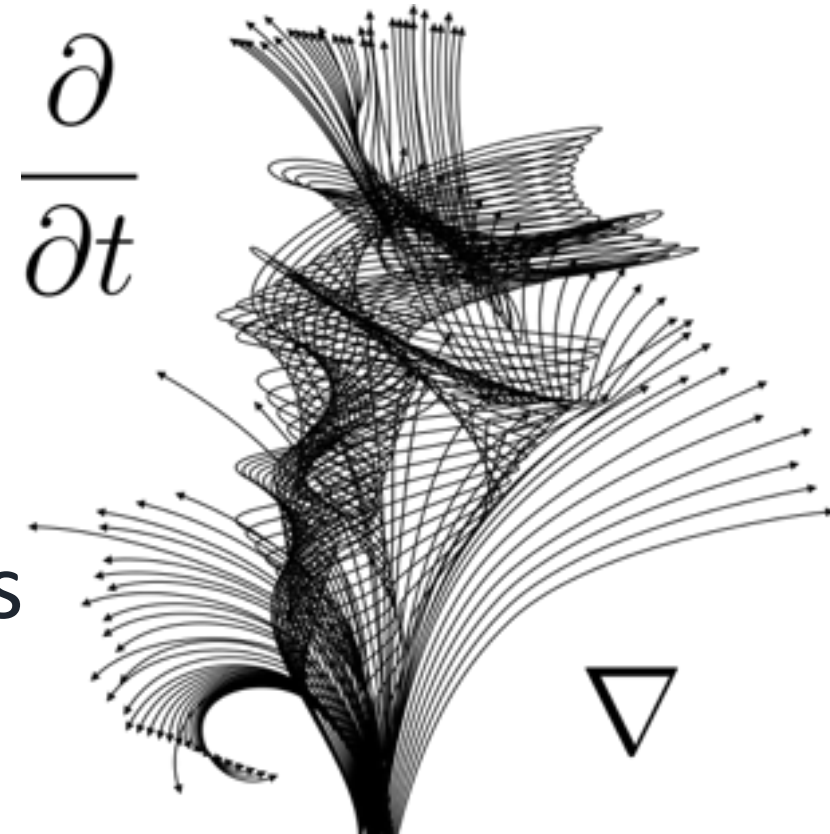# Differential Calculus with Applications to Life Sciences

Math 102:105

Pooya Ronagh

Agenda for today:
- Continue graphing functions
- Rational functions
- Limit behaviour of rational functions

$$\frac{\partial}{\partial t}$$

Office Hours
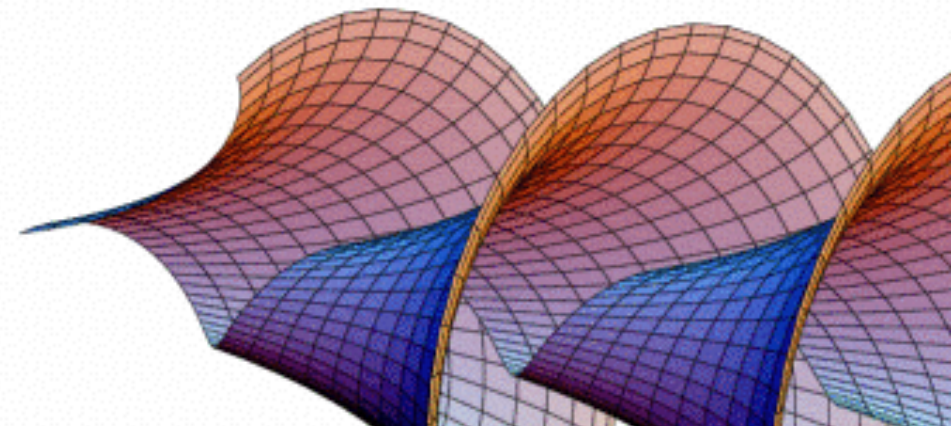
Which one do you prefer?

Mondays 10am and Tuesdays 8:30am
Mondays 9am and Thursdays 8:30am
Tuesdays 8:30am and Thursdays 8:30am
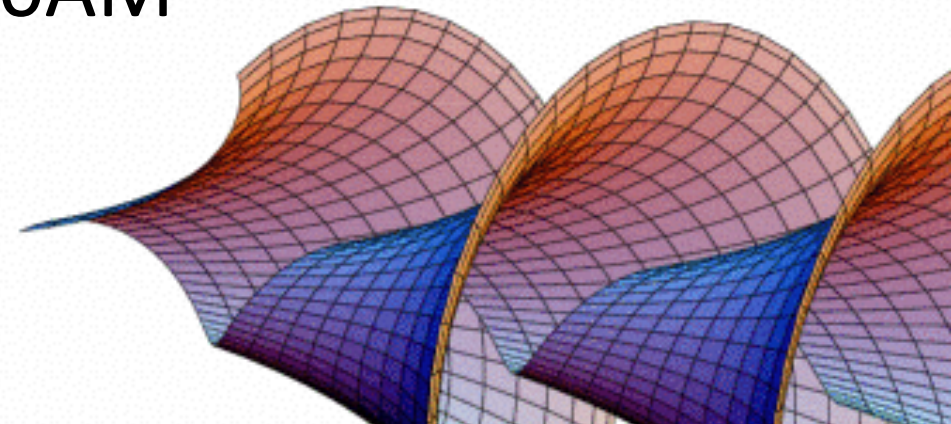Mondays 10am and Thursdays 11:30am
Mondays 8am and Thursdays 11:30am

Upcoming due dates

OSH0 :Tuesday September 13, 11:59PM

OSH1: Friday September 16

PL 2.2: Wednesday September 14, 7:00AM
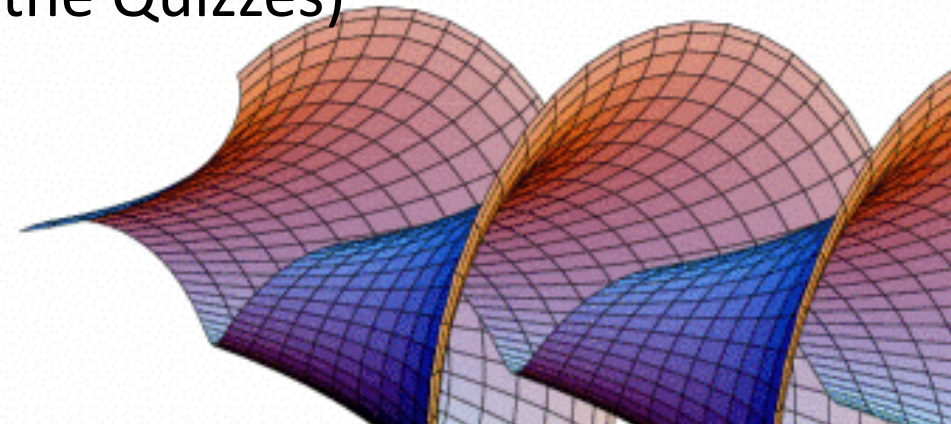
Clicker? socrative

by MasteryConnect

You will receive a code from me to submit on Socrative.

Two of the quizzes will be through Secretive (counts for marks)

Quick Questions do not count for marks

Other Questions (bonus up to +3% on the 15% of the Quizzes)
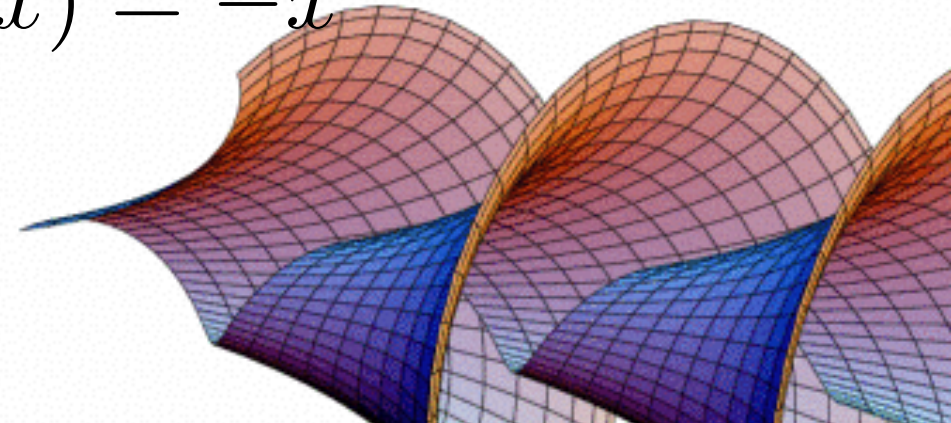
Last time: Drawing simple functions

