1. (a) True.
   (b) False.
   (c) False.
   (d) True.
   (e) True.
   (f) False.
   (g) True.
   (h) False
   (i) False.
   (j) False. Take $f(x) = |x|$.

2. (a) False. Find li
   (b) False. Think
   (c) True.
   (d) False. Apply
   Theorem.
   (e) False. Apply
   (f) False.
   (g) False.
   (h) True.
   (i) True. The limit equals $g'(2)$.
   (j) False.
   (k) True. $\tan^2 x - \sec^2 x = -1$.

   $^2 + x|$ is not differen-
   real numbers.

   $\lim_{\to 5} \dfrac{x-5}{x-5}$.

   $f(x) = \dfrac{1}{x-1}$ if $x > 1$
   if $x \leq 1$.

   (q) False.
   (r) True.
   (s) False. c might be an isolated point.
   (t) False. Take $f(x) = x^3$.

3. (a) True.
   (b) True. $\dfrac{\ln 2^{\sqrt{x}}}{\sqrt{x}} = \ln 2$, $x > 0$.
   (c) True.
   (d) False. $f(x) \geq 1$.
   (e) True.
   (f) False $f(x) = -\dfrac{x^4 - 256}{4} + 3$.
   (g) False. Take $f(x) = x^2$ and $c = 1$.
   (h) True $\dfrac{1}{\csc u} = \sin u$ with $\sin u \neq 0$.
   (i) True. Use the chain rule.
   (j) False. $\sinh^2 x - \cosh^2 x = -1$.
   (k) False. $\displaystyle\int \frac{dx}{x^2+1} = \arctan x + C$.
   (l) False. $\displaystyle\int \frac{dx}{3-2x} = -\frac{1}{2}\ln|3-2x| + C$.

4. (a) False.
   (b) False. Take $f(x) = \dfrac{x^2}{x}$ and $a = 0$.
   (c) False. Take $f(x) = \dfrac{x^2}{x}$, $a = -1$, and $b = 1$.
   (d) False. Take $f(x) = x|x|$.
   (e) False. Take $f(x) = 1$ if x is rational
   and $f(x) = 0$ if x is irrational.
   (f) False. Take $g(x) = 0$.
   (g) True. Take $f(x) = \dfrac{1}{x}$ if $x \neq 0$, $f(0) = 0$, and $g(x) = -f(x)$.
   (h) False. Take $f(x) = \sin x$ and $g(x) = -\sin x$.
   (i) False. The numerator is an expo-

nential function with a base greater than 1 and the denominator is a polynomial.

(j) False. Take $f(x) = \tan \dfrac{\pi x}{2}$.

5. (a) False. Take $f(x) = 10x$ and $g(x) = 20x$ if $x \in [0, 0.5]$ and $g(x) = 10x$ if $x \in (0.5, 1]$.

(b) True. Take $F(x) = f(x) - g(x)$ and apply Rolle's Theorem.

(c) True.

6. (a) False. The limit is missing.

(b) False. One should use the Squeeze Theorem.

(c) True.

(d) True.

(e) True

(f) False. For $x < 3$ the function is decreasing.

(g) True.

(h) False. It should be $L(x) = f(a) + f'(a)(x - a)$.

(i) False. The eccentricity of a circle is $e = 0$.

(j) True. Note that $g'(x) = -0.5$ and $f'(3) \approx 0.5$.

7. (a) True.

(b) True.

(c) False. $f(g(x)) = (x + 1)^2$.

(d) True.

(e) True.

(f) False. $f(3) = 16$.

(g) False.

(h) True.

(i) False.

8. (a) False. It is a quadratic polynomial.

(b) False. The function should be also continuous on $[a, b]$.

(c) False. Take $f(x) = -x$.

(d) False. Take $f(x) = -|x|$.

(e)

9. (a) False. Use the Mean Value Theorem.

(b) False. Take $y = (x - 5)^4$.

(c) False. Take $f(x) = x^3$, $c = 0$.

