$\boxed{17P}$ #3

displacement: $s(t) = \overbrace{-4.9t^2}^{\text{half the acceleration}} \overbrace{+4.9t}^{\text{initial velocity}} \overbrace{+10}^{\text{initial height}}$
(position)

$$v(t) = \frac{ds}{dt} = -9.8t + 4.9$$

$$a(t) = \frac{dv}{dt} = -9.8$$

b) $s(t) = -4.9t^2 + 4.9t + 10 = 0$

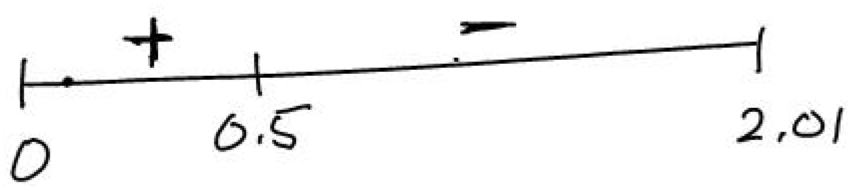
$t = 2.01$ secs.

(c) $v(t) = -9.8t + 4.9 = 0$

$$t = \frac{4.9}{9.8} = \frac{1}{2} \text{ sec.}$$

(d)

$v(t)$:




$a(t)$:


speeding up for $0.5 < t < 2.01$
slowing down for $0 \le t < 0.5$

$\boxed{7R}$ #6. $f(x) = x^2 e^{-x}$

deriv. of $-x$

$$f'(x) = \underbrace{x^2}_{1^{st}} \cdot \underbrace{e^{-x} \cdot (-1)}_{D\,2^{nd}} + \underbrace{e^{-x}}_{+\,2^{nd}} \cdot \underbrace{2x}_{D\,1^{st}}$$

$$f'(x) = xe^{-x}(-x+2) = 0$$

$x = 0$ $\quad x = 2$ ← critical values

$f'(x)$: $\quad - \quad 0 \quad + \quad 2 \quad -$

f is decr. $\quad$ f is incr. $\quad$ f is decr.

$- \ +$

$+ \ +$

Min. at $x = 0$; Max at $x = 2$

---

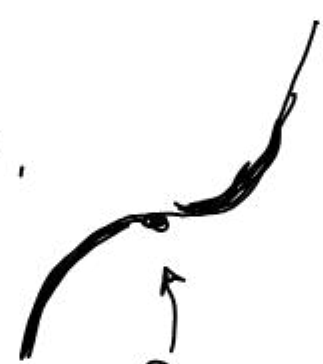
#3 $f(x) = x^{5/3}$

$$f'(x) = \frac{5}{3} x^{2/3} = 0$$

$x = 0$ ← C.V.

$f'(x)$: $\quad + \quad 0 \quad +$

No extremum



# 7S Concavity and Points of Inflection (flex points)

**#2** $f(x) = -x^4 + 4x^3$

$$f'(x) = -4x^3 + 12x^2 = 0$$

$$f''(x) = -12x^2 + 24x$$

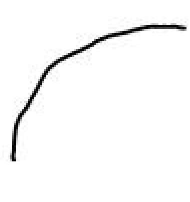
$f'(x) = -4\underset{+}{x^2}(x-3) = 0 \Rightarrow \underbrace{x = 0, 3}_{\text{critical values}}$

