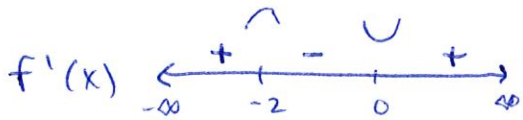
$\boxed{1}$ $f(x) = x^3 + 3x^2$

$f'(x) = 3x^2 + 6x$

$3x(x+2) = 0$

$x = 0, -2$



$f''(x) = 6x + 6 = 0$

$6(x+1) = 0$

$x = -1$

a. crit pts: $x = -2, 0$

b. local min: $x = 0$

local max: $x = -2$

c. int of inc: $(-\infty, -2)$ $(0, \infty)$

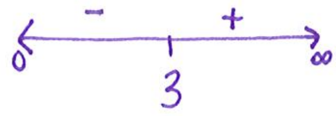
int of dec: $(-2, 0)$

d. $x = -1$

e. int of concave up: $(-1, \infty)$

f. int of concave down: $(-\infty, -1)$

* I changed f(x) by eliminating last term, so that the quadratic formula would <u>not</u> have to be used

$\boxed{2}$ f' 

min;
at $x=3$, f' changes from neg. to pos.

b. $f'' = (x-3)e^x + e^x(1) = 0$

$e^x(x-3+1) = 0$

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

$x = 2$

f'' 

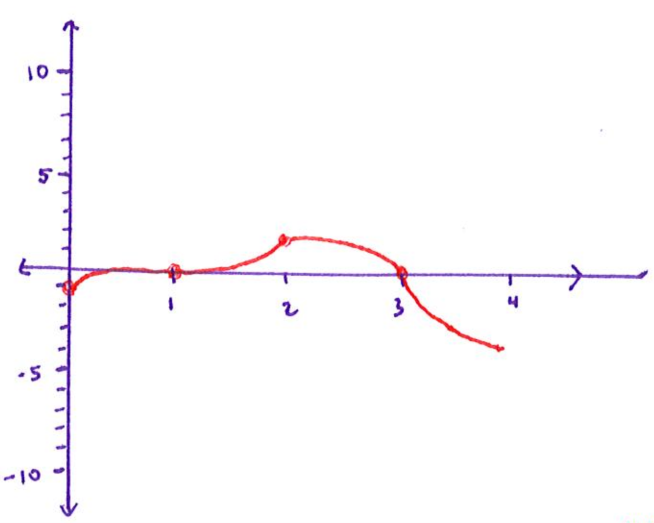
f is both decreasing and concave up on the interval $[2,3]$ since this is the only interval where $f'<0$ AND $f''>0$

$\boxed{3}$

a. $x=2$: maximum; at $x=2$ f' changes from pos. to. neg.

$x=0$: minimum; after this endpoint at $x=0$, f' is positive

b.



4 * Note $R(t)$ is a derivative since problem said this is Rate of change

1st deriv. a. $R(6) = 5\sqrt{6}\cos\left(\frac{6}{5}\right)$

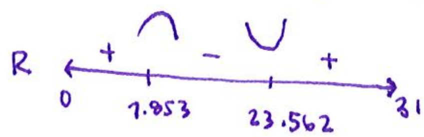
$R(6) > 0$ so # of mosquitoes is increasing

2nd deriv. b. $R'(t) = 5\sqrt{t} \cdot -\sin\left(\frac{t}{5}\right) \cdot \frac{1}{5} + \cos\left(\frac{t}{5}\right) \cdot 5 \cdot \frac{1}{2} t^{-1/2}$

$R'(6) < 0$ so # of mosquitoes is increasing at a decreasing rate

c. $R(t) = 0$

$t = 0,\ 7.853,\ 23.562$



~~R(T).~~

$t = 7.853$ is a max since $R(7.853)$ changes from pos. to. neg.

$t = 31$ is a max since $R(31)$ is an endpoint and before this endpoint R is pos.

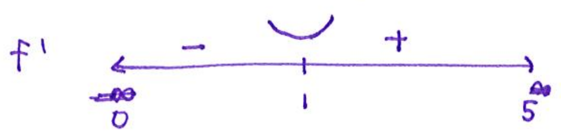
$\boxed{5}$ * Note $F(t)$ is a derivative

