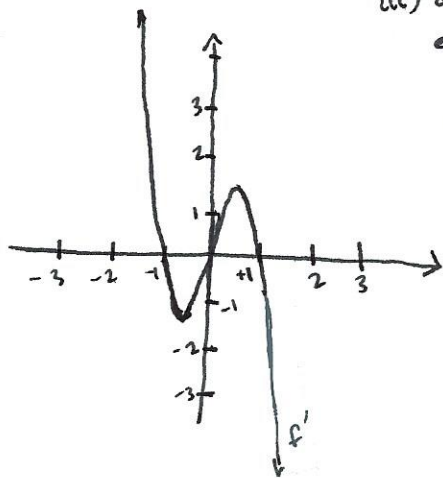


Use the graph of  $f'$  to i) identify critical numbers of  $f$

- ii) identify open intervals on which  $f$  is increasing or decreasing  
 iii) determine whether  $f$  has local max, min, or neither at each critical number

Math 2413  
 Dr. Liu  
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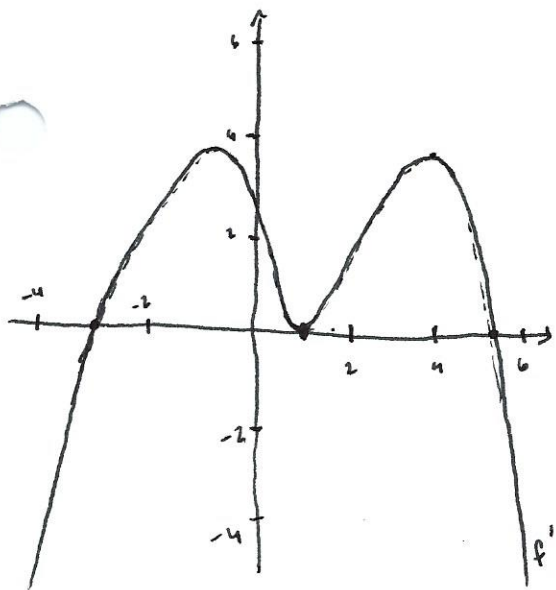
i)  $f'(x)$  defined everywhere  
 $f'(x) = 0 \rightarrow x = 0, \pm 1$

\*  $x=c$  is a crit. # if  $f'(c) = 0$  or DNE

ii)  $f$  increasing on  $(-\infty, -1) \cup (0, 1)$   
 decreasing on  $(-1, 0) \cup (1, \infty)$

iii)  $f$  has local min at  $x=0$   
 max at  $x = \pm 1$

\*  $f$  has local max if  $f'$  changes from  $+$  to  $-$   
 $f$  has local min if  $f'$  changes from  $-$  to  $+$



i)  $f'(x)$  defined everywhere.  
 $f'(x) = 0 \Rightarrow x = -3, 1, 5$

ii)  $f$  increasing on  $(-5, -3) \cup (1, 5)$   
 decreasing on  $(-\infty, -5) \cup (3, \infty)$

iii)  $f$  has local min at  $x = -3$   
 max at  $x = 5$

$f$  has neither max nor min at  $x = 0$

The position of a particle is given by the equation  $s(t) = t^3 - 6t^2 + 9t$ , with  $t$  in seconds and  $s$  in meters

- a) Find  $v(t)$
- b)  $v(2) = ?$
- c) When is particle at rest?
- d) When is particle moving forward?
- e) Draw diagram of particle's motion
- f) Find total distance traveled during first five seconds
- g) Find  $a(t)$  and  $a(4)$
- h) Graph  $s(t)$ ,  $v(t)$ , and  $a(t)$  for  $0 \leq t \leq 5$
- i) When is particle speeding up? When is it slowing down?

a)  $v(t) = s'(t) = 3t^2 - 12t + 9$

b)  $v(2) = 3(4) - 12(2) + 9 = -12 + 9 = -3$

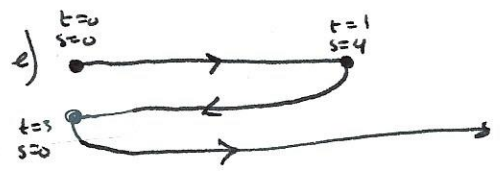
c)  $v(t) = 0 = 3t^2 - 12t + 9$   
 $= 3(t^2 - 4t + 3)$   
 $= 3(t-1)(t-3)$   
 $t = 1, 3$

d)  $v(t) > 0 \Rightarrow 3(t-1)(t-3) > 0$

$3 \cdot (\frac{1}{2}-1)(\frac{1}{2}-3) > 0$   
 $3 \cdot (2-1)(2-3) < 0$   
 $3 \cdot (4-1)(4-3) > 0$

$\rightarrow v(t) > 0$  on  $(0,1) \cup (3,4)$

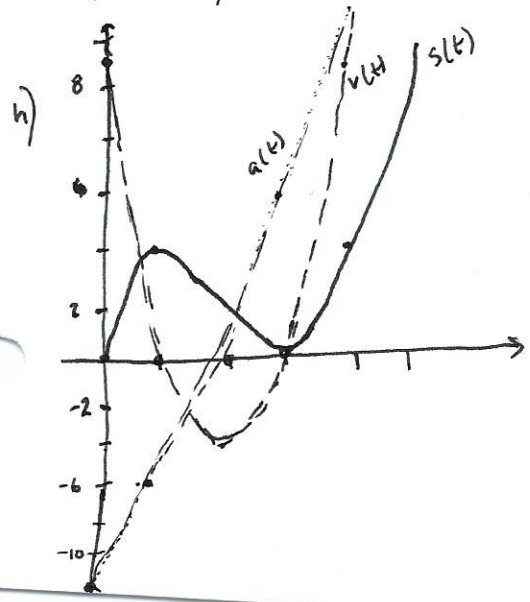
time always non-negative



f) 1st sec:  $|s(1) - s(0)| = |4 - 0| = 4$   
 $t \in (1,3)$ :  $|s(3) - s(1)| = |0 - 4| = 4$   
 $t \in (3,5)$ :  $|s(5) - s(3)| = |20 - 0| = 20$

$\Rightarrow$  total dist during 1st 5 seconds = 28m

g)  $a(t) = v'(t) = (3t^2 - 12t + 9)' = 6t - 12$   
 $a(4) = 6(4) - 12 = 24 - 12 = 12 \text{ m/s}^2$



i) speeding up means  $a$  and  $v$  have same sign  
 $\Rightarrow t \in (1,2) \cup (3,5)$

slowing down means  $a$  and  $v$  have different sign  
 $\Rightarrow t \in (0,1) \cup (2,3)$