$32,768.46 < x < \$37,042.61}$$	**105.** $0.9\, r_T \leq r_R \leq 1.1\, r_T$
106. $\dfrac{S}{N} \geq 2$ if N fluctuates by 10% $\dfrac{S}{1.1\,N} > 2$ or $\boxed{S > 2.2\,N}$	**107.** $0.85L \leq B \leq 0.95L$
108. $0.95h_t \leq h_m \leq 1.05h_t$	**109.** Let x = number of times play. We want the smallest value of x for which $$160 + 10x \leq 55x.$$ Solving yields: $$160 \leq 45x$$ $$3.56 \approx \frac{160}{45} \leq x$$ So, they would need to play $\boxed{4\ \text{times}}$ in order to make the membership a better deal.
110. Let x = number of times play. We want the smallest value of x for which $$125 + 10x \leq 40x.$$ Solving yields: $$125 \leq 30x$$ $$4.17 \approx \frac{125}{30} \leq x$$ So, they would need to play $\boxed{5\ \text{times}}$ in order to make the membership a better deal.	**111.** Let T = amount of tax paid. Least amount of tax = \$5,156.25 Greatest amount of tax = \$18,481 So, the range of taxes is: $$\boxed{5,156.25 \leq T \leq 18,481.25}$$
112. Let T = amount of tax paid. Least amount of tax = \$18,481.25 Greatest amount of tax = \$46,075.25 So, the range of taxes is: $\boxed{18,481.25 \leq T \leq 46,075.25}$	**113.** Mixed up parenthesis and brackets $[-1,4)$
114. Performed union instead of intersection. $(3,4)$	**115.** Forgot to flip the sign when dividing by -3. Answer should be $[2,\infty)$.

116. $x \geq -2$ corresponds to $[-2, \infty)$		
117. True. In fact, the two inequalities are equivalent.	118. False. Need to switch the sign.	
119. a, b	120. c, d	121. a, b
122. c, d	123. c	124. a, b
125. Mentally, realize that $x \leq -x$ holds only when the left-side is negative or zero. Hence, the solution set is $(-\infty, 0]$.	126. Mentally, realize that $x > -x$ holds only with the right-side is negative, which occurs when $x > 0$. Hence, the solution set is $(0, \infty)$.	
127. Observe that $$ax + b < ax - c$$ $$b < -c$$ This is false because we are assuming that $0 < b < c$, so that $-c < b$. Hence, the inequality has no solution.	128. Observe that $$-ax + b < -ax + c$$ $$b < c$$ This is true, by assumption. Hence, the solution set is all real numbers.	

129.

a)

$$2.7x + 3.1 < 9.4x - 2.5$$

$$2.7x + 5.6 < 9.4x$$

$$5.6 < 6.7x$$

$$x > 0.83582 \text{ (rounded)}$$

c) Agree

b)

130.

a)

$$-0.5x + 2.7 > 4.1x - 3.6$$

$$2.7 > 4.6x - 3.6$$

$$6.3 > 4.6x$$

$$x < 1.36957 \text{ (rounded)}$$

c) Agree

b)

131.

a)

$$x - 3 < 2x - 1 < x + 4$$

$$-3 < x - 1 < 4$$

$$-2 < x < 5$$

$$(-2, 5)$$

c) Agree

b)
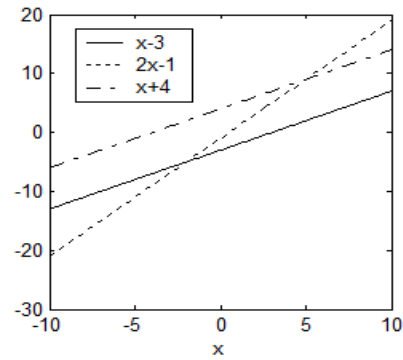
132. **a)**

$$x - 2 < 3x + 4 \le 2x + 6$$

$$x - 2 < 3x + 4 \quad \text{and} \quad 3x + 4 \le 2x + 6$$

$$-6 < 2x \quad \text{and} \quad x \le 2$$

$$-3 < x$$

$$(-3, 2]$$

c) Agree

b) Graphically, let

$$y1 = x - 2, \ y2 = 3x + 4, \ y3 = 2x + 6$$
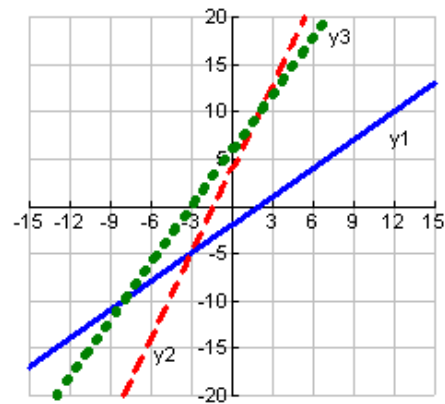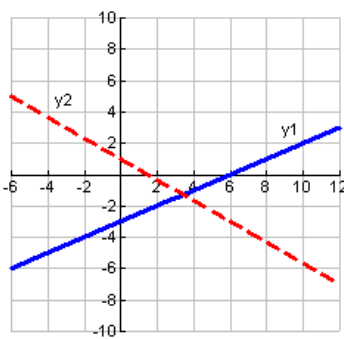
133.

a)

$$x + 3 < x + 5$$
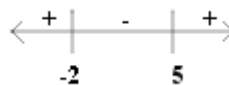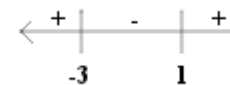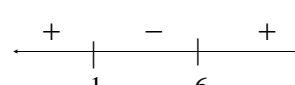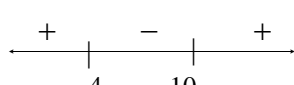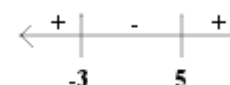
$$3 < 5$$
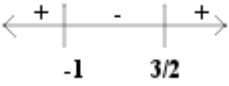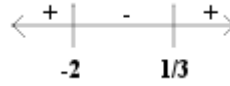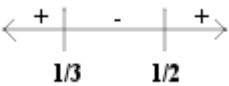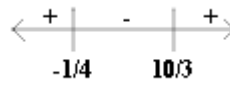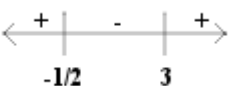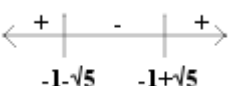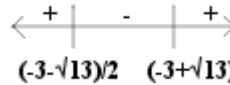
true for any $x \in (-\infty, \infty)$

c) Agree

b)

109
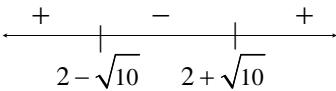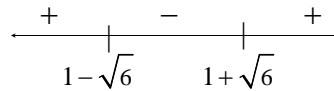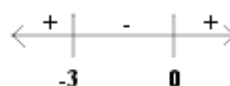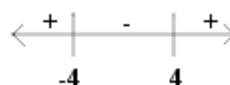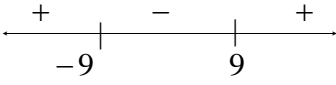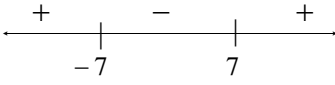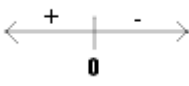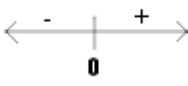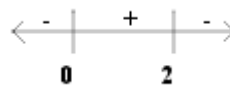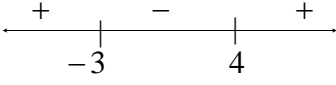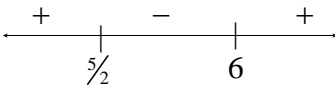
134. **a)**

$$\tfrac{1}{2}x - 3 > -\tfrac{2}{3}x + 1$$

$$\tfrac{7}{6}x > 4$$

$$x > 4\left(\tfrac{6}{7}\right) = \tfrac{24}{7}$$

$$\left(\tfrac{24}{7}, \infty\right)$$

c) Agree

b) Graphically, let

$$y1 = \tfrac{1}{2}x - 3, \ \ y2 = -\tfrac{2}{3}x + 1$$
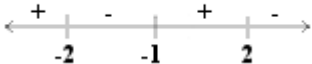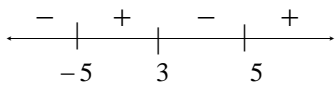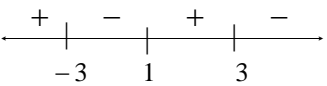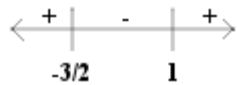
Section 1.6 Solutions --

1. $(x-5)(x+2) \geq 0$

CP's: $x = -2, 5$

$$\boxed{(-\infty, -2] \cup [5, \infty)}$$

2. $(x+3)(x-1) < 0$

CP's: $x = -3, 1$

$$\boxed{(-3, 1)}$$

3. $u^2 - 5u - 6 \leq 0$

$(u-6)(u+1) \leq 0$

CP's: $u = 6, -1$

$$\boxed{[-1, 6]}$$

4. $u^2 - 6u - 40 > 0$

$(u-10)(u+4) > 0$

CPs: $-4, 10$

$$\boxed{(-\infty, -4) \cup (10, \infty)}$$

5. $p^2 + 4p + 3 < 0$

$(p+3)(p+1) < 0$

CP's: $p = -3, -1$

$$\boxed{(-3, -1)}$$

6. $p^2 - 2p - 15 \geq 0$

$(p-5)(p+3) \geq 0$

CP's: $p = -3, 5$

$$\boxed{(-\infty, -3] \cup [5, \infty)}$$

7. $2t^2 - t - 3 \le 0$	8. $3t^2 + 5t - 2 \ge 0$
$(2t-3)(t+1) \le 0$	$(3t-1)(t+2) \ge 0$
CP's: $t = -1, 3/2$	CP's: $t = -2, 1/3$
 + - + -1 3/2	 + - + -2 1/3
$\boxed{[-1, 3/2]}$	$\boxed{(-\infty, -2] \cup [1/3, \infty)}$

9. $6v^2 - 5v + 1 < 0$	10. $12t^2 - 37t - 10 < 0$
$(3v-1)(2v-1) < 0$	$(3t-10)(4t+1) < 0$
CP's: $v = 1/3, 1/2$	CP's: $t = -1/4, 10/3$
 + - + 1/3 1/2	 + - + -1/4 10/3
$\boxed{(1/3, 1/2)}$	$\boxed{(-1/4, 10/3)}$

11. $2s^2 - 5s - 3 \ge 0$	12. $s^2 + 8s + 12 \le 0$
$(2s+1)(s-3) \ge 0$	$(s+2)(s+6) \le 0$
CP's: $s = -1/2, 3$	CP's: $s = -6, -2$
 + - + -1/2 3	 + - + -6 -2
$\boxed{(-\infty, -1/2] \cup [3, \infty)}$	$\boxed{[-6, -2]}$

13. $y^2 + 2y - 4 \ge 0$ Note: Can't factor	14. $y^2 + 3y - 1 \le 0$ Note: can't factor
To find CP's solve $y^2 + 2y - 4 = 0$	To find CP's solve $y^2 + 3y - 1 = 0$
$y = \dfrac{-2 \pm \sqrt{2^2 - 4(1)(-4)}}{2(1)}$	$y = \dfrac{-3 \pm \sqrt{3^2 - 4(1)(-1)}}{2(1)}$
$y = \dfrac{-2 \pm \sqrt{20}}{2}$	$y = \dfrac{-3 \pm \sqrt{13}}{2}$
$y = \dfrac{-2 \pm 2\sqrt{5}}{2} = -1 \pm \sqrt{5}$	 + - + (-3-√13)/2 (-3+√13)/2
 + - + -1-√5 -1+√5	$\boxed{\left[\dfrac{-3 - \sqrt{13}}{2}, \dfrac{-3 + \sqrt{13}}{2}\right]}$
$\boxed{(-\infty, -1 - \sqrt{5}] \cup [-1 + \sqrt{5}, \infty)}$	
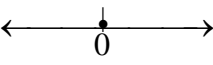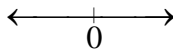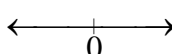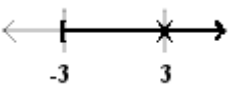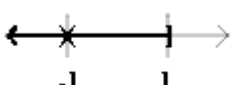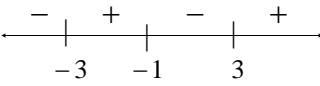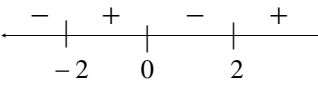
15. $x^2 - 4x < 6$ $x^2 - 4x - 6 < 0$ CPs: Use quadratic formula: $x = \dfrac{4 \pm \sqrt{16 - 4(1)(-6)}}{2} = \dfrac{4 \pm 2\sqrt{10}}{2}$ $= 2 \pm \sqrt{10}$ $\boxed{\left(2 - \sqrt{10},\, 2 + \sqrt{10}\right)}$	**16.** $x^2 - 2x > 5$ $x^2 - 2x - 5 > 0$ CPs: Use quadratic formula: $x = \dfrac{2 \pm \sqrt{4 - 4(1)(-5)}}{2} = \dfrac{2 \pm 2\sqrt{6}}{2}$ $= 1 \pm \sqrt{6}$ $\boxed{\left(-\infty, 1 - \sqrt{6}\right) \cup \left(1 + \sqrt{6}, \infty\right)}$
17. $u^2 - 3u \geq 0$ $u(u - 3) \geq 0$ CP's: $u = 0,\ 3$ $\boxed{(-\infty, 0] \cup [3, \infty)}$	**18.** $u^2 + 4u \leq 0$ $u(u + 4) \leq 0$ CP's: $u = 0, -4$ $\boxed{[-4, 0]}$
19. $x^2 - 2x \leq 0$ $x(x - 2) \leq 0$ CP's: $x = 0, 2$ $\boxed{[0, 2]}$	**20.** $x^2 + 3x \geq 0$ $x(x + 3) \geq 0$ CP's: $x = -3,\ 0$ $\boxed{(-\infty, -3] \cup [0, \infty)}$
21. $x^2 - 9 > 0$ $(x - 3)(x + 3) > 0$ CP's: $x = -3, 3$ $\boxed{(-\infty, -3) \cup (3, \infty)}$	**22.** $x^2 - 16 \geq 0$ $(x - 4)(x + 4) \geq 0$ CP's: $-4,\ 4$ $\boxed{(-\infty, -4] \cup [4, \infty)}$
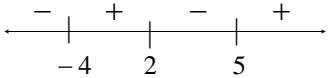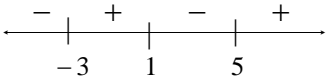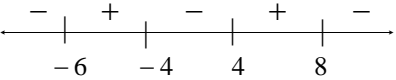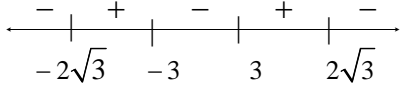
23. $t^2 - 81 < 0$ $(t-9)(t+9) < 0$ CP's: $t = -9, 9$ $+ \quad - \quad +$ $-9 \qquad 9$ $\boxed{(-9, 9)}$	**24.** $t^2 - 49 \le 0$ $(t-7)(t+7) \le 0$ CP's: $t = -7, 7$ $+ \quad - \quad +$ $-7 \qquad 7$ $\boxed{[-7, 7]}$
25. $z^2 + 16 > 0$ No critical points $z^2 + 16 > 0$ for all z $\boxed{\mathbb{R}}$ (consistent)	**26.** $z^2 + 2 \ge 0$ $\boxed{\mathbb{R}}$ (consistent)
27. $y^2 < -4$ $\boxed{\text{no real solution}}$ $\left(\begin{array}{c} \text{A real number squared} \\ \text{is always non-negative.} \end{array}\right)$	**28.** $y^2 \le -25$ $\boxed{\text{no real solution}}$ $\left(\begin{array}{c} \text{A real number squared} \\ \text{is always non-negative.} \end{array}\right)$
29. $\dfrac{-3}{x} \le 0$ $\quad x = 0$ is CP $+ \quad - $ 0 $\boxed{(0, \infty)}$	**30.** $\dfrac{3}{x} \le 0$ $\quad x = 0$ is CP $- \quad + $ 0 $\boxed{(-\infty, 0)}$
31. $\dfrac{y}{y+3} > 0$ $\quad$ CP's: $y = -3, 0$ $+ \quad - \quad +$ $-3 \qquad 0$ $\boxed{(-\infty, -3) \cup (0, \infty)}$	**32.** $\dfrac{y}{2-y} \le 0$ $\quad$ CP's: $y = 0, 2$ $- \quad + \quad -$ $0 \qquad 2$ $\boxed{(-\infty, 0] \cup (2, \infty)}$
33. $\dfrac{t+3}{t-4} \ge 0$ CPs: $-3, 4$ $+ \quad - \quad +$ $-3 \qquad 4$ $\boxed{(-\infty, -3] \cup (4, \infty)}$	**34.** $\dfrac{2t-5}{t-6} < 0$ CPs: $\tfrac{5}{2}, 6$ $+ \quad - \quad +$ $\tfrac{5}{2} \qquad 6$ $\boxed{\left(\tfrac{5}{2}, 6\right)}$
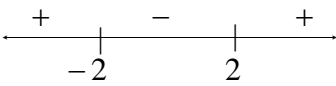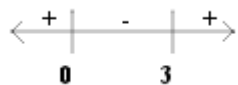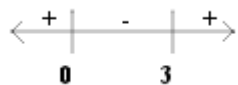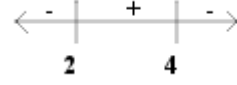
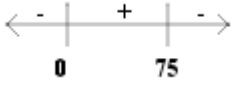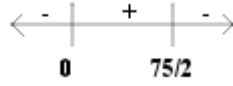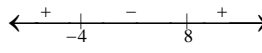|	
35. $$\frac{s+1}{(2-s)(2+s)} \geq 0$$ CP's: $s = -2, -1, 2$ $$\boxed{(-\infty, -2) \cup [-1, 2)}$$	**36.** $$\frac{s+5}{(2-s)(2+s)} \leq 0$$ CP's: $s = -5, -2, 2$ $$\boxed{[-5, -2) \cup (2, \infty)}$$
37. $$\frac{x-3}{x^2-25} \geq 0$$ $$\frac{x-3}{(x-5)(x+5)} \geq 0$$ CPs: $3, \pm 5$ $$\boxed{(-5, 3] \cup (5, \infty)}$$	**38.** $$\frac{1-x}{x^2-9} \leq 0$$ $$\frac{1-x}{(x-3)(x+3)} \leq 0$$ CPs: $1, \pm 3$ $$\boxed{(-3, 1] \cup (3, \infty)}$$
39. $2u^2 + u < 3$ $2u^2 + u - 3 < 0$ $(2u+3)(u-1) < 0$ CP's: $u = -3/2, 1$ $$\boxed{(-3/2, 1)}$$	**40.** $u^2 - 3u \geq 18$ $u^2 - 3u - 18 \geq 0$ $(u-6)(u+3) \geq 0$ CP's: $u = -3, 6$ $$\boxed{(-\infty, -3] \cup [6, \infty)}$$