Understand the **overall** shape of

$$g(x) = x^2 - x^3$$

only by understanding the asymptotic behaviour of the following power functions:
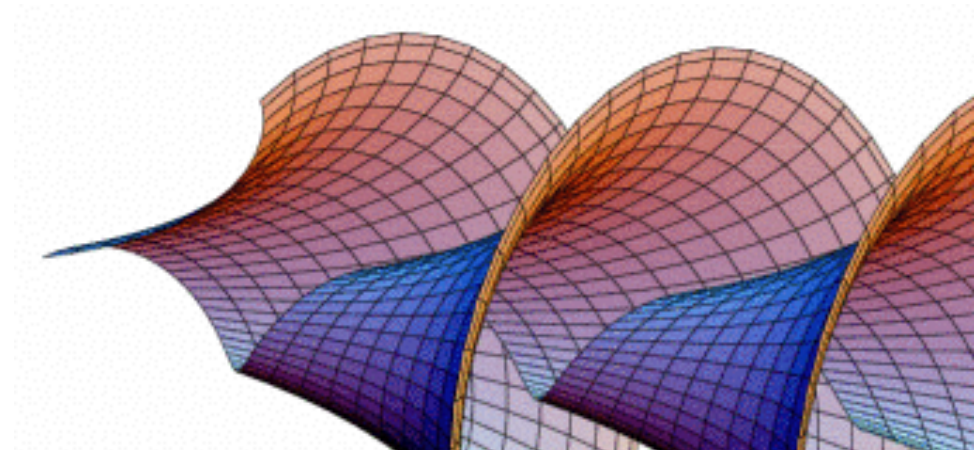
$$f_1(x) = x^2 \qquad\qquad f_2(x) = -x^3$$

Useful in drawing simple functions

Where are the zeros of the function

$$g(x) = x^2 - x^3$$
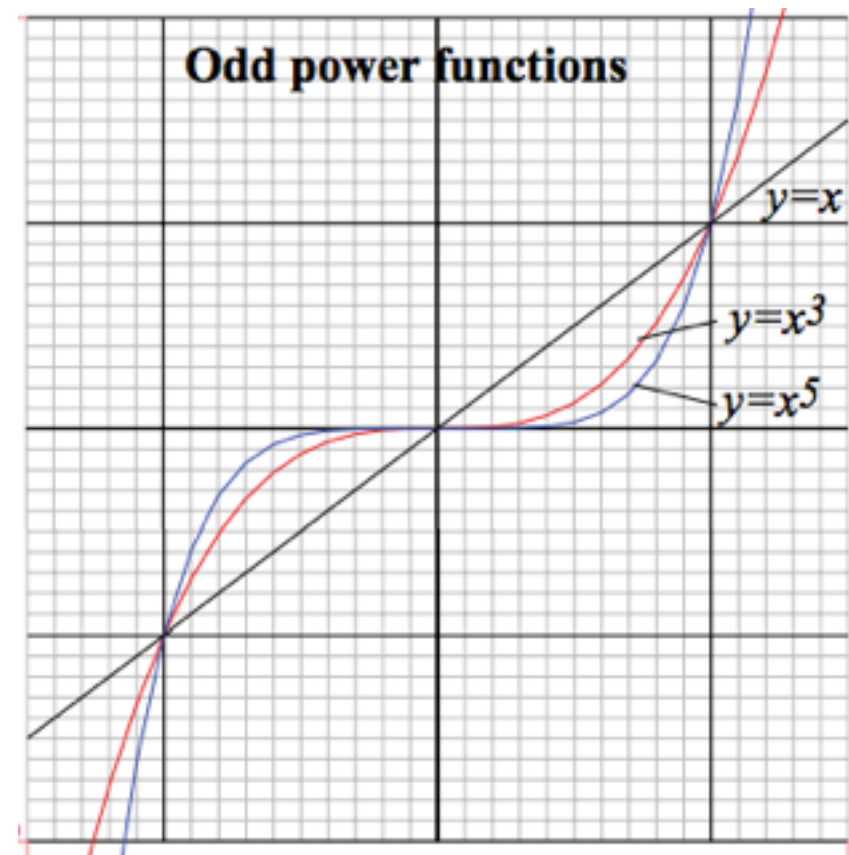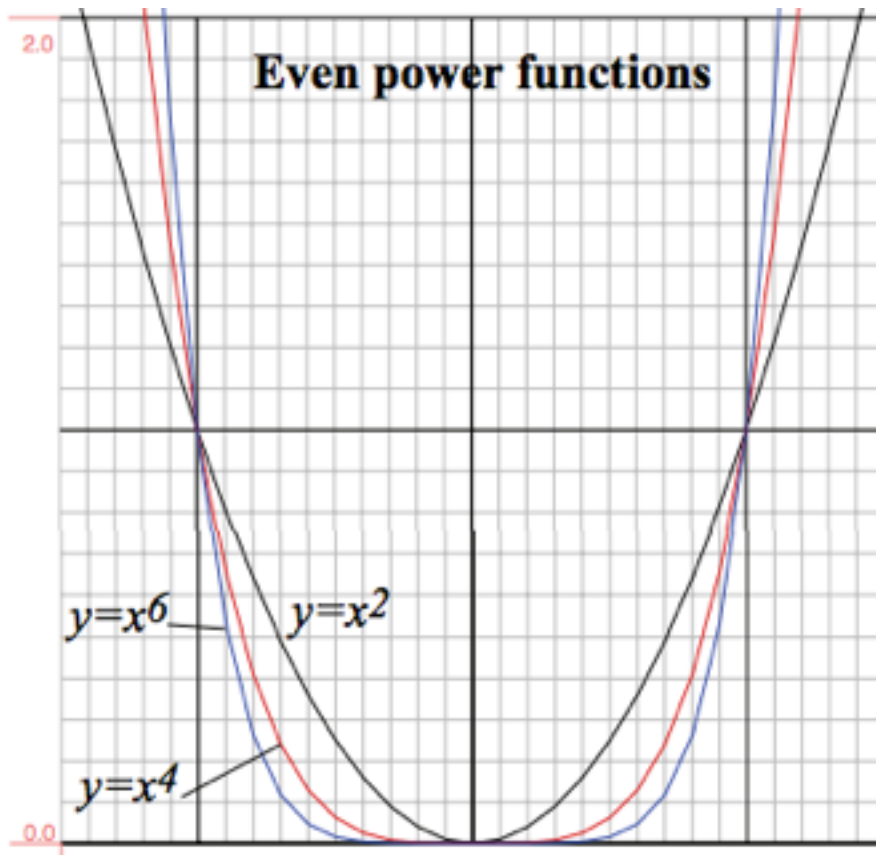
The first piece of information for drawing a function

Zeros = Roots = x-intercepts

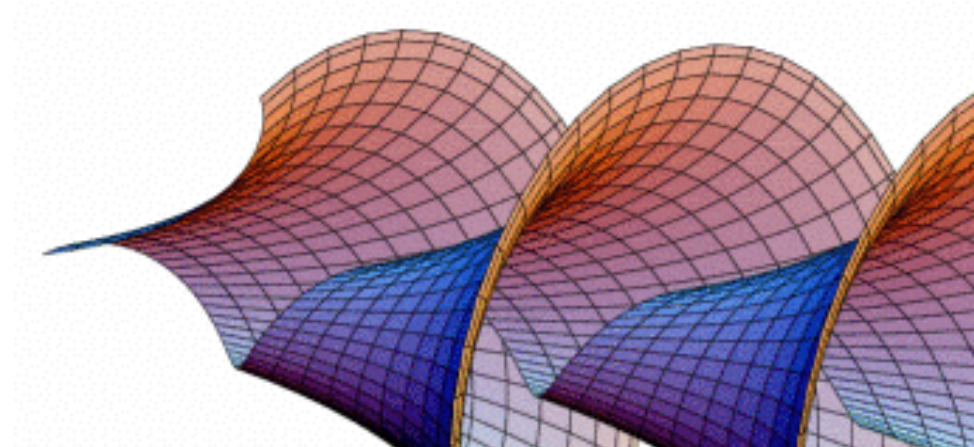# Useful in drawing simple functions

Is the function **odd** or **even**?

