

Simplify each expression:

1- $\frac{24pn}{18p^2} = \frac{4n}{3p}$

3- $\frac{2x^2-6x}{x^3-9x} = \frac{2x(x-3)}{x(x^2-9)} = \frac{2x(x-3)}{x(x-3)(x+3)} = \frac{2}{x+3}$

5- $\frac{x^2-9}{2x^2-3x-9} = \frac{(x-3)(x+3)}{(2x+3)(x-3)} = \frac{x+3}{2x+3}$

2- $\frac{x^2-5x-14}{x^2+7x+10} = \frac{(x-7)(x+2)}{(x+2)(x+5)} = \frac{x-7}{x+5}$

4- $\frac{x^2+2x-15}{3x^2-4x-15} = \frac{(x+5)(x-3)}{(3x+5)(x-3)} = \frac{x+5}{3x+5}$

6- $\frac{3x^2-3x-18}{3x^2-27} = \frac{3(x^2-x-6)}{3(x^2-9)} = \frac{3(x-3)(x+2)}{3(x-3)(x+3)} = \frac{x+2}{x+3}$

Simplify each product or quotient:

7- $\frac{y^2-1}{2y-1} \cdot \frac{2y^2+y-1}{y^2+2y+1} = \frac{(y+1)(y-1)}{(2y-1)} \cdot \frac{(2y-1)(y+1)}{(y+1)(y+1)} = y-1$

8- $\frac{x^2+5x+4}{x^2+2x+1} \cdot \frac{2x+2}{x+4} = \frac{(x+4)(x+1)}{(x+1)(x+1)} \cdot \frac{2(x+1)}{(x+4)} = 2$

9- $\frac{\frac{m^2}{5f^2} \cdot \frac{m}{f^3}}{\frac{m^2}{5f^2} \cdot \frac{f^3}{m}} = \frac{mf}{5}$

10- $\frac{m+2f}{6} \div \frac{m^2-4f^2}{10} = \frac{(m+2f)}{6} \cdot \frac{10}{(m-2f)(m+2f)} = \frac{5}{3(m-2f)}$

11- $\frac{x^3}{x^2-64} \div \frac{x^2}{x+8} = \frac{x^3}{(x-8)(x+8)} \cdot \frac{(x+8)}{x^2} = \frac{x}{x-8}$

12- $\frac{\frac{3m^2-12}{4m^2+8m}}{\frac{6m-12}{8m^2+16m}} = \frac{3(m^2-4)}{4m(m+2)} \cdot \frac{8m(m+2)}{6(m-2)} = \frac{3(m-2)(m+2)}{4m(m+2)} \cdot \frac{8(m+2)}{6(m-2)} = \frac{2(m+2)}{m(m-2)}$

Simplify each sum or difference:

13. $\frac{1}{5} - \frac{3}{2w} + \frac{3}{10w}$

$$\frac{2w(1)}{10w} - \frac{5(3)}{10w} + \frac{3}{10w}$$

$$\frac{2w - 12}{10w} = \frac{2(w-6)}{10w} = \frac{(w-6)}{5w}$$

14. $\frac{2}{x} - \frac{x-2}{3x} + \frac{x}{3}$

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

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

15. $\frac{30}{m^2-25} + \frac{3}{m-5}$

$$\frac{30}{(m-5)(m+5)} + \frac{3(m+5)}{(m-5)(m+5)}$$

$$\frac{30 + 3m + 15}{(m-5)(m+5)} = \frac{45 + 3m}{(m-5)(m+5)}$$

16. $\frac{2}{x-2} - \frac{3x}{x^2+2x-8}$

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

$$\frac{2x + 8 - 3x}{(x-2)(x+4)} = \frac{-x + 8}{(x-2)(x+4)}$$

17. $\frac{3r}{r+4} - \frac{r+3}{2r+8}$

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

$$\frac{6r - r - 3}{2(r+4)} = \frac{(5r-3)}{2(r+4)}$$

18. $\frac{3r}{r^2-7r+10} - \frac{1}{r-2} + \frac{6}{r-2}$

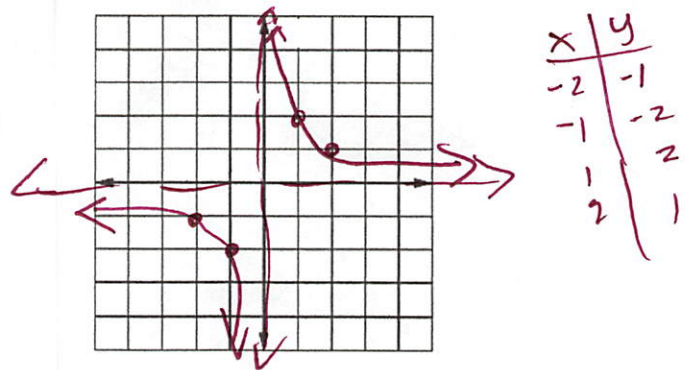
$$\frac{3r}{(r-5)(r-2)} - \frac{(r-5)}{(r-5)(r-2)} + \frac{6(r-5)}{(r-5)(r-2)}$$

$$\frac{3r - r + 5 + 6r - 30}{(r-5)(r-2)} = \frac{(8r - 25)}{(r-5)(r-2)}$$

Graph each function. State the domain and range and the asymptotes.