$F(7) > 0$ so at this time, traffic flow is increasing

$\boxed{6}$ $f(x) = x^2 - 2x - 3$

$f'(x) = 2x - 2 = 0$

$x = 1$

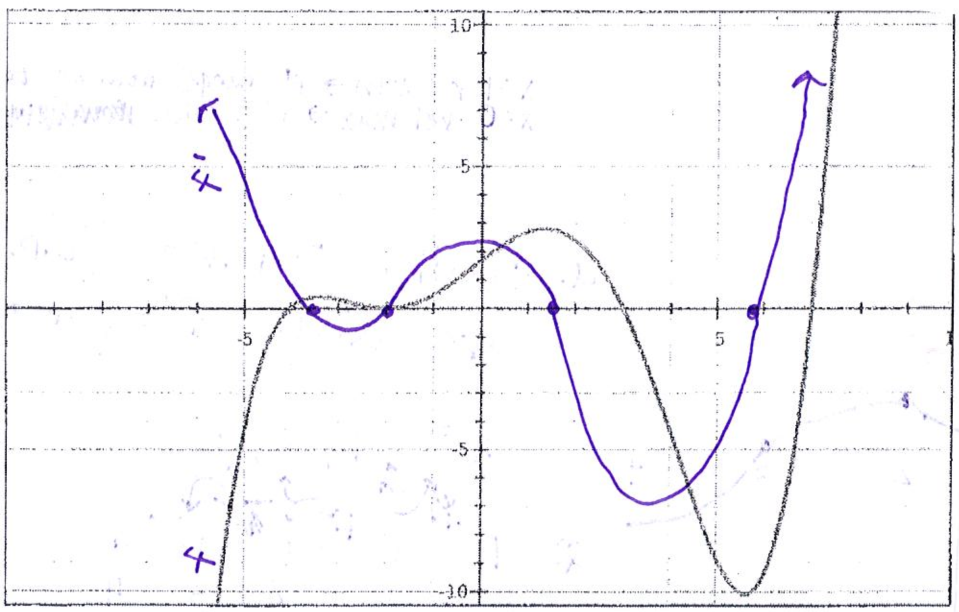


Max: $x = 0$ rel max

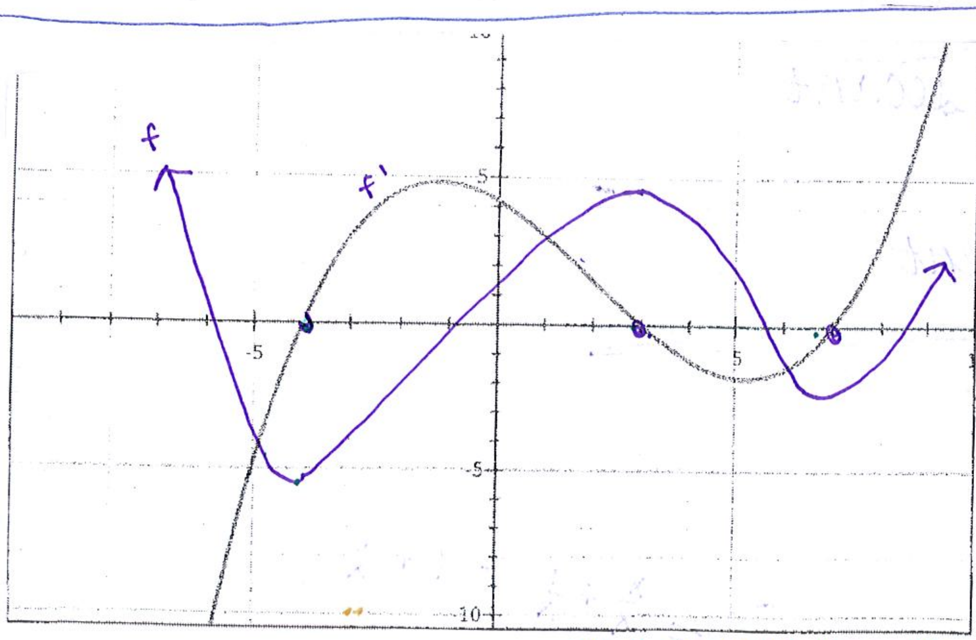
$x = 5$ abs max

min: $x = 1$ abs min

$\boxed{7}$



$\boxed{8}$



$\boxed{9}$ $s(t) = (t-2)^3(t-6)$

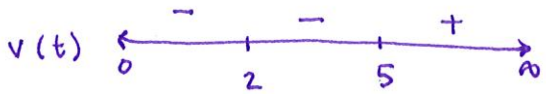
a. $s'(t) = v(t) = (t-2)^3 \cdot 1 + (t-6) \cdot 3(t-2)^2 \cdot 1 = 0$

$= (t-2)^3 + 3(t-2)^2(t-6) = 0$

$= (t-2)^2\left((t-2) + 3(t-6)\right) = 0$

$= (t-2)^2(4t-20) = 0$

$t = 2, 5$



particle moving to right when $t > 5$

b. particle at rest at $t = 2, 5$ (when $v(t) = 0$)

c. particle changes direction at $t = 5$

d. furthest left at $t = 5$

$\boxed{10}$ a. velocity is parabola, acceleration is linear

b. $(0, 2)$ and $(4, 6)$

c. $t = 2, 4$

d. $t = 2, 4$

e. speeding up: $(2, 3)$ $(4, 6)$

slowing down: $(0, 2)$ $(3, 4)$