Quick question:

Is this function
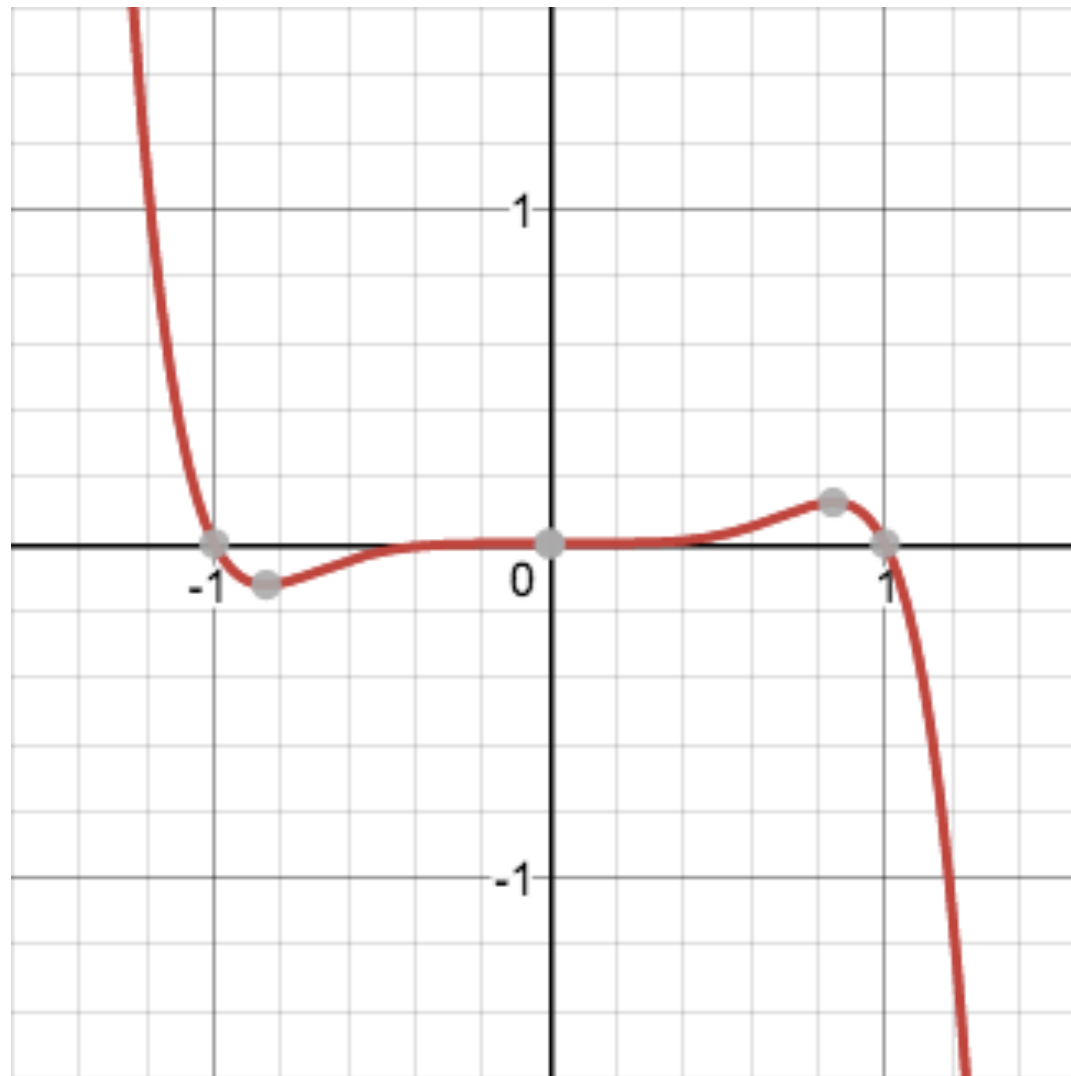(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^5 - x^7$$

Quick question:

Is this function
(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^5 - x^7$$

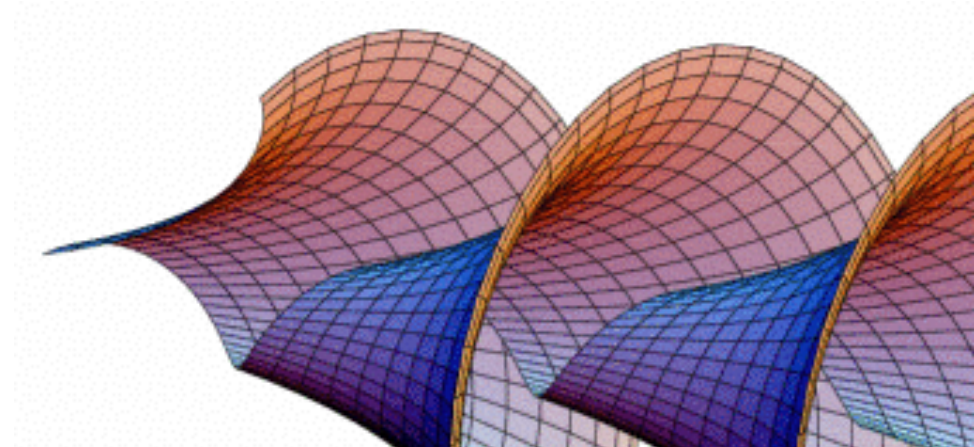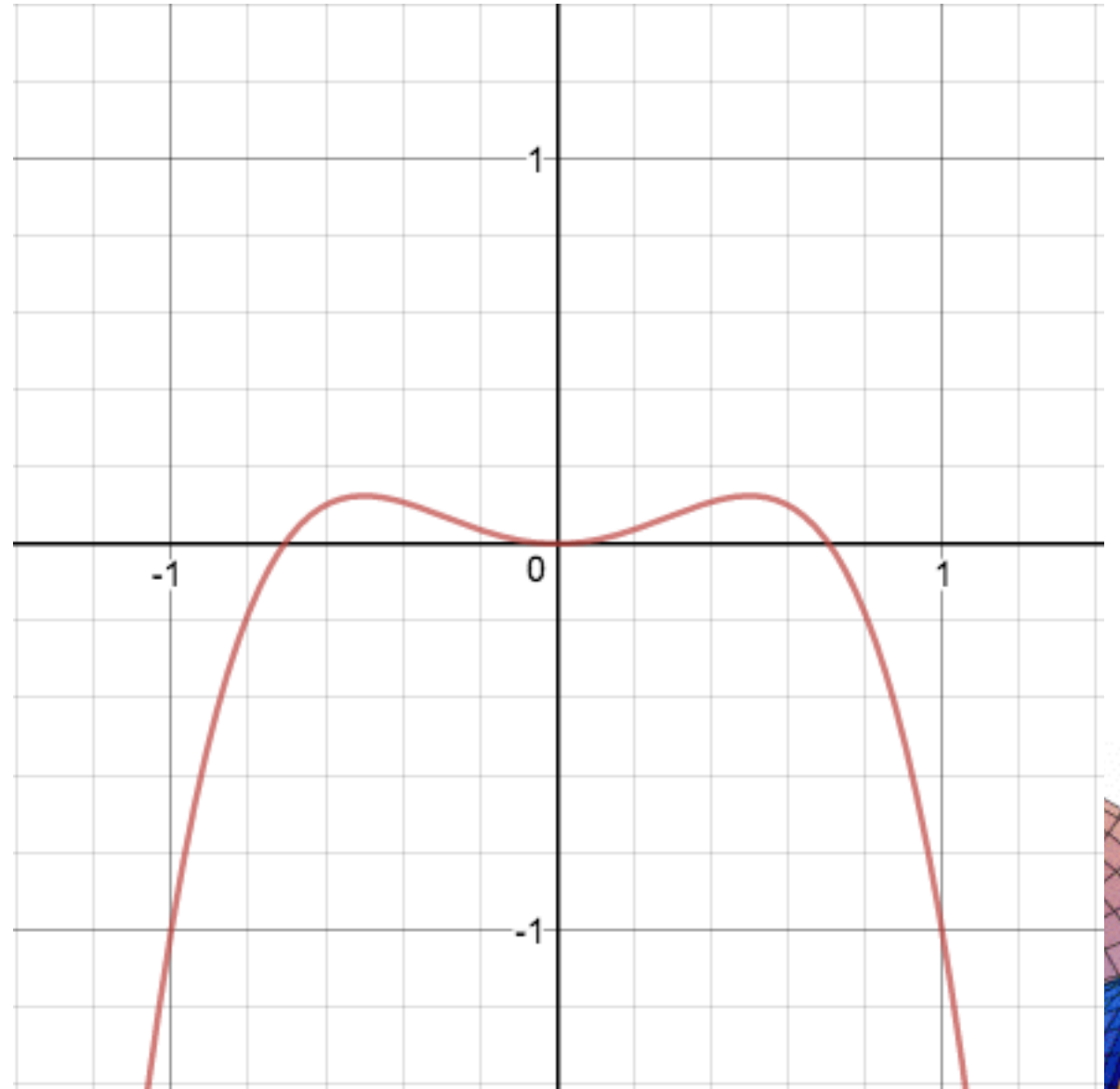# Quick question:

Is this function
(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^2 - 2x^4$$

Quick question:

Is this function
(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^2 - 2x^4$$
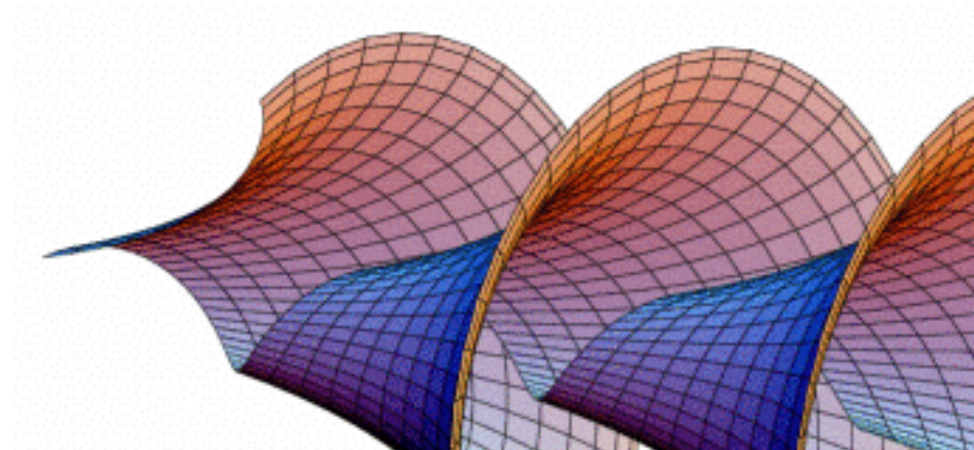
Quick question:

Is this function
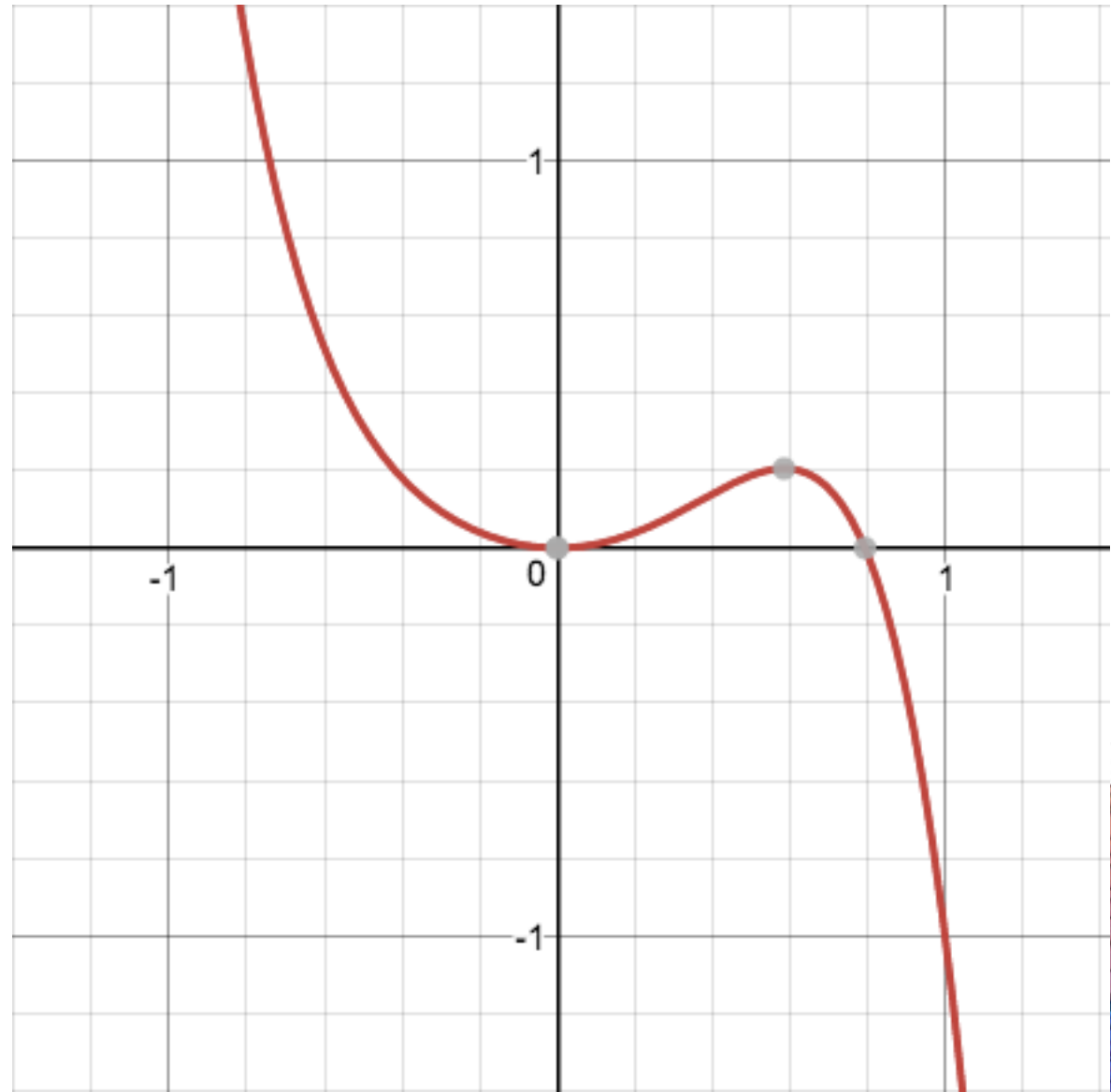(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^2 - 2x^5$$

Quick question:
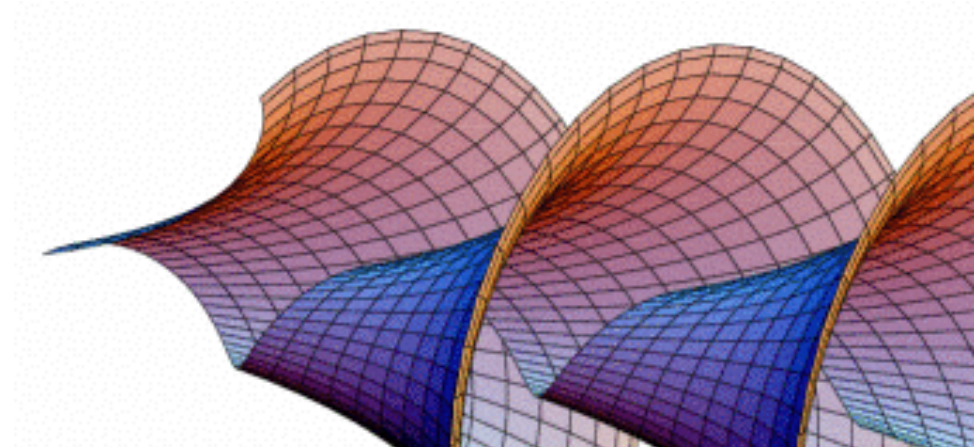
Is this function
(A) odd
(B) even
(C) both
(D) none?

$$f(x) = x^2 - 2x^5$$

Polynomials and Rational functions

Which one is a polynomial?