19. $f(x) = \frac{2}{x}$

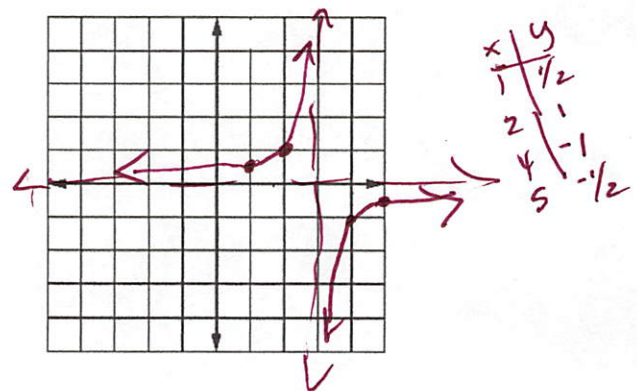
V.A. $x=0$ H.A. $y=0$



Domain. $x \neq 0$ Range. $y \neq 0$

20. $f(x) = \frac{-1}{x-3}$

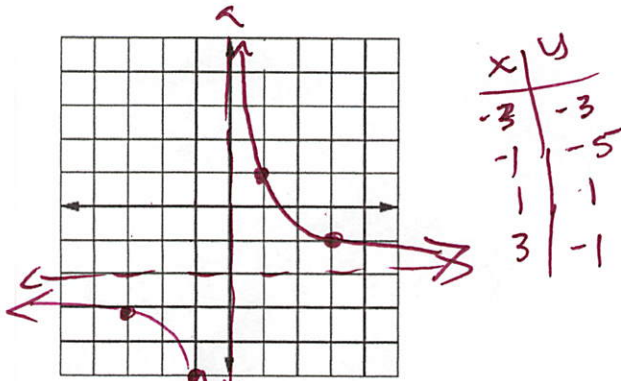
V.A. $x=3$ H.A. $y=0$



Domain. $x \neq 3$ Range. $y \neq 0$

21. $f(x) = \frac{3}{x} - 2$

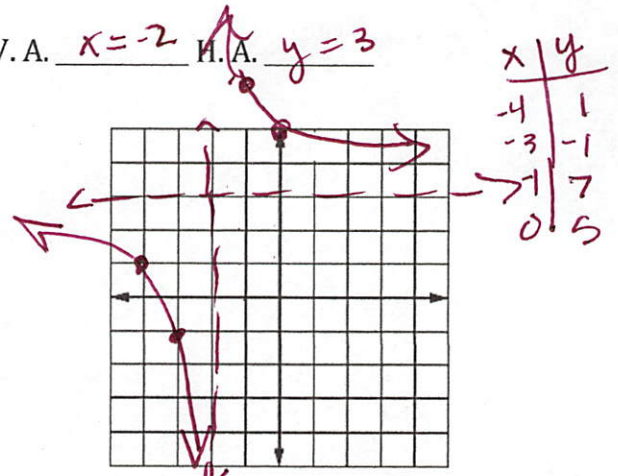
V.A. $x=0$ H.A. $y=-2$



Domain. $x \neq 0$ Range. $y \neq -2$

22. $f(x) = \frac{4}{x+2} + 3$

V.A. $x=-2$ H.A. $y=3$

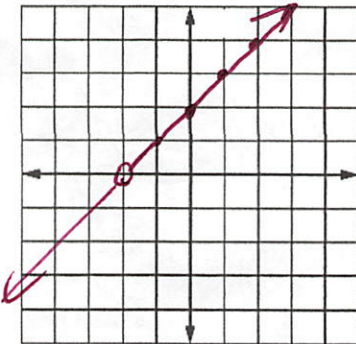


Domain. $x \neq -2$ Range. $y \neq 3$

Graph each function: Identify any holes and asymptotes.