114

41.

$$\frac{3t^2}{t+2} - 5t \geq 0$$

$$\frac{3t^2 - 5t(t+2)}{t+2} \geq 0$$

$$\frac{3t^2 - 5t^2 - 10t}{t+2} \geq 0$$

$$\frac{-2t^2 - 10t}{t+2} \geq 0$$

$$\frac{-2t(t+5)}{t+2} \geq 0 \quad \text{CP's:} \, t = -5, -2, 0$$

$$\begin{array}{ccccc} & + & - & + & - \\ \hline & -5 & -2 & 0 & \end{array}$$

$$\boxed{(-\infty, -5] \cup (-2, 0]}$$

42.

$$\frac{-2t - t^2}{4 - t} - t \geq 0$$

$$\frac{-2t - t^2 - t(4-t)}{4 - t} \geq 0$$

$$\frac{-2t - t^2 - 4t + t^2}{4 - t} \geq 0$$

$$\frac{-6t}{4 - t} \geq 0$$

CP's: $t = 0, 4$

$$\begin{array}{ccccc} & + & - & + \\ \hline & 0 & 4 & \end{array}$$

$$\boxed{(-\infty, 0] \cup (4, \infty)}$$

43.

$$\frac{3p - 2p^2}{4 - p^2} - \frac{(3+p)}{(2-p)} < 0$$

$$\frac{p(3 - 2p)}{(2-p)(2+p)} - \frac{(3+p)}{(2-p)} < 0$$

$$\frac{p(3 - 2p) - (3+p)(2+p)}{(2-p)(2+p)} < 0$$

$$\frac{3p - 2p^2 - 6 - 5p - p^2}{(2-p)(2+p)} > 0$$

$$\frac{-3p^2 - 2p - 6}{(2-p)(2+p)} < 0$$

$$\frac{3p^2 + 2p + 6}{(2-p)(2+p)} > 0$$

CP's: $p = -2, 2$

$$\begin{array}{ccccc} & - & + & - \\ \hline & -2 & 2 & \end{array}$$

$$\boxed{(-2, 2)}$$

44.

$$\frac{-7p}{(p-10)(p+10)} - \frac{(p+2)}{(p+10)} \leq 0$$

$$\frac{-7p - (p+2)(p-10)}{(p-10)(p+10)} \leq 0$$

$$\frac{-7p - p^2 + 8p + 20}{(p-10)(p+10)} \leq 0$$

$$\frac{-p^2 + p + 20}{(p-10)(p+10)} \leq 0$$

$$\frac{(-p+5)(p+4)}{(p-10)(p+10)} \leq 0$$

CP's: $p = -10, -4, 5, 10$

$$\begin{array}{ccccccc} & - & + & - & + & - \\ \hline & -10 & -4 & 5 & 10 & \end{array}$$

$$\boxed{(-\infty, -10) \cup [-4, 5] \cup (10, \infty)}$$

45.	$$\frac{x^2}{5+x^2} < 0$$ $$\boxed{\text{No solution}}$$	**46.**	$$\frac{x^2}{5+x^2} \le 0$$ $$\boxed{x=0}$$

47.	$$\frac{x^2+10}{x^2+16} > 0$$ $$\boxed{\mathbb{R}}\ \text{(consistent)}$$	**48.**	$$-\left(\frac{x^2+2}{x^2+4}\right) < 0$$ $$\boxed{\mathbb{R}}\ \text{(consistent)}$$

49.	$$\frac{(v-3)(v+3)}{(v-3)} \ge 0 \ \boxed{v \ne 3}$$ $$v+3 \ge 0$$ $$v \ge -3$$ $$\boxed{[-3,3) \cup (3,\infty)}$$	**50.**	$$(v-1)\frac{(v+1)}{(v+1)} \le 0 \ \boxed{v \ne -1}$$ $$(v-1) \le 0$$ $$v \le 1$$ $$\boxed{(-\infty,-1) \cup (-1,-1]}$$

51.	$$\frac{2}{t-3}+\frac{1}{t+3} \ge 0$$ $$\frac{2(t+3)+(t-3)}{(t-3)(t+3)} \ge 0$$ $$\frac{3t+3}{(t-3)(t+3)} \ge 0$$ $$\frac{3(t+1)}{(t-3)(t+3)} \ge 0$$ CPs: $-1, \pm 3$ $$\boxed{(-3,-1] \cup (3,\infty)}$$	**52.**	$$\frac{1}{t-2}+\frac{1}{t+2} \le 0$$ $$\frac{(t+2)+(t-2)}{(t-2)(t+2)} \le 0$$ $$\frac{2t}{(t-2)(t+2)} \le 0$$ CPs: $0, \pm 2$ $$\boxed{(-\infty,-2) \cup [0,2)}$$

116

53.

$$\frac{3}{x+4} - \frac{1}{x-2} \leq 0$$

$$\frac{3(x-2)-(x+4)}{(x+4)(x-2)} \leq 0$$

$$\frac{2x-10}{(x+4)(x-2)} \leq 0$$

$$\frac{2(x-5)}{(x+4)(x-2)} \leq 0$$

CPs: $-4, 2, 5$

$$\boxed{(-\infty,-4)\cup(2,5]}$$

54.

$$\frac{2}{x-5} - \frac{1}{x-1} \geq 0$$

$$\frac{2(x-1)-(x-5)}{(x-5)(x-1)} \geq 0$$

$$\frac{x+3}{(x-5)(x-1)} \geq 0$$

CPs: $-3, 1, 5$

$$\boxed{[-3,1)\cup(5,\infty)}$$

55.

$$\frac{1}{p+4} + \frac{1}{p-4} - \frac{p^2-48}{p^2-16} > 0$$

$$\frac{(p-4)+(p+4)-\left(p^2-48\right)}{(p+4)(p-4)} > 0$$

$$\frac{-\left(p^2-2p-48\right)}{(p+4)(p-4)} > 0$$

$$\frac{-(p-8)(p+6)}{(p+4)(p-4)} > 0$$

CPs: $-6, \pm 4, 8$

$$\boxed{(-6,-4)\cup(4,8)}$$

56.

$$\frac{1}{p-3} - \frac{1}{p+3} - 2 \leq 0$$

$$\frac{(p+3)-(p-3)-\left(p^2-9\right)}{(p+3)(p-3)} \leq 0$$

$$\frac{-p^2+12}{(p+3)(p-3)} \leq 0$$

$$\frac{-\left(p-2\sqrt{3}\right)\left(p+2\sqrt{3}\right)}{(p+3)(p-3)} \leq 0$$

CPs: $\pm 3, \pm 2\sqrt{3}$

$$\boxed{\left(-\infty,-2\sqrt{3}\,\right]\cup(-3,3)\cup\left[2\sqrt{3},\infty\right)}$$

57.	$\dfrac{1}{p-2}-\dfrac{1}{p+2}-\dfrac{3}{p^2-4}\geq 0$	**58.**	$\dfrac{2}{2p-3}-\dfrac{1}{p+1}-\dfrac{1}{2p^2-p-3}\leq 0$

57.

$$\frac{1}{p-2}-\frac{1}{p+2}-\frac{3}{p^2-4}\geq 0$$

$$\frac{(p+2)-(p-2)-3}{(p+2)(p-2)}\geq 0$$

$$\frac{1}{(p+2)(p-2)}\geq 0$$

CPs: ± 2

```
      +        −         +
  ─────────┼─────────┼─────────
         − 2         2
```

$$\boxed{(-\infty,-2)\cup(2,\infty)}$$

58.

$$\frac{2}{2p-3}-\frac{1}{p+1}-\frac{1}{2p^2-p-3}\leq 0$$

$$\frac{2}{2p-3}-\frac{1}{p+1}-\frac{1}{(2p-3)(p+1)}\leq 0$$

$$\frac{2(p+1)-(2p-3)-1}{(2p-3)(p+1)}\leq 0$$

$$\frac{4}{(2p-3)(p+1)}\leq 0$$

CPs: $-1,\tfrac{3}{2}$

```
      +        −         +
  ─────────┼─────────┼─────────
         −1         3/2
```

$$\boxed{\left(-1,\tfrac{3}{2}\right)}$$

59.

$$-x^2+130x-3000>0$$

$$x^2-130x+3000<0$$

$$(x-30)(x-100)<0$$

CP's: $x=30,100$

```
     +    -    +
  ───┼────────┼───→
    30      100
```

$\boxed{\text{Between 30 and 100 orders}}$

60.

$$x^2-130x+3600>0$$

$$(x-40)(x-90)>0$$

CP's: $x=40,90$

```
     +    -    +
  ←──┼────────┼──→
    40      90
```

$\boxed{\text{Less than 40 or more than 90 orders}}$

61. Car is worth more than you owe:

$$\frac{t}{t-3}>0 \quad \text{CP's:}\, t=0,3$$

```
     +    -    +
  ←──┼────────┼──→
     0       3
```

$\boxed{(3,\infty)}$ $\boxed{\text{Greater than 3 years}}$

You owe more than it's worth:

$$\frac{t}{t-3}<0 \quad \text{CP's:}\, t=0,3$$

```
     +    -    +
  ←──┼────────┼──→
     0       3
```

$\boxed{(0,3)}$ $\boxed{\text{First 3 years}}$

62. Car is worth more than you owe:

$$-\left(\frac{2-t}{4-t}\right)>0$$

```
     -    +    -
  ←──┼────────┼──→
     2       4
```

$\boxed{(2,4)}$ $\boxed{\text{Between 2 and 4 years}}$

You owe more than it's worth:

$$-\left(\frac{2-t}{4-t}\right)<0$$

$$\boxed{(0,2)\cup(4,\infty)}$$

63. $h = -16t^2 + 1200t$ bullet is in the air if $h > 0$ $-16t^2 + 1200t > 0$ $-16t(t - 75) > 0$ CP's: $t = 0, 75$ $(0, 75)$ Bullet is in the air for 75 sec	**64.** $h = -16t^2 + 600t$ bullet is in the air if $h > 0$ $-16t^2 + 600t > 0$ $-8t(2t - 75) > 0$ CP's: $t = 0, 75/2$ $(0, 75/2)$ Bullet is in the air for 37.5 sec
65. $\text{Area} = l \cdot w$ $P = 2l + 2w = 100$ $l = \dfrac{100 - 2w}{2}$ $A = l \cdot w = \left(\dfrac{100 - 2w}{2}\right)(w)$ $50w - w^2 \geq 600$ $w^2 - 50w + 600 \leq 0$ $(w - 20)(w - 30) \leq 0$ CP's: $w = 20, 30$ $[20, 30]$ $20 \leq \text{width} \leq 30$ $20 \leq \text{length} \leq 30$ Between 20 and 30 feet	**66.** $6.25t^2 - 25t + 325 \leq 525$ $6.25t^2 - 25t - 200 \leq 0$ $625t^2 - 2500t - 20000 \leq 0$ $625(t^2 - 4t - 32) \leq 0$ $625(t - 8)(t + 4) \leq 0$ CP's: $t = -4, 8$ $[-4, 8]$ $t = 0$ corresponds to Nov. 2014 $t = 8$ corresponds to July 2015 From Nov. 2014 to July 2015 the stock value was no more than $525
67. $-5(x + 3)(x - 24) < 460$ $-5x^2 + 105x + 360 < 460$ $-5x^2 + 105x - 100 < 0$ $x^2 - 21x + 20 > 0$ $(x - 20)(x - 1) > 0$ The solution set is $(-\infty, 1) \cup (20, \infty)$. So, a price increase less than $1 or greater than $20 per bottle.	**68.** $-5(x + 3)(x - 24) > 550$ $-5x^2 + 105x + 360 > 550$ $-5x^2 + 105x - 190 > 0$ $x^2 - 21x + 38 < 0$ $(x - 19)(x - 2) < 0$ The solution set is $(2, 19)$. So, a price increase between $2 and $19 per bottle.

69.	$400 \pm 7 = 393, 407$	**70.**	$1000 \pm 10 = 990, 1010$

69. $400 \pm 7 = 393, 407$

$$\frac{1,360,000}{407} \le \text{price per acre} \le \frac{1,360,000}{393}$$

$\$3,341.52 \le \text{price per acre} \le \$3460.56$

$\boxed{\$3,342 \text{ to } \$3,461 \text{ per acre}}$

70. $1000 \pm 10 = 990, 1010$

$$\frac{1,000,000}{1010} \le \text{price per acre} \le \frac{1,000,000}{990}$$

$\$990.10 \le \text{price per acre} \le \$1010.10$

$\boxed{\$990 \text{ to } \$1,010 \text{ per acre}}$

71. Cannot divide by x.

$x^2 - 3x > 0$

$x(x-3) > 0$

$(-\infty, 0) \cup (3, \infty)$

72. Cannot take square root.

$u^2 - 25 < 0$

$(u-5)(u+5) < 0$

$(-5, 5)$

73. $\dfrac{(x-2)(x+2)}{(x+2)} > 0 \quad \boxed{x \ne 2}$

$x - 2 > 0$

$x > 2$

Should have considered $x = -2$ a CP

74. Can't cross-multiply

$$\frac{x+4}{x} + \frac{1}{3} < 0$$

$$\frac{3(x+4) + x}{3x} < 0$$

$$\frac{4x+12}{3x} < 0$$

$$\frac{4(x+3)}{3x} < 0$$

$x = 0, -3$ are CP's

$(-3, 0)$

75. False $(-a, a)$

76. False $(-\infty, -a] \cup [a, \infty)$

77. Assume that $ax^2 + bx + c < 0$. If $b^2 - 4ac < 0$, then either there are infinitely many solutions or no real solution.

78. Assume that $ax^2 + bx + c > 0$. If $b^2 - 4ac < 0$, then either there are infinitely many solutions or no real solution.

79. $x^2 + a^2 \ge 0$

True for all real values of x

$\boxed{\mathbb{R}}$

80. $\dfrac{x^2 - b^2}{x + b} < 0 \quad \boxed{x \ne -b}$

$$\frac{(x-b)(x+b)}{x+b} < 0$$

$x - b < 0$

$x < b \quad \boxed{(-\infty, -b) \cup (-b, b)}$

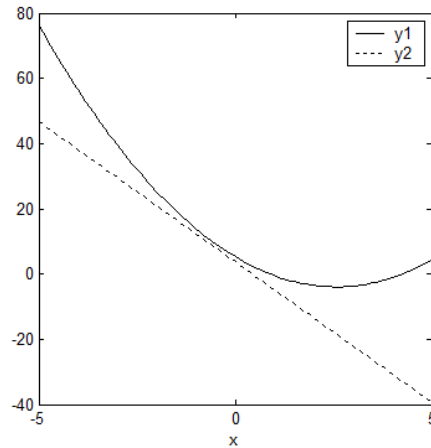| 81.	$\dfrac{x^2+a^2}{x^2+b^2} \geq 0$ $\boxed{\mathbb{R}}$	82.	$\dfrac{a}{x^2}+b<0$ $\dfrac{a+bx^2}{x^2}<0$ No real values for which this is true. $\boxed{\text{No solution}}$

83.

$y_1 = 1.4x^2 - 7.2x + 5.3$

$y_2 = -8.6x + 3.7$

Find when $y_1 > y_2$

$\boxed{\mathbb{R}}$

84.