(A) 0 (B) -43 (C) x^2 (D) All (E) None

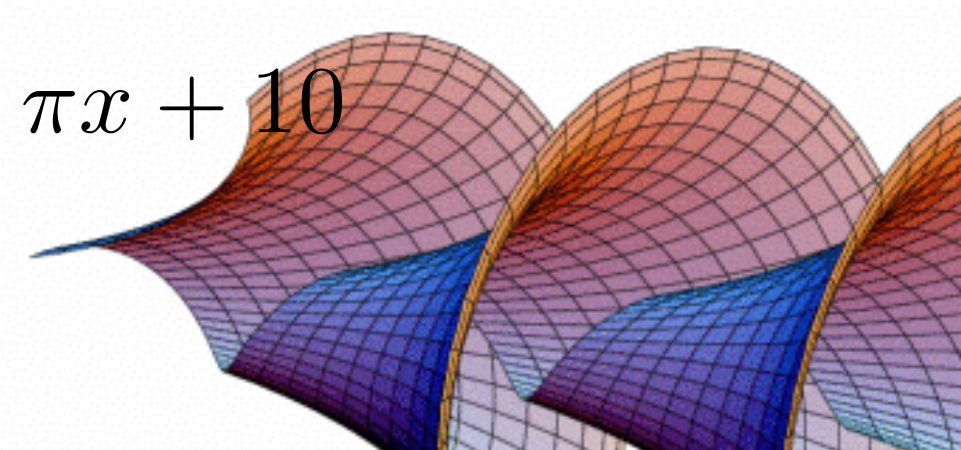# Polynomials and Rational functions

Which one is a polynomial?

(A) $\dfrac{1}{x}$

(B) $\dfrac{x^2}{x}$

(C) 2^x

(D) $x^{100} - e^{\pi} x$
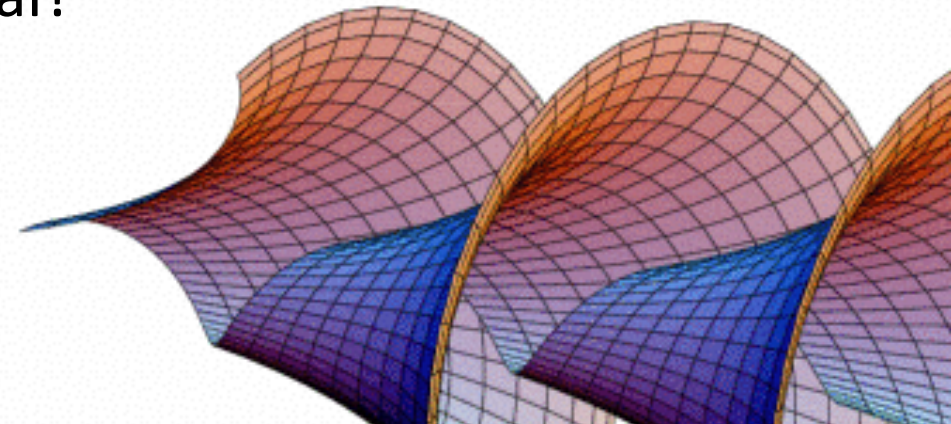
(E) $x^5 - 5x^4 + x^3 + 52x^2 + \pi x + 10$

Polynomials and Rational functions

Rational functions are of the form:

$$r(x) = \frac{p(x)}{q(x)}$$

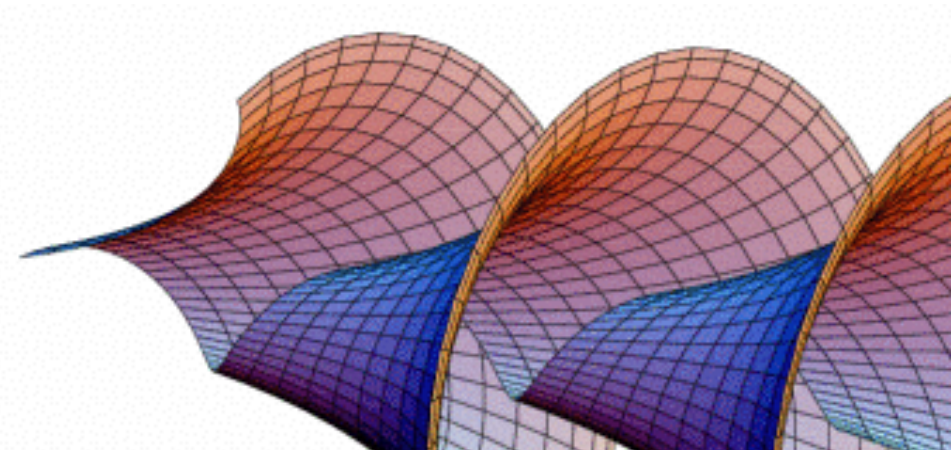Question: Example of a function that is not rational?

Sketching rational functions

$$\frac{x^2 - 2x^5}{1 + 5x^3}$$

Behaviour near the origin = lowest-term contributions
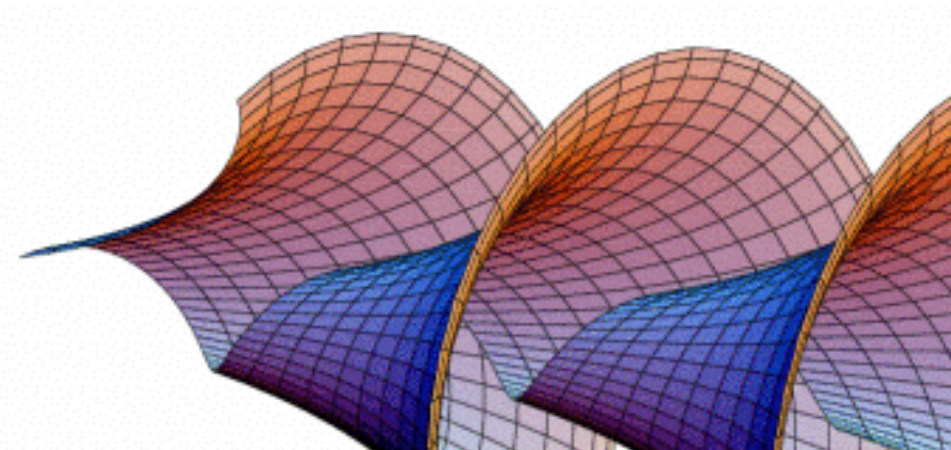
Behaviour far away = highest-term contributions

Case study: Hill functions

$$f(x) = \frac{ax^n}{b^n + x^n}$$

Odd or even?
(A) even when n is even and odd when n is odd
(B) even when n is odd and odd when n is even
(C) only even when n is even, neither when n is odd
(D) even for all n
(E) neither even nor odd for any n

Sketching the Hill functions

$$f(x) = \frac{ax^n}{b^n + x^n}$$

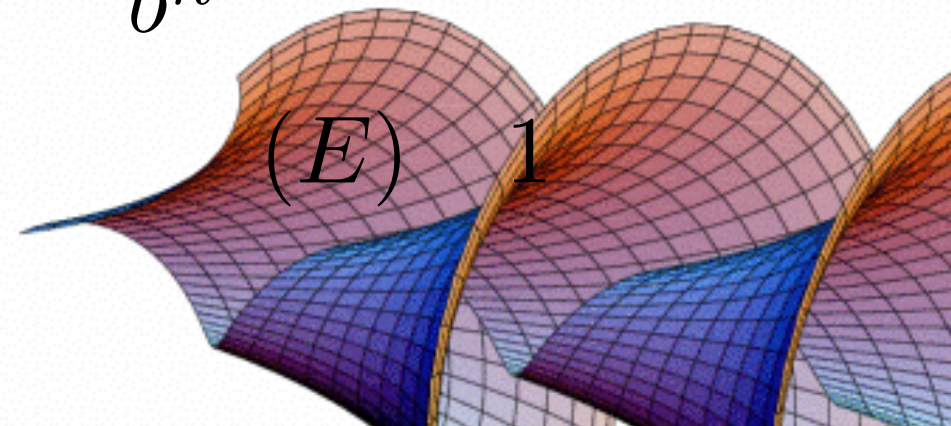Close to the origin (when $|x| \ll b$) the function can be approximated by