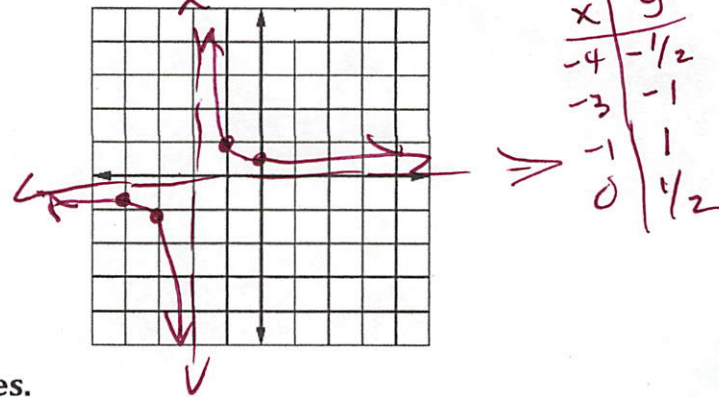
23. $f(x) = \frac{x^2+4x+4}{x+2} = \frac{(x+2)(x+2)}{(x+2)}$

V.A. none H.A. none Holes: $x = -2$



24. $f(x) = \frac{x+3}{x^2+5x+6} = \frac{(x+3)}{(x+2)(x+3)} = \frac{1}{(x+2)}$

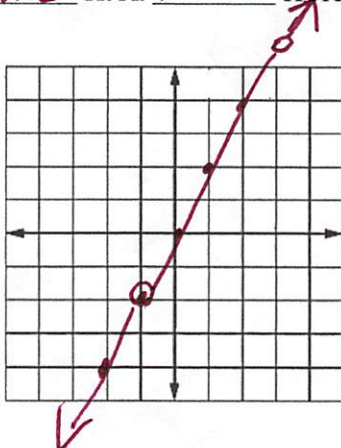
V.A. $x = -2$ H.A. $y = 0$ Holes: $x = -3$



Graph each function: Identify any holes and asymptotes.

25. $f(x) = \frac{2x^3-4x^2+6x}{x^2-2x+3} = \frac{2x(x^2-2x+3)}{(x-3)(x+1)} = \frac{2x(x-3)(x+1)}{(x-3)(x+1)}$

V.A. none H.A. none Holes: $x=3, x=-1$



For each function: Identify any holes, asymptotes and intercepts:

26. $f(x) = \frac{x-2}{x^2}$

Holes: ~~None~~
 V.A.: $x = 0$
 H.A.: $y = 0$
 x-int: $(2, 0)$
 y-int: ~~none~~

27. $f(x) = \frac{x^2-9}{x+5} = \frac{(x+3)(x-3)}{(x+5)}$

Holes: ~~none~~
 V.A.: $x = -5$
 H.A.: ~~none~~ / slant
 x-int: $(3, 0), (-3, 0)$
 y-int: $(0, -9/5)$

28. $f(x) = \frac{x^2-x-30}{2x^2+5x+3} = \frac{(x-6)(x+5)}{(2x+3)(x+1)}$

Holes: ~~none~~
 V.A.: $x = -3/2, x = -1$
 H.A.: $y = 1/2$
 x-int: $(6, 0), (-5, 0)$
 y-int: $(0, -10)$

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

Holes: ~~none~~
 V.A.: $x = -3$
 H.A.: ~~none~~ / slant
 x-int: $(0, 0), (-2, 0)$
 y-int: $(0, 0)$

Solve each equation (check for extraneous solutions):

30. $y + 4 = \frac{5}{y}$

$y^2 + 4y = 5$
 $y^2 + 4y - 5 = 0$
 $(y+5)(y-1) = 0$
 $y = 1, -5$

31. $-\frac{n}{n-4} + n = \frac{12-4n}{n-4}$

$-n + n(n-4) = 12 - 4n$
 $-n + n^2 - 4n = 12 - 4n$
 $n^2 - n - 12 = 0$
 $(n-4)(n+3) = 0$
 $n = 4, \text{ or } -3$

32. $\frac{3}{k-3} + \frac{4}{k-4} = \frac{25}{k^2-7k+12}$

$3(k-4) + 4(k-3) = 25$
 $3k - 12 + 4k - 12 = 25$
 $7k - 24 = 25$
 $7k = 49$
 $k = 7$

33. $\frac{12}{2x+4} = \frac{x-7}{x+2} + \frac{1}{4}$

$2(x+2)$
 $12(2) = 4(x-7) + 1(x+2)$
 $24 = 4x - 28 + x + 2$
 $24 = 5x - 26$
 $50 = 5x$
 $x = 10$

34. $\frac{x+1}{x-3} = 4 - \frac{12}{x^2-2x-3}$

$(x-3)(x+1)$ LCD: $(x-3)(x+1)$

$(x+1)(x+1) = 4(x^2-2x-3) - 12$
 $x^2+2x+1 = 4x^2-8x-12-12$
 $0 = 3x^2-10x-25$
 $0 = (3x+5)(x-5)$
 $x = -5/3 \text{ or } 5$

35. $\frac{x+5}{x^2+x} = \frac{1}{x^2+x} - \frac{x-6}{x+1}$

$x(x+1)$ LCD: $x(x+1)$

$x+5 = 1 - x(x-6)$
 $x+5 = 1 - x^2 + 6x$
 $x^2 - 5x + 4 = 0$
 $(x-4)(x-1) = 0$
 $x = 4 \text{ or } x = 1$