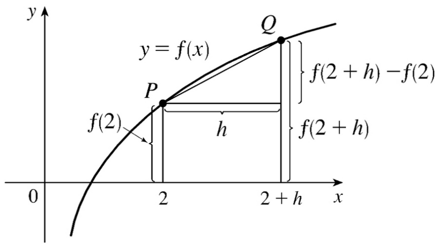
1.

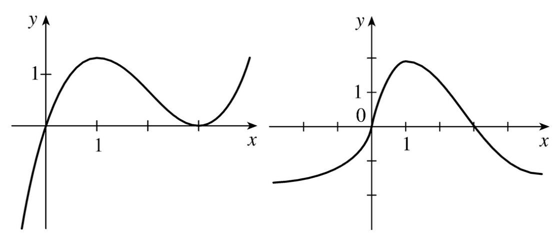


The line from $P(2,f(2))$ to $Q(2+h,f(2+h))$ is the line that has slope $\dfrac{f(2+h)-f(2)}{h}$

3. $g'(0)$ is the only negative value. The slope at $x=4$ is smaller than the slope at $x=2$ and both are smaller than the slope at $x=-2$. Thus, $g'(0)<0<g'(4)<g'(2)<g'(-2)$.

5.

We begin by drawing a curve through the origin at a slope of 3 to satisfy $f(0)=0$ and $f'(0)=3$. Since $f'(1)=0$, we will round off our figure so that there is a horizontal tangent directly over $x=1$. Lastly, we make sure that the curve has a slope of -1 as we pass over $x=2$. Two of the many possibilities are shown.



9. **(a)** Using Definition 2 with $F(x)=x^3-5x+1$ and the point $(1,-3)$, we have

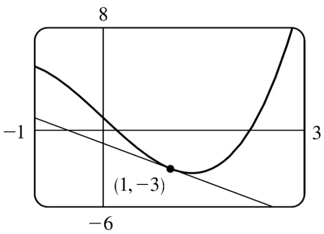
$$F'(1)=\lim_{h\to 0}\frac{F(1+h)-F(1)}{h}=\lim_{h\to 0}\frac{[(1+h)^3-5(1+h)+1]-(-3)}{h}$$

$$=\lim_{h\to 0}\frac{(1+3h+3h^2+h^3-5-5h+1)+3}{h}=\lim_{h\to 0}\frac{h^3+3h^2-2h}{h}$$

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

So an equation of the tangent line at $(1,-3)$ is $y-(-3)=-2(x-1)\Leftrightarrow y=-2x-1$.

(b)



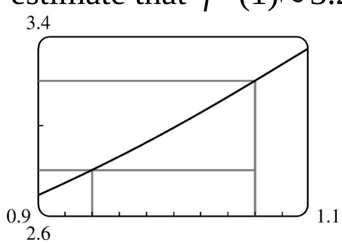
11. **(a)** $f'(1)=\lim_{h\to 0}\frac{f(1+h)-f(1)}{h}=\lim_{h\to 0}\frac{3^{1+h}-3^{1}}{h}$.

So let $F(h)=\frac{3^{1+h}-3}{h}$. We calculate:

h	$F(h)$	h	$F(h)$
0.1	3.484	–0.1	3.121
0.01	3.314	–0.01	3.278
0.001	3.298	–0.001	3.294
0.0001	3.296	–0.0001	3.296

We estimate that $f'(1)\approx 3.296$.

(b)



From the graph, we estimate that the slope of the tangent is about $\frac{3.2-2.8}{1.06-0.94}=\frac{0.4}{0.12}\approx 3.3$.

13. Use Definition 2 with $f(x)=3-2x+4x^2$.

$$f'(a)=\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}=\lim_{h\to 0}\frac{[3-2(a+h)+4(a+h)^2]-(3-2a+4a^2)}{h}$$

$$=\lim_{h\to 0}\frac{[3-2a-2h+4a^2+8ah+4h^2]-(3-2a+4a^2)}{h}=\lim_{h\to 0}\frac{-2h+8ah+4h^2}{h}=\lim_{h\to 0}\frac{h(-2+8a+4h)}{h}=\lim_{h\to 0}(-2+8a+4h)=-2+8a$$

19. By Definition 2, $\lim_{h\to 0} \frac{(1+h)^{10}-1}{h} = f'(1)$, where $f(x)=x^{10}$ and $a=1$. *Or:* By Definition 2, $\lim_{h\to 0} \frac{(1+h)^{10}-1}{h} = f'(0)$, where $f(x)=(1+x)^{10}$ and $a=0$.

29. **(a)** $f'(v)$ is the rate at which the fuel consumption is changing with respect to the speed. Its units are $(gal\ /\ h)\ /\ (mi\ /\ h)$.
(b) The fuel consumption is decreasing by $0.05(gal\ /\ \text{h})\ /\ (mi\ /\ h)$ as the car's speed reaches $20\ mi/h$. So if you increase your speed to $21\ mi/h$, you could expect to decrease your fuel consumption by about $0.05(gal\ /\ \text{h})\ /\ (mi\ /\ h)$.

31. $T'(10)$ is the rate at which the temperature is changing at 10:00 A.M. To estimate the value of $T'(10)$, we will average the difference quotients obtained using the times $t=8$ and $t=12$. Let $A=\frac{T(8)-T(10)}{8-10}=\frac{72-81}{-2}=4.5$ and $B=\frac{T(12)-T(10)}{12-10}=\frac{88-81}{2}=3.5$. Then $T'(10)=\lim_{t\to 10}\frac{T(t)-T(10)}{t-10}\approx\frac{A+B}{2}=\frac{4.5+3.5}{2}=4^{\circ}F\ /\ h$.