

Simplify. Identify any x-values for which the expression is undefined.

$$1. \frac{6x^3}{27x^2+12x} = \frac{6x^3}{3x(9x+4)}$$

$$= \frac{2x^2}{9x+4}$$

$x \neq 0, -\frac{4}{9}$

$$2. \frac{x^2-x-2}{3x-6} = \frac{(x-2)(x+1)}{3(x-2)}$$

$$= \frac{x+1}{3}$$

$x \neq 2$

$$3. \frac{-x^2+16}{-x^2-9x-20} = \frac{-1(x+4)(x-4)}{-1(x+4)(x+5)}$$

$$= \frac{x-4}{x+5}$$

$x \neq -4, -5$

$$4. \frac{4xy^3}{5x^2} \cdot \frac{20x^3y^2}{-16xy^7}$$

$$= \frac{x}{-1 \cdot y^2}$$

$x, y \neq 0$

$$5. \frac{x^2-9}{2x+10} \cdot \frac{x+5}{x-3}$$

$$= \frac{(x+3)}{2}$$

$x \neq -5, 3$

$$6. \frac{x-4}{2x^2} \cdot \frac{x}{x^2-x-12} = \frac{x(x-4)}{2x^2(x-4)(x+3)}$$

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

$x \neq -3, 0$

$$7. \frac{3x^3}{4x+4} \div \frac{9x}{x+1}$$

$$= \frac{3x^3}{4(x+1)} \cdot \frac{x+1}{9x}$$

$$= \frac{x^2}{12}$$

$x \neq -1, 0$

$$8. \frac{12x^3y^6}{9xy} \div \frac{6y^2}{3x}$$

$$= \frac{2x^3y^3}{3}$$

$x, y \neq 0$

$$9. \frac{x^2-16}{x^2+4x+3} \div \frac{x-4}{x+1}$$

$$= \frac{(x+4)(x-4)}{(x+3)(x+1)} \cdot \frac{(x+1)}{(x-4)}$$

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

$x \neq -3, -1, 4$

Add or Subtract. Identify any x-values for which the expression is undefined.

$$10. \frac{x+9}{2x+1} + \frac{3x+6}{2x+1}$$

$$= \frac{4x+15}{2x+1}$$

$x \neq -\frac{1}{2}$

$$11. \frac{2}{x+3} + \frac{4x}{x^2-9}$$

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

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

$x \neq 3, -3$

$$12. \frac{1}{x^2+6x+8} + \frac{1}{x^2-6x-16}$$

$$= \frac{1}{(x+4)(x+2)} + \frac{1}{(x-8)(x+2)}$$

$$= \frac{2x-4}{(x+4)(x+2)(x-8)}$$

$x \neq -4, -2, 8$

$$13. \frac{x-6}{x+5} - \frac{8x+7}{x+5}$$

$$= \frac{-7x-13}{x+5}$$

$x \neq -5$

$$14. \frac{x}{x+1} - \frac{3}{x+4}$$

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

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

$x \neq -1, -4$

$$15. \frac{7}{x-9} - \frac{2x-6}{x^2-13x+36}$$

$$= \frac{7}{(x-9)} \cdot \frac{x-4}{x-4} - \frac{2(x-3)}{(x-4)(x-9)}$$

$$= \frac{5x-22}{(x-9)(x-4)}$$

$x \neq 9, 4$

Simplify.

$$16. \frac{\frac{3x}{3x+21}}{\frac{9x^2}{x+7}}$$

$$= \frac{3x}{3(x+7)} \cdot \frac{x+7}{9x^2}$$

$$= \frac{1}{9x}$$

$$17. \frac{\frac{x}{x-1}}{\frac{10x^2}{-4x+4}}$$

$$= \frac{x}{x-1} \cdot \frac{-4(x-1)}{10x^2}$$

$$= \frac{-2}{5x}$$

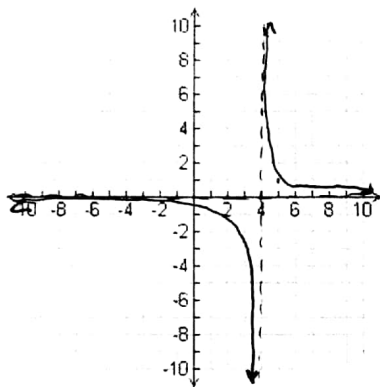
$$18. \frac{\frac{1}{x-2}}{\frac{x-2}{x+3}}$$