$y_1 = 17x^2 + 50x - 19$

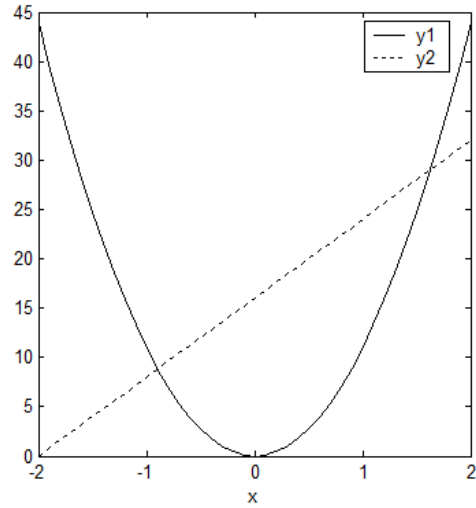$y_2 = 9x^2 + 2$

Find when $y_1 < y_2$

$\boxed{(-6.65, 0.4)}$
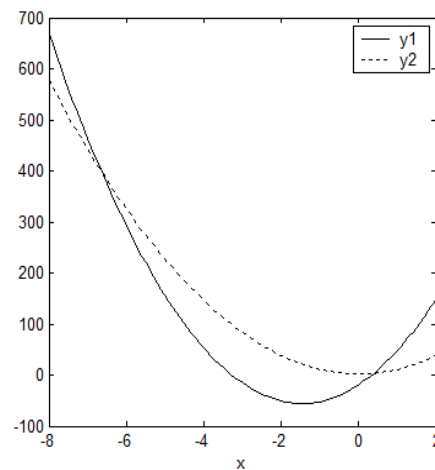
85.

$y_1 = 11x^2$

$y_2 = 8x + 16$
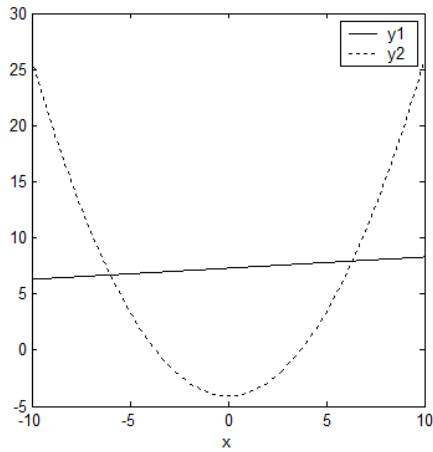
Find when $y_1 < y_2$

$\boxed{(-0.8960, 1.6233)}$

86.

$y_1 = 0.1x + 7.3$

$y_2 = 0.3x^2 - 4.1$

Find when $y_1 > y_2$

$\boxed{(-6, 6.33)}$

87.

$y_1 = x$

$y_2 = x^2 - 3x$

$y_3 = 6 - 2x$
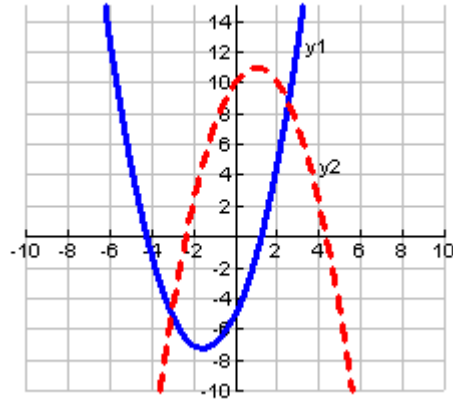
Find when $y_1 < y_2 < y_3$.

$\boxed{(-2, 0)}$
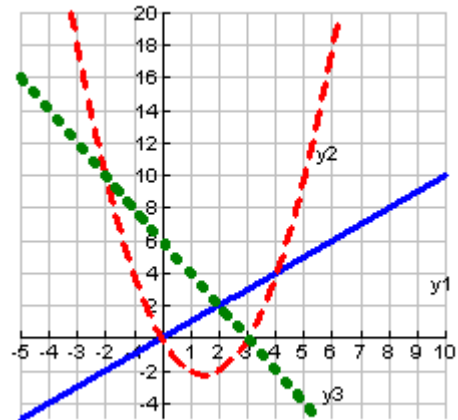
88.

$y_1 = x^2 + 3x - 5$

$y_2 = -x^2 + 2x + 10$

Find when $y_1 \geq y_2$.
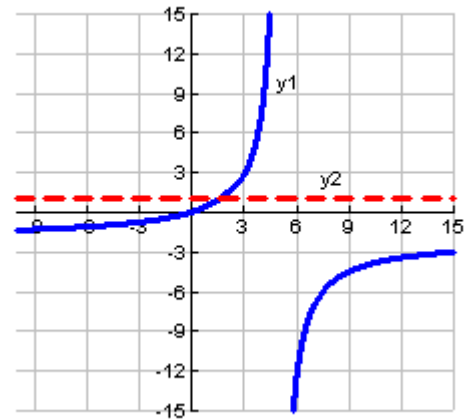
$\boxed{(-\infty, -3] \cup [2.5, \infty)}$

89.

$y_1 = \dfrac{2p}{5-p}$

$y_2 = 1$

Find when $y_1 > y_2$.

$\boxed{\left(\frac{5}{3}, 5\right)}$
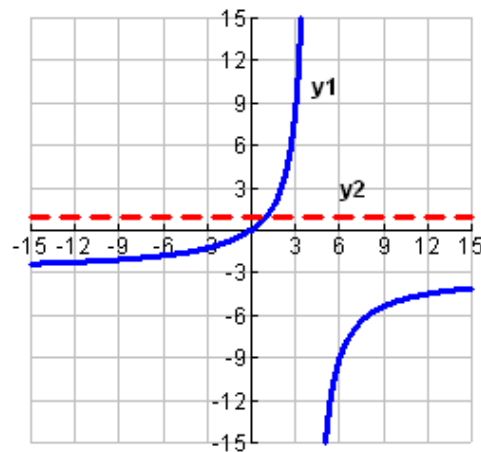

90.

$y_1 = \dfrac{3p}{4-p}$

$y_2 = 1$

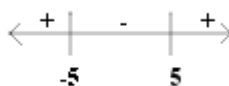Find when $y_1 < y_2$.

$\boxed{(-\infty, 1) \cup (4, \infty)}$

Section 1.7 Solutions --

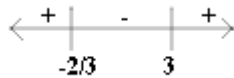|					
1.	$x = -3$ or $x = 3$		**2.**	$x = -2$ or $x = 2$	
3.	No solution (absolute value is always non-negative)		**4.**	No solution (absolute value is always non-negative)	
5.	$t + 3 = -2$ $\boxed{t = -5}$	$t + 3 = 2$ $\boxed{t = -1}$	**6.**	$t - 3 = -2$ $\boxed{t = 1}$	$t - 3 = 2$ $\boxed{t = 5}$
7.	$p - 7 = 3$ $\boxed{p = 10}$	$p - 7 = -3$ $\boxed{p = 4}$	**8.**	$p + 7 = 3$ $\boxed{p = -4}$	$p + 7 = -3$ $\boxed{p = -10}$
9.	$4 - y = -1$ $\boxed{y = 5}$	$4 - y = 1$ $\boxed{y = 3}$	**10.**	$2 - y = -11$ $\boxed{y = 13}$	$2 - y = 11$ $\boxed{y = -9}$
11.	$3x = -9$ $\boxed{x = -3}$	$3x = 9$ $\boxed{x = 3}$	**12.**	$5x = -50$ $\boxed{x = -10}$	$5x = 50$ $\boxed{x = 10}$
13.	$2x + 7 = -9$ $2x = -16$ $\boxed{x = -8}$	$2x + 7 = 9$ $2x = 2$ $\boxed{x = 1}$	**14.**	$2x - 5 = 7$ $2x = 12$ $\boxed{x = 6}$	$2x - 5 = -7$ $2x = -2$ $\boxed{x = -1}$
15.	$3t - 9 = 3$ $3t = 12$ $\boxed{t = 4}$	$3t - 9 = -3$ $3t = 6$ $\boxed{t = 2}$	**16.**	$4t + 2 = 2$ $4t = 0$ $\boxed{t = 0}$	$4t + 2 = -2$ $4t = -4$ $\boxed{t = -1}$
17.	$7 - 2x = -9$ $2x = 16$ $\boxed{x = 8}$	$7 - 2x = 9$ $2x = -2$ $\boxed{x = -1}$	**18.**	$6 - 3y = 12$ $-3y = 6$ $\boxed{y = -2}$	$6 - 3y = -12$ $-3y = -18$ $\boxed{y = 6}$
19.	$1 - 3y = 1$ $-3y = 0$ $\boxed{y = 0}$	$1 - 3y = -1$ $-3y = -2$ $\boxed{y = \tfrac{2}{3}}$	**20.**	$5 - x = 2$ $-x = -3$ $\boxed{x = 3}$	$5 - x = -2$ $-x = -7$ $\boxed{x = 7}$
21.	$4.7 - 2.1x = -3.3$ $2.1x = 8$ $\boxed{x = \frac{80}{21}}$	$4.7 - 2.1x = 3.3$ $2.1x = 1.4$ $\boxed{x = \frac{2}{3}}$	**22.**	$5.2x + 3.7 = -2.4$ $5.2x = -6.1$ $\boxed{x = -\frac{61}{52}}$	$5.2x + 3.7 = 2.4$ $5.2x = -1.3$ $\boxed{x = -\frac{1}{4}}$

23.	$\dfrac{2}{3}x - \dfrac{4}{7} = -\dfrac{5}{3}$ $\dfrac{2}{3}x - \dfrac{4}{7} = \dfrac{5}{3}$ LCD $= 21$ LCD $= 21$ $14x - 12 = -35$ $14x - 12 = 35$ $14x = -23$ $14x = 47$ $\boxed{x = -23/14}$ $\boxed{x = 47/14}$	**24.**	$\dfrac{1}{2}x + \dfrac{3}{4} = -\dfrac{1}{16}$ $\dfrac{1}{2}x + \dfrac{3}{4} = \dfrac{1}{16}$ $8x + 12 = -1$ $8x + 12 = 1$ $8x = -13$ $8x = -11$ $\boxed{x = -13/8}$ $\boxed{x = -11/8}$
25.	$\lvert x - 5 \rvert = 8$ $x - 5 = 8$ $x - 5 = -8$ $\boxed{x = 13}$ $\boxed{x = -3}$	**26.**	$\lvert x + 3 \rvert = 11$ $x + 3 = 11$ $x + 3 = -11$ $\boxed{x = 8}$ $\boxed{x = -14}$
27.	$3\lvert x - 2 \rvert + 1 = 19$ $3\lvert x - 2 \rvert = 18$ $\lvert x - 2 \rvert = 6$ $x - 2 = 6 \ or \ x - 2 = -6$ $x = -4, 8$	**28.**	$2\lvert 1 - x \rvert - 4 = 2$ $2\lvert 1 - x \rvert = 6$ $\lvert 1 - x \rvert = 3$ $1 - x = 3 \ or \ 1 - x = -3$ $x = -2, 4$
29.	$5 = 7 - \lvert 2 - x \rvert$ $-2 = -\lvert 2 - x \rvert$ $2 = \lvert 2 - x \rvert$ $2 - x = 2 \ or \ 2 - x = -2$ $x = 0, 4$	**30.**	$-1 = 3 - \lvert x - 3 \rvert$ $-4 = -\lvert x - 3 \rvert$ $4 = \lvert x - 3 \rvert$ $x - 3 = 4 \ or \ x - 3 = -4$ $x = -1, 7$
31.	$2\lvert p + 3 \rvert = 20$ $\lvert p + 3 \rvert = 10$ $p + 3 = 10$ $p + 3 = -10$ $\boxed{p = 7}$ $\boxed{p = -13}$	**32.**	$-3\lvert p - 4 \rvert = -6$ $\lvert p - 4 \rvert = 2$ $p - 4 = 2$ $p - 4 = -2$ $\boxed{p = 6}$ $\boxed{p = 2}$
33.	$5\lvert y - 2 \rvert - 10 = 4\lvert y - 2 \rvert - 3$ $\lvert y - 2 \rvert = 7$ $y - 2 = 7$ $y - 2 = -7$ $\boxed{y = 9}$ $\boxed{y = -5}$	**34.**	$3 - \lvert y + 9 \rvert = 11 - 3\lvert y + 9 \rvert$ $2\lvert y + 9 \rvert = 8$ $\lvert y + 9 \rvert = 4$ $y + 9 = 4$ $y + 9 = -4$ $\boxed{y = -5}$ $\boxed{y = -13}$

35. $4 - x^2 = -1$ $x^2 = 5$ $\boxed{x = \pm\sqrt{5}}$	$4 - x^2 = 1$ $x^2 = 3$ $\boxed{x = \pm\sqrt{3}}$	**36.** $7 - x^2 = -3$ $x^2 = 10$ $\boxed{x = \pm\sqrt{10}}$	$7 - x^2 = 3$ $x^2 = 4$ $\boxed{x = \pm 2}$
37. $x^2 + 1 = -5$ $x^2 = -6$ no solution	$x^2 + 1 = 5$ $x^2 = 4$ $\boxed{x = \pm 2}$	**38.** $x^2 - 1 = -5$ $x^2 = -4$ $x = \pm 2i$	$x^2 - 1 = 5$ $x^2 = 6$ $\boxed{x = \pm\sqrt{6}}$

39. $-7 < x < 7$ $\left(-7, 7\right)$	**40.** $-9 < y < 9$ $\left(-9, 9\right)$	**41.** $y \le -5$ or $y \ge 5$ $\left(-\infty, -5\right] \cup \left[5, \infty\right)$	**42.** $x \le -2$ or $x \ge 2$ $\left(-\infty, -2\right] \cup \left[2, \infty\right)$

43. $-7 < x + 3 < 7$ $-10 < x < 4$ $\left(-10, 4\right)$	**44.** $-4 \le x + 2 \le 4$ $-6 \le x \le 2$ $\left[-6, 2\right]$
45. $\begin{array}{ccc} x - 4 < -2 & & x - 4 > 2 \\ & \text{or} & \\ x < 2 & & x > 6 \end{array}$ $\left(-\infty, 2\right) \cup \left(6, \infty\right)$	**46.** $-3 < x - 1 < 3$ $-2 < x < 4$ $\left(-2, 4\right)$

47. $-1 \le 4 - x \le 1$ $-5 \le -x \le -3$ $3 \le x \le 5$ $\left[3, 5\right]$	**48.** $-3 < 1 - y < 3$ $-4 < -y < 2$ $4 > y > -2$ $\left(-2, 4\right)$	**49.** $\mathbb{R}$ **50.** No solution

51. $\left\|2t + 3\right\| < 5$ $-5 < 2t + 3 < 5$ $-8 < 2t < 2$ $-4 < t < 1$ $\boxed{\left(-4, 1\right)}$	**52.** $\left\|3t - 5\right\| > 1$ $3t - 5 > 1$ or $3t - 5 < -1$ $3t > 6$ or $3t < 4$ $t > 2$ or $t < \tfrac{4}{3}$ $\boxed{\left(-\infty, \tfrac{4}{3}\right) \cup \left(2, \infty\right)}$

53. $\left|7-2y\right|\geq 3$	54. $\left|6-5y\right|\leq 1$
$7-2y\geq 3 \ \text{ or } \ 7-2y\leq -3$	$-1\leq 6-5y\leq 1$
$-2y\geq -4 \ \text{ or } \ -2y\leq -10$	$-7\leq -5y\leq -5$
$y\leq 2 \quad \text{ or } \quad y\geq 5$	$\tfrac{7}{5}\geq y\geq 1$
$\boxed{(-\infty,2]\cup[5,\infty)}$	$\boxed{\left[1,\tfrac{7}{5}\right]}$

55. $\mathbb{R}$

56. $4-3x\leq -1 \qquad 4-3x\geq 1$	57. $2\left|4x\right|-9\geq 3$
$-3x\leq -5 \quad \text{or} \quad -3x\geq -3$	$2\left|4x\right|\geq 12$
$x\geq 5/3 \qquad\qquad x\leq 1$	$\left|4x\right|\geq 6$
	$4x\geq 6 \ \text{ or } \ 4x\leq -6$
$\boxed{(-\infty,1]\cup[5/3,\infty)}$	$x\geq \tfrac{3}{2} \ \text{ or } \ x\leq -\tfrac{3}{2}$
	$\boxed{(-\infty,-\tfrac{3}{2}]\cup[\tfrac{3}{2},\infty)}$

58. $5\left|x-1\right|+2\leq 7$	59. $2\left|x+1\right|-3\leq 7$
$5\left|x-1\right|\leq 5$	$2\left|x+1\right|\leq 10$
$\left|x-1\right|\leq 1$	$\left|x+1\right|\leq 5$
$-1\leq x-1\leq 1$	$-5\leq x+1\leq 5$
$0\leq x\leq 2$	$-6\leq x\leq 4$
$\boxed{[0,2]}$	$\boxed{[-6,4]}$

60. $3\left|x-1\right|-5>4$	61. $3-2\left|x+4\right|<5$
$3\left|x-1\right|>9$	$-2\left|x+4\right|<2$
$\left|x-1\right|>3$	$\left|x+4\right|>-1$
$x-1>3 \ or \ x-1<-3$	$\boxed{(-\infty,\infty)}$
$x>4 \ or \ x<-2$	
$\boxed{(-\infty,-2)\cup(4,\infty)}$	

