21.) $f(x) = (x^2 - 2x)e^x \quad [0,2]$

Cont. [0,2] yes
Diff. (0,2) yes
f(0) = f(2) yes

$$f'(x) = \underbrace{(x^2-2x)e^x} + \underbrace{e^x(2x-2)}$$

$$= e^x(x^2 - 2x + 2x - 2)$$

$$0 = e^x(x^2 - 2)$$

$$x = \pm\sqrt{2}$$

$$\boxed{c = \sqrt{2}}$$

47.) $f(x) = \cos x + \cancel{\tan x}$ $[0, \pi]$

VA @ $x = \frac{\pi}{2}$

(discontinuity)

MVT does not apply

3.2: Tabular Data (Theorems)

ex: Consider the differentiable function v(t) with select values given in the table below.

t (min)	0	5	10	15	20	25	30
v(t) (meters/min)	7	9.2	9.5	7	4.5	2.4	2.4

a) Estimate a(7). Indicate units of measure.

$$\frac{v(10)-v(5)}{10-5} = \frac{9.5-9.2}{5} = \frac{.3}{5}$$

$$= \frac{3}{50}\ \text{m/min}^2$$

t (min)	0	5	10	15	20	25	30
v(t) (meters/min)	7	9.2	9.5	7	4.5	2.4	2.4

b) Estimate a(20). Indicate units of measure.

$$\frac{4.5-7}{20-15}$$

$-\frac{1}{2}\ m/min^2$

$$\frac{2.4-4.5}{25-20}$$

$-\frac{21}{50}\ m/min^2$

t (min)	0	5	10	15	20	25	30
v(t) (meters/min)	7	9.2	9.5	7	4.5	2.4	2.4

c) What is the smallest number of instances in which v(t)=8 on (0, 30)? Justify your answer.

Two; On the interval (0,5) and (10,15), since v(t) is diff. and cont.and $v(0) < 8 < v(5)$ and $v(15) < 8 < v(10)$ by IVT there must exist a value c such that $v(t) = 8$ on both intervals.

t (min)	0	5	10	15	20	25	30
v(t) (meters/min)	7	9.2	9.5	7	4.5	2.4	2.4

d) What is the smallest number of instances in which $a(t)=0$ on $(0, 30)$? Justify your answer.

2; Since v(t) is diff. and cont. and v(0)=v(15) and v(25) = v(30) then by Rolle's Theorem there must exist at least 1 value c in (0,15) and (25,30) such that a(c) = 0.

t (min)	0	5	10	15	20	25	30
v(t) (meters/min)	7	9.2	9.5	7	4.5	2.4	2.4

e) On the interval (0, 20) must there be a time when a(t)=-1/8? Justify your answer.

Yes, since v(t) is differentiable and continuous, and the slope on the interval from (0,20) is -1/8, there must exist a value c such that a(c) = -1/8

$$\frac{v(20)-v(0)}{20-0} = \frac{4.5-7}{20} = \frac{-1}{8}$$

or

$$v'(c) = -\frac{1}{8}$$

2.

Which of the following functions below satisfy the conditions of the MVT?

I. $f(x) = \frac{1}{x+1}$, $[0,2]$ II. $f(x) = x^{1/3}$, $[0,1]$ III. $f(x) = |x|$, $[-1,1]$

a) I only
b) I and II only
c) I and III only
d) II only
e) II and III only

4.

If f is a continuous function on $[a,b]$, which of the following is necessarily true?

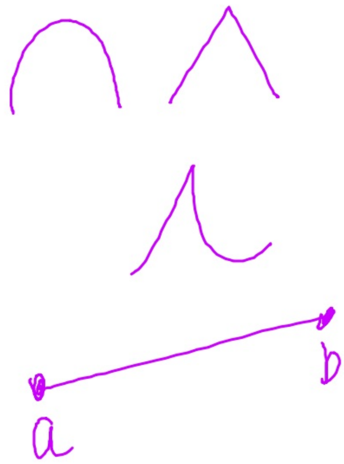
(A) f' exists on (a,b).

(B) If $f(x_0)$ is a maximum of f, then $f'(x_0)=0$.

(C) $\lim\limits_{x\to x_0} f(x) = f\left(\lim\limits_{x\to x_0} x\right)$ for $x_0 \in (a,b)$

(D) $f'(x)=0$ for some $x \in [a,b]$

(E) The graph of f' is a straight line.



5.

If f is continuous for $a \le x \le b$ and differentiable for $a < x < b$, which of the following could be false?

(A) $f'(c) = \dfrac{f(b) - f(a)}{b - a}$ for some c such that $a < c < b$.

(B) $f'(c) = 0$ for some c such that $a < c < b$.

(C) f has a minimum value on $a \le x \le b$. T

(D) f has a maximum value on $a \le x \le b$. T

EVT (extreme value theorem)

$[a, b]$

7.

x	0	1	2
$f(x)$	1	k	2

The function f is continuous on the closed interval $[0,2]$ and has values that are given in the table above. The equation $f(x)=\frac{1}{2}$ must have at least two solutions in the interval $[0,2]$ if $k=$

(A) 0 (B) $\frac{1}{2}$ (C) 1 (D) 2 (E) 3

Find the critical value(s).

$$g(x) = 2x^{5/3} - 5x^{2/3}$$

$$g'(x) = \frac{10}{3}x^{2/3} - \frac{10}{3}x^{-1/3}$$

$$= \frac{10}{3}x^{-1/3}(x-1) = \frac{10(x-1)}{3x^{1/3}}$$

$$x = 0, 1$$

Find the absolute extrema for y = cos(x/2) on [0,4pi]

points

$$y' = -\frac{1}{2}\sin\left(\frac{x}{2}\right)$$

$$-\frac{1}{2}\sin\left(\frac{x}{2}\right) = 0$$

$$\sin\frac{x}{2} = 0$$

$$\frac{x}{2} = 0, \pi, 2\pi, 3\pi, \ldots$$

$$x = 0, 2\pi, 4\pi, \ldots$$

Abs min: (2pi,-1)
Abs max: (0,1)
and (4pi, 1)

x	y
0	1
2π	-1
4π	1