$$(A) \quad a \left(\frac{x}{b} \right)^n \qquad\qquad (B) \quad \frac{0}{b^n}$$

$$(C) \quad \frac{a}{b^n} \qquad\qquad (D) \quad 0 \qquad\qquad (E) \quad 1$$

Sketching the Hill functions

$$f(x) = \frac{ax^n}{b^n + x^n}$$

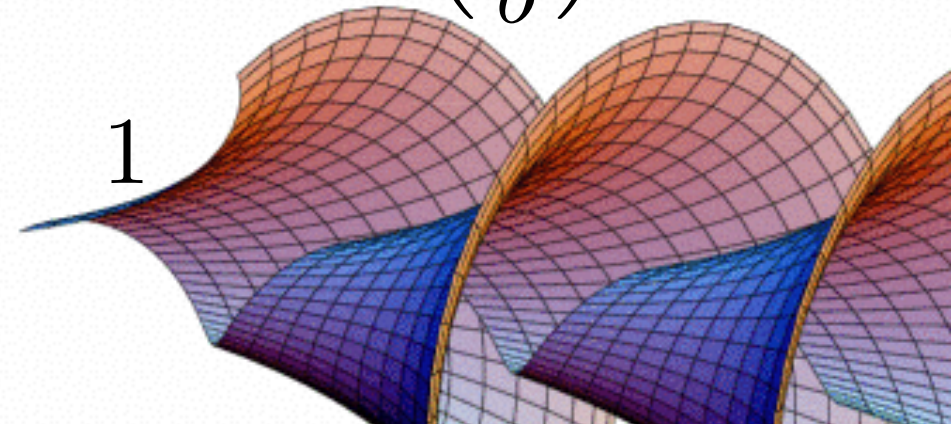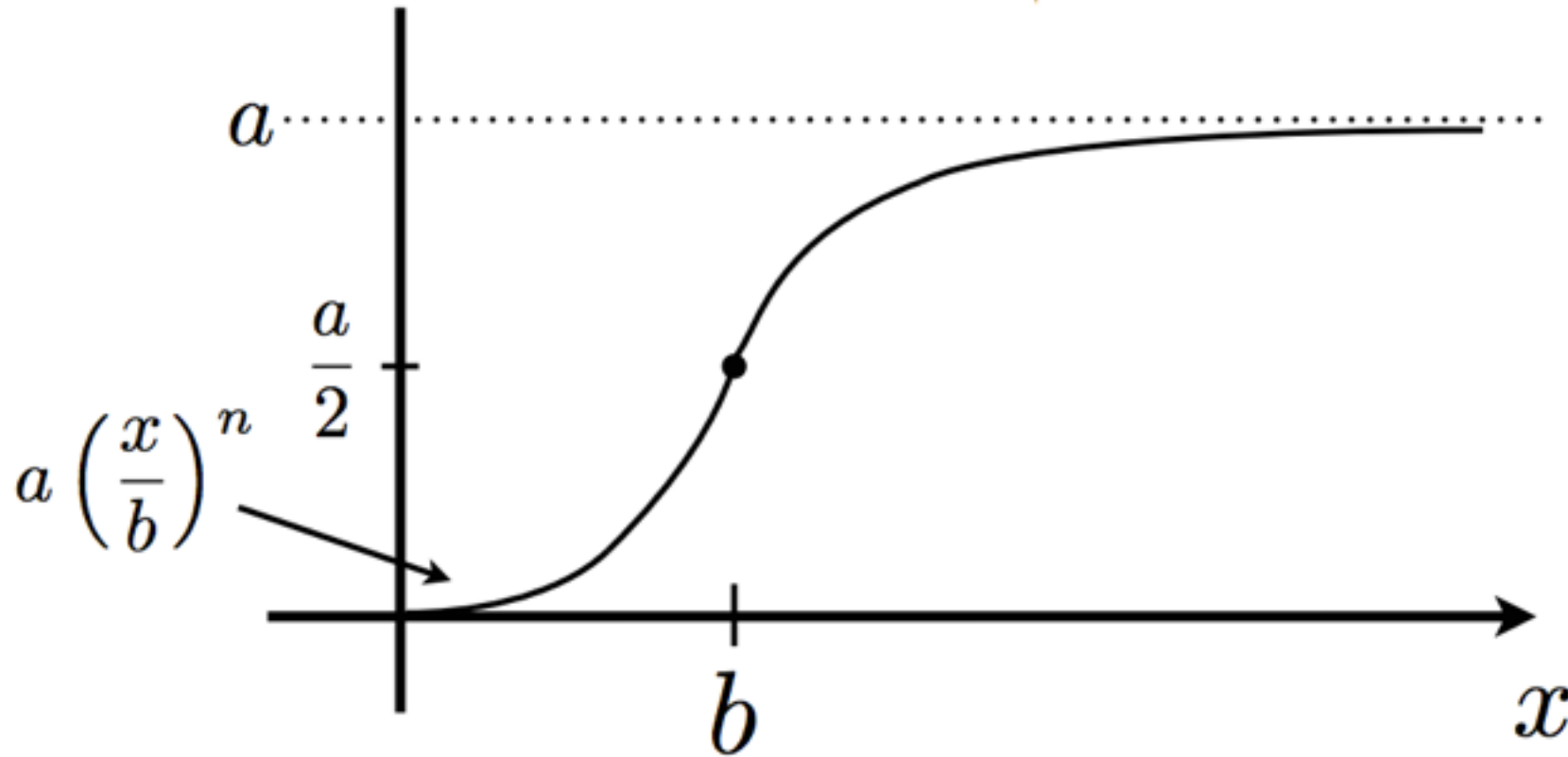Away from the origin (when $|x| \gg b$) the function can be approximated by

$(A) \quad a$ $\qquad (B) \quad \dfrac{a}{b^n}$ $\qquad (C) \quad a\left(\dfrac{x}{b}\right)^n$
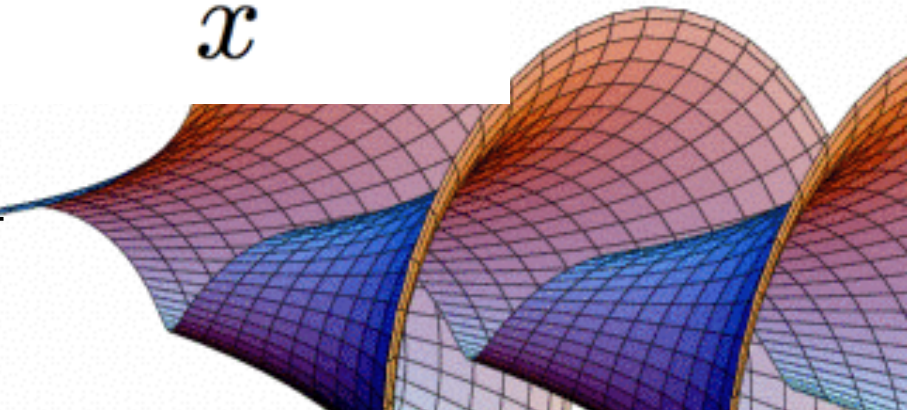
$(D) \quad 0$ $\qquad (E) \quad 1$

Sketching the Hill functions

$$f(x) = \frac{ax^n}{b^n + x^n}$$

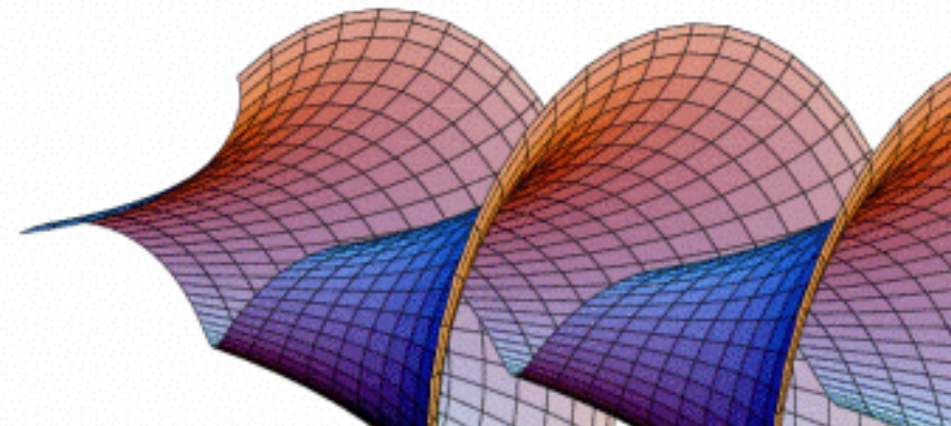# Secants and Derivates (Intro)

