1) When is the particle speeding up? When is it slowing down? $s = f(t) = t^3 - 6t^2 + 9t$

Speeding up

I. $v > 0$ & $a > 0$

velocity > 0

$3t^2 - 12t + 9 > 0$

$t^2 - 4t + 3 > 0$

$(t-3)(t-1) > 0$

$t = 1, 3$

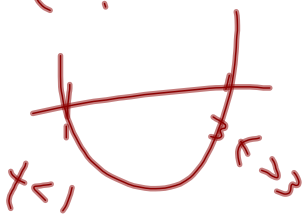
AND

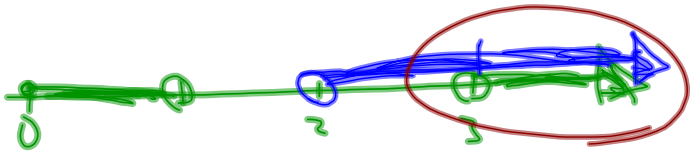
Accel. > 0

$6t - 12 > 0$

$6t > 12$

$t > 2$





Speeding up: $\{t > 3\}$

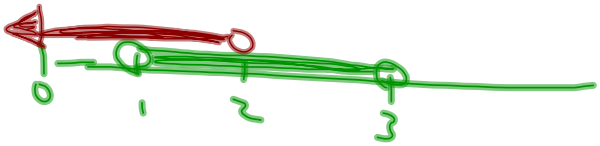
II. vel < 0 & accel < 0

$1 < t < 3$

$6t - 12 < 0$

$6t < 12$

$t < 2$

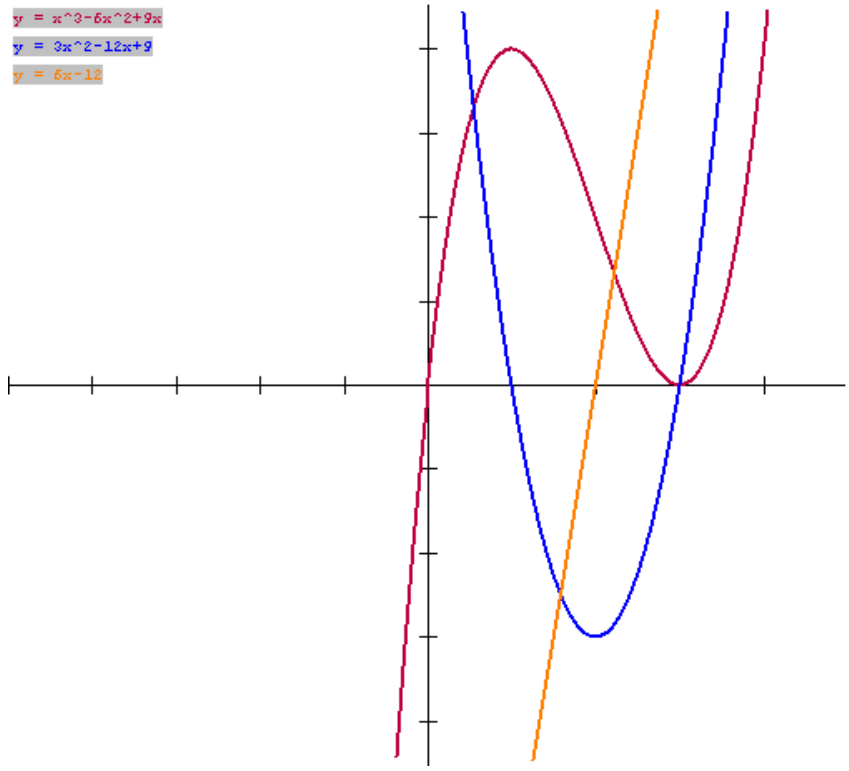


$\{1 < t < 2\}$

Speeding up: $\{t \mid 1 < t < 2 \text{ or } t > 3, t \in R\}$

Slowing Down: $\{0 \leq t < 1 \text{ or } 2 < t < 3\}$

h) Graph the position, velocity, and acceleration functions for $0 \le t \le 5$.



i) When is the particle speeding up? When is it slowing down?

Time to check your understanding...

A particle moves according to a law of motion $s(t) = 2t^3 - 9t^2 + 12t + 1$, $t \geq 0$.

(a) Determine the velocity of the particle when it has acceleration 2 units/s^2.

(b) When is this particle moving in a positive direction? ($s'(x) > 0$)

(c) Sketch the path of this particle, and determine how far it has traveled during the first 8 seconds.

(a) $s'(t) = 6t^2 - 18t + 12$

$s''(t) = 12t - 18$

$12t - 18 = 2$

$12t = 20$

$t = \frac{20}{12} = \frac{5}{3}$

$s'\left(\frac{5}{3}\right) = 6\left(\frac{5}{3}\right)^2 - 18\left(\frac{5}{3}\right) + 12$

$= 6\left(\frac{25}{9}\right) - 30 + 12$

$= \frac{50}{3} - \frac{18}{1}$

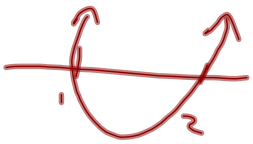
$= -\frac{4}{3}$ units/sec

(b) $\frac{6t^2}{6} - \frac{18t}{6} + \frac{12}{6} > \frac{0}{6}$

$t^2 - 3t + 2 > 0$

$(t-2)(t-1) > 0$

$t = 1, 2$

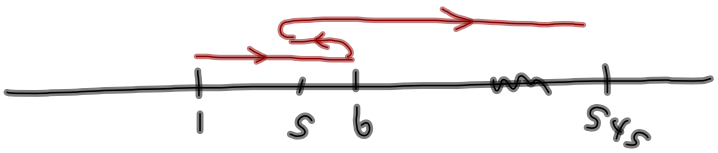


$\{0 \leq t < 1 \text{ or } t > 2\}$

c)

t	s
0	1
1	6
2	5
8	545

X=



Distance = $5 + 1 + 540$

$= 546$ units

Practice exercises...

Page 125

#3, 4, 5, 8, 9

Page 129

#6, 7, 8

Topics to Review:

- Power rule, product rule, quotient rule, chain rule
- Derivatives of trigonometric functions
- Applications of derivatives...
  *slopes of tangent lines
  *rectilinear motion
- Implicit differentiation
- Higher order derivatives

Review Questions...

Page 112 - 114
#1 c, d
#7 b, d
#8 b, d
9 a, b, d, f
#11
#12

Bonus #13

Page 115
#1 (ii)
#3
#4
#5

Page 154
#2
#3