62.	$7-3\|x+2\|\geq -14$ $-3\|x+2\|\geq -21$ $\|x+2\|\leq 7$ $-7\leq x+2\leq 7$ $-9\leq x\leq 5$ $\boxed{[-9,5]}$	**63.**	$9-\|2x\|<3$ $-\|2x\|<-6$ $\|2x\|>6$ $2x>6$ or $2x<-6$ $x>3$ or $x<-3$ $\boxed{(-\infty,-3)\cup(3,\infty)}$
64.	$4-\|x+1\|>1$ $-\|x+1\|>-3$ $\|x+1\|<3$ $-3<x+1<3$ $-4<x<2$ $\boxed{(-4,2)}$	**65.**	$-\dfrac{1}{2}<1-2x<\dfrac{1}{2}$ $-\dfrac{3}{2}<-2x<-\dfrac{1}{2}$ $\dfrac{3}{4}>x>\dfrac{1}{4}$ $\boxed{(1/4,3/4)}$

66. $\|2-3x\|\geq 2$

$2-3x\leq -2$ or $2-3x\geq 2$

$4\leq 3x$ or $0\geq 3x$

$4/3\leq x$ $x\leq 0$

$\boxed{(-\infty,0]\cup[4/3,\infty)}$

67. $-1.8<2.6x+5.4<1.8$

$-7.2<2.6x<-3.6$

$-2.769<x<-1.385$

$\boxed{(-2.769,-1.385)}$

68. $3.7-5.5x<-4.3$ or $3.7-5.5x>4.3$

$-5.5x<-8$ $-5.5x>0.6$

$x>\frac{16}{11}$ $x<-\frac{6}{55}$

$\boxed{\left(-\infty,-\frac{6}{55}\right)\cup\left(\frac{16}{11},\infty\right)}$

69. $x^2-1\leq 8$

$x^2-9\leq 0$

$(x-3)(x+3)\leq 0$

CP's: $x=-3,3$

$-3\leq x\leq 3$

$\boxed{[-3,3]}$

70. $x^2+4\geq 29$

$x^2-25\geq 0$

$(x-5)(x+5)\geq 0$

CP's: $-5,5$

$\boxed{(-\infty,-5]\cup[5,\infty)}$

71.	$\|x-2\|<7$
72.	$\|x+2\|>3$
73.	$\|x-3/2\|\geq 1/2$
74.	$\|x-11/3\|\leq 5/3$
75.	$\|x-a\|\leq 2$
76.	$\|x+3\|\geq a$

77.	$\lvert T-83 \rvert \le 15$	**78.**	$\lvert x-97.8 \rvert \le 1.2$
79.	In order to win the hole, $d<4$. In order to have a tie, $d=4$.	**80.**	$\lvert f-f_C \rvert \le 15$

81.
$$\lvert (200+5x)-(210+4.8x) \rvert < 5$$
$$\lvert -10+0.2x \rvert < 5$$
$$-5<-10+0.2x<5$$
$$5<0.2x<15$$
$$25<x<75$$
So, where the number of units sold is between 25 and 75.

82.
$$\lvert (200+5x)-(210+4.8x) \rvert < 3$$
$$\lvert -10+0.2x \rvert < 3$$
$$-3<-10+0.2x<3$$
$$7<0.2x<13$$
$$35<x<65$$
So, when the number of units sold is between 35 and 65.

83.	$x-3=-7$ also yields a solution $x=-4$	**84.**	$-7<x-3<7$ is the appropriate inequality. The answer is (-4,10).
85.	Didn't switch signs when dividing by -2. The answer is [2,3].	**86.**	Absolute value can never yield a negative number, so no solution.
87.	True	**88.**	True
89.	False	**90.**	$x-7\ge 0$ $\boxed{x\ge 7}$

91.
$$-b<x-a<b$$
$$a-b<x<a+b$$
$$\boxed{(a-b,a+b)}$$

92.
$$a-x<-b \qquad \text{or} \qquad a-x>b$$
$$a+b<x \qquad\qquad a-b>x$$
$$\boxed{(-\infty,a-b)\cup(a+b,\infty)}$$

93.	$\mathbb{R}$	**94.**	No solution

95.
$x-a=-b$ $\qquad$ $x-a=b$
$\boxed{x=a-b}$ $\qquad$ $\boxed{x=a+b}$

96. No solution $\qquad$ **97.** No solution

98.
$$3x^2-7x+2<-8 \qquad\qquad 3x^2-7x+2>8$$
$$3x^2-7x+10<0 \qquad\qquad 3x^2-7x-6>0$$
$$\text{no solution} \qquad\qquad (3x+2)(x-3)>0$$
$$\text{CP's: } x=-2/3,\ 3$$

$$\boxed{(-\infty,-2/3)\cup(3,\infty)}$$

99.

$$y_1 = |x - 7|$$
$$y_2 = x - 7$$
$$\boxed{x \geq 7}$$
Agree
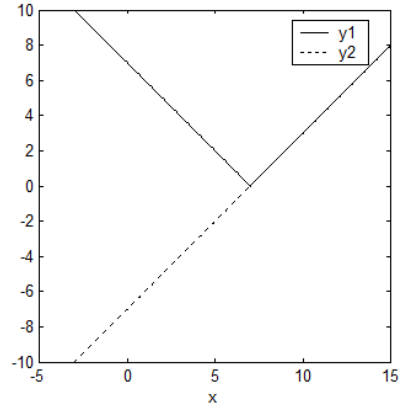
100.

$$y_1 = |x + 1|$$
$$y_2 = |x - 2| + 4$$
Do not coincide, agree.
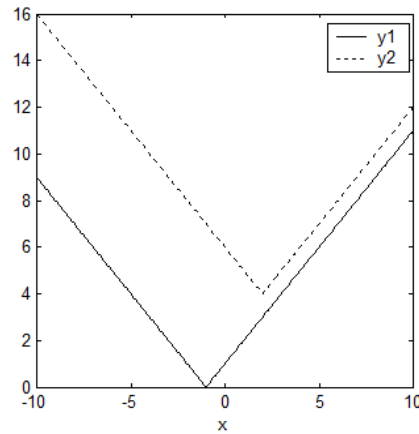
101.

$$y_1 = |3x^2 - 7x + 2|$$
$$y_2 = 8$$
$$\left(-\infty, -\tfrac{2}{3}\right) \cup \left(3, \infty\right)$$
Agree
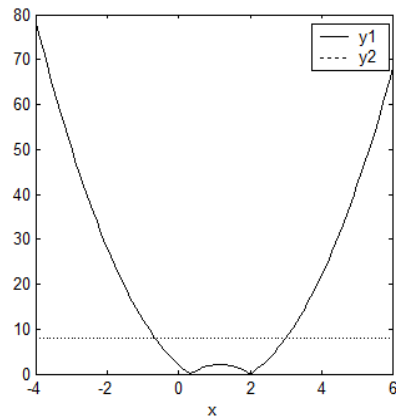
102.

$$y_1 = \left| 2.7x^2 - 7.9x + 5 \right|$$

$$y_2 = \left| 5.3x^2 - 9.2 \right|$$

$$x = -4.31, \ x = -0.38$$

$$(-\infty, -4.31] \cup [-0.38, \infty)$$
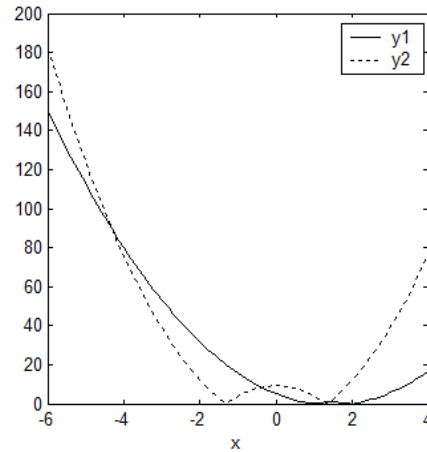
103.

$$y_1 = \left| \frac{x}{x+1} \right|$$

$$y_2 = 1$$

Find when $y_1 < y_2$.

$$\boxed{\left(-\tfrac{1}{2}, \infty\right)}$$
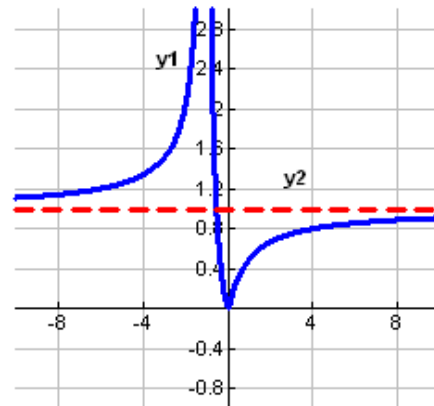
104.

$$y_1 = \left| \frac{x}{x+1} \right|$$

$$y_2 = 2$$

Find when $y_1 < y_2$.

$$\boxed{(-\infty, -2) \cup \left(-\tfrac{2}{3}, \infty\right)}$$
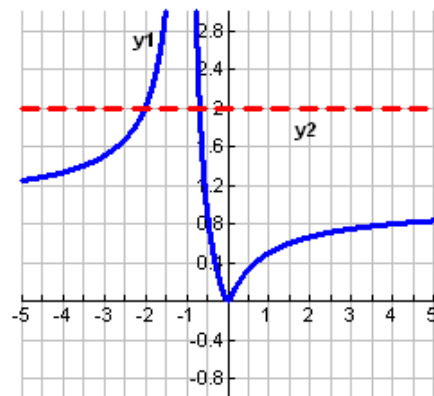
Chapter 1 Review Solutions --

1.	$7x - 4 = 12$ $7x = 16$ $\boxed{x = 16/7}$	**2.**	$13d + 12 = 7d + 6$ $6d = -6$ $\boxed{d = -1}$
3.	$20p + 14 = 6 - 5p$ $25p = -8$ $\boxed{p = -8/25}$	**4.**	$4x - 28 - 4 = 4$ $4x = 36$ $\boxed{x = 9}$
5.	$3x + 21 - 2 = 4x - 8$ $\boxed{x = 27}$	**6.**	$7c + 3c - 15 = 2c + 6 - 14$ $10c - 15 = 2c - 8$ $8c = 7$ $\boxed{c = 7/8}$
7.	$14 - \left[-3y + 12 + 9\right] = 8y + 12 - 6 + 4$ $14 + 3y - 21 = 8y + 10$ $-17 = 5y$ $\boxed{y = -17/5}$	**8.**	$6 - 4x + 2x - 14 - 52 = 6x - 12 + 6\left[6x - 9 + 6\right]$ $-2x - 60 = 6x - 12 + 36x - 18$ $-2x - 60 = 42x - 30$ $-30 = 44x$ $\boxed{x = \frac{-30}{44} = \frac{-15}{22}}$
9.	$b \neq 0$ $12 - 3b = 6 + 4b$ $6 = 7b$ $\boxed{b = 6/7}$	**10.**	$3g + 9g = 7$ $12g = 7$ $\boxed{g = 7/12}$
11.	$LCD = 28$ $4(13x) - 28x = 7x - 2(3)$ $52x - 28x = 7x - 6$ $17x = -6$ $\boxed{x = -6/17}$	**12.**	$LCD = 6$ $30b + b = 2b - 29$ $29b = -29$ $\boxed{b = -1}$

13.	$x \neq 0$ $\text{LCD} = x$ $1 - 4x = 3 - 5x$ $-2 = -x$ $2 = x$ $\boxed{x = 2}$	**14.**	$x \neq -1, 1$ $\text{LCD} = (x+1)(x-1)$ $4(x-1) - 8(x+1) = 3(x+1)(x-1)$ $4x - 4 - 8x - 8 = 3(x^2 - 1)$ $-4x - 12 = 3x^2 - 3$ $3x^2 + 4x + 9 = 0$ $x = \dfrac{-4 \pm \sqrt{4^2 - 4(3)(9)}}{2(3)}$ $x = \dfrac{-4 \pm \sqrt{-92}}{6} = \dfrac{-4 \pm 2i\sqrt{23}}{6}$ $\boxed{x = -\dfrac{2}{3} \pm i\dfrac{\sqrt{23}}{3}}$
15.	$t \neq -4, 0$ $\text{LCD} = t(t+4)$ $2t - 7(t+4) = 6$ $2t - 7t - 28 = 6$ $-5t = 34$ $\boxed{t = -34/5}$	**16.**	$x \neq -\dfrac{1}{3}, \dfrac{7}{2}$ $-2(2x - 7) = 3(3x + 1)$ $-4x + 14 = 9x + 3$ $13x = 11$ $\boxed{x = 11/13}$
17.	$x \neq 0$ $\text{LCD} = 2x$ $3 - 12 = 18x$ $-9 = 18x$ $\boxed{x = -\dfrac{1}{2}}$	**18.**	$m \neq -\dfrac{5}{2}, 0$ $3 - \dfrac{5}{m} = 2 + \dfrac{5}{m}$ $3m - 5 = 2m + 5$ $\boxed{m = 10}$
19.	$7x - 2 + 4x = 3[5 - 2x] + 12$ $11x - 2 = 15 - 6x + 12$ $17x = 29$ $\boxed{x = 29/17}$	**20.**	$\text{LCD} = 15$ $3x - (x - 3) = -90$ $2x + 3 = -90$ $2x = -93$ $\boxed{x = -93/2}$

21.	$3x - 2\left[3y + 12 - 7\right] = y - 2x + 6x - 18$	22.	$y + 2 = \dfrac{x+3}{1+2x} + 2 = \dfrac{5x+5}{1+2x}$
	$3x - 6y - 10 = y - 2x + 6x - 18$		$1 - 2y = 1 - 2\left(\dfrac{x+3}{1+2x}\right) = \dfrac{-5}{1+2x}$
	$-x + 8 = 7y$		
	$\boxed{x = 8 - 7y}$		$\dfrac{y+2}{1-2y} = \dfrac{\dfrac{5(x+1)}{1+2x}}{\dfrac{-5}{1+2x}} = \boxed{-(x+1)}$

23.	Let x = total distance	24.	$B + L + D + 4S = 2000$
	Drives: 16 miles		$D = 1.5B$
	Bus: $\dfrac{3}{4}x$		$L = D - 100 = 1.5B - 100$
	Taxi: $\dfrac{1}{12}x$		$S = \dfrac{1}{4}L = \dfrac{1}{4}\left(1.5B - 100\right)$
	$16 + \dfrac{3}{4}x + \dfrac{1}{12}x = x$		$\underbrace{B}_{\text{breakfast}} + \underbrace{1.5B - 100}_{\text{lunch}} + \underbrace{1.5B}_{\text{dinner}}$
	$\text{LCD} = 12$		$+ \underbrace{4 \cdot \dfrac{1}{4}\left(1.5B - 100\right)}_{\text{snacks}} = 2000$
	$192 + 9x + x = 12x$		$B + 1.5B - 100 + 1.5B + 1.5B - 100 = 2000$
	$2x = 192$		$5.5B = 2200$
	$\boxed{x = 96 \text{ miles}}$		$B = 400$
			$\boxed{\begin{array}{l} B = 400 \\ L = 500 \\ D = 600 \\ S = 125 \end{array}}$

25.	x = number	26.	$x, x+2, x+4, x+6$
	$12 + \dfrac{1}{4}x = \dfrac{1}{3}x$		$x + (x+2) + (x+4) + (x+6) = 3 + 3(x+6)$
	$\text{LCD} = 12$		$4x + 12 = 3x + 21$
	$144 + 3x = 4x$		$x = 9$
	$\boxed{x = 144}$		$\boxed{9, 11, 13, 15}$

Chapter 1 Review

27.
$$P = 2l + 2w$$
$$l = 1 + 2w$$
$$P = 2(1 + 2w) + 2w$$
$$P = 20$$
$$20 = 2 + 4w + 2w$$
$$6w = 18$$
$$\boxed{w = 3 \text{ inches}}$$
$$\boxed{l = 7 \text{ inches}}$$

28.
$$x = \text{Perimeter}$$
$$10 + \frac{1}{3}x + \frac{1}{6}x = x$$
$$\text{LCD} = 18$$
$$180 + 6x + 3x = 18x$$
$$9x = 180$$
$$\boxed{x = 20 \text{ inches}}$$

29.
$$x = \text{amount invested @ 20\%}$$
$$25000 - x = \text{amount invested @ 8\%}$$
$$\text{Earned interest} = 27600 - 25000 = 2600$$
$$0.2x + 0.08(25000 - x) = 2600$$
$$0.2x + 2000 - 0.08x = 2600$$
$$0.12x = 600$$
$$x = 5000$$
$$\boxed{\$5,000 @ 20\%}$$
$$\boxed{\$20,000 @ 8\%}$$

30.
$$\$2500 \text{ in mutual funds}$$
$$\$2500 \text{ in stock}$$
$$x = \text{rate of mutual fund}$$
$$4x = \text{rate of stock}$$
$$x(2500) + 4x(2500) = 250$$
$$2500x + 10000x = 250$$
$$12500x = 250$$
$$x = 0.02$$
$$\boxed{\begin{array}{l}\text{Mutual Fund: } 2\% \\ \text{Stock: } 8\%\end{array}}$$

31.
$$x = \text{ml of } 5\%$$
$$150 - x = \text{ml of } 10\%$$
$$0.05x + 0.10(150 - x) = 0.08(150)$$
$$0.05x + 15 - 0.10x = 12$$
$$-0.05x = -3$$
$$x = 60$$
$$\boxed{\begin{array}{l}60 \text{ ml of } 5\% \\ 90 \text{ ml of } 10\%\end{array}}$$

