

1.  $f(x) = \frac{2x+5}{3}$   $N = \{-\frac{5}{2}\}$   $D = \emptyset$     2.  $F(x) = \frac{2}{x+4}$   $N = \emptyset$   $D = \{-4\}$     3.  $F(x) = \frac{x-5}{x}$   $N = \{5\}$   $D = \{0\}$

- a) zero (in  $N$  not  $D$ )    a)  $-\frac{5}{2}$     a)  $\emptyset$     a) 5  
 b) undefined (in  $D$  not  $N$ )    b)  $\emptyset$     b)  $-4$     b) 0  
 c) indeterminate (in  $D$  and  $N$ )    c)  $\emptyset$     c)  $\emptyset$     c)  $\emptyset$

4.  $f(x) = \frac{3x+9}{4x-8}$   $\frac{3(x+3)}{4(x-2)}$   $N = \{-3\}$   $D = \{2\}$     5.  $F(x) = \frac{(x-2)(x+1)}{x(x-2)}$   $N = \{-1\}$   $D = \{0, 2\}$     6.  $f(x) = \frac{(3x-5)(2x+7)(x-6)}{(3x+5)(3x-5)(x+6)}$   $N = \{-\frac{7}{2}, 6\}$   $D = \{-\frac{5}{3}, \frac{5}{3}, -6\}$

a)  $-3$     a)  $-1$     a)  $-\frac{7}{2}, 6$   
 b) 2    b) 0    b)  $-\frac{5}{3}, -6$   
 c)  $\emptyset$     c) 2    c)  $\frac{5}{3}$

$5x^2 - 11x - 12$  7.  
 $5x^2 - 15x + 4x - 12$   
 $5x(x-3) + 4(x-3)$

$f(x) = \frac{x^2-9}{x^2-5x+6}$

$f(x) = \frac{(x+3)(x-3)}{(x-3)(x-2)}$   
 $N = \{-3, 3\}$   
 $D = \{3, 2\}$

- a)  $-3$   
 b) 2  
 c) 3

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

$F(x) = \frac{(x+2)(x-2)}{x^2+4}$   
 $N = \{-2, 2\}$   
 $D = \emptyset$

- a)  $-2, 2$   
 b)  $\emptyset$   
 c)  $\emptyset$

9.  $F(x) = \frac{25x^2-16}{5x^2-11x-12}$

$f(x) = \frac{(5x+4)(5x-4)}{(5x+4)(x-3)}$   
 $N = \{-\frac{4}{5}, \frac{4}{5}\}$   
 $D = \{-\frac{4}{5}, 3\}$

- a)  $\frac{4}{5}$   
 b) 3  
 c)  $-\frac{4}{5}$

10.  $f(x) = \frac{x^3+2x^2-x-2}{x^3+5x^2-4x-20}$

$= \frac{(x+2)(x+1)(x-1)}{(x+5)(x+2)(x-2)}$   
 $N = \{-2, -1, 1\}$   
 $D = \{-5, -2, 2\}$

- a)  $-1, 1$   
 b)  $-5, 2$   
 c)  $-2$

1.3 → Continued

17. a)  $f(x) = (x-4)^2$   
At  $x=4$

defined  
(zero) ✓

b)  $f(x) = \frac{x+4}{(x-4)^2}$

Vertical Asymptote:  $x=4$   
(undefined) ✓

c)  $f(x) = \frac{(x-4)^2}{x-4}$  (gap)  
 $= (x-4)$  hole at  $x=4$   
(indeterminate)

d)  $f(x) = \frac{x+4}{x+4}$   
defined  
(zero)

e)  $f(x) = \frac{x^3(x-4)^2}{(x-4)^3} = \frac{x^3}{(x-4)}$

Vertical Asymptote  
at  $x=4$   
(undefined)

f)  $f(x) = \frac{10(x-4)^5}{(x-4)^5}$

Hole at  $x=4$   
(indeterminate)