Calculus UNIT 3 **APPLICATION of DERIVATIVES Part 1 (MCV + AP)**– journal questions

Summarize everything you need to know about these topics. Use examples and concise (not long – but with enough detail) explanations. Include definitions and diagrams if necessary



2. FUNCTION ANALYSIS (MCV)

a. Copy/Paste the following	
If the graph of f lies above all of its tangents on an interval I , then it is called concave upward on I . If the graph of f lies below all of its tangents on I , it is called concave downward on I .	A critical number of a function f is a number c in the domain of f such that either $f'(c) = 0$ or DNE. A point P on a curve y = f(x) is called an inflection point if f is continuous there and the curve changes from concave upward to concave downward (or vice versa) at P and $f''(c) = 0$ or DNE
Increasing/Decreasing Test: If $f'(x) > 0$ on an interval, then f is increasing on that interval. If $f'(x) < 0$ on an interval, then f is decreasing on that interval.	Concavity Test If $f''(x) > 0$ for all x in I , then the graph of f is <u>concave</u> <u>upward</u> on I . If $f''(x) < 0$ for all x in I , then the graph of f is <u>concave</u> <u>downward</u> on I .

b.	Fill in the char	rt with condition	ns to check:.					
	CRITICAL POINTS							
	$\overline{}$	\bigvee	\frown		\wedge	\int		
	HT & Inf Point	HT	HT	VT	VT	VT & Inf Point		
1 st deriv TEST							OTHER PTS Corner or jump	VA or hole
2 nd deriv TEST								

c. Classify the critical points:

i)
$$y = xe^x$$
 apply the 1st derivative test

ii)
$$y = x^{\frac{4}{5}} (2-x)^2$$
 apply the 2nd derivative test

3. SKETCHING (MCV)

- a. Read over PreCalculus Journal Unit 7 question #2 about the Algorithm for sketching. Then copy/paste the updated algorithm: Note that * steps can be skipped since everything else may give enough info to determine all details of the graph.
 - From f
 - Factor to see if any Holes exist then state VA's and Domain (watch out for restrictions in denominators, roots and log functions)
 - Find x and y intercepts
 - Decide on the end behavior (do the limit as $x \to \pm \infty$ to see if diverging or HA, for OA don't forget PreCalc Unit 7)
 - Look at multiplicities of zeros and VA's to determine function behavior near zeros and VA's
 - *Find positive/negative intervals ie. test intervals between zeros and VA's
 - From f'
 - Find critical points
 - *Find increasing/decreasing intervals + classify the critical points using 1st derivative test
 - From f''
 - Find possible inflection points
 - Find concave up/down intervals + decide if above pts are actual inflection points + classify critical points using 2nd derivative test
 - At the end use f again to find the y values of critical and inflection points to order to sketch them. Don't forget intercepts.

b. Sketch and label all intercepts, asymptotes, critical points and inflection points. Show all justifying steps without use of desmos

i)
$$y = x^{\frac{1}{3}}(x-4)$$
 ii) $y = 2\ln|x| - x^2 + 1$ iii) $y = \frac{x^3}{x^2 - 1}$ find derivatives using: http://goo.gl/IVbExS

- 4. VELOCITY & ACCELERATION (MCV)
 - a. Copy/Paste the following

			Condition	Event	Condition	Event
Displacement	$\mathbf{s}(t)$		s<0	Object to the left (below) of the origin	$\mathbf{s} \cdot \mathbf{v} < 0$	Object moving toward the origin
Displacement S(1)			s=0	Object at the origin	$\mathbf{s} \cdot \mathbf{v} \ge 0$	Object moving away from the origin
			s>0	Object to the right (above) of the origin	5:2<0	Acceleration is directed toward the origin
Velocity $v(t)$	v(t) = ds	m/s	v<0	Moving to the left (downward)	<u> </u>	Acceleration is directed away from the
			v=0	At rest	$s \cdot a > 0$	origin
	$V(t) = \frac{1}{dt}$		v>0	Moving to the right (upward)	V:3 < 0	Object is slowing down
			a<0	s-t grigh concase indian Speed	$\frac{\mathbf{v} \mathbf{a} < 0}{\mathbf{v} \cdot \mathbf{a} > 0}$	Object is speeding up
	J_{1} J_{2}^{2}			Acceleration directed to the left (downward)		
Acceleration $a(t) = \frac{dv}{dt} = \frac{ds}{dt}$		m/s ²		Acceleration directed to the left (downward)		
$dt dt^2$	a=0		Constant velocity			
			a>0	S-t gray concere story speed of		
Jerk/Turbulence	$j(t) = \frac{da}{dt} = \frac{d^2v}{dt^2} = \frac{d^3s}{dt^3}$	m/s ³		Acceleration directed to the right (upward)		

 Explain what is happening in the following displacement graph.
Then talk about why an increasing s-t graph may not mean necessarily speeding up.



d. For the s-t graph below explain what's going on and sketch the v-t graph on separate coordinate axes.



5. OTHER APPLICATIONS (MCV)

a.

A sperical balloon is being inflated. $V = \frac{4}{3}\pi r^3$

- i. Find the rate of change in volume as radius changes from r = 1 cm to r = 3 cm
- ii. Find the change in volume at r = 10cm

Explain what is happening in the following velocity graph. Then talk about why zero on a v-t graph does not mean object is at the origin. Also the graph shows negative acceleration, talk about that this doesn't always mean slowing down.



e. For the v-t graph below explain what's going on and sketch the possible s-t graph and a-t graph on separate coordinate axes.



b.

ii.

An arrow is shot so that its height, in meters, above the ground is

given by: $h(t) = 1.5 + 32t - 5t^2$ where t is time, in seconds

- i. Determine the max height using the derivative
 - What speed is it traveling at when it hits the ground?
- iii. Determine the acceleration of the arrow and its relevance.