1. Compute $\frac{d}{dx}(x^2 \sin(2x))$
2. Compute $\frac{d}{dx}\frac{x^2+1}{x^2+x-4}$
3. Compute $\frac{d}{dx}(\tan(x+3))^3$
4. Compute $\frac{d}{dx}\sqrt[5]{(x^3+2)^2}$
5. Compute $\frac{d}{dx}\frac{\sin x}{1+\sec x}$
6. Compute $\frac{d}{dx}\frac{\csc^2 x+3}{\pi}$
7. Use the definition of derivative to compute $\dfrac{d}{dx}\sqrt{2x+3}$
8. Use the definition of derivative to compute $\dfrac{d}{dx}\dfrac{2x+3}{x-1}$
9. Derive the formula for the derivative of $\sec x$. You may use the formula for the derivative of $\sin x$ and $\cos x$.
10. Compute the limit and use the definition of limit to prove it is what you say: $\lim\limits_{x\to 4}(3x^2+2x+1)$
11. Compute the limit and use the definition of limit to prove it is what you say: $\lim\limits_{x\to -1}\dfrac{2x+3}{x-1}$
12. Compute the limit and use the definition of limit to prove it is what you say: $\lim\limits_{t\to 5}(3t^3-2t^2+4)$
13. Prove: $\lim\limits_{x\to 0}\dfrac{\sin x}{x}=1$.
14. Prove: $\lim\limits_{x\to 0}\dfrac{1-\cos x}{x}=0$. (You may use Problem 12.)
15. Derive the formula for the derivative of $\sin x$. (You may use Problems 12 and 13.)
16. Derive the formula for the derivative of $\cos x$ (You may use Problems 12 and 13.)
17. Use the fact that $\dfrac{d}{dx}x^n = nx^{n-1}$ for any positive integer n to show that $\dfrac{d}{dx}x^n = nx^{n-1}$ for any negative integer n.
18. Find an equation of the tangent line to $y=\sin^3 x\cos x$ at the point where $x=\frac{\pi}{4}$.
19. Find an equation of the tangent line to $y=x\sin x$ at the point where $x=\frac{\pi}{3}$.
20. Find an equation of the tangent line to $y=\sqrt{3x-2}$ at the point where $x=6$.
21. Find equations for all the lines that pass through the point $(2,10)$ and are tangent to the graph of $y=x^2+2x+3$. (Note that the point is not on the graph.)
22. Find equations for all the lines that pass through the point $(1,50/9)$ and are tangent to the graph of $y=\frac{10}{x}$. (Note that the point is not on the graph.)
23. Compute $\lim_{x\to 0}\frac{\sin x+x}{x}$.
24. Compute $\lim_{x\to 0}\frac{\tan x}{x}$.
25. Compute $\lim_{\theta\to 0}\frac{1-\cos^2\theta}{\theta^2}$.
26. Compute $\lim_{t\to 0} t\csc t$.
27. Compute $\lim_{t\to 0}\frac{\sin(2t)}{3t}$.

28. Prove $\lim_{x\to 3}\sqrt{x^2+7}=4$

29. Prove $\lim_{x\to 2}\frac{5x^2+2x-2}{x^2-x-4}=-11$

30. Let
$$f(x)=\begin{cases}\frac{\sin x}{x} & : \quad x<0\\ \frac{\tan x}{x} & : \quad 0<x\\ 0 & : \quad x=0\end{cases}$$
Is f continuous at $x=0$? If so show why. If not, determine if 0 is a removable discontinuity.

31. Give an example of a function that is continuous at $x=1$, but it is not differentiable there.

32. Prove that if $f'(a)$ exists, then $f(x)$ is continuous at $x=a$.

33. State why $\lim_{x\to 0}(3x+2)\neq 3$.

34. State why $\lim_{x\to 0}\frac{x+1}{x^2}$ does not exist.

35. State why $\lim_{x\to 4}\frac{x-4}{|x-4|}$ does not exist.

36. State the definition of $\lim_{x\to a}f(x)=l$ and state the negation of the definition.

37. Prove the product formula for derivatives.

38. Prove the quotient formula for derivatives.

39. Compute $\lim_{x\to 3^+}f(x)$ and $\lim_{x\to 3^-}f(x)$. Does $\lim_{x\to 3}f(x)$ exist? If so state how you know, if not state why.
$$f(x)=\begin{cases}\sin x & : \quad x\le 0\\ x & : \quad 0<x\le 3\\ x^2-4 & : \quad x>3\end{cases}$$

40. Compute $\lim_{x\to 0^+}f(x)$ and $\lim_{x\to 0^-}f(x)$. Does $\lim_{x\to 0}f(x)$ exist? If so state how you know, if not state why.
$$f(x)=\begin{cases}\sin x & : \quad x\le 0\\ x & : \quad 0<x\le 3\\ x^2-4 & : \quad x>3\end{cases}$$

41. Is there a number c that makes the function f continuous, where f is defined below? If so, find c.
$$f(x)=\begin{cases}x^2+3 & : \quad x\le 1\\ -2x^2+c & : \quad x>1\end{cases}$$

42. Prove that if $\lim_{x\to a}f(x)=l$ and $\lim_{x\to a}g(x)=k$, then $\lim_{x\to a}(f(x)+g(x))=l+k$.

43. Prove that if $\lim_{x\to a}f(x)=l$ and c is a constant, then $\lim_{x\to a}(cf(x))=cl$.