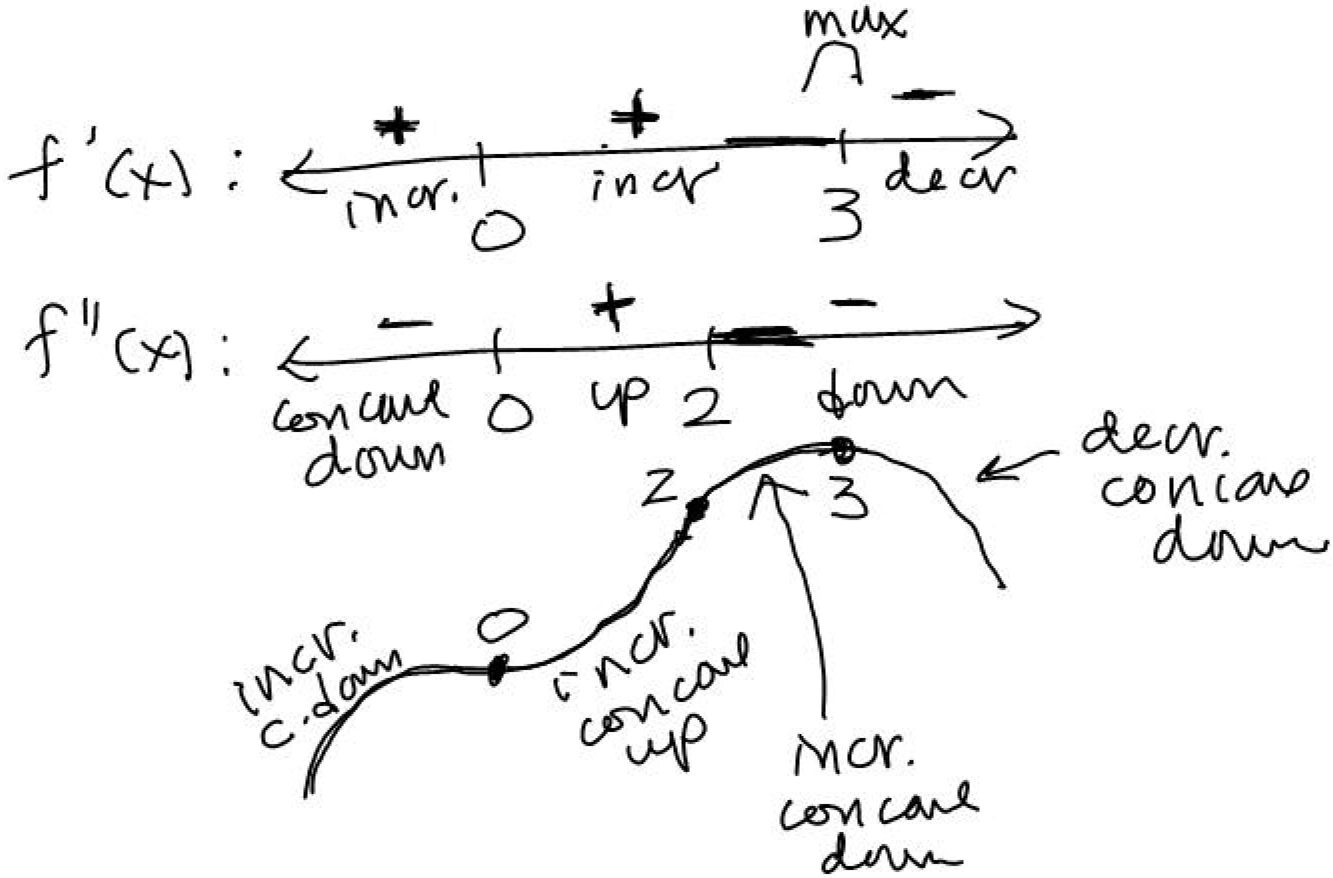
$f''(x) = -12x(x-2) = 0 \Rightarrow \underbrace{x = 0, 2}$

places you __could__ have a flex point $\longrightarrow$ hypercritical values

$f'(x)$: + incr. | 0 | + incr | 3 (max) | −

$f''(x)$: − concave down | 0 | + up | 2 | − down






#6. $f(x) = \dfrac{1}{x^2+1}$

$$f'(x) = \frac{0 - 2x}{(x^2+1)^2} = \frac{-2x}{(x^2+1)^2} = 0 \quad \overset{\text{C.V.}}{\boxed{x=0}}$$

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

$$= \frac{-2\cancel{(x^2+1)}\left[x^2+1-4x^2\right]}{(x^2+1)^{\cancel{4}\,3}}$$

$$f''(x) = \frac{-2(1-3x^2)}{(x^2+1)^3} = 0$$

$$3x^2 = 1$$

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

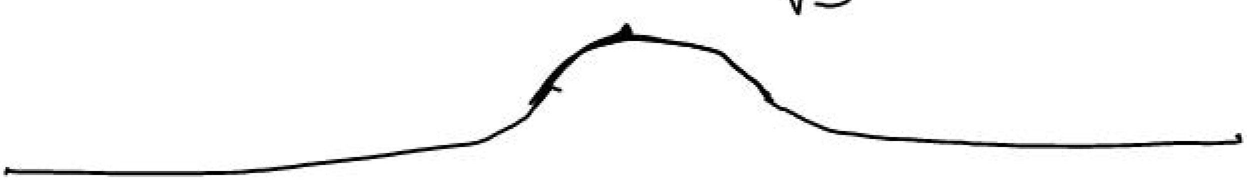
$$\boxed{x = \pm\frac{1}{\sqrt{3}}}$$ hypercritical values

$f'(x)$: + max −

incr. 0 decr.

$f''(x)$: + − +

$-\frac{1}{\sqrt{3}}$ $\frac{1}{\sqrt{3}}$



HW $\boxed{7S}$ #3, 5, 8 $\boxed{7T}$ #6