32.
$$x = \text{ounces of } 8\%$$
$$4 \text{ ounces of } 20\%$$
$$\text{Desired: } 12\%$$
$$0.08x + 0.20(4) = 0.12(x + 4)$$
$$\text{Multiply by } 100$$
$$8x + 80 = 12x + 48$$
$$32 = 4x$$
$$\boxed{x = 8}$$

33.	$x = $ final exam grade $$\frac{3x+95+82+90}{6} \geq 90$$ $3x + 267 \geq 540$ $3x \geq 273$ $\boxed{\text{At least 91}}$	**34.**	$x = $ original price $0.80x = 25000$ $x = 31250$ $\boxed{\$31,250}$
35.	$b^2 - 4b - 21 = 0$ $(b-7)(b+3) = 0$ $\boxed{b = -3, 7}$	**36.**	$x^2 - 3x - 54 = 0$ $(x-9)(x+6) = 0$ $\boxed{x = -6, 9}$
37.	$x^2 - 8x = 0$ $x(x-8) = 0$ $\boxed{x = 0, 8}$	**38.**	$(3y-5)(2y+1) = 0$ $3y - 5 = 0 \quad 2y + 1 = 0$ $\boxed{y = 5/3 \text{ or } y = -1/2}$
39.	$q^2 = 169$ $q = \pm\sqrt{169}$ $\boxed{q = \pm 13}$	**40.**	$c^2 = -36$ $c = \pm\sqrt{-36}$ $\boxed{c = \pm 6i}$
41.	$2x - 4 = \pm\sqrt{-64}$ $2x - 4 = \pm 8i$ $2x = 4 \pm 8i$ $\boxed{x = 2 \pm 4i}$	**42.**	$d + 7 = \pm\sqrt{4}$ $d = -7 \pm 2$ $\boxed{d = -9, -5}$

43. $x^2 - 4x = 12$ $x^2 - 4x + 4 = 12 + 4$ $(x-2)^2 = 16$ $x - 2 = \pm 4$ $x = 2 \pm 4$ $\boxed{x = -2, 6}$	**44.** $2x^2 - 5x = 7$ $2\left(x^2 - \dfrac{5}{2}x\right) = 7$ $2\left(x^2 - \dfrac{5}{2}x + \dfrac{25}{16}\right) = 7 + \dfrac{25}{8}$ $2\left(x - \dfrac{5}{4}\right)^2 = \dfrac{81}{8}$ $\left(x - \dfrac{5}{4}\right)^2 = \dfrac{81}{16}$ $x - \dfrac{5}{4} = \pm\dfrac{9}{4}$ $x = \dfrac{5}{4} \pm \dfrac{9}{4}$ $\boxed{x = -1, \dfrac{7}{2}}$
45. $x^2 - x = 8$ $x^2 - x + \dfrac{1}{4} = 8 + \dfrac{1}{4}$ $\left(x - \dfrac{1}{2}\right)^2 = \dfrac{33}{4}$ $x - \dfrac{1}{2} = \pm\sqrt{\dfrac{33}{4}}$ $\boxed{x = \dfrac{1 \pm \sqrt{33}}{2}}$	**46.** $m^2 - 8m = -15$ $m^2 - 8m + 16 = -15 + 16$ $(m-4)^2 = 1$ $m - 4 = \pm 1$ $m = 4 \pm 1$ $\boxed{m = 3, 5}$
47. $3t^2 - 4t - 7 = 0$ $a = 3, b = -4, c = -7$ $t = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(3)(-7)}}{2(3)}$ $t = \dfrac{4 \pm \sqrt{100}}{6} = \dfrac{4 \pm 10}{6}$ $\boxed{t = -1, \dfrac{7}{3}}$	**48.** $4x^2 + 5x + 7 = 0$ $a = 4, b = 5, c = 7$ $x = \dfrac{-5 \pm \sqrt{5^2 - 4(4)(7)}}{2(4)}$ $x = \dfrac{-5 \pm \sqrt{-87}}{8}$ $\boxed{x = \dfrac{-5 \pm i\sqrt{87}}{8}}$

Chapter 1

49.	50.
$8f^2 - \dfrac{1}{3}f - \dfrac{7}{6} = 0$ $\text{LCD} = 6$ $48f^2 - 2f - 7 = 0$ $a = 48,\ b = -2,\ c = -7$ $f = \dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(48)(-7)}}{2(48)}$ $f = \dfrac{2 \pm \sqrt{1348}}{96}$ $f = \dfrac{2 \pm 2\sqrt{337}}{96}$ $\boxed{f = \dfrac{1 \pm \sqrt{337}}{48}}$	$x^2 + 6x - 6 = 0$ $a = 1,\ b = 6,\ c = -6$ $x = \dfrac{-6 \pm \sqrt{6^2 - 4(1)(-6)}}{2(1)}$ $x = \dfrac{-6 \pm \sqrt{60}}{2}$ $x = \dfrac{-6 \pm 2\sqrt{15}}{2}$ $\boxed{x = -3 \pm \sqrt{15}}$
51. $a = 5,\ b = -3,\ c = -3$ $q = \dfrac{-(-3) \pm \sqrt{(-3)^2 - 4(5)(-3)}}{2(5)}$ $\boxed{q = \dfrac{3 \pm \sqrt{69}}{10}}$	**52.** $x - 7 = \pm\sqrt{-12}$ $\boxed{x = 7 \pm 2i\sqrt{3}}$
53. $(2x - 5)(x + 1) = 0$ $\boxed{x = -1, \dfrac{5}{2}}$	**54.** $g^2 + 3g - 3 = 0$ $a = 1,\ b = 3,\ c = -3$ $g = \dfrac{-3 \pm \sqrt{3^2 - 4(1)(-3)}}{2(1)}$ $\boxed{g = \dfrac{-3 \pm \sqrt{21}}{2}}$
55. $7x^2 + 19x - 6 = 0$ $(7x - 2)(x + 3) = 0$ $\boxed{x = -3, 2/7}$	**56.** $2b^2 + 1 = 7$ $2b^2 = 6$ $b^2 = 3$ $\boxed{b = \pm\sqrt{3}}$
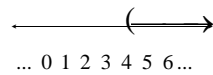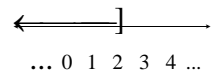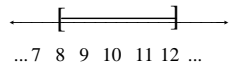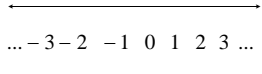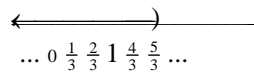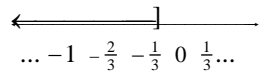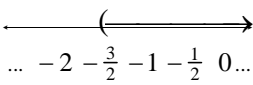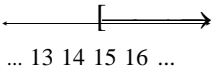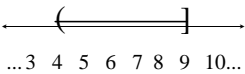
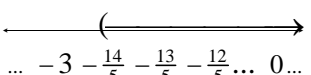|	
57. $$r^2 = \frac{S}{\pi h}$$ $$r = \pm\sqrt{\frac{S}{\pi h}}$$ $$\boxed{r = \sqrt{\frac{S}{\pi h}}} \quad \left(\begin{array}{l}\text{negative radius is}\\\text{non-physical}\end{array}\right)$$	**58.** $$r^3 = \frac{3V}{\pi h}$$ $$\boxed{r = \sqrt[3]{\frac{3V}{\pi h}}}$$
59. $$vt = h + 16t^2$$ $$\boxed{v = \frac{h+16t^2}{t} = \frac{h}{t} + 16t}$$	**60.** $$2\pi r h = A - 2\pi r^2$$ $$\boxed{h = \frac{A - 2\pi r^2}{2\pi r}}$$
61. $$A = \frac{1}{2}bh$$ $$b = h + 3 \quad A = 2$$ $$2 = \frac{1}{2}(h+3)h$$ $$4 = h^2 + 3h$$ $$h^2 + 3h - 4 = 0$$ $$(h+4)(h-1) = 0$$ $$h = -4, 1 \text{ (height must be positive)}$$ $$\boxed{h = 1 \text{ ft}, b = 4 \text{ ft}}$$	**62.** $$-16t^2 + 500 = 0$$ $$16t^2 = 500$$ $$t^2 = \frac{500}{16}$$ $$t = \pm\sqrt{\frac{500}{16}} = \pm\frac{10\sqrt{5}}{4} = \pm\frac{5\sqrt{5}}{2}$$ $$\boxed{\text{Approximately 5.6 seconds}}$$
63. $$2x - 4 = 2^3 = 8$$ $$2x = 12$$ $$\boxed{x = 6}$$	**64.** $$\boxed{\text{no solution}}$$
65. $$2x - 7 = 3^5$$ $$2x = 7 + 243 = 250$$ $$\boxed{x = 125}$$	**66.** $$x^2 = 7x - 10$$ $$x^2 - 7x + 10 = 0$$ $$(x-2)(x-5) = 0$$ $$\boxed{x = 2, 5}$$
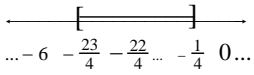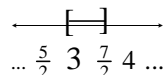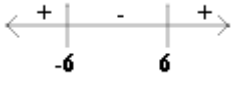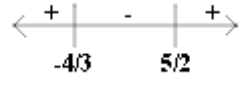
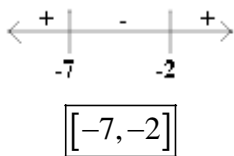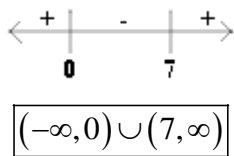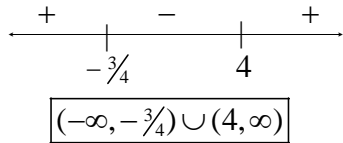|	
67. $(x-4)^2 = x^2 + 5x + 6$ $x^2 - 8x + 16 = x^2 + 5x + 6$ $13x = 10$ $x \not= \dfrac{10}{13} \left(\begin{array}{l} \text{This answer would make} \\ \text{the first } \sqrt{} \text{ equal to a} \\ \text{negative number} \end{array} \right)$ $\boxed{\text{no solution}}$	**68.** $2x - 7 = x + 3$ $\boxed{x = 10}$
69. $x + 3 = 4 - 4\sqrt{3x+2} + 3x + 2$ $-2x - 3 = -4\sqrt{3x+2}$ $2x + 3 = 4\sqrt{3x+2}$ $(2x+3)^2 = 16(3x+2)$ $4x^2 + 12x + 9 = 48x + 32$ $4x^2 - 36x - 23 = 0$ $x = \dfrac{36 \pm \sqrt{36^2 - 4(4)(-23)}}{2(4)}$ $x = \dfrac{36 \pm \sqrt{1664}}{8} \cong -0.6, 9.6$ $\boxed{x \cong -0.6}\ (9.6 \text{ doesn't check})$	**70.** $16 + 8\sqrt{x-3} + x - 3 = x - 5$ $8\sqrt{x-3} = -18$ $\boxed{\text{no solution}}$
71. $x^2 - 4x + 4 = 49 - x^2$ $2x^2 - 4x - 45 = 0$ $x = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(2)(-45)}}{2(2)}$ $x = \dfrac{4 \pm \sqrt{376}}{4}$ $x \cong \cancel{-3.85}, 5.85$ $\boxed{x \cong 5.85}$	**72.** $\sqrt{2x-5} = 3 + \sqrt{x+2}$ $2x - 5 = 9 + 6\sqrt{x+2} + x + 2$ $x - 16 = 6\sqrt{x+2}$ $(x-16)^2 = 36(x+2)$ $x^2 - 32x + 256 = 36x + 72$ $x^2 - 68x + 184 = 0$ $x = \dfrac{68 \pm \sqrt{68^2 - 4(1)(184)}}{2}$ $x = \dfrac{68 \pm \sqrt{3888}}{2}$ $\boxed{x \cong 65.2}$
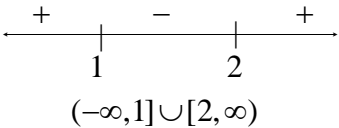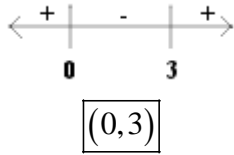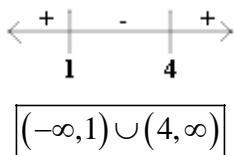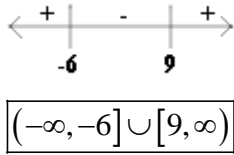
73.	**74.**
$x^2 = 3 - x$	$15 + 2\sqrt{x-4} + \sqrt{x} = 25$
$x^2 + x - 3 = 0$	$2\sqrt{x-4} + \sqrt{x} = 10$
$x = \dfrac{-1 \pm \sqrt{1 - 4(1)(-3)}}{2(1)}$	$2\sqrt{x-4} = 10 - \sqrt{x}$
	$4(x-4) = 100 - 20\sqrt{x} + x$
	$4x - 16 = 100 - 20\sqrt{x} + x$
$x = \dfrac{-1 \pm \sqrt{13}}{2} \cong -2.303, \cancel{1.3}$	$3x - 116 = -20\sqrt{x}$
	$9x^2 - 696x + 13456 = 400x$
$\boxed{x \cong -2.303}$	$9x^2 - 1096x + 13456 = 0$
	$x = \dfrac{1096 \pm \sqrt{1096^2 - 4(9)(13456)}}{18}$
	$x \cong \dfrac{1096 \pm 846.6}{18} \cong 108, 13.9$
	$\boxed{x = 13.9}$

75.	**76.**
$(3x-2)^2 - 11(3x-2) + 28 = 0$	$u = x^2$
Let $u = 3x - 2$	$u^2 - 6u + 9 = 0$
$u^2 - 11u + 28 = 0$	$(u-3)^2 = 0$
$(u-4)(u-7) = 0$	$u = 3$
$u = 4, 7$	$x^2 = 3$
$3x - 2 = 4 \qquad\qquad 3x - 2 = 7$	$\boxed{x = \pm\sqrt{3}}$
$3x = 6 \Rightarrow \boxed{x = 2} \qquad 3x = 9 \Rightarrow \boxed{x = 3}$	

77.	**78.**
$u = \dfrac{x}{1-x} \quad \boxed{x \neq 1}$	Let $u = (x-4)^2$
$u^2 + 2u - 15 = 0$	$3u^2 - 11u - 20 = 0$
$(u+5)(u-3) = 0$	$(3u+4)(u-5) = 0$
$u = -5, 3$	$u = -\dfrac{4}{3}, 5$
$-5 = \dfrac{x}{1-x} \qquad 3 = \dfrac{x}{1-x}$	$(x-4)^2 = -\dfrac{4}{3} \qquad (x-4)^2 = 5$
$-5 + 5x = x \qquad 3 - 3x = x$	$(\text{no solution}) \qquad x - 4 = \pm\sqrt{5}$
$4x = 5 \qquad\qquad 4x = 3$	$\boxed{x = 4 \pm \sqrt{5}}$
$\boxed{x = \dfrac{5}{4}} \qquad\qquad \boxed{x = \dfrac{3}{4}}$	

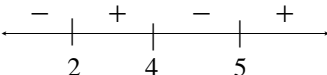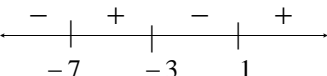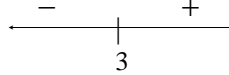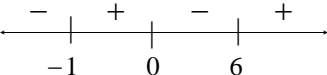|	
79. $y^{-2} - 5y^{-1} + 4 = 0$ Let $u = y^{-1}$ $u^2 - 5u + 4 = 0$ $(u-4)(u-1) = 0$ $u = 4, 1$ So, we have: $y^{-1} = 4 \Rightarrow \boxed{y = \frac{1}{4}}$ $y^{-1} = 1 \Rightarrow \boxed{y = 1}$	**80.** $p^{-2} + 4p^{-1} - 12 = 0$ Let $u = p^{-1}$ $u^2 + 4u - 12 = 0$ $(u+6)(u-2) = 0$ $u = -6, 2$ So, we have: $p^{-1} = -6 \Rightarrow \boxed{p = -\frac{1}{6}}$ $p^{-1} = 2 \Rightarrow \boxed{p = \frac{1}{2}}$
81. $2x^{2/3} + 3x^{1/3} - 5 = 0$ Let $u = x^{1/3}$ $2u^2 + 3u - 5 = 0$ $(2u+5)(u-1) = 0$ $u = -\dfrac{5}{2}, 1$ $x^{1/3} = -\dfrac{5}{2}$ $\qquad$ $x^{1/3} = 1$ $\qquad\qquad\qquad\qquad \boxed{x = 1}$ $x = \left(-\dfrac{5}{2}\right)^3$ $\boxed{x = -\dfrac{125}{8}}$	**82.** $\qquad$ Let $u = x^{1/3}$ $2u^2 - 3u - 5 = 0$ $(2u-5)(u+1) = 0$ $u = -1, \dfrac{5}{2}$ $x^{1/3} = \dfrac{5}{2}$ $\qquad$ $x^{1/3} = -1$ $\qquad\qquad\qquad \boxed{x = -1}$ $\boxed{x = \dfrac{125}{8}}$
83. $x^{-2/3} + 3x^{-1/3} + 2 = 0$ Let $u = x^{-1/3}$. $u^2 + 3u + 2 = 0$ $(u+2)(u+1) = 0$ $u = -2, -1$ So, we have: $x^{-1/3} = -2 \Rightarrow x = (-2)^{-3} = \boxed{-\frac{1}{8}}$ $x^{-1/3} = -1 \Rightarrow x = (-1)^{-3} = \boxed{-1}$	**84.** $y^{-1/2} - 2y^{-1/4} + 1 = 0$ Let $u = y^{-1/4}$. $u^2 - 2u + 1 = 0$ $(u-1)^2 = 0$ $u = 1$ So, we have: $y^{-1/4} = 1 \Rightarrow \boxed{y = 1}$