$$= \frac{1}{x-2} \cdot \frac{(x+2)(x-2)}{(x+3)}$$

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

Using the graph of $f(x) = \frac{1}{x}$ as a guide, describe the transformation and graph each function.

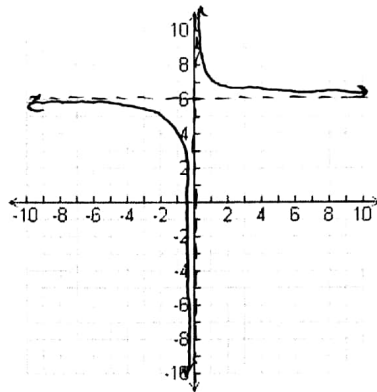
19. $g(x) = \frac{1}{x-4}$



Transformation

$g(x) = f(x-4)$ Right 4

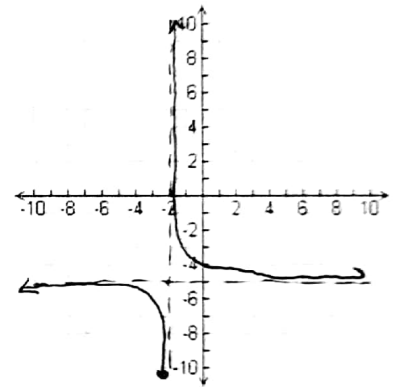
20. $g(x) = \frac{1}{x} + 6$



Transformation

$g(x) = f(x) + 6$ up 6

21. $g(x) = \frac{1}{x+2} - 5$



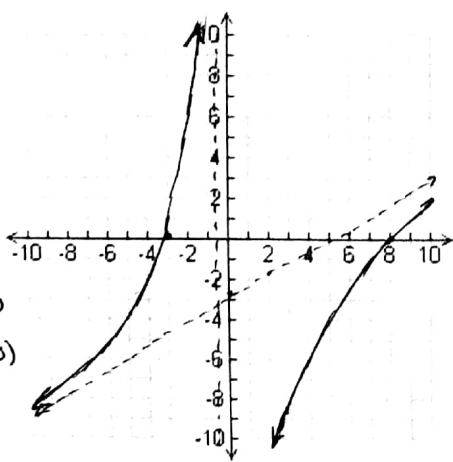
Transformation

$g(x) = f(x+2) - 5$ left 2 down 5

Graph each function. Identify any discontinuities and the end behavior

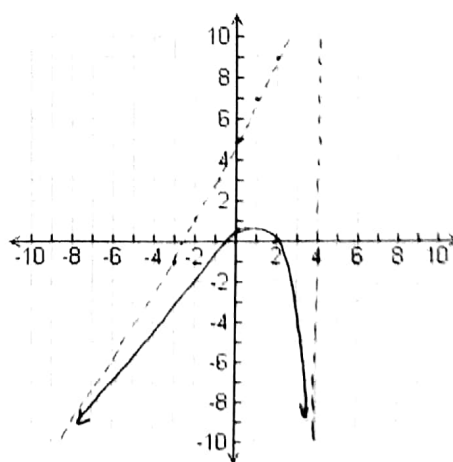
22. $f(x) = \frac{x^2 - 5x - 24}{2x + 1} = \frac{(x-8)(x+3)}{2x+1}$

Disc
 $x \neq -\frac{1}{2}$
VA: $x = -\frac{1}{2}$
EB
SA: $\frac{1}{2}x - 2.75$
y int: $(0, -24)$
x int: $(8, 0), (-3, 0)$