S

A

fr

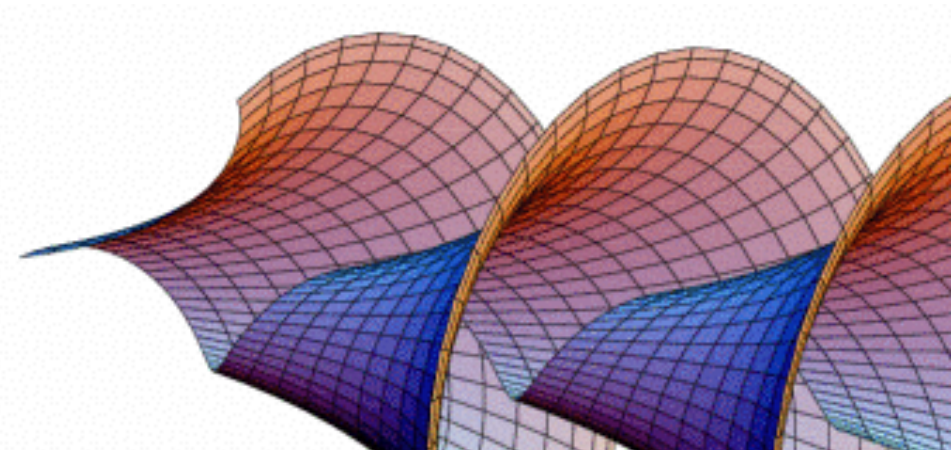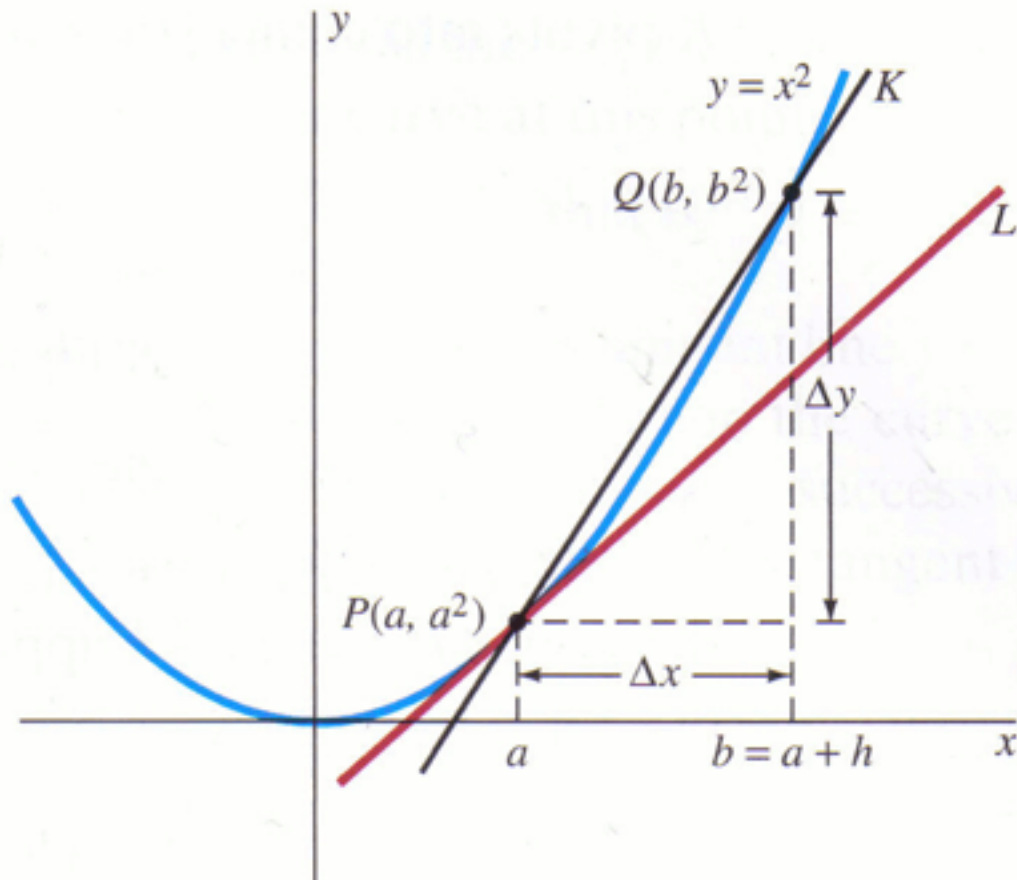The figure shows the parabola $y = x^2$ with points $P(a, a^2)$ and $Q(b, b^2)$, the secant line L, the tangent line K, with Δx, Δy, and $b = a + h$ labeled.
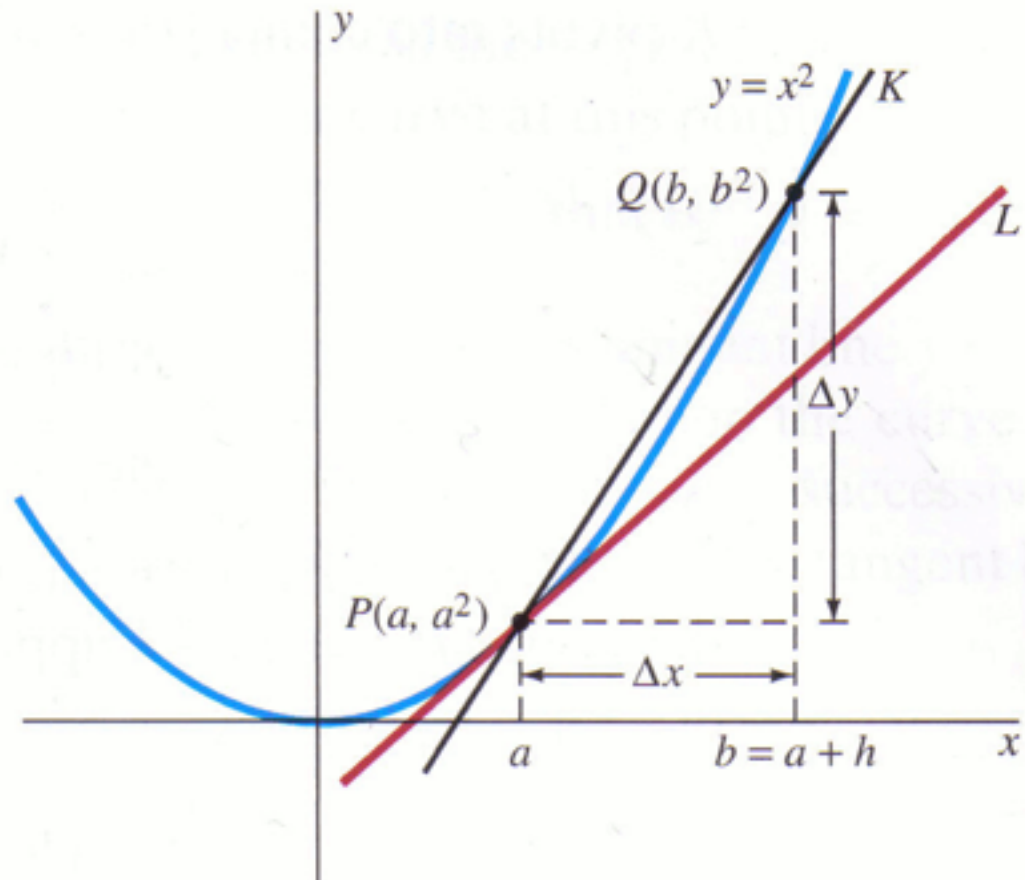
Average rate of change

