# CALCULUS I REVIEW

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## 2. Derivatives

(1) Use the limit definition, no other method, to compute:
   (a) $y'$ of $y = \dfrac{1}{2x}$
   (b) $y'(2)$ of $y = \sqrt{x-1}$

(2) Is the function

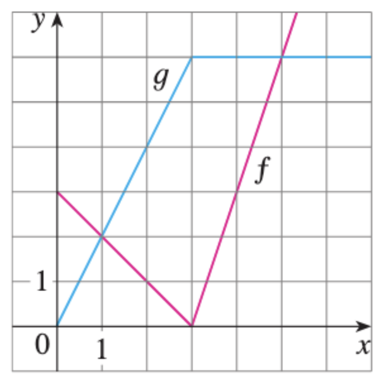
$$f(x) = \begin{cases} x^2, & \text{if } x \le 1 \\ 2x-1, & \text{if } x > 1 \end{cases}$$

differentiable at $x = 1$?

(3) Find $y'$:
   (a) $y = (x^2+1)^{2025}$
   (b) $y = \dfrac{\sqrt{x} + x^2 + 3}{x}$
   (c) $y = x \arcsin(x)$
   (d) $y = \ln \sec x$
   (e) $y = \sin^2(\cos(\sin \pi x))$
   (f) $xe^y = y \sin x$
   (g) $y = 4^{x \ln x}$
   (h) $y = \tan\left(\dfrac{x}{1+x^2}\right)$
   (i) $y = (\cos x)^x$
   (j) $y = \dfrac{\sqrt{x+1}(2+x)^3}{(1+x^2)^{10}}$

(4) Find $y^{(2)}(0)$, the second derivative of $y$ at $x = 0$, of $y = xe^x$.

(5) We are given below the graphs of two functions $f$ and $g$. Let $P(x) = f(g(x))$, $Q(x) = (g(x))^2$, and $R(x) = x^2 g(x)$. Find $P'(2)$, $Q'(2)$ and $R'(2)$.




(6) Find an equation of the tangent line to the curve $y = e^x$ that passes through the origin.

(7) Find the equation of the tangent line to the curve $x^2 + 4xy + y^2 = 13$ at $(2, 1)$.

(8) Find slope of the tangent line to the inverse function $y^{-1}$ of $y = x^3 + 2x - 8$ at $x = 4$.

(9) Two points on the graph of

$$f(x) = x^3 - 3x^2 + 3x + 2025$$

are separated horizontally by 1 unit and have parallel tangents. Which of the two points is the largest point?