26. (a) When V increases from 200 in^3 to 250 in^3, we have $\Delta V = 250 - 200 = 50$ in^3, and since $P = 800/V$, $\Delta P = P(250) - P(200) = \dfrac{800}{250} - \dfrac{800}{200} = 3.2 - 4 = -0.8$ lb/in^2. So the average rate of change is $\dfrac{\Delta P}{\Delta V} = \dfrac{-0.8}{50} = -0.016\ \dfrac{\text{lb/in}^2}{\text{in}^3}$.

(b) Since $V = 800/P$, the instantaneous rate of change of V with respect to P is

$$\lim_{h\to 0}\frac{\Delta V}{\Delta P} = \lim_{h\to 0}\frac{V(P+h) - V(P)}{h} = \lim_{h\to 0}\frac{800/(P+h) - 800/P}{h}$$
$$= \lim_{h\to 0}\frac{800\,[P-(P+h)]}{h(P+h)P} = \lim_{h\to 0}\frac{-800}{(P+h)P} = -\frac{800}{P^2}$$

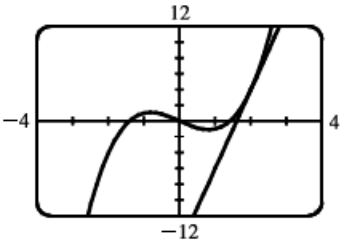
which is inversely proportional to the square of P.

28. (a) $f'(2) = \lim\limits_{x\to 2}\dfrac{f(x)-f(2)}{x-2} = \lim\limits_{x\to 2}\dfrac{x^3-2x-4}{x-2}$

$$= \lim_{x\to 2}\frac{(x-2)(x^2+2x+2)}{x-2} = \lim_{x\to 2}\left(x^2+2x+2\right) = 10$$

(b) $y - 4 = 10(x-2)$ or $y = 10x - 16$

(c)

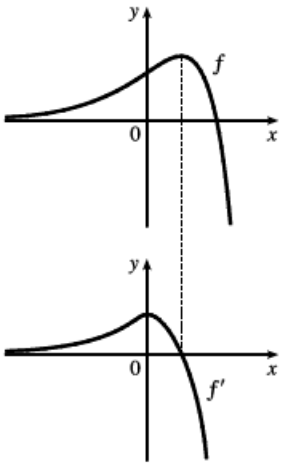


31. (a) $f'(r)$ is the rate at which the total cost changes with respect to the interest rate. Its units are dollars/(percent per year).

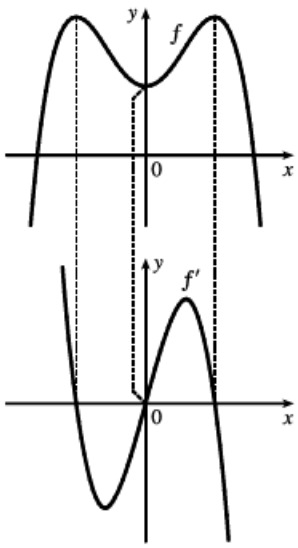
(b) The total cost of paying off the loan is increasing by \$1200/(percent per year) as the interest rate reaches 10%. So if the interest rate goes up from 10% to 11%, the cost goes up approximately \$1200.

(c) As r increases, C increases. So $f'(r)$ will always be positive.

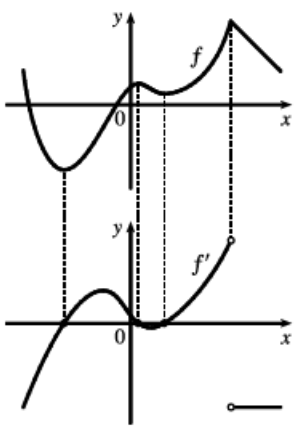
32.



33.



34.



