

$$17) f(x) = \frac{x^2}{x^2+2}$$

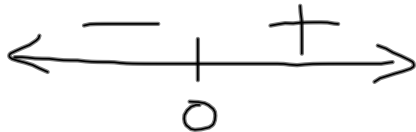
$$f''(x) = \frac{(x^2+2)^2 \cdot 4 - 4x \cdot 2(x^2+2) \cdot 2x}{(x^2+2)^4}$$

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

$$f''(x) = \frac{(x^2+2)[(x^2+2) \cdot 4 - 16x^2]}{(x^2+2)^3}$$

$$f'(x) = \frac{4x}{(x^2+2)^2}$$

$$f''(x) = \frac{8-12x^2}{(x^2+2)^3}$$



Can never = 0

inc: $[0, \infty)$ c: u: $(-\sqrt{2/3}, \sqrt{2/3})$
 dec: $(-\infty, 0]$ c d: $(-\infty, -\sqrt{2/3})$ $(\sqrt{2/3}, \infty)$
 inf: $x = \pm \sqrt{2/3}$

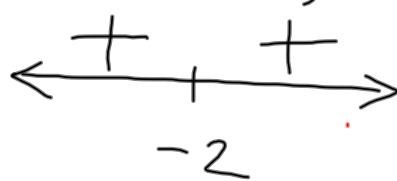
$$\begin{aligned} 8 - 12x^2 &= 0 \\ 12x^2 &= 8 \\ x^2 &= \frac{2}{3} \\ x &= \pm \sqrt{\frac{2}{3}} \end{aligned}$$

A horizontal number line with tick marks at $-\sqrt{2/3}$ and $\sqrt{2/3}$. Above the line, there is a minus sign (-) to the left of $-\sqrt{2/3}$, a plus sign (+) between $-\sqrt{2/3}$ and $\sqrt{2/3}$, and a minus sign (-) to the right of $\sqrt{2/3}$. Arrows at both ends of the line indicate it extends infinitely in both directions.

$$19) f(x) = \sqrt[3]{x+2} = (x+2)^{1/3}$$

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

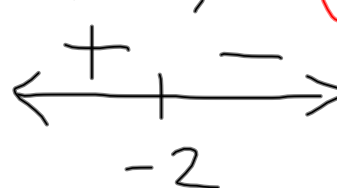
$$f'(x) = \frac{1}{3(x+2)^{2/3}}$$



even, so
double root

$$f''(x) = -\frac{2}{9}(x+2)^{-5/3}$$

$$f''(x) = \frac{-2}{9(x+2)^{5/3}}$$



odd,
no double
root

$$\text{inc: } (-\infty, \infty) \quad \text{cu: } (-\infty, -2)$$

$$\text{dec: never} \quad \text{cd: } (-2, \infty)$$

$$\text{inf: } x = -2$$

$$31) f(x) = \sin x \cos x \quad [0, \pi]$$

$$f'(x) = \sin x \cdot -\sin x + \cos x \cdot \cos x$$

$$f'(x) = \cos^2 x - \sin^2 x = 0$$

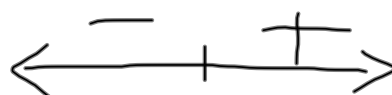
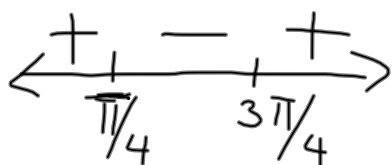
$$\cos^2 x = \sin^2 x$$

$$\pm \cos x = \pm \sin x$$

$$x = \pi/4, 3\pi/4$$

$$f''(x) = -2\cos x \sin x - 2\cos x \sin x$$

$$f''(x) - 4\cos x \sin x = 0$$



$$\begin{aligned} \text{inc: } & [0, \pi/4] \quad [3\pi/4, \pi] \\ \text{dec: } & [\pi/4, 3\pi/4] \\ \text{cu: } & (\pi/2, \pi) \\ \text{cd: } & (0, \pi/2) \\ \text{inf: } & x = \pi/2 \end{aligned}$$

21) $f(x) = x^{1/3}(x+4)$

$f'(x) = x^{1/3}(1) + (x+4) \cdot \frac{1}{3}x^{-2/3}$

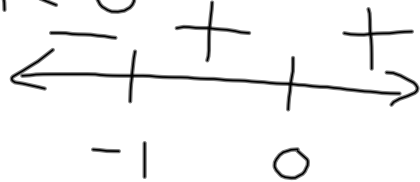
$= \frac{3x^{1/3} \cdot x^{2/3} + (x+4)}{3x^{2/3}}$

$= \frac{3x + x + 4}{3x^{2/3}}$

$f'(x) = \frac{4(x+1)}{3x^{2/3}}$

$x = -1$

$x = 0$



inc: $[-1, \infty)$ cu: $(-\infty, 0) \cup (2, \infty)$

dec: $(-\infty, -1]$ cd: $(0, 2)$

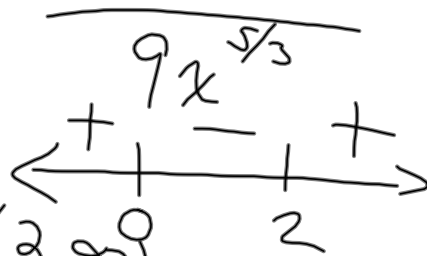
inf: $x = 0, 2$

$f''(x) = \frac{3x^{2/3} \cdot 4 - (4x+4) \cdot 2x^{-1/3}}{9x^{4/3}}$

$= \frac{12x^{2/3} - \frac{8x+8}{x^{1/3}}}{9x^{4/3}}$

$= \frac{12x - 8x - 8}{9x^{5/3}}$

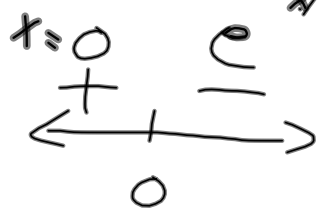
$= \frac{4(x-2)}{9x^{5/3}}$



$$23) f(x) = e^{-x^2/2}$$

$$f'(x) = e^{-x^2/2} \cdot -x$$

$$f'(x) = \frac{-x}{e^{x^2/2}}$$



inc: $(-\infty, 0)$ cu: $(-\infty, -1)$ $(1, \infty)$

dec: $(0, \infty)$ cd: $(-1, 1)$

inf: $x = 1, -1$

$$f''(x) = -e^{-x^2/2} + -x \cdot e^{-x^2/2} \cdot -x$$

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

