3.7

1. zeros
zeros

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

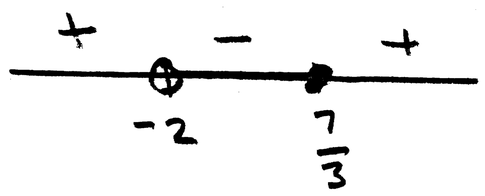
$[-2,0] \cup [1,\infty)$

2. zeros
zeros
cut points

		-4	-2	1	3
$x+2$	$-$	$-$	$+$	$+$	$+$
$x-1$	$-$	$-$	$-$	$+$	$+$
$x-3$	$-$	$-$	$-$	$-$	$+$
$x+4$	$-$	$+$	$+$	$+$	$+$
$r(x)$	$+$	$-$	$+$	$-$	$+$

$(-\infty,-4) \cup [-2,1] \cup (3,\infty)$

18. $\dfrac{3x-7}{x+2} \le 0$

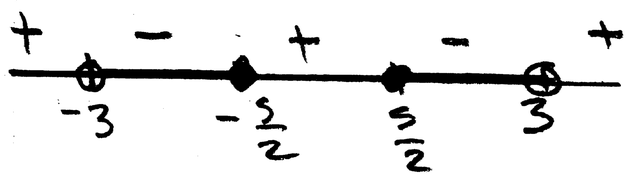


	$x-\frac{7}{3}$	$x+2$	
−3	−	−	+
0	−	+	−
3	+	+	+

$(-2, \frac{7}{3}]$

20. $\dfrac{4x^2-25}{x^2-9} \le 0$

$\dfrac{(2x+5)(2x-5)}{(x+3)(x-3)} \le 0$



	$x+\frac{5}{2}$	$x-\frac{5}{2}$	$x+3$	$x-3$	
−4	−	−	−	−	+
$-2\frac{3}{4}$	−	−	+	−	−
0	+	−	+	−	+
$2\frac{3}{4}$	+	+	+	−	−
4	+	+	+	+	+

$(-3, -\frac{5}{2}] \cup [\frac{5}{2}, 3)$

22. $\dfrac{x+1}{2x^2-4x+1} > 0$

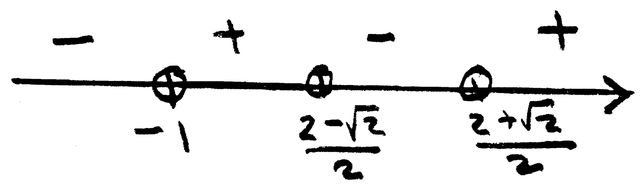
$x = \dfrac{4 \pm \sqrt{16-8}}{4}$

$= \dfrac{4 \pm \sqrt{8}}{4}$

$= \dfrac{4 \pm 2\sqrt{2}}{4}$

$x = \dfrac{2 \pm \sqrt{2}}{2}$

$\dfrac{x+1}{\left(x-\frac{2-\sqrt{2}}{2}\right)\left(x-\frac{2+\sqrt{2}}{2}\right)} > 0$



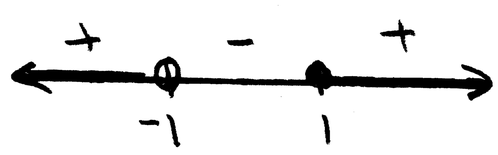
	$x+1$	$x-\frac{2-\sqrt{2}}{2}$	$x-\frac{2+\sqrt{2}}{2}$	
−2	−	−	−	−
0	+	−	−	+
1	+	+	−	−
2	+	+	+	+

$(-1, \frac{2-\sqrt{2}}{2}) \cup (\frac{2+\sqrt{2}}{2}, \infty)$

24. $\dfrac{x-1}{x^3+1} \geq 0$

$$
\begin{array}{r|l}
 & x^2 - x + 1 \\
\hline
x+1 & x^3 + 0x^2 + 0x + 1 \\
 & \underline{x^3 + x^2} \\
 & -x^2 + 0x \\
 & \underline{-x^2 - x} \\
 & x + 1 \\
 & \underline{x + 1} \\
 & 0
\end{array}
$$

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



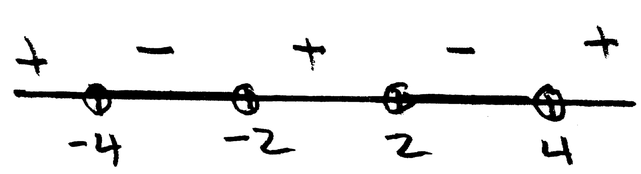
	$x+1$	$x-1$	
−2	−	−	+
0	+	−	−
2	+	+	+

$(-\infty, -1) \cup [1, \infty)$

26. $\dfrac{x^2-16}{x^4-16} < 0$

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

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



26. (Continued)

	$x+4$	$x-4$	$x+2$	$x-2$	
−5	−	−	−	−	+
−3	+	−	−	−	−
0	+	−	+	−	+
3	+	−	+	+	−
5	+	+	+	+	+