85.
Let $u = x^2$

$u^2 + 5u - 36 = 0$

$(u+9)(u-4) = 0$

$u = -9, 4$

$-9 = x^2$ $\qquad$ $4 = x^2$

$\boxed{x = \pm 3i}$ $\qquad$ $\boxed{x = \pm 2}$

86.
Let $u = x^{-1/2}$

$u^2 - 4u + 3 = 0$

$(u-1)(u-3) = 0$

$u = 1, 3$

$1 = x^{-1/2}$ $\qquad$ $3 = x^{-1/2}$

$\boxed{x = 1^{-2} = 1}$ $\qquad$ $\boxed{x = 3^{-2} = \dfrac{1}{9}}$

87.
$x^3 + 4x^2 - 32x = 0$

$x(x^2 + 4x - 32) = 0$

$x(x+8)(x-4) = 0$

$\boxed{x = 0, -8, 4}$

88.
$9t^3 - 25t = 0$

$t(9t^2 - 25) = 0$

$t(3t-5)(3t+5) = 0$

$\boxed{t = 0, \pm \tfrac{5}{3}}$

89.
$p^3 - 3p^2 - 4p + 12 = 0$

$(p^3 - 3p^2) - 4(p-3) = 0$

$p^2(p-3) - 4(p-3) = 0$

$(p^2 - 4)(p-3) = 0$

$(p-2)(p+2)(p-3) = 0$

$\boxed{p = \pm 2, 3}$

90.
$4x^3 - 9x^2 + 4x - 9 = 0$

$(4x^3 - 9x^2) + (4x-9) = 0$

$x^2(4x-9) + (4x-9) = 0$

$(x^2 + 1)(4x-9) = 0$

$\boxed{x = \pm i, \tfrac{9}{4}}$

91.
$p(2p-5)^2 - 3(2p-5) = 0$

$(2p-5)[p(2p-5)-3] = 0$

$(2p-5)(2p^2 - 5p - 3) = 0$

$(2p-5)(2p+1)(p-3) = 0$

$\boxed{p = -\tfrac{1}{2}, \tfrac{5}{2}, 3}$

92.
$2(t^2-9)^3 - 20(t^2-9)^2 = 0$

$2(t^2-9)^2 \underbrace{[t^2 - 9 - 10]}_{t^2 - 19} = 0$

$2(t-3)(t+3)(t-\sqrt{19})(t+\sqrt{19}) = 0$

$\boxed{t = \pm 3, \pm \sqrt{19}}$

93.	94.
$y - 81y^{-1} = 0$ $y - \dfrac{81}{y} = 0$ $\dfrac{y^2 - 81}{y} = 0$ $\dfrac{(y-9)(y+9)}{y} = 0$ $\boxed{y = \pm 9}$	$9x^{3/2} - 37x^{1/2} + 4x^{-1/2} = 0$ $x^{-1/2}\left(9x^2 - 37x + 4\right) = 0$ $x^{-1/2}(9x - 1)(x - 4) = 0$ $\boxed{x = \tfrac{1}{9},\ 4}$

95. $\left(-\infty, -4\right]$	96. $\left(-1, 7\right]$	97. $\left[2, 6\right]$	98. $\left(-1, \infty\right)$
99. $x > -6$	100. $x \le 0$	101. $-3 \le x \le 7$	102. $-5 < x \le 2$

103. $x \ge -4$ $\left[-4, \infty\right)$	104. $\left[-4, 4\right]$ $-4 \le x \le 4$	105. $\left(4, \infty\right)$ ... 0 1 2 3 4 5 6...	106. $\left(-\infty, 2\right]$ ... 0 1 2 3 4 ...

107. $\left[8, 12\right]$ ...7 8 9 10 11 12 ...	108. $\varnothing$ ... −3 −2 −1 0 1 2 3 ...	109. $3x < 5$ $x < 5/3$ $\boxed{\left(-\infty, 5/3\right)}$ ... 0 $\frac{1}{3}$ $\frac{2}{3}$ 1 $\frac{4}{3}$ $\frac{5}{3}$ ...	110. $6x \le -2$ $x \le -1/3$ $\boxed{\left(-\infty, -1/3\right]}$ ... −1 $-\frac{2}{3}$ $-\frac{1}{3}$ 0 $\frac{1}{3}$...

111. $4x - 4 > 2x - 7$ $2x > -3$ $x > -3/2$ $\boxed{\left(-3/2, \infty\right)}$ ... -2 $-\frac{3}{2}$ -1 $-\frac{1}{2}$ 0...	112. $x + 3 \ge 18$ $x \ge 15$ $\boxed{\left[15, \infty\right)}$ ... 13 14 15 16 ...	113. $6 < 2 + x \le 11$ $4 < x \le 9$ $\boxed{\left(4, 9\right]}$ ...3 4 5 6 7 8 9 10...

114.	$-6 \le -4x - 7 \le 16$	**115.**	$LCD = 12$

114.

$-6 \le -4x - 7 \le 16$

$1 \le -4x \le 23$

$-\dfrac{1}{4} \ge x \ge -\dfrac{23}{4}$

$$\boxed{\boxed{\left[-\dfrac{23}{4}, -\dfrac{1}{4} \right]}}$$

$\begin{array}{c} \leftarrow\!\!\rule[0.4ex]{0.5em}{0.4pt}[\rule[0.4ex]{2em}{0.4pt}]\rule[0.4ex]{0.5em}{0.4pt}\!\!\rightarrow \\ \text{...} -6 \quad -\frac{23}{4} \ -\frac{22}{4} \text{...} \ -\frac{1}{4} \ 0\text{...} \end{array}$

115.

$LCD = 12$

$8 \le 2(1 + x) \le 9$

$8 \le 2 + 2x \le 9$

$6 \le 2x \le 7$

$3 \le x \le 7/2$

$$\boxed{\left[3, 7/2 \right]}$$

$\begin{array}{c} \leftarrow\!\!\rule[0.4ex]{1em}{0.4pt}[\rule[0.4ex]{1em}{0.4pt}]\rule[0.4ex]{1em}{0.4pt}\!\!\rightarrow \\ \text{...} \ \frac{5}{2} \ \ 3 \ \ \frac{7}{2} \ \ 4 \ \text{...} \end{array}$

116.

$LCD = 18$

$6x + 2(x + 4) > 3x - 6$

$6x + 2x + 8 > 3x - 6$

$5x > -14$

$x > -14/5$

$$\boxed{\left(-14/5, \infty \right)}$$

$\begin{array}{c} \leftarrow\!\!\rule[0.4ex]{2em}{0.4pt}(\rule[0.4ex]{3em}{0.4pt}\!\!\rightarrow \\ \text{...} \ -3 \ -\frac{14}{5} \ -\frac{13}{5} \ -\frac{12}{5}\text{...} \ 0\text{...} \end{array}$

117.

$\dfrac{72 + 65 + 69 + 70 + x}{5} \ge 70$

$x + 276 \ge 350$

$$\boxed{x \ge 74}$$

So, the lowest score is 74.

118.

$\text{Cost} = 8500 + 50x$

$\text{Revenue} = 300x$

$\text{Profit} = 300x - (8500 + 50x) > 0$

$250x > 8500$

$$\boxed{x > 34}$$

So, greater than 34 suits.

119.

$x^2 - 36 \le 0$

$(x - 6)(x + 6) \le 0$

CP's: $x = -6, 6$

$\begin{array}{c} \leftarrow\!\! + \ | \ - \ | \ + \!\!\rightarrow \\ \ \ \ -6 \quad\ \ 6 \end{array}$

$$\boxed{\left[-6, 6 \right]}$$

120.

$6x^2 - 7x - 20 < 0$

$(3x + 4)(2x - 5) < 0$

CP's: $x = -\dfrac{4}{3}, \dfrac{5}{2}$

$\begin{array}{c} \leftarrow\!\! + \ | \ - \ | \ + \!\!\rightarrow \\ \ \ \ -4/3 \quad\ 5/2 \end{array}$

$$\boxed{\left(-\dfrac{4}{3}, \dfrac{5}{2} \right)}$$

121.

$x^2 - 4x \ge 0$

$x(x - 4) \ge 0$

CP's: $x = 0, x = 4$

$\begin{array}{c} \leftarrow\!\! + \ | \ - \ | \ + \!\!\rightarrow \\ \ \ \ 0 \quad\quad\ 4 \end{array}$

$$\boxed{\left(-\infty, 0 \right] \cup \left[4, \infty \right)}$$

122. $x^2 + 9x + 14 \le 0$ $(x+7)(x+2) \le 0$ CP's: $-7, -2$ $\boxed{[-7, -2]}$	**123.** $x^2 - 7x > 0$ $x(x-7) > 0$ CP's: $x = 0, 7$ $\boxed{(-\infty, 0) \cup (7, \infty)}$
124. $x^2 < -4$ $\boxed{\text{no solution}}$	**125.** $4x^2 - 12 > 13x$ $4x^2 - 13x - 12 > 0$ $(4x+3)(x-4) > 0$ CPs: $x = -\tfrac{3}{4}, 4$ $\boxed{(-\infty, -\tfrac{3}{4}) \cup (4, \infty)}$
126. $3x \le x^2 + 2$ $x^2 - 3x + 2 \ge 0$ $(x-2)(x-1) \ge 0$ CPs: $x = 1, 2$ $(-\infty, 1] \cup [2, \infty)$	**127.** $\dfrac{x}{x-3} < 0 \quad \boxed{x \ne 3}$ CP's: $x = 0, 3$ $\boxed{(0, 3)}$
128. $\dfrac{x-1}{x-4} > 0 \quad \boxed{x \ne 4}$ CP's: $1, 4$ $\boxed{(-\infty, 1) \cup (4, \infty)}$	**129.** $\dfrac{x^2 - 3x}{3} - \dfrac{18(3)}{3} \ge 0$ $\dfrac{x^2 - 3x - 54}{3} \ge 0$ $\dfrac{(x-9)(x+6)}{3} \ge 0$ CP's: $x = -6, 9$ $\boxed{(-\infty, -6] \cup [9, \infty)}$

130.

$$\frac{(x-7)(x+7)}{x-7} \geq 0 \quad \boxed{x \neq 7}$$

$$x+7 \geq 0$$

$$x \geq -7$$

$$\boxed{[-7,7) \cup (7,\infty)}$$

131.

$$\frac{3}{x-2} - \frac{1}{x-4} \leq 0$$

$$\frac{3(x-4)-(x-2)}{(x-2)(x-4)} \leq 0$$

$$\frac{2x-10}{(x-2)(x-4)} \leq 0$$

$$\frac{2(x-5)}{(x-2)(x-4)} \leq 0$$

CPs: $x = 2, 4, 5$

$$\begin{array}{ccccc} - & + & - & + \\ \hline & 2 & 4 & 5 & \end{array}$$

$$\boxed{(-\infty, 2) \cup (4,5]}$$

132.

$$\frac{4}{x-1} \leq \frac{2}{x+3}$$

$$\frac{4}{x-1} - \frac{2}{x+3} \leq 0$$

$$\frac{4(x+3)-2(x-1)}{(x-1)(x+3)} \leq 0$$

$$\frac{2(x+7)}{(x-1)(x+3)} \leq 0$$

CPs: $x = -7, -3, 1$

$$\begin{array}{ccccc} - & + & - & + \\ \hline & -7 & -3 & 1 & \end{array}$$

$$\boxed{(-\infty, -7] \cup (-3,1)}$$

133.

$$\frac{x^2+9}{x-3} \geq 0$$

CP: 3 (since $x^2 + 9 > 0$, for all x)

$$\begin{array}{ccc} - & + \\ \hline & 3 & \end{array}$$

$$(3,\infty)$$

134.

$$x < \frac{5x+6}{x} \implies x - \frac{5x+6}{x} < 0$$

$$\frac{x^2-5x-6}{x} < 0$$

$$\frac{(x-6)(x+1)}{x} < 0$$

CPs: $-1, 0, 6$

$$\begin{array}{ccccc} - & + & - & + \\ \hline & -1 & 0 & 6 & \end{array}$$

$$\boxed{(-\infty, -1) \cup (0,6)}$$

135.

$$|x-3| = -4$$

$$\boxed{\text{no solution}}$$

147

136. $2 + x = -5$ or $2 + x = 5$ $\boxed{x = -7 \text{ or } x = 3}$	**137.** $3x - 4 = -1.1 \qquad 3x - 4 = 1.1$ $\ 3x = 2.9 \qquad\quad 3x = 5.1$ $\ \boxed{x \approx 0.9667} \qquad \boxed{x = 1.7}$
138. $x^2 - 6 = -3 \qquad x^2 - 6 = 3$ $\ x^2 = 3 \qquad\qquad x^2 = 9$ $\ \boxed{x = \pm\sqrt{3}} \qquad \boxed{x = \pm 3}$	**139.** $-4 < x < 4$ $\boxed{(-4, 4)}$
140. $-6 < x - 3 < 6$ $\ -3 < x < 9$ $\boxed{(3, 9)}$	**141.** $x + 4 < -7 \qquad x + 4 > 7$ $\ x < -11 \qquad\quad x > 3$ $\boxed{(-\infty, -11) \cup (3, \infty)}$
142. $\qquad\qquad -4 \le -7 + y \le 4$ $\qquad\qquad\qquad 3 \le y \le 11$ $\qquad\qquad\quad \boxed{[3, 11]}$	**143.** $\lvert 2x \rvert > 6$ $\ 2x < -6 \qquad\qquad 2x > 6$ $\ x < -3 \qquad\qquad\ x > 3$ $\boxed{(-\infty, -3) \cup (3, \infty)}$
144. $\dfrac{4 + 2x}{3} \le -\dfrac{1}{7} \qquad \dfrac{4 + 2x}{3} \ge \dfrac{1}{7}$ $\text{LCD} = 21 \qquad\qquad 7(4 + 2x) \ge 3$ $7(4 + 2x) \le -3 \qquad 28 + 14x \ge 3$ $28 + 14x \le -3 \qquad 14x \ge -25$ $14x \le -31 \qquad\qquad x \ge -25/14$ $x \le -31/14$ $\boxed{(-\infty, -31/14] \cup [-25/14, \infty)}$	**145.** $\mathbb{R}$
146. $\qquad\qquad -4 \le 1 - 2x \le 4$ $\qquad\qquad\quad -5 \le -2x \le 3$ $\qquad\qquad\quad \dfrac{5}{2} \ge x \ge -\dfrac{3}{2}$ $\qquad\qquad\quad \boxed{\left[-\dfrac{3}{2}, \dfrac{5}{2} \right]}$	**147.** $\lvert T - 85 \rvert \le 10$ or $75 \le T \le 95$ <hr> **148.** $\lvert B - 0.08 \rvert \le 0.007$

149.

$$y1 = 0.031x + 0.017(4000 - x)$$

$$y2 = 103.14$$
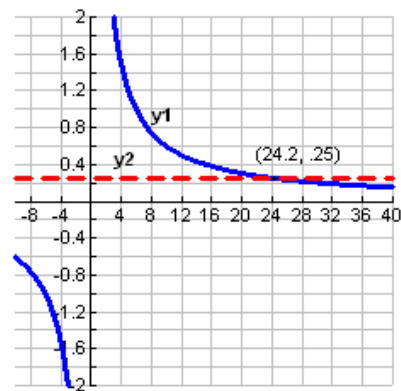
$$\boxed{x = 2,510}$$
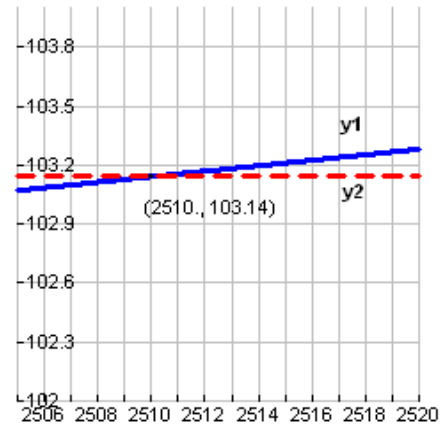
150.

$$y1 = \frac{1}{0.16x} - \frac{0.2}{x}$$
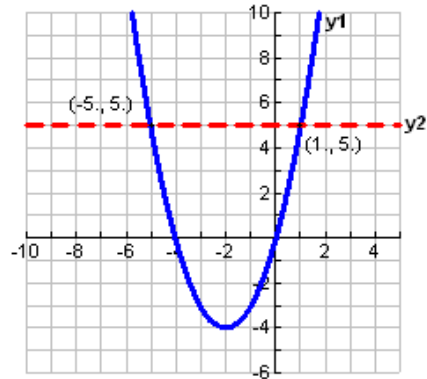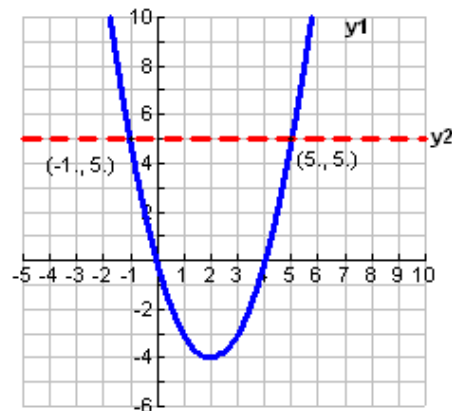
$$y2 = \frac{1}{4}$$

$$\boxed{x = 24.2}$$

151. (a) Consider $x^2 + 4x - b = 0$. **(1)** For $b = 5$, **(1)** factors as $(x-1)(x+5) = 0$, so that $x = -5,1$.

