Name _____

AP Calculus Skill Builder: Topic 5.1 – Using the Mean Value Theorem

For the exercises below, determine whether Rolle's Theorem can be applied to the function in the indicated interval. If Rolle's Theorem can be applied, find all values of *c* that satisfy Rolle's Theorem.

1.) $f(x) = x^2 - 4x$ on $[0,4]$	**2.)** $f(x) = x^2 - 11x + 30$ on $[5,6]$
3.) $f(x) = 4 - \|x - 2\|$ on $[-2,2]$	**4.)** $f(x) = \sin x$ on $[0,2\pi]$

5.) $f(x) = cos\,2\,x$ on $\left[\frac{\pi}{3}, \frac{2\pi}{3}\right]$

6.) $f(x) = \frac{6x}{\pi} - 4\,sin^2\,x$ on $\left[0, \frac{\pi}{6}\right]$

For the exercises below, apply the Mean Value Theorem to $f(x)$ on the indicated interval. Find all values of c which satisfy the Mean Value Theorem.

9.) $f(x) = x^2$ on $[-1,2]$

10.) $f(x) = x^3 - x^2 - 2x$ on $[-1,1]$

11.) $f(x) = \frac{x+2}{x}$ on $\left[\frac{1}{2}, 2\right]$

12.) $f(x) = \sqrt{x-3}$ on [3,7]

13.) $f(x) = x^3$ on [0,1]

14.) $f(x) = 2\,cos\,x + cos\,2\,x$ on $[0, \pi]$

15.) A trucker handed a ticket at a toll booth showing that in 2 hours the truck had covered 159 miles on a toll road in which the speed limit was 65 mph. The trucker was cited for speeding. Why?

16.) A marathoner ran the 26.2 mile New York City Marathon in 2 hours, 12 minutes. Like all the other runners, he started from a standing position. During the last 5 meters, his leg cramped and he fell down and had to roll across the finish line. Prove that at least twice, the marathoner was running at exactly 11 mph.

17.) The order and transportation cost *C* of bottles of Pepsi® is approximated by the function: $C(x) = 10{,}000\left(\frac{1}{x} + \frac{x}{x+3}\right)$ where *x* is the order size of bottles of Pepsi® in hundreds.

According to Rolle's Theorem, the rate of change of cost must be zero for some order size in the interval [3,6]. Find the order size.

18.) A car company introduces a new car for which the number of cars sold *S* is the function $S(t) = 300\left(5 - \frac{9}{t+2}\right)$ where *t* is the time in months.

a.) Find the average rate of cars sold over the first 12 months.

b.) During what month does the average rate of cars sold equal the rate of change of car sales?