Problem 3.

(a) The slope of the secant line through P and $Q = m(h) = \frac{f(1+h)-f(1)}{h} = \frac{(1+h)^3-1^3}{h} = \frac{h^3+3h^2+3h}{h} = h^2+3h+3$. Now $m(-0.1) = 2.71$, $m(-0.01) = 2.9701$, $m(-0.001) = 2.99700$, $m(0.0001) = 3.00030$, $m(0.001) = 3.00300$, $m(0.01) = 3.0301$, and $m(0.1) = 3.31$.

(b) $f'(1) = \lim_{h\to 0} m(h) = \lim_{h\to 0}(h^2+3h+3) = 3$.

(c) The function $f(x) = x^3$ is increasing at an increasing rate; that is, the slopes of tangent lines are nonnegative and increasing as x increases. Thus any secant line with $h > 0$ will have a greater slope that the slope of the tangent line at $x = 1$, and any secant line with $h < 0$ will have a slope less that the slope of the tangent line at $x = 1$. Therefore, the difference quotients for $h > 0$ are greater than $f'(1)$, and the difference quotients for $h < 0$ are less than $f'(1)$.

Problem 5.

$f'(9) = \frac{1}{6} \approx 0.16667$

$2-h$	8.9	8.99	8.999	9.0001	9.001	9.01	9.1
$f(2-h)-f(2)$	0.16713	0.16671	0.16667	0.16667	0.16666	0.16662	0.16621

Problem 13.

(a) $m = \frac{f(w)-f(3)}{w-3}$

(b) (iii)

(c) Expression i. corresponds the the slope of a secant line when $w \neq 3$. Expression ii. limits to the slope of the secant line to f through the points $P = (3, f(3))$ and $Q = (0, f(0))$. Expression iii. is the slope of the tangent line to the graph of f at P because Q approaches P as w approaches 3. Figure 5.4 in the text illustrates this concept.

Problem 17.

(a) $A = (4-w, g(4-w))$, $B = (4, g(4))$, $C = (4+w, g(4+w))$, $D = (s, g(s))$, $E = (s+p, g(s+p))$, $F = (r, g(r))$

(b) i) B, ii) C, iii) E, iv) A, v) G, vi) F, vii) D, viii) G

Problem 4.

$$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h} = \lim_{h\to 0}\frac{(x+h)^3-x^3}{h} = \lim_{h\to 0}\frac{3x^2h+3xh^2+h^3}{h} = \lim_{h\to 0} 3x^2+3xh+h^2 = 3x^2$$

Problem 11.

From problem 2, we have $f'(x) = 2x$. $f'(0) = 2(0) = 0$; $f'(2) = 2(2) = 4$; $f'(-1) = 2(-1) = 2$.

Problem 17.

(a) The graph of $\sqrt{x-1}$ is an one-unit horizontal shift to the right of the graph of $\sqrt{x}$.

(b) The graph of the derivative of $\sqrt{x-1}$ is an one-unit horizontal shift to the right of the graph of the derivative of $\sqrt{x}$.

(c) The equation holds because the graph of the derivative of $\sqrt{x-1}$ is an one-unit horizontal shift to the right of the graph of the derivative of $\sqrt{x}$.

(d) $$f'(5) = \lim_{x\to 5}\frac{f(x)-f(5)}{x-5} = \lim_{x\to 5}\frac{\sqrt{x-1}-\sqrt{5-1}}{x-5} = \lim_{x\to 5}\frac{(x-1)-4}{(x-5)(\sqrt{x-1}+2)} = \lim_{x\to 5}\frac{1}{\sqrt{x-1}+2} = \frac{1}{4}.$$