35. (a) $f'(x) = \lim_{h \to 0} \dfrac{f(x+h) - f(x)}{h} = \lim_{h \to 0} \dfrac{\sqrt{3-5(x+h)} - \sqrt{3-5x}}{h} \dfrac{\sqrt{3-5(x+h)} + \sqrt{3-5x}}{\sqrt{3-5(x+h)} + \sqrt{3-5x}}$

$$= \lim_{h \to 0} \frac{[3-5(x+h)] - (3-5x)}{h\left(\sqrt{3-5(x+h)} + \sqrt{3-5x}\right)} = \lim_{h \to 0} \frac{-5}{\sqrt{3-5(x+h)} + \sqrt{3-5x}} = \frac{-5}{2\sqrt{3-5x}}$$

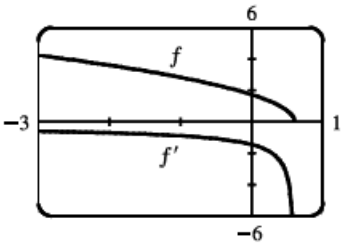
(b) Domain of f: (the radicand must be nonnegative) $3 - 5x \geq 0 \quad \Rightarrow$

$5x \leq 3 \quad \Rightarrow \quad x \in \left(-\infty, \frac{3}{5}\right]$

Domain of f': exclude $\frac{3}{5}$ because it makes the denominator zero;

$x \in \left(-\infty, \frac{3}{5}\right)$

(c) Our answer to part (a) is reasonable because $f'(x)$ is always negative and f is always decreasing.



37. f is not differentiable: at $x = -4$ because f is not continuous, at $x = -1$ because f has a corner, at $x = 2$ because f is not continuous, and at $x = 5$ because f has a vertical tangent.

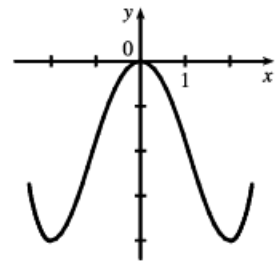
38. The graph of a has tangent lines with positive slope for $x < 0$ and negative slope for $x > 0$, and the values of c fit this pattern, so c must be the graph of the derivative of the function for a. The graph of c has horizontal tangent lines to the left and right of the x-axis and b has zeros at these points. Hence, b is the graph of the derivative of the function for c. Therefore, a is the graph of f, c is the graph of f', and b is the graph of f''.

41. (a) $f'(x) > 0$ on $(-2, 0)$ and $(2, \infty)$ $\Rightarrow$ f is increasing on those intervals. $f'(x) < 0$ on $(-\infty, -2)$ and $(0, 2)$ $\Rightarrow$ f is decreasing on those intervals.

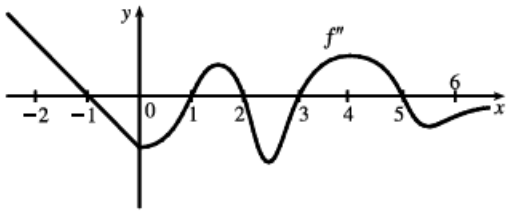
(b) $f'(x) = 0$ at $x = -2$, 0, and 2, so these are where local maxima or minima will occur. At $x = \pm 2$, f' changes from negative to positive, so f has local minima at those values. At $x = 0$, f' changes from positive to negative, so f has a local maximum there.

(c) f' is increasing on $(-\infty, -1)$ and $(1, \infty)$ $\Rightarrow$ $f'' > 0$ and f is concave upward on those intervals. f' is decreasing on $(-1, 1)$ $\Rightarrow$ $f'' < 0$ and f is concave downward on this interval.

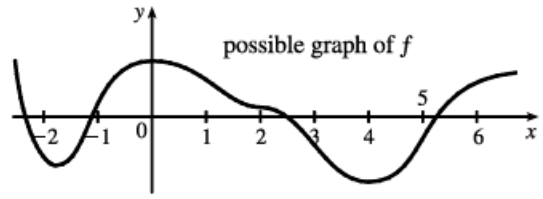
(d)



42. (a)



(b)



46. Let f be the function shown. Since f is negative for $x < 0$ and positive for $x > 0$, F is decreasing for $x < 0$ and increasing for $x > 0$. f is increasing on $(-a, a)$ (from the low point to the high point) so its derivative f' (the second derivative of F) is positive, making F concave upward on $(-a, a)$. f is decreasing elsewhere, so its derivative f' is negative and F is concave downward on $(-\infty, -a)$ and (a, ∞).