Note that they intersect at precisely the *x*-values obtained algebraically. So, yes, these values agree with the points of intersections.

Graphically, we let $y1 = x^2 + 4x$, $y2 = 5$ and look for the intersection points of the graphs:

(b) We do the same thing now for different values of b.

$\underline{b = -5}$:

$$x^2 + 4x + 5 = 0$$

$$x = \frac{-4 \pm \sqrt{16 - 4(5)}}{2} = \frac{-4 \pm 2i}{2} = -2 \pm i$$

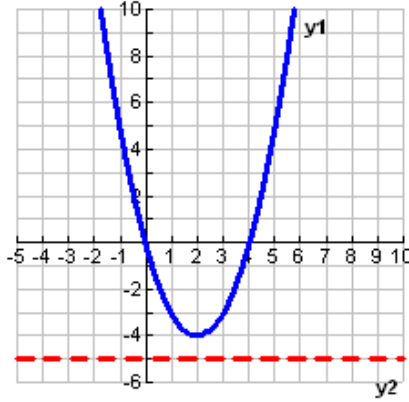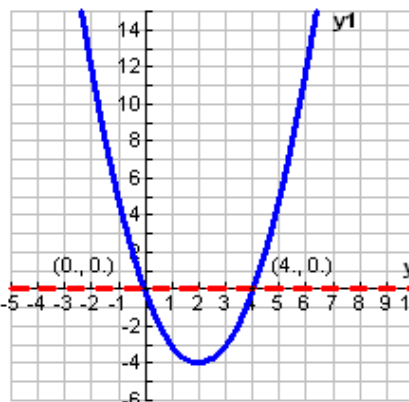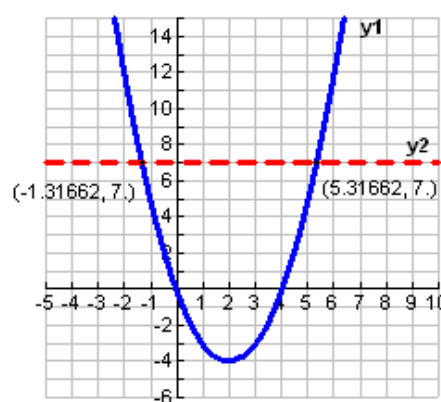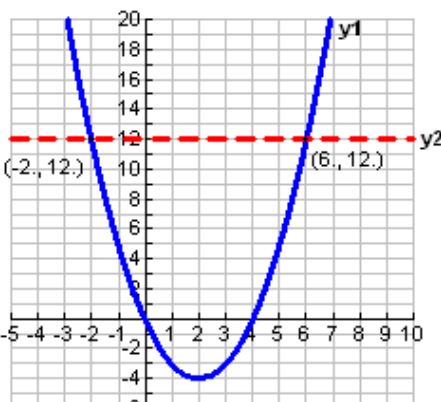So, we don't expect the graphs to intersect. Indeed, we have:

$\underline{b = 7}$:

$$x^2 + 4x - 7 = 0$$

$$x = \frac{-4 \pm \sqrt{16 + 4(7)}}{2} = \frac{-4 \pm 2\sqrt{11}}{2} = -2 \pm \sqrt{11}$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:
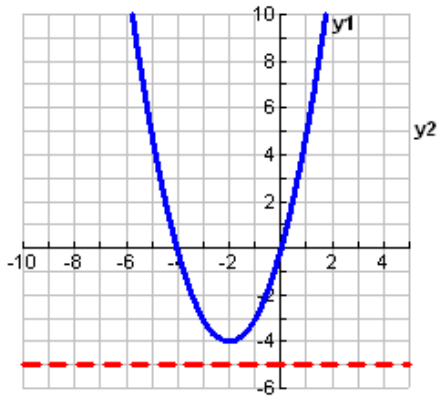
$\underline{b = 0}$:

$$x^2 + 4x = 0$$

$$x(x + 4) = 0$$

$$x = 0, -4$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:
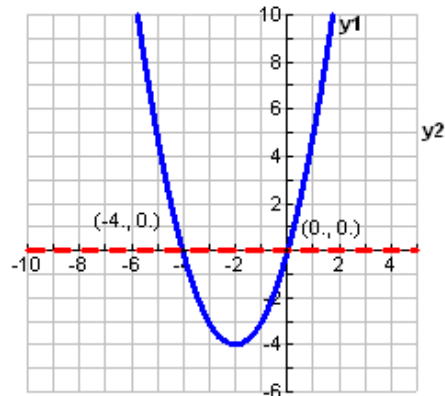
$\underline{b = 12}$:

$$x^2 + 4x - 12 = 0$$

$$(x + 6)(x - 2) = 0$$

$$x = -6, 2$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:
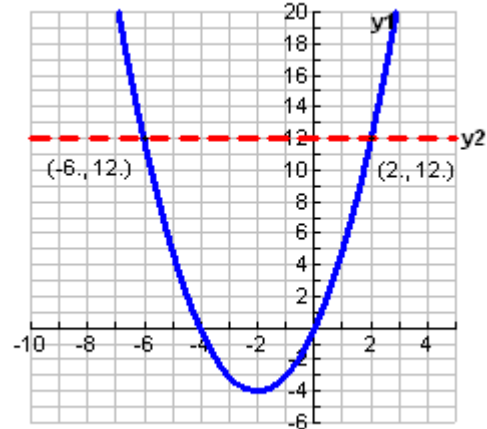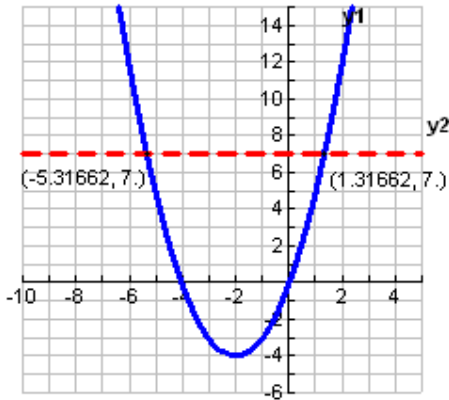
152. (a) Consider $x^2 - 4x - b = 0$. **(1)** For $b = 5$, **(1)** factors as $(x+1)(x-5) = 0$, so that $x = -1, 5$.

Note that they intersect at precisely the x-values obtained algebraically. So, yes, these values agree with the points of intersections.

(b) We do the same thing now for different values of b.

Graphically, we let $y1 = x^2 - 4x$, $y2 = 5$ and look for the intersection points of the graphs:

$b = -5$:	$b = 0$:
$x^2 - 4x + 5 = 0$	$x^2 - 4x = 0$
$x = \dfrac{4 \pm \sqrt{16 - 4(5)}}{2} = \dfrac{4 \pm 2i}{2} = 2 \pm i$	$x(x - 4) = 0$
	$x = 0, 4$
So, we don't expect the graphs to intersect. Indeed, we have:	So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

$\underline{b = 7}$:

$$x^2 - 4x - 7 = 0$$

$$x = \frac{4 \pm \sqrt{16 + 4(7)}}{2} = \frac{4 \pm 2\sqrt{11}}{2} = 2 \pm \sqrt{11}$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

$\underline{b = 12}$:

$$x^2 - 4x - 12 = 0$$

$$(x - 6)(x + 2) = 0$$

$$x = 6, -2$$

So, we expect the graphs to intersect twice as in part **(a)**. Indeed, we have:

153.

$2x^{1/4} = -x^{1/2} + 6$

$x^{1/2} + 2x^{1/4} - 6 = 0$

Let $u = x^{1/4}$ to obtain

$u^2 + 2u - 6 = 0$

$u = \dfrac{-2 \pm \sqrt{4 + 4(6)}}{2} = -1 \pm \sqrt{7}$

$x^{1/4} = -1 - \sqrt{7}$ $\qquad$ $x^{1/4} = -1 + \sqrt{7}$

$\boxed{\text{no solution}}$ $\qquad$ $\boxed{x = \left(-1 + \sqrt{7}\right)^4 \approx 7.34}$

Graphically, let

$y1 = 2x^{1/4}$, $y2 = -x^{1/2} + 6$
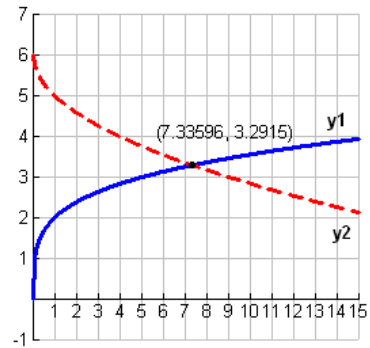
154.

$2x^{-1/2} = x^{-1/4} + 6$

$2x^{-1/2} - x^{-1/4} - 6 = 0$

Let $u = x^{-1/4}$ to obtain

$2u^2 - u - 6 = 0$

$u = \dfrac{-1 \pm \sqrt{1 + 4(2)(6)}}{2(2)} = \dfrac{1 \pm 7}{4} = 2, \ -\tfrac{3}{2}$

$x^{-1/4} = 2$ $\qquad$ $x^{-1/4} = -\tfrac{3}{2}$

$\boxed{x = \tfrac{1}{16}}$ $\qquad$ $\boxed{\text{no solution}}$

Graphically, let

$y1 = 2x^{-1/2}$, $y2 = x^{-1/4} + 6$
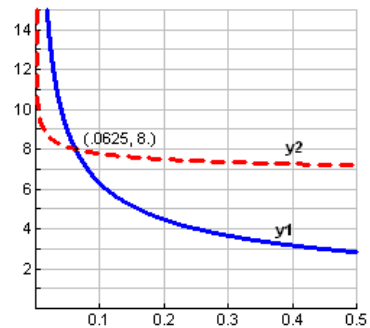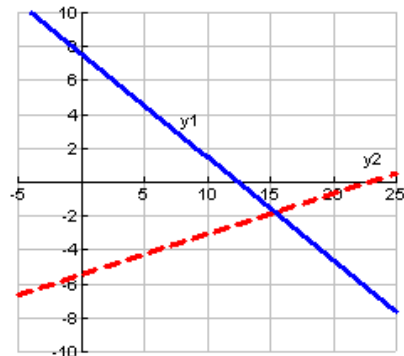

155. a)

$-0.61x + 7.62 > 0.24x - 5.47$

$13.09 > 0.85x$

$15.4 > x$

$\boxed{(-\infty, 15.4)}$

c) Agree

b) Graphically, let

$y1 = -0.61x + 7.62, \ y2 = 0.24x - 5.47$

156. a)

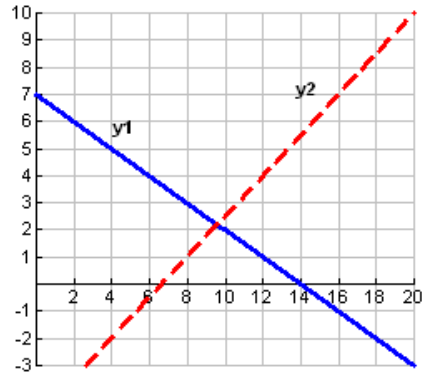$$-\frac{1}{2}x+7<\frac{3}{4}x-5$$

$$-2x+28<3x-20$$

$$48<5x$$

$$9.6<x$$

$$\boxed{(9.6,\infty)}$$

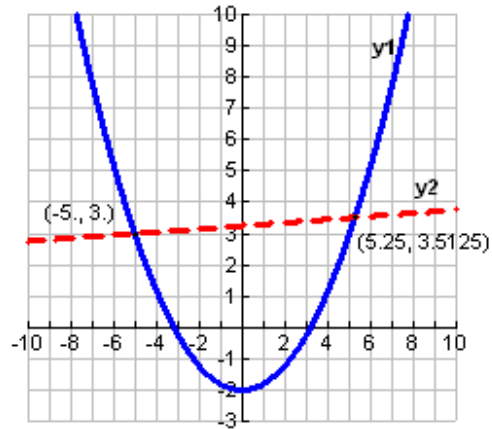**c)** Agree

Graphically, let

$$y1=-0.5x+7,\quad y2=0.75x-5$$

157.

$$y1=0.2x^2-2$$

$$y2=0.05x+3.25$$

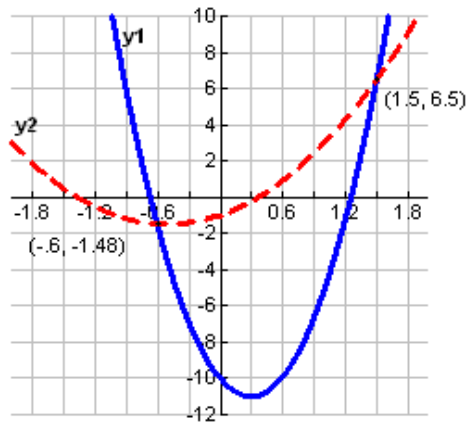Find when $y1>y2$

$$\boxed{(-\infty,-5)\cup(5.25,\infty)}$$

158.

$$y1=12x^2-7x-10$$

$$y2=2x^2+2x-1$$

Find when $y1<y2$
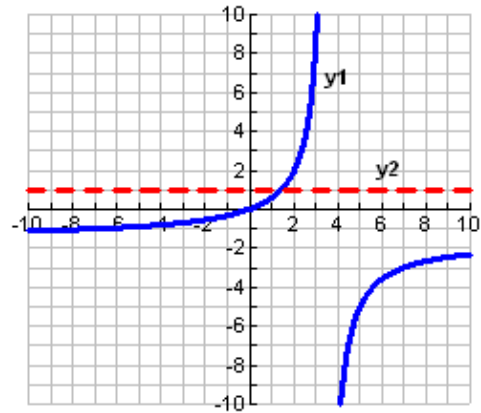
$$\boxed{\left(-\frac{3}{5},\frac{3}{2}\right)}$$

159.

$$y1 = \frac{3p}{7 - 2p}$$

$$y2 = 1$$

Find when $y1 > y2$

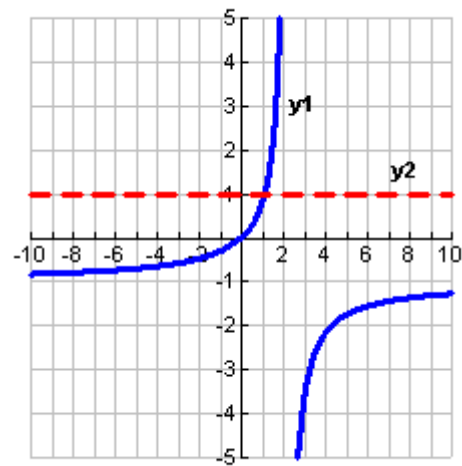$$\boxed{\left(\frac{7}{5}, \frac{7}{2}\right)}$$

160.

$$y1 = \frac{7p}{15 - 2p}$$

$$y2 = 1$$

Find when $y1 < y2$

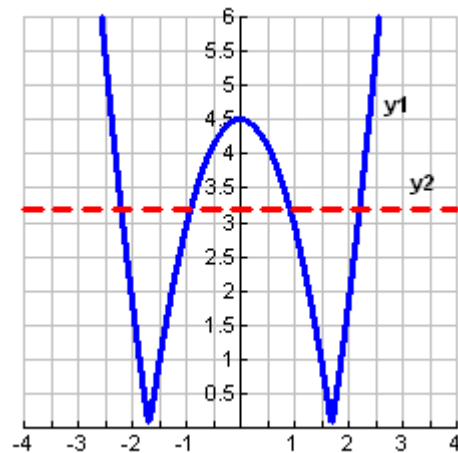$$\boxed{\left(-\infty, \frac{5}{3}\right) \cup \left(\frac{15}{2}, \infty\right)}$$

161.

$$y1 = \left|1.6x^2 - 4.5\right|$$

$$y2 = 3.2$$

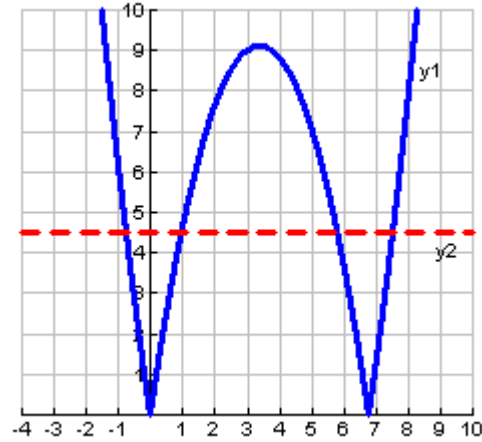Find when $y1 < y2$

$$\boxed{(-2.19, -0.9) \cup (0.9, 2.19)}$$
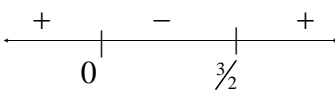
162.