23. $f(x) = \frac{2x^2 - 3x - 2}{x - 4} = \frac{(2x+1)(x-2)}{x-4}$

Disc
 $x \neq 4$ VA: $x = 4$
EB
SA: $2x + 5$
y int: $(0, \frac{1}{2})$
x int: $(\frac{1}{2}, 0), (2, 0)$



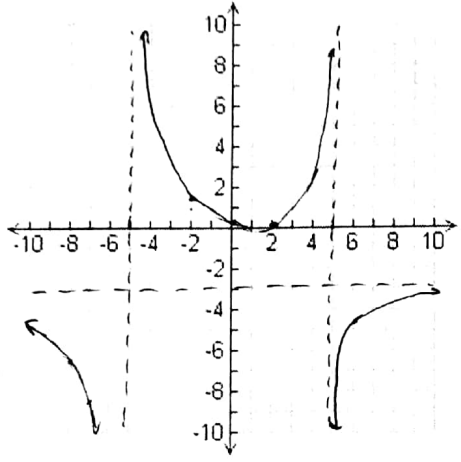
$$24. f(x) = \frac{-3x^2 + 8x - 4}{x^2 - 25} = \frac{(-3x+2)(x-2)}{(x+5)(x-5)}$$

Disc

$x \neq 5, -5$
 VA: $x = 5$
 $x = -5$

EB

HA: $y = -3$
 y int: $(0, \frac{4}{25})$
 x int: $(2, 0)$
 $(\frac{2}{3}, 0)$



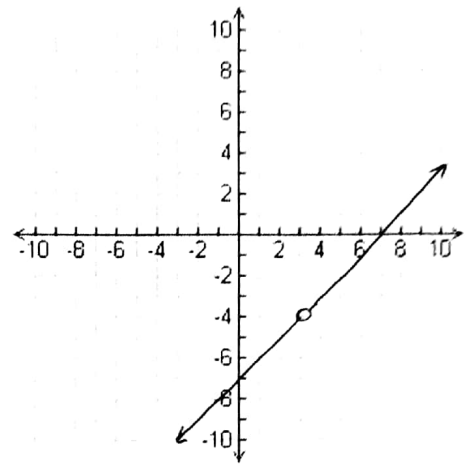
x	f(x)
-6	-14.54...
-2	1.5238...
3	.4375
6	-5.818
-7	-8.625
-8	-6.6

$$25. f(x) = \frac{x^2 - 4x - 21}{x + 3} = \frac{(x-7)(x+3)}{x+3}$$

Disc

$x \neq 3$
 Hole: $x = 3 (3, 4)$

EB:
 SA: $y = x - 7$



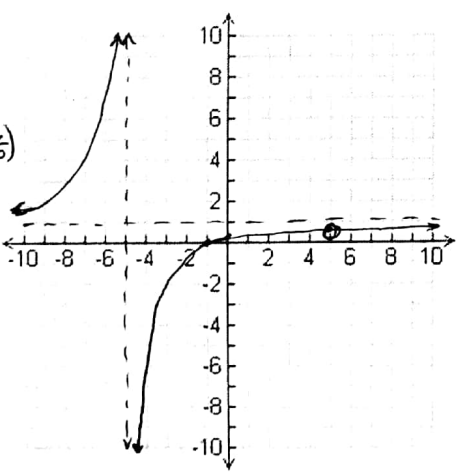
$$26. f(x) = \frac{x^2 - 4x - 5}{x^2 - 25} = \frac{(x-5)(x+1)}{(x+5)(x-5)}$$