(d) True. Since f is differentiable, by Rolle's Theorem there is a local extremum between any two isolated solutions of $f(x) = 0$.

(e) False. Take $f(x) = x - 1$.

10. (a) False.

(b) False. Take $f(x) = \sin x$.

(c) False. $g'(2) = 4$.

(d) False.

(e) False.

(f) False. Take $f(x) = |x|$.

(g) True. If if is differentiable at c then f is continuous at c.

(h) False. It is not given that f is continuous.

(i) True.

(j) True.

11. (a) True.

(b) False. Take functions $f(x) = xe^{-1/x^2}\sin(x^{-4})$ and $g(x) = e^{-1/x^2}$.

(c) False. Take $f(x) = x^4$.

(d) False. Take $f(x) = |x|$ and $x = 0$.

(e) True.

(f) False. Take $f(x) = e^x$.

(g) True.

(h) True.

12. (a) B.

(b) C. The range of $y = \arcsin x$ is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

(c) C. $\dfrac{10-2}{4-2} = 4$.

(d) C. Use $\dfrac{dP}{dt} = kP$.

(e) B. f is increasing.

13. (a) B. Consider $f(x) = x^5 + 10x + 3$ and its first derivative.

(b) E. $\cosh(\ln 3) = \dfrac{3 + \frac{1}{3}}{2}$.

(c) B. $f(2.9) \approx 2 + 4(2.9 - 3)$.

(d) E. $F(x) = \frac{3}{4}x^{\frac{4}{3}} + \frac{1}{4}$.

(e) B.

14. (a) A.

(b) E. $\lim\limits_{x\to 0^+} \dfrac{\ln x}{x} = -\infty$.

(c) B. Use L'Hospital's rule.

(d) C. $(x-1)^2 + y^2 = 5$.

(e) B. $\dfrac{dV}{dt} = 3x^2\dfrac{dx}{dt}$.

(f) E. $\dfrac{dy}{dt} = \dfrac{\frac{dy}{d\theta}}{\frac{dy}{d\theta}}$.

(g) D. $A(t) = 16\left(\dfrac{3}{4}\right)^t$.

(h) D. For (1) take $f(x) = x^3$ on $(0, 1)$. For (2) take $f(x) = \sqrt[3]{x}$. For (3) take $f(x) = x^4$.

(i) B. For (1) take $g(x) = 0$. For (3) take $f(x) = |x|$, $g(x) = -|x|$, and $a = 0$.

(j) A.

15. (a) C.

(b) B. Note $y' \sinh y = 1 + 3x^2y + x^3y'$.

(c) D.

(d) D.

(e) B.

16. (a) π.

(b) $f'(x) = \ln|x|$.

(c) 0. $\dfrac{dy}{dt} = 2\sin x \cdot \cos x \cdot \dfrac{dx}{dt}$.

(d) $F(x) = e^{x^2} + C$.

(e) 0. $\lim\limits_{t\to\infty} \ln\dfrac{t+1}{t}$.

(f) Yes.

(g) $r = 5$.

(h) 1.

17. (a) $F = x \cdot \sin \dfrac{1}{x}$ and $a = 0$.
    (b) $f(x) = |x|$.
    (c) $f(x) = x^3$.
    (d) $f(x) = x^3$.

18. (a) The derivative of function f at a number a, denoted by $f'(a)$, is $f'(a) = \lim\limits_{h \to 0} \dfrac{f(a+h) - f(a)}{h}$ if this limit exists.
    (b) A critical number of a function f is a number c in the domain of f such that $f'(c) = 0$ or $f'(c)$ does not exist.
    (c) If f is continuous on a closed interval $[a, b]$, the f attains an absolute maximum value $f(c)$ and an absolute minimum value $f(d)$ at some numbers c and d in $[a, b]$.

19. (a) ii
    (b) ix
    (c) v
    (d) vi
    (e) iv
    (f) no match
    (g) no match
    (h) viii
    (i) vii
    (j) iii
    (k) no match
    (l) i