$(-4,-2) \cup (2,4)$

28. $\dfrac{1}{x} + \dfrac{1}{x+1} < \dfrac{2}{x+2}$

$$\frac{(x+1)+x}{x(x+1)} - \frac{2}{x+2} < 0$$

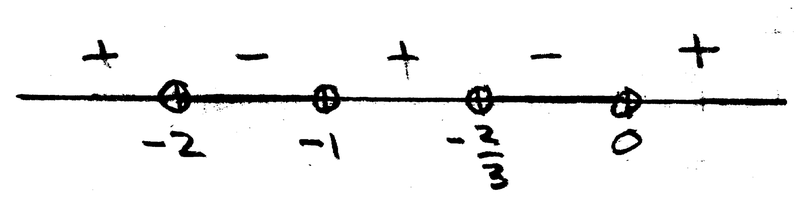
$$\frac{2x+1}{x(x+1)} - \frac{2}{x+2} < 0$$

$$\frac{(2x+1)(x+2) - 2x(x+1)}{x(x+1)(x+2)} < 0$$

$$\frac{\cancel{2x^2}+5x+2-\cancel{2x^2}-2x}{x(x+1)(x+2)} < 0$$

$$\frac{3x+2}{x(x+1)(x+2)} < 0$$

$$\frac{3\left(x+\frac{2}{3}\right)}{x(x+1)(x+2)} < 0$$



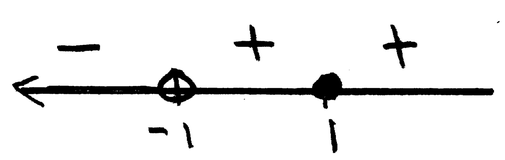
28. (Continued)

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

$(-2,-1) \cup (-\frac{2}{3},0)$

32. $\dfrac{x^2-2x+1}{x^3+3x^2+3x+1} \le 0$

$\dfrac{(x-1)^2}{(x+1)^3} \le 0$



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

34. $\dfrac{x}{2} \ge \dfrac{5}{x+1} + 4$

$\dfrac{x}{2} - \dfrac{5}{x+1} - 4 \ge 0$

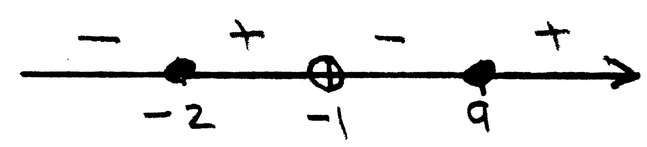
$\dfrac{x(x+1)-5(2)-4(2)(x+1)}{2(x+1)} \ge 0$

$\dfrac{x^2+x-10-8x-8}{2(x+1)} \ge 0$

$\dfrac{x^2-7x-18}{2(x+1)} \ge 0$

$\dfrac{(x-9)(x+2)}{2(x+1)} \ge 0$

34 (Continued)



	$x+2$	$x+1$	$x-9$	
-3	$-$	$-$	$-$	$-$
$-1\frac{1}{2}$	$+$	$-$	$-$	$+$
0	$+$	$+$	$-$	$-$
10	$+$	$+$	$+$	$+$

$[-2,-1) \cup [9,\infty)$

36. $\dfrac{1}{x+1} + \dfrac{1}{x+2} \le \dfrac{1}{x+3}$

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

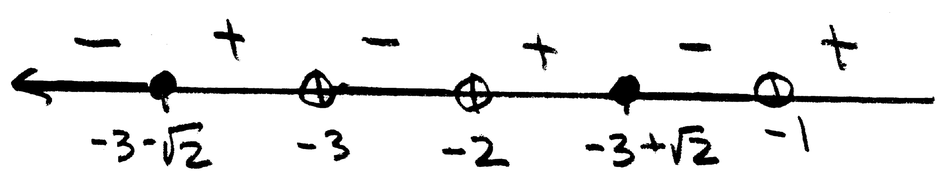
$$\frac{(x+2)(x+3) + (x+1)(x+3) - (x+1)(x+2)}{(x+1)(x+2)(x+3)} \le 0$$

$$\frac{(x^2+5x+6) + (x^2+4x+3) - (x^2+3x+2)}{(x+1)(x+2)(x+3)} \le 0$$

$$\frac{x^2+6x+7}{(x+1)(x+2)(x+3)} \le 0$$

$$x = \frac{-6 \pm \sqrt{36-28}}{2}$$
$$= \frac{-6 \pm \sqrt{8}}{2}$$
$$= \frac{-6 \pm 2\sqrt{2}}{2}$$
$$x = -3 \pm \sqrt{2}$$

$$\frac{[x-(-3-\sqrt{2})][x-(-3+\sqrt{2})]}{(x+1)(x+2)(x+3)} \le 0$$



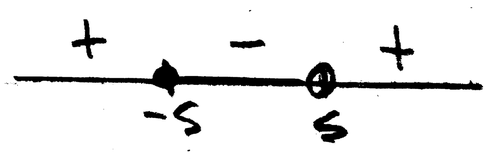
	$x-(-3-\sqrt{2})$	$x+3$	$x+2$	$x-(-3+\sqrt{2})$	$x+1$	
-5	−	−	−	−	−	−
-4	+	−	−	−	−	+
$-2\frac{1}{2}$	+	+	−	−	−	−
-1.9	+	+	+	−	−	+
-1.5	+	+	+	+	−	−
2	+	+	+	+	+	+

$(-\infty, -3-\sqrt{2}] \cup (-3, -2) \cup [-3+\sqrt{2}, -1)$

42. $g(x) = \sqrt{\dfrac{5+x}{5-x}}$

$$\frac{5+x}{5-x} \geq 0$$

$$\frac{x+5}{x-5} \leq 0$$



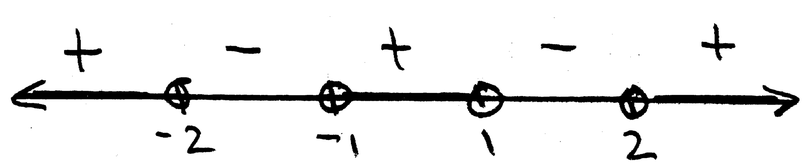
$[-5, 5)$

44. $f(x) = \dfrac{1}{\sqrt{x^4 - 5x^2 + 4}}$

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

$$f(x) = \frac{1}{\sqrt{(x+2)(x+1)(x-1)(x-2)}}$$

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



$(-\infty, -2) \cup (-1, 1) \cup (2, \infty)$