① $f(x)=4x^2-4x+1 \quad [0,2]$

$f'(x)=8x-4$

$x=\frac{1}{2}$

$f(0)=1$

$f(\frac{1}{2})=0$ abs min

$f(2)=9$ abs max

② $f(x)=2x^3-3x^2-12x-1 \quad [-2,3]$

$f'(x)=6x^2-6x-12$

$0=6(x^2-x-2)$

$=6(x-2)(x+1)$

$x=2,-1$

$f(-2)=-5$

$f(-1)=6$ abs max

$f(2)=-10$

$f(3)=-21$ abs min

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③ $f(x)=\frac{x}{x^2+2} \quad [-1,4]$

$f'(x)=\frac{(x^2+2)(1)-x(2x)}{(x^2+2)^2} \rightarrow \frac{x^2+2-2x^2}{(x^2+2)^2} \rightarrow \frac{-x^2+2}{(x^2+2)^2}$

$-x^2+2=0$

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

$x=\pm\sqrt{2}$

$f(-1)=-\frac{1}{3}$ ← abs min

$f(\sqrt{2})=.354$ ← abs max

$f(4)=2/9$

$(x^2+2)^2=0$

$x^2+2=0$

$x^2=-2$

$x\neq\pm i\sqrt{2}$ reject

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⑤ $f(x)=x^{2/3}(20-x) \quad [-1,20]$

$f'(x)=x^{2/3}(-1)+(20-x)\cdot\frac{2}{3}x^{-\frac{1}{3}}$

$=\frac{-x^{2/3}}{1}\frac{(3x^{\frac{1}{3}})}{(3x^{\frac{1}{3}})}+\frac{2(20-x)}{3x^{\frac{1}{3}}}$

$x^{\frac{2}{3}}\cdot x^{\frac{1}{3}}$

$x^{\frac{2}{3}+\frac{1}{3}}\rightarrow x$

$=\frac{-3x}{3x^{\frac{1}{3}}}+\frac{2(20-x)}{3x^{\frac{1}{3}}}$

$=\frac{-3x+40-2x}{3x^{\frac{1}{3}}}$

$=\frac{-5x+40}{3x^{\frac{1}{3}}}$

abs min: 0
abs max: 48

$x=0$

$-5x+40=0$

$x=8$

$f(-1)=21$

$f(0)=0$

$f(8)=48$

$f(20)=0$

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Find the x-coordinates of all critical points, find all discontinuities & open intervals where the function is increasing and decreasing.

$y=x^3-11x^2+39x-47$

$y'=3x^2-22x+39$

$x=\frac{22\pm\sqrt{(-22)^2-4(3)(39)}}{2(3)}$

$x=3,\ 13/3$

y': $+$ 3 $-$ $\frac{13}{3}$ $+$

$y'<0$ decreasing

$y'>0$ increasing

increasing $(-\infty,3)\cup(13/3,\infty)$

decreasing $(3,13/3)$

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Steps to determine where a function is increasing/decreasing

1) Find the derivative
2) Set the derivative $=0$
3) Solve for the critical numbers
4) Make a number line of y' using critical values
5) The intervals where
   $y'>0$ ↑
   $y'<0$ ↓

Dec 9-10:09 AM