Welcome to
Math 102 Section 102

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Sep. 5, 2018

Math 102: Announcements

- Instructor: Mingfeng Qiu
- Email: mqiu@math.ubc.ca
- Course webpage: https://canvas.ubc.ca
  - Check the calendar!!!
- Sectional webpage: http://www.math.ubc.ca/~mqiu/m102.html
- Today:
  - Course information
  - Power functions and cell shape

Marking Scheme

- Homework
  - WeBWorK (online) - 15% (5% points dropped)
    - Pre-lecture
    - Post-lecture
  - Old-School Homework (written) - 20%
- Midterm (October 25) - 15%
- Final exam (Time TBD) - 50% ($\geq$44% to pass)
  - don't make travel plans yet!

Typical Math 102 Week

- Monday:
  - 8-8:50 am: Lecture
  - 11:59 pm: Pre-lecture WeBWorK due
- Wednesday:
  - 8-8:50 am: Lecture
  - 11:59 pm: Pre-lecture WeBWorK due
- Thursday:
  - 11:59 pm: WeBWorK due
- Friday:
  - 8-8:50 am: Lecture
  - 11:59 pm: OSH due (every other week)

Next Week

- Monday: WeBWork logistics assignment
- Tuesday: Pre-lecture WeBWork 1
- Wednesday: OSH 0
- Thursday: Pre-lecture WeBWork 2
- Friday: OSH 1
- Sunday: WeBWork diagnostic test

Resources

- Canvas (first place to check)
- Free online course notes and videos
- Lecture slides posted after class (sectional webpage)
- Your classmates (study groups)
- Math Learning Centre (LSK 301)
- Piazza
- Office hours: W 9-11, F 9-10 @ LSK 300B (temporary)
- UBC website

Class Reps

Liaison between the class and me

- Class rep duty: meet me briefly every 1-2 weeks
- Class: talk to your reps about any concern or things going well

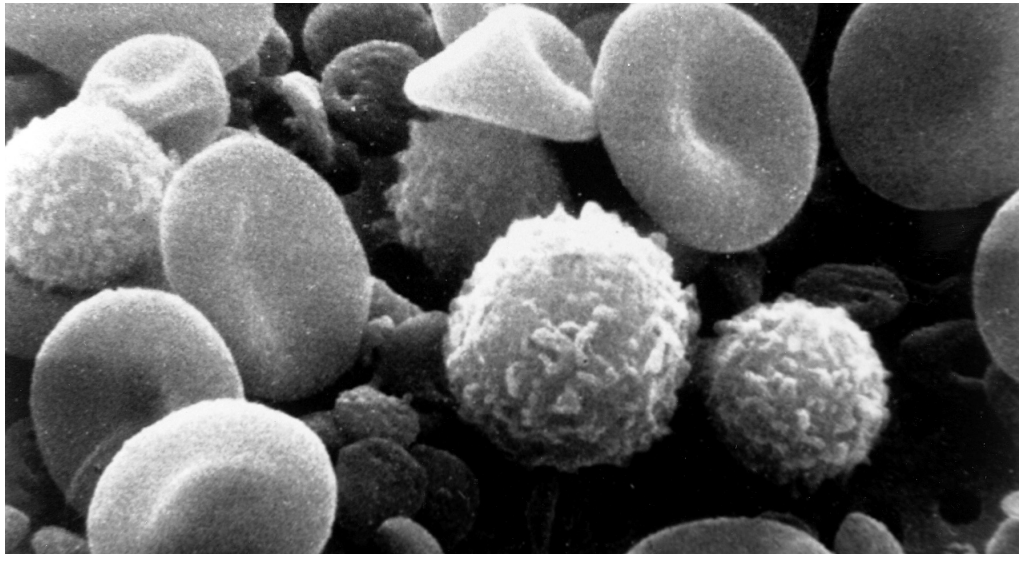
Lectures

- Before lecture: watch the online video/read the text
  - Bring questions to lecture
- During lecture: interact (register your clicker on Canvas)

How do I learn Math 102 well?

Mathematics is a language.