Disc

$x \neq -5, 5$
 Hole: $x = 5 (5, \frac{6}{10})$
 VA: $x = -5$

EB

HA: $y = 1$
 y int: $(0, \frac{1}{5})$
 x int: $(-1, 0)$



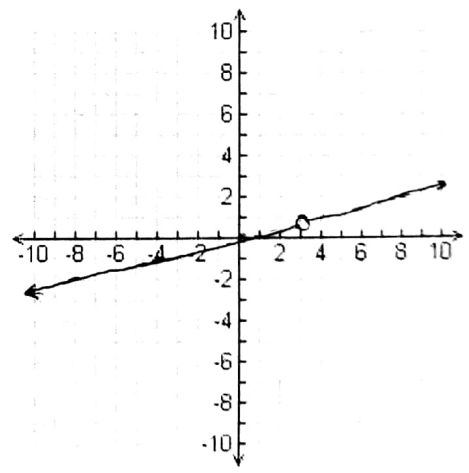
$$27. f(x) = \frac{x^2 - 3x}{4x - 12} = \frac{x(x-3)}{4(x-3)}$$

Disc

$x \neq 3$
 Hole: $x = 3 (3, \frac{3}{4})$

EB:
 SA: $y = \frac{x}{4}$

y int: $(0, 0)$
 x int: $(0, 0)$



Solve each equation.

28. $12 + \frac{2}{3x} = 6 \quad x \neq 0$

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

$36x + 2 = 18x$

$x = \frac{-1}{9}$

29. $x - \frac{1}{x} = \frac{35}{x} \quad x \neq 0$

$x \left(x - \frac{1}{x}\right) = \left(\frac{35}{x}\right) \cdot x$

$x^2 - 1 = 35$

$x = \pm 6$

30. $\frac{x}{x+1} + \frac{x}{4} = \frac{3x}{4x+4} \quad x \neq -1$

$4(x+1) \left(\frac{x}{x+1} + \frac{x}{4}\right) = \left(\frac{3x}{4x+4}\right) 4(x+1)$

$4x + x^2 = 3x$

$x = 0, -2$

31. $\frac{x-1}{x-4} = \frac{x+6}{x} \quad x \neq 4, 0$

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

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

$x = 8$

32. $\frac{6x}{x+5} = \frac{2x-20}{x+5} \quad x \neq -5$

$(x+5) \left(\frac{6x}{x+5}\right) = \left(\frac{2x-20}{x+5}\right) (x+5)$

$6x = 2x - 20$

$x = -5$
Extraneous
So no solution

33. $\frac{4}{x-4} = -\frac{x}{x-4} + \frac{x}{2} \quad x \neq 4$

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

$8 = -2x + x^2 - 4x$

$x = 3 \pm \sqrt{17}$

Solve each inequality

34. $\frac{2x+1}{x} \geq 3 \quad x \neq 0$

35. $\frac{10}{x-2} < 2 \quad x \neq 2$

36. $\frac{15}{x+3} \leq 1 \quad x \neq -3$

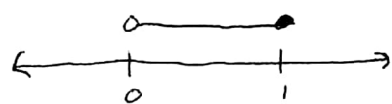
$x \left(\frac{2x+1}{x}\right) = (3)x$

$2x+1 = 3x$

$1 = x$



x	f(x)
-1	false
.5	True
2	false



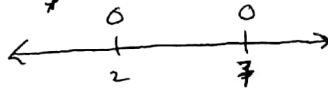
Interval - $(0, 1]$

$(x+2) \left(\frac{10}{x+2}\right) = (2)(x+2)$

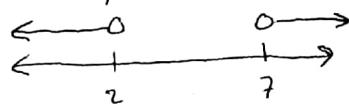
$10 = 2x+4$

$14 = 2x$

$7 = x$



x	f(x)
0	True
2.5	false
8	true



Interval - $(-\infty, 2) \cup (7, \infty)$

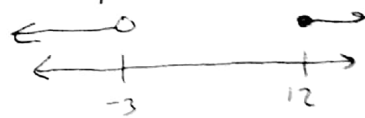
$(x+3) \left(\frac{15}{x+3}\right) = (1)x+3$

$15 = x+3$

$12 = x$



x	f(x)
-4	True
0	false
27	True



Interval - $(-\infty, -3) \cup [12, \infty)$