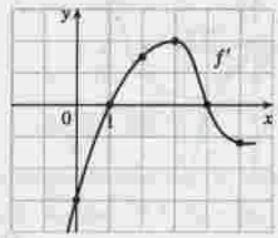
2.8

2. From the graph of f, it appears that

(a) $f'(0) \approx -3$ (b) $f'(1) \approx 0$

(c) $f'(2) \approx 1.5$ (d) $f'(3) \approx 2$

(e) $f'(4) \approx 0$ (f) $f'(5) \approx -1.2$



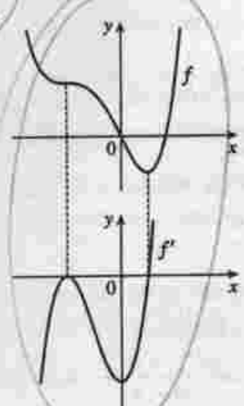
3. (a)$' =$ II, since from left to right, the slopes of the tangents to graph (a) start out negative, become 0, then positive, then 0, then negative again. The actual function values in graph II follow the same pattern.

(b)$' =$ IV, since from left to right, the slopes of the tangents to graph (b) start out at a fixed positive quantity, then suddenly become negative, then positive again. The discontinuities in graph IV indicate sudden changes in the slopes of the tangents.

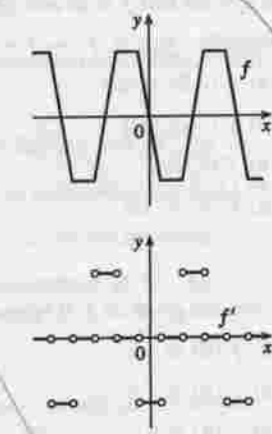
(c)$' =$ I, since the slopes of the tangents to graph (c) are negative for $x < 0$ and positive for $x > 0$, as are the function values of graph I.

(d)$' =$ III, since from left to right, the slopes of the tangents to graph (d) are positive, then 0, then negative, then 0, then positive, then 0, then negative again, and the function values in graph III follow the same pattern.

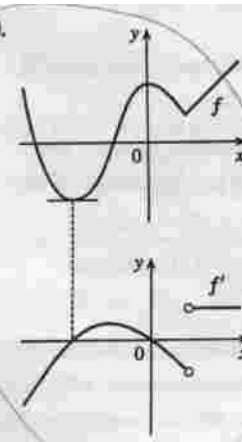
4.



9.



10.



30. (a) $S'(t)$ is the rate at which the smoking rate is changing with respect to time. Its units are percent per year.

(b) To find $S'(t)$, we use $\lim_{h\to 0} \dfrac{S(t+h)-S(t)}{h} \approx \dfrac{S(t+h)-S(t)}{h}$ for small values of h.

For 1980: $S'(1980) \approx \dfrac{S(1982)-S(1980)}{1982-1980} = \dfrac{21.0-21.4}{2} = \dfrac{-0.4}{2} = -0.20$

For 1982: We estimate $S'(1982)$ by using $h=-2$ and $h=2$, and then averaging the two results to obtain a final estimate.

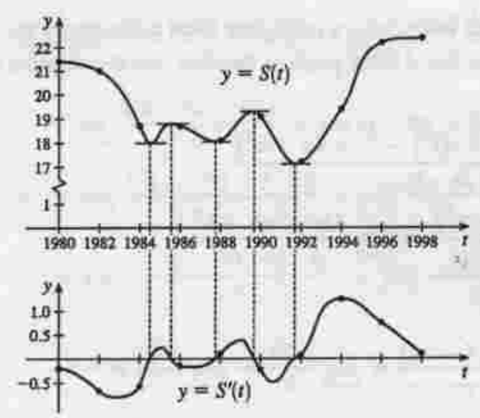
$h=-2 \;\Rightarrow\; S'(1982) = \dfrac{S(1980)-S(1982)}{1980-1982} = \dfrac{21.4-21.0}{-2} = -0.20$

$h=2 \;\Rightarrow\; S'(1982) = \dfrac{S(1984)-S(1982)}{1984-1982} = \dfrac{18.7-21.0}{2} = -1.15$

So we estimate that $S'(1982) \approx \frac{1}{2}(-0.20-1.15) = -0.675$.

t	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998
$S'(t)$	-0.20	-0.675	-0.575	-0.15	0.10	-0.225	0.075	1.25	0.75	0.10

(c)



(d) We could get more accurate values for $S'(t)$ by obtaining data for the odd-numbered years.

31. f is not differentiable at $x=-1$ or at $x=11$ because the graph has vertical tangents at those points; at $x=4$, because there is a discontinuity there; and at $x=8$, because the graph has a corner there.

36. Where d has horizontal tangents, only c is 0, so $d'=c$. c has negative tangents for $x<0$ and b is the only graph that is negative for $x<0$, so $c'=b$. b has positive tangents on $\mathbb{R}$ (except at $x=0$), and the only graph that is positive on the same domain is a, so $b'=a$. We conclude that $d=f$, $c=f'$, $b=f''$, and $a=f'''$.