1. **(a)** The point $(-1,-2)$ is on the graph of f, so $f(-1)=-2$.
(b) When $x=2$, y is about 2.8, so $f(2)\approx 2.8$.
(c) $f(x)=2$ is equivalent to $y=2$. When $y=2$, we have $x=-3$ and $x=1$.
(d) Reasonable estimates for x when $y=0$ are $x=-2.5$ and $x=0.3$.
(e) The domain of f consists of all x –values on the graph of f. For this function, the domain is $-3\leq x\leq 3$, or $[-3,3]$. The range of f consists of all y –values on the graph of f. For this function, the range is $-2\leq y\leq 3$, or $[-2,3]$.
(f) As x increases from -1 to 3, y increases from -2 to 3. Thus, f is increasing on the interval $[-1,3]$.

19. $f(x)=3x^2-x+2$.

$f(2)=3(2)^2-2+2=12-2+2=12$.

$f(-2)=3(-2)^2-(-2)+2=12+2+2=16$.

$f(a)=3a^2-a+2$.

$f(-a)=3(-a)^2-(-a)+2=3a^2+a+2$.

$f(a+1)=3(a+1)^2-(a+1)+2=3(a^2+2a+1)-a-1+2=3a^2+6a+3-a+1=3a^2+5a+4$.

$2f(a)=2\cdot f(a)=2(3a^2-a+2)=6a^2-2a+4$.

$f(2a)=3(2a)^2-(2a)+2=3(4a^2)-2a+2=12a^2-2a+2$.

$f(a^2)=3(a^2)^2-(a^2)+2=3(a^4)-a^2+2=3a^4-a^2+2$.

$$\begin{aligned}[f(a)]^2 &= \left[3a^2-a+2\right]^2=\left(3a^2-a+2\right)\left(3a^2-a+2\right)\\ &=9a^4-3a^3+6a^2-3a^3+a^2-2a+6a^2-2a+4=9a^4-6a^3+13a^2-4a+4.\end{aligned}$$

$f(a+h)=3(a+h)^2-(a+h)+2=3(a^2+2ah+h^2)-a-h+2=3a^2+6ah+3h^2-a-h+2$.

21. $f(x)=x-x^2$, so $f(2+h)=2+h-(2+h)^2=2+h-(4+4h+h^2)=2+h-4-4h-h^2=-\left(h^2+3h+2\right)$,
$f(x+h)=x+h-(x+h)^2=x+h-(x^2+2xh+h^2)=x+h-x^2-2xh-h^2$, and

$$\frac{f(x+h)-f(x)}{h}=\frac{x+h-x^2-2xh-h^2-x+x^2}{h}=\frac{h-2xh-h^2}{h}=\frac{h(1-2x-h)}{h}=1-2x-h.$$

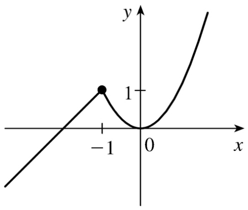
23. $f(x)=x/(3x-1)$ is defined for all x except when $0=3x-1\Leftrightarrow x=\frac{1}{3}$, so the domain is

$$\left\{x\in R\,|\,x\neq\frac{1}{3}\right\}=\left(-\infty,\frac{1}{3}\right)\cup\left(\frac{1}{3},\infty\right).$$

27. $h(x)=1/\sqrt[4]{x^2-5x}$ is defined when $x^2-5x>0 \Leftrightarrow x(x-5)>0$. Note that $x^2-5x\neq 0$ since that would result in division by zero. The expression $x(x-5)$ is positive if $x<0$ or $x>5$. (See Appendix A for methods for solving inequalities.) Thus, the domain is $(-\infty,0)\cup(5,\infty)$.

39. $f(x)=\begin{cases} x+2 & \text{if } x\leq -1 \\ x^2 & \text{if } x>-1 \end{cases}$

Note that for $x=-1$, both $x+2$ and x^2 are equal to 1. Domain is $\mathbb{R}$.



45. For $-1\leq x\leq 2$, the graph is the line with slope 1 and $y-$ intercept 1, that is, the line $y=x+1$. For $2<x\leq 4$, the graph is the line with slope $-\frac{3}{2}$ and $x-$ intercept 4, so $y-0=-\frac{3}{2}(x-4)=-\frac{3}{2}x+6$. So the function is $f(x)=\begin{cases} x+1 & \text{if } -1\leq x\leq 2 \\ -\frac{3}{2}x+6 & \text{if } 2<x\leq 4 \end{cases}$

49. Let the length of a side of the equilateral triangle be x. Then by the Pythagorean Theorem, the height y of the triangle satisfies $y^2+\left(\frac{1}{2}x\right)^2=x^2$, so that $y^2=x^2-\frac{1}{4}x^2=\frac{3}{4}x^2$ and $y=\frac{\sqrt{3}}{2}x$. Using the formula for the area A of a triangle, $A=\frac{1}{2}(\text{base})(\text{height})$, we obtain $A(x)=\frac{1}{2}(x)\left(\frac{\sqrt{3}}{2}x\right)=\frac{\sqrt{3}}{4}x^2$, with domain $x>0$.

53. The height of the box is x and the length and width are $L=20-2x$, $W=12-2x$. Then $V=LWx$ and so $V(x)=(20-2x)(12-2x)(x)=4(10-x)(6-x)(x)=4x\left(60-16x+x^2\right)=4x^3-64x^2+240x$.
The sides L, W, and x must be positive. Thus, $L>0\Leftrightarrow 20-2x>0\Leftrightarrow x<10$; $W>0\Leftrightarrow 12-2x>0\Leftrightarrow x<6$; and $x>0$. Combining these restrictions gives us the domain $0<x<6$.