1. As x approaches 2, $f(x)$ approaches 5. [Or, the values of $f(x)$ can be made as close to 5 as we like by taking x sufficiently close to 2 (but $x \neq 2$).] Yes, the graph could have a hole at $(2, 5)$ and be defined such that $f(2) = 3$.

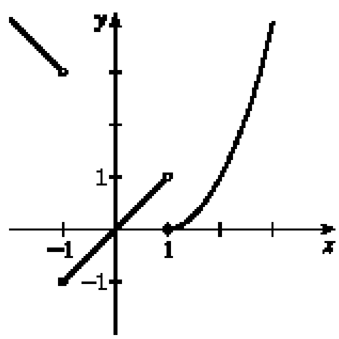
2. As x approaches 1 from the left, $f(x)$ approaches 3; and as x approaches 1 from the right, $f(x)$ approaches 7. No, the limit does not exist because the left- and right-hand limits are different.

4. (a) $\lim_{x\to 0} f(x) = 3$ (b) $\lim_{x\to 3^-} f(x) = 4$ (c) $\lim_{x\to 3^+} f(x) = 2$

(d) $\lim_{x\to 3} f(x)$ does not exist because the limits in part (b) and part (c) are not equal.

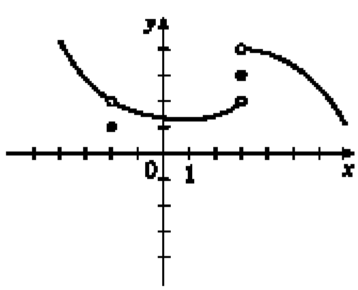
(e) $f(3) = 3$

6. $\lim_{x\to a} f(x)$ exists for all a except $a = \pm 1$.



11. $\lim_{x\to 3^+} f(x) = 4$, $\lim_{x\to 3^-} f(x) = 2$, $\lim_{x\to -2} f(x) = 2$,

$f(3) = 3$, $f(-2) = 1$



14. For $f(x) = \dfrac{x^2 - 2x}{x^2 - x - 2}$:

x	$f(x)$
0	0
−0.5	−1
−0.9	−9
−0.95	−19
−0.99	−99
−0.999	−999

x	$f(x)$
−2	2
−1.5	3
−1.1	11
−1.01	101
−1.001	1001

It appears that $\lim_{x \to -1} \dfrac{x^2 - 2x}{x^2 - x - 2}$ *does not exist* since

$f(x) \to -\infty$ as $x \to -1^-$ and $f(x) \to \infty$ as $x \to -1^+$.

20. For $f(x) = \dfrac{9^x - 5^x}{x}$:

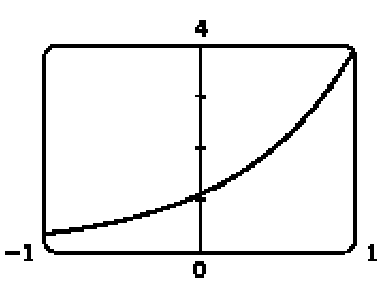
x	$f(x)$
0.5	1.527864
0.1	0.711120
0.05	0.646496
0.01	0.599082
0.001	0.588906

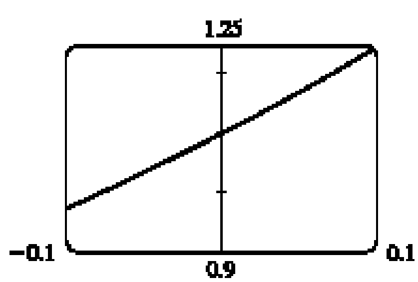
x	$f(x)$
−0.5	0.227761
−0.1	0.485984
−0.05	0.534447
−0.01	0.576706
−0.001	0.586669

It appears that $\lim_{x \to 0} \dfrac{9^x - 5^x}{x} = 0.59$. Later we will be able

to show that the exact value is $\ln(9/5)$.

22. (a) From the following graphs, it seems that $\lim_{x \to 0} \dfrac{6^x - 2^x}{x} \approx 1.10$.





(b)

x	$f(x)$
−0.01	1.085052
−0.001	1.097248
−0.0001	1.098476
0.0001	1.098749
0.001	1.099978
0.01	1.112353