$y1 = \left|0.8x^2 - 5.4x\right|$

$y2 = 4.5$
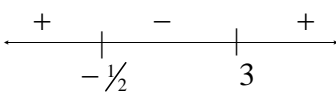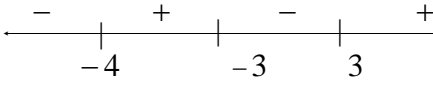
Find when $y1 > y2$
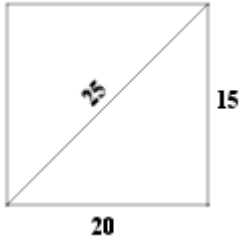
$\boxed{(-\infty, -0.75) \cup (0.97, 5.78) \cup (7.5, \infty)}$

Chapter 1 Practice Test Solutions --

1.	$4p - 7 = 6p - 1$ $-6 = 2p$ $\boxed{-3 = p}$	**2.**	$-2z + 2 + 3 = -3z + 3z - 3$ $-2z = -8$ $\boxed{z = 4}$
3.	$3t = t^2 - 28$ $t^2 - 3t - 28 = 0$ $(t-7)(t+4) = 0$ $\boxed{t = -4, 7}$	**4.**	$8x^2 - 13x = 6$ $8x^2 - 13x - 6 = 0$ $(8x + 3)(x - 2) = 0$ $\boxed{x = -\tfrac{3}{8}, 2}$
5.	$6x^2 - 13x - 8 = 0$ $(3x - 8)(2x + 1) = 0$ $\boxed{x = -\dfrac{1}{2}, \dfrac{8}{3}}$	**6.**	$\dfrac{3}{x-1} - \dfrac{5}{x+2} = 0$ $\dfrac{3(x+2) - 5(x-1)}{(x-1)(x+2)} = 0$ $\dfrac{-2x + 11}{(x-1)(x+2)} = 0$ $\boxed{x = 11\tfrac{1}{2}}$

7.	$\dfrac{5}{y-3}+1-\dfrac{30}{y^2-9}=0$	8.	$x^4-5x^2-36=0$
	$\dfrac{5(y+3)+(y^2-9)-30}{(y-3)(y+3)}=0$		$\left(x^2+4\right)\left(x^2-9\right)=0$
	$\dfrac{y^2+5y-24}{(y-3)(y+3)}=0$		$(x-2i)(x+2i)(x-3)(x+3)=0$
	$\dfrac{(y+8)\,\cancel{(y-3)}}{\cancel{(y-3)}\,(y+3)}=0$		$\boxed{x=\pm3,\ \pm2i}$
	$\boxed{y=-8}$		

9.	$\sqrt{2x+1}+x=7$	10.	Let $u=x^{1/3}$
	$\sqrt{2x+1}=7-x$		$2u^2+3u-2=0$
	$2x+1=(7-x)^2$		$\left(2u-1\right)\left(u+2\right)=0$
	$2x+1=49-14x+x^2$		$u=-2,1/2$
	$x^2-16x+48=0$		So, $\boxed{x=-8,\ \tfrac{1}{8}}$
	$(x-12)(x-4)=0$		
	$\boxed{x=4},\ \cancel{12}$		

11.	$3y-2=9-6\sqrt{3y+1}+3y+1$	12.	$x(3x-5)^3-2(3x-5)^2=0$
	$-12=-6\sqrt{3y+1}$		$(3x-5)^2\left[x(3x-5)-2\right]=0$
	$\sqrt{3y+1}=2$		$(3x-5)^2\left(3x^2-5x-2\right)=0$
	$3y+1=4$		$(3x-5)^2(3x+1)(x-2)=0$
	$3y=3$		$\boxed{x=\tfrac{5}{3},\ -\tfrac{1}{3},\ 2}$
	$\boxed{y=1}$		

13.	$x^{7/3}-8x^{4/3}+12x^{1/3}=0$	14.	$F=\tfrac{9}{5}C+32$
	$x^{1/3}\left(x^2-8x+12\right)=0$		$F-32=\tfrac{9}{5}C$
	$x^{1/3}(x-6)(x-2)=0$		$\boxed{C=\tfrac{5}{9}\left(F-32\right)}$
	$\boxed{x=0,2,6}$		

15.	$P=2L+2W$	16.	$7-5x>-18$
	$P-2W=2L$		$-5x>-25$
	$\boxed{L=\dfrac{P-2W}{2}}$		$x<5$
			$\boxed{(-\infty,5)}$

17.	$3x+19 \geq 5x-15$ $34 \geq 2x$ $17 \geq x$ $\boxed{(-\infty,17]}$	**18.**	$-1 \leq 3x+5 < 26$ $-6 \leq 3x < 21$ $-2 \leq x < 7$ $\boxed{[-2,7)}$

19.
$$\frac{2}{5} < \frac{x+8}{4} \leq \frac{1}{2}$$
$$8 < 5(x+8) \leq 10$$
$$-32 < 5x \leq -30$$
$$-\frac{32}{5} < x \leq -6$$
$$\boxed{\left(-\frac{32}{5},-6\right]}$$

20.
$$3x \geq 2x^2$$
$$0 \geq 2x^2 - 3x$$
$$0 \geq x(2x-3)$$
CPs: $x = 0, \frac{3}{2}$

$$\boxed{\left[0,\frac{3}{2}\right]}$$

21.
$$3p^2 - p - 4 \geq 0$$
$$(3p-4)(p+1) \geq 0$$
CP's: $p = \frac{4}{3}, -1$

$$\boxed{(-\infty,-1] \cup \left[\frac{4}{3},\infty\right)}$$

22.
$$|5-2x| > 1$$
$5-2x > 1$ or $5-2x < -1$
$-2x > -4$ or $-2x < -6$
$x < 2$ or $x > 3$

$$\boxed{(-\infty,2) \cup (3,\infty)}$$

23.
$$\frac{x-3}{2x+1} \leq 0$$
CPs: $x = -\frac{1}{2}, 3$

$$\boxed{\left(-\frac{1}{2},3\right]}$$

24.
$$\frac{x+4}{x^2-9} \geq 0$$
$$\frac{x+4}{(x-3)(x+3)} \geq 0$$
CPs: $x = -4, \pm 3$

$$\boxed{[-4,-3) \cup (3,\infty)}$$

|	
25. Let x = height of piling Sand: $\dfrac{1}{4}x$ Water: 150 Air: $\dfrac{3}{5}x$ $\dfrac{1}{4}x + 150 + \dfrac{3}{5}x = x$ $\text{LCD} = 20$ $5x + 3000 + 12x = 20x$ $3x = 3000$ $\boxed{x = 1000 \text{ ft}}$	**26.** Let x = purchase price $\left\|150{,}000 - x\right\| \leq \underbrace{15{,}000}_{\text{10\% of list price}}$ $135{,}000 \leq \text{Purchase Price} \leq 165{,}000$ $0.07(135{,}000) \leq \text{commission} \leq 0.07(165{,}000)$ $\boxed{\$9{,}450 \leq \text{commission} \leq \$11{,}550}$

27. Let x = number of minutes in excess of 600

$\text{Charges} = 49 + 0.17x$

$53.59 \leq 49 + 0.17x \leq 69.74$

$4.59 \leq 0.17x \leq 20.74$

$27 \leq x \leq 122$

$\quad + 600 \text{ base}$

$\boxed{627 \leq x \leq 722}$

28. DVD: $\dfrac{21}{9}$ ratio

Let x = height of DVD movie

$\dfrac{21}{9} = \dfrac{20}{x}$

$21x = 180$

$x \cong 8.6 \text{ inches}$

$\boxed{\text{Movie: } 20 \text{ in.} \times 8.6 \text{ in.}}$

$15 - 8.6 \text{ inches} = 6.4 \text{ inches of black space}$

$\boxed{\text{Bars: } 20 \text{ in.} \times 3.2 \text{ in. each}}$

29.

$$y1 = \frac{1}{0.75x} - \frac{0.45}{x}$$

$$y2 = \frac{1}{9}$$

$$\boxed{x = 7.95}$$
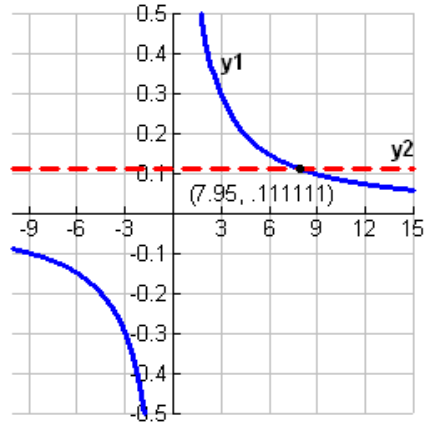
30.

$$y1 = 0.3 + \left|2.4x^2 - 1.5\right|$$

$$y2 = 6.3$$

Find when $y1 \le y2$

$$\boxed{[-1.768, 1.768]}$$
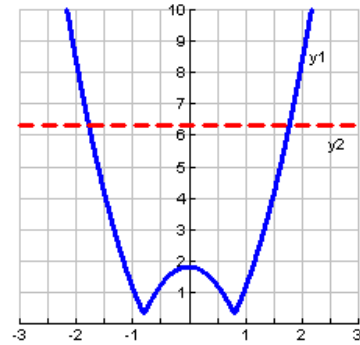
Chapter 1 Cumulative Review---

1.

$$5 \cdot (7 - 3 \cdot 4 + 2) = 5 \cdot (7 - 12 + 2)$$
$$= 5 \cdot (-5 + 2)$$
$$= 5 \cdot (-3) = \boxed{-15}$$

2.

$$\left(4x^{-3}b^4\right)^{-3} = 4^{-3}x^9b^{-12} = \boxed{\frac{x^9}{64b^{12}}}$$

3.

$$\frac{\left(x^2y^{-2}\right)^3}{\left(x^2y\right)^{-3}} = \frac{x^6y^{-6}}{x^{-6}y^{-3}} = \boxed{\frac{x^{12}}{y^3}}$$

4.

$$\left(-x^4 + 2x^3\right) + \left(x^3 - 5x - 6\right)$$
$$- \left(5x^4 + 4x^3 - 6x + 8\right) =$$
$$-x^4 + 2x^3 + x^3 - 5x - 6 - 5x^4 - 4x^3 + 6x - 8 =$$
$$\boxed{-6x^4 - x^3 + x - 14}$$

5.

$$x^2(x+5)(x-3) = x^2(x^2+2x-15)$$
$$= \boxed{x^4 + 2x^3 - 15x^2}$$

6.

$$3x^3 - 3x^2 - 60x = 3x\left(x^2 - x - 20\right)$$
$$= \boxed{3x(x-5)(x+4)}$$

7.

$$2a^3 + 2000 = 2\left(a^3 + \underbrace{1000}_{=10^3}\right)$$
$$= \boxed{2(a+10)\left(a^2 - 10a + 100\right)}$$

8.

$$\frac{3-x}{x^2-1} \div \frac{5x-15}{x+1} = \frac{-(\cancel{x-3})}{(x-1)\cancel{(x+1)}} \cdot \frac{\cancel{(x+1)}}{5\cancel{(x-3)}}$$
$$= \boxed{-\frac{1}{5(x-1)}}$$

where $x \neq -1, 1, 3$

9.

$$\frac{6x}{x-2} - \frac{5x}{x+2} = \frac{6x(x+2) - 5x(x-2)}{x^2-4}$$
$$= \frac{6x^2 + 12x - 5x^2 + 10x}{x^2-4}$$
$$= \boxed{\frac{x^2 + 22x}{x^2-4}}$$

where $x \neq -2, 2$

10.

$$x^3 - x^2 - 30x = 0$$
$$x\left(x^2 - x - 30\right) = 0$$
$$x(x-6)(x+5) = 0$$
$$\boxed{x = -5, 0, 6}$$

11.

$$\tfrac{2}{7}x = \tfrac{1}{8}x + 9$$
$$16x = 7x + 504$$
$$9x = 504$$
$$\boxed{x = 56}$$

12.

$$\frac{45}{6-3i} \cdot \frac{6+3i}{6+3i} = \frac{270 + 135i}{45} = \boxed{6+3i}$$

13.

$$\frac{6x}{5} - \frac{8x}{3} = 4 - \frac{7x}{15}$$
$$18x - 40x = 60 - 7x$$
$$-22x = 60 - 7x$$
$$-15x = 60$$
$$\boxed{x = -4}$$

14.

$$\frac{x-6}{6-x} = \frac{3}{2}, \qquad x \neq 6$$
$$-\frac{\cancel{x-6}}{\cancel{x-6}} = \frac{3}{2}$$
$$-1 = \frac{3}{2}$$

Since this statement is false, the equation has no solution .

161

15. Tim rate: 1/9 job in one hour Chelsea and Tim combined rate: 1/5 job in one hour Let x = number of hours it takes Chelsea to complete job by herself Solve: $$\frac{1}{9}+\frac{1}{x}=\frac{1}{5}$$ $$5x+45=9x$$ $$45=4x \implies 11.25=x$$ It takes Chelsea $\boxed{11.25 \text{ hours}}$ by herself.	**16.** $$y^2+36=0$$ $$y^2=-36$$ $$y=\pm\sqrt{-36}=\boxed{\pm 6i}$$
17. $$x^2+12x+40=0$$ $$\left(x^2+12x+36\right)+40-36=0$$ $$(x+6)^2+4=0$$ $$(x+6)^2=-4$$ $$x+6=\pm\sqrt{-4}=\pm 2i$$ $$\boxed{x=-6\pm 2i}$$	**18.** $$x^2+x+9=0$$ $$x=\frac{-1\pm\sqrt{1-4(9)}}{2}$$ $$=\frac{-1\pm\sqrt{-35}}{2}$$ $$=\boxed{\frac{-1\pm i\sqrt{35}}{2}}$$
19. $$\sqrt{4-x}=x-4$$ $$4-x=(x-4)^2$$ $$4-x=x^2-8x+16$$ $$x^2-7x+12=0$$ $$(x-4)(x-3)=0$$ $$x=\cancel{3},\boxed{4}$$	**20.** $$3x^{-2}+8x^{-1}+4=0$$ Let $u=x^{-1}$. $$3u^2+8u+4=0$$ $$(3u+2)(u+2)=0$$ $$u=-\tfrac{2}{3},-2$$ $$x^{-1}=-\tfrac{2}{3}\implies x=\boxed{-\tfrac{3}{2}}$$ $$x^{-1}=-2\implies x=\boxed{-\tfrac{1}{2}}$$
21. $$0<4-x\le 7$$ $$-4<-x\le 3$$ $$4>x\ge -3$$ $$\boxed{[-3,4)}$$	**22.** $$4x^2<9x-11$$ $$4x^2-9x+11<0$$ $$x=\frac{9\pm\sqrt{81-4(4)(11)}}{2(4)}=\frac{9\pm i\sqrt{95}}{8}$$ No real solution

23.

$$\frac{x+2}{9-x^2} \geq 0$$

$$\frac{x+2}{(3-x)(3+x)} \geq 0$$

CPs: $x = -2, \pm 3$

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   +        −        +        −
————|————————|————————|————————
   −3       −2        3
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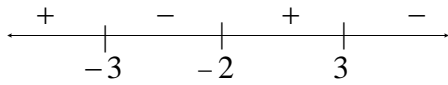
$$\boxed{(-\infty,-3)\cup[-2,3)}$$

24.

$$\left|\frac{4-5x}{7}\right| \geq \frac{3}{14}$$

$$\frac{|4-5x|}{7} \geq \frac{3}{14}$$

$$2|4-5x| \geq 3$$

$$2(4-5x) \geq 3 \quad \text{or} \quad 2(4-5x) \leq -3$$

$$8-10x \geq 3 \qquad\qquad 8-10x \leq -3$$

$$-10x \geq -5 \qquad\qquad -10x \leq -11$$

$$x \leq \tfrac{1}{2} \qquad\qquad x \geq \tfrac{11}{10}$$

$$\boxed{(-\infty,\tfrac{1}{2}]\cup[\tfrac{11}{10},\infty)}$$

25.

$$\left|\frac{1}{5}x+\frac{2}{3}\right| = \frac{7}{15}$$

$$\frac{|3x+10|}{15} = \frac{7}{15}$$

$$|3x+10| = 7$$

$$3x+10 = 7 \quad \text{or} \quad 3x+10 = -7$$

$$3x = -3 \qquad\qquad 3x = -17$$

$$\boxed{x=-1} \qquad\qquad \boxed{x=-\tfrac{17}{3}}$$

26.

$$x^6+\frac{37}{8}x^3-27=0$$

$$8x^6+37x^3-216=0$$

Let $u = x^3$.

$$8u^2+37u-216=0$$
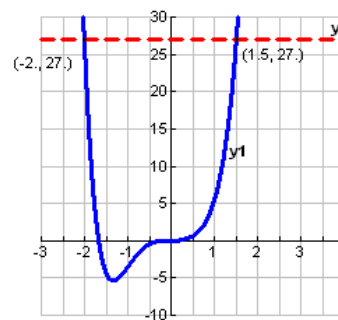
$$u = \frac{-37\pm\sqrt{37^2+4(8)(216)}}{2(8)} = -8, \tfrac{27}{8}$$

$$x^3 = -8 \implies \boxed{x=-2}$$

$$x^3 = \tfrac{27}{8} \implies \boxed{x=\tfrac{3}{2}}$$

Graphically, let

$$y1 = x^6+\frac{37}{8}x^3, \quad y2 = 27.$$

27.

$$y1 = \left| \frac{3x}{x-2} \right|$$

$$y2 = 1$$

Find when $y1 < y2$

$$\boxed{\left(-1, \tfrac{1}{2}\right)}$$