S

A
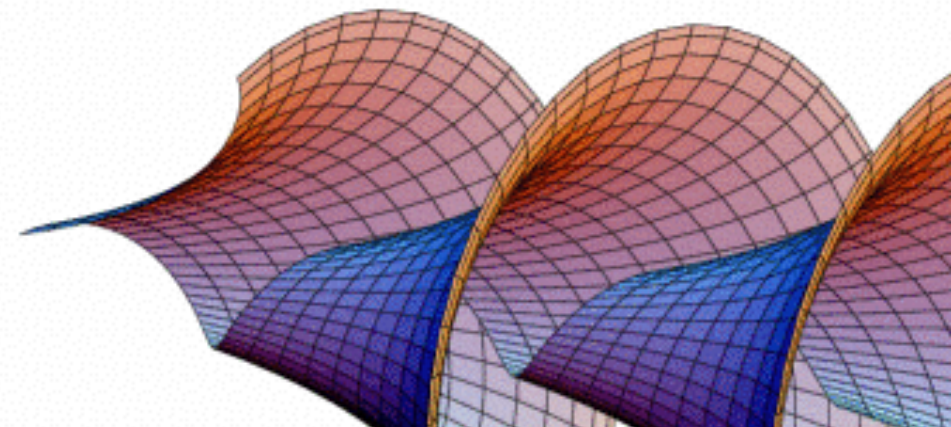fr
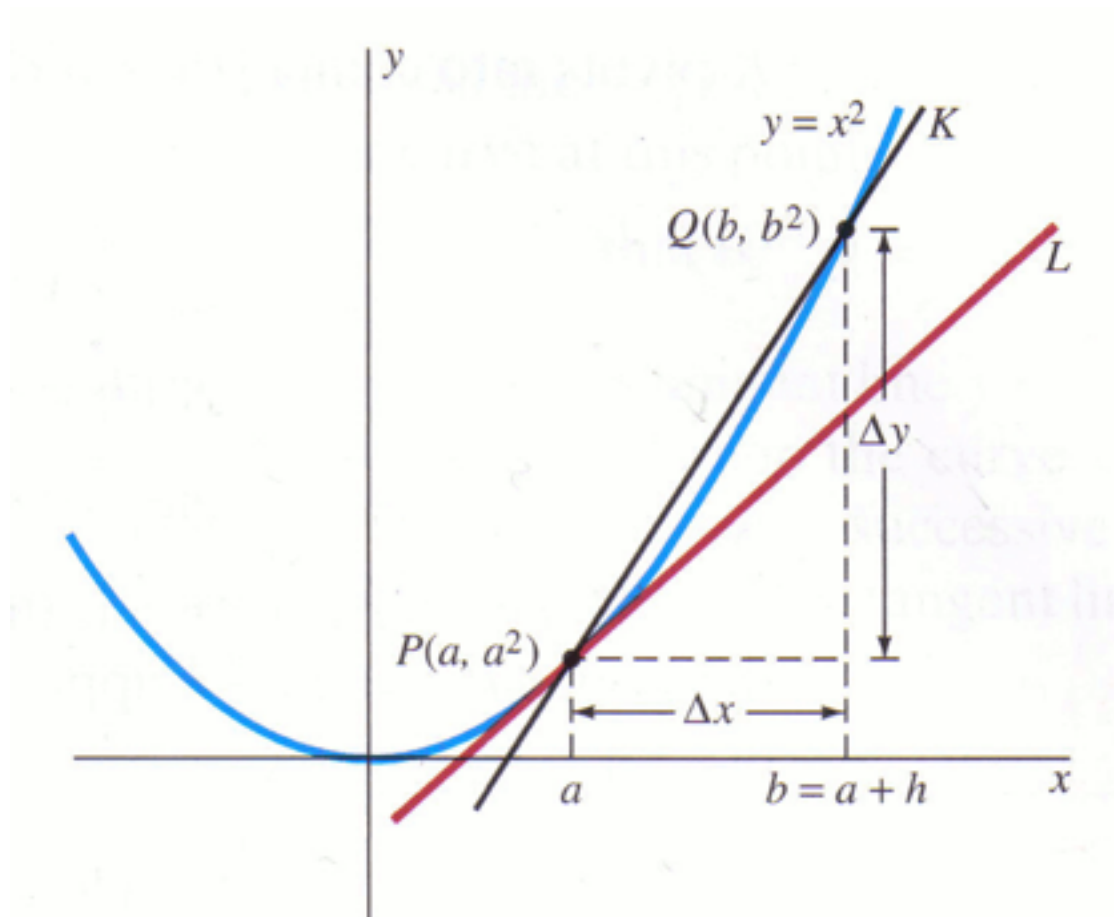
Average rate of change
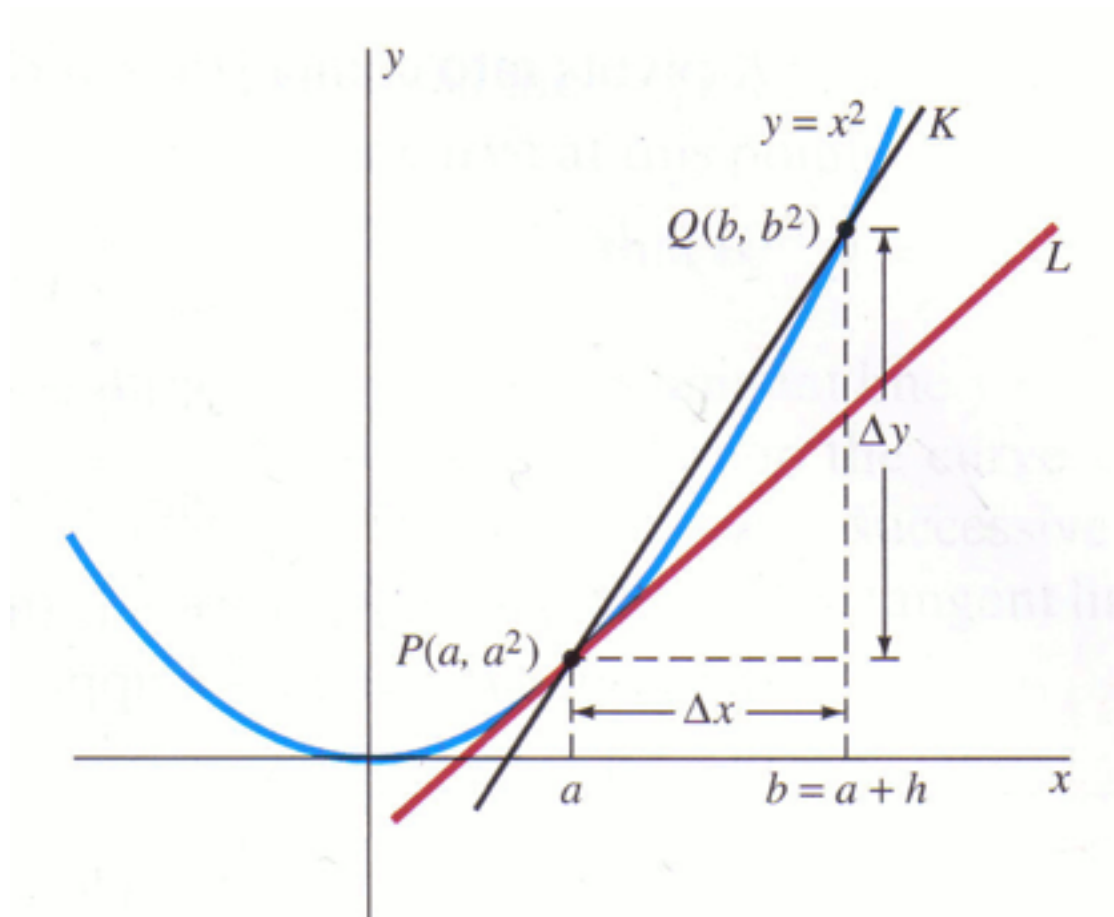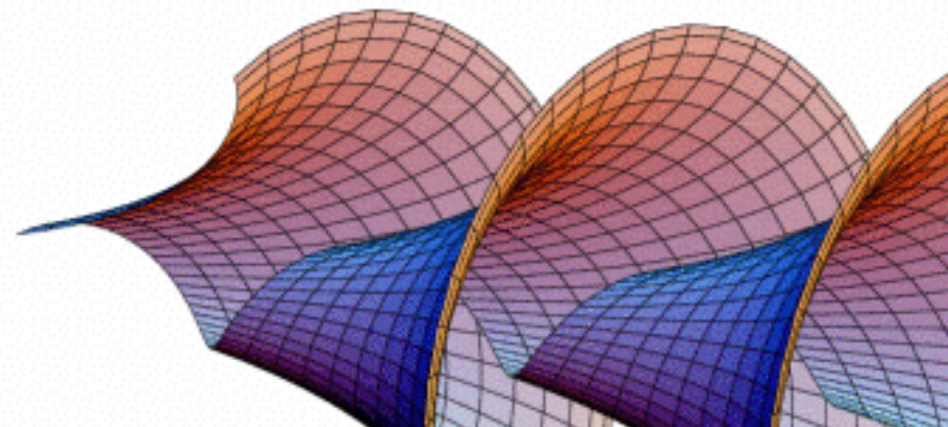

$$m = \frac{f(b) - f(a)}{b - a}$$

$$= \frac{f(a + h) - f(a)}{h}$$

Instantaneous rate of change

$$\lim_{b \to a} \frac{f(b) - f(a)}{b - a}$$

$$\lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

See you on Thursday =)

OSH0 :Tuesday Sept 13, 11:59PM

OSH1: Friday Sept 16

PL 2.2: Wednesday Sept 14, 7:00AM

$$\frac{\partial}{\partial t}$$