Cell shape



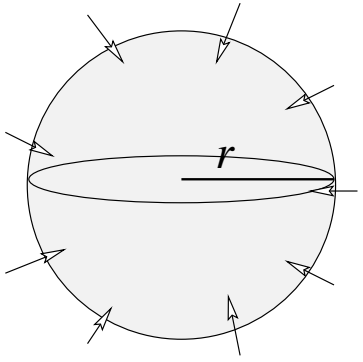
https://en.wikipedia.org/wiki/White_blood_cell/media/File:SEM_blood_cells.jpg

- Why can't a cell be as big as a baseball?
- Cellular Metabolism: balance of uptake and depletion of nutrients

Cell shape

- Mathematical model: description of the inner logic of a situation which simplifies things by representing the most important aspects.
- Step 1: make reasonable assumptions
  1. The cell is spherical.
  2. Nutrient absorbstion rate is proportional to surface area.
  3. Consumption rate is proportional to volume.
- Step 2: Express the relations in mathematical terms

Cell shape



1. Nutrient absorpstion rate is proportional to surface area

$$A = k_1 S = k_1 4\pi r^2$$

2. Consumption rate is proportional to volume

$$C = k_2 V = k_2 \frac{4}{3}\pi r^3$$

where k_1 and k_2 are positive constants called proportionality constants.

Cell shape

$$A(r) = 4\pi k_1 r^2 \qquad C(r) = \frac{4}{3}\pi k_2 r^3$$

Q1. Which of the following is true?

A. Absorpstion is greater than consumption for sufficiently large cells and vice versa for small cells.

B. Consumption is greater than absorption for sufficiently large cells and vice versa for small cells.

C. Both A and B are possible, depending on k_1 and k_2.

Power functions

- A function of the form $f(x) = ax^n$ (where a is a constant and n is an integer) is called a power function.

Example

$$A(r) = 4\pi k_1 r^2 \quad \text{and} \quad C(r) = \frac{4}{3}\pi k_2 r^3$$

are power functions with independent variable r.

Power functions

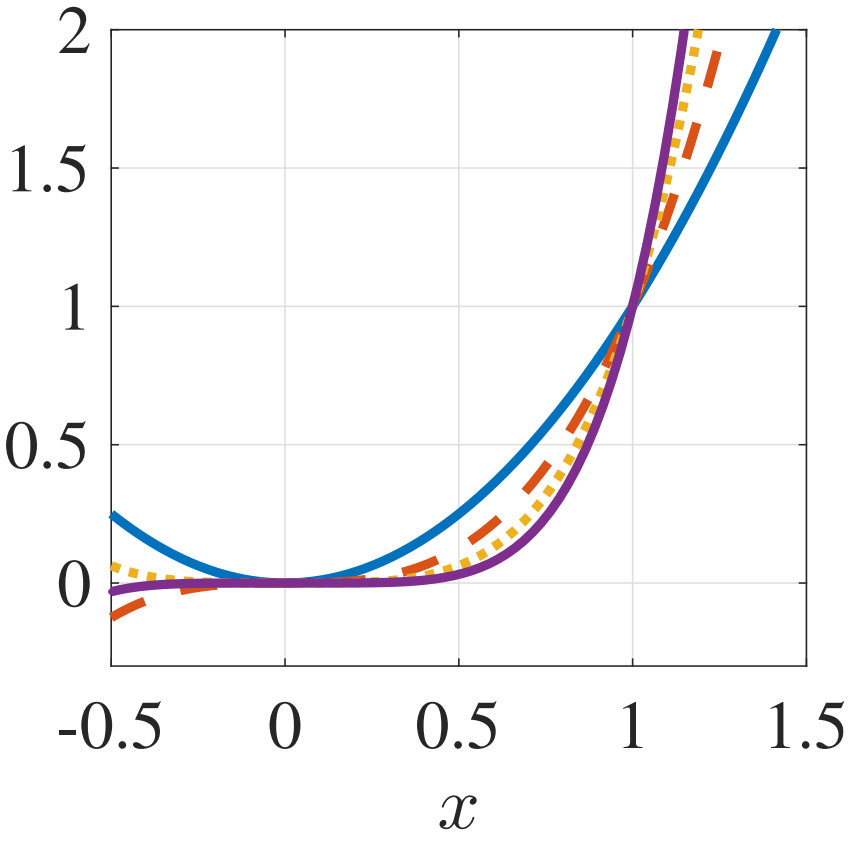
Q2. Match!

A. Red: x^3, blue: x^2, purple: x^5, yellow: x^4.

B. Red: x^5, blue: x^4, purple: x^3, yellow: x^2.

C. Red: x^3, blue: x^4, purple: x^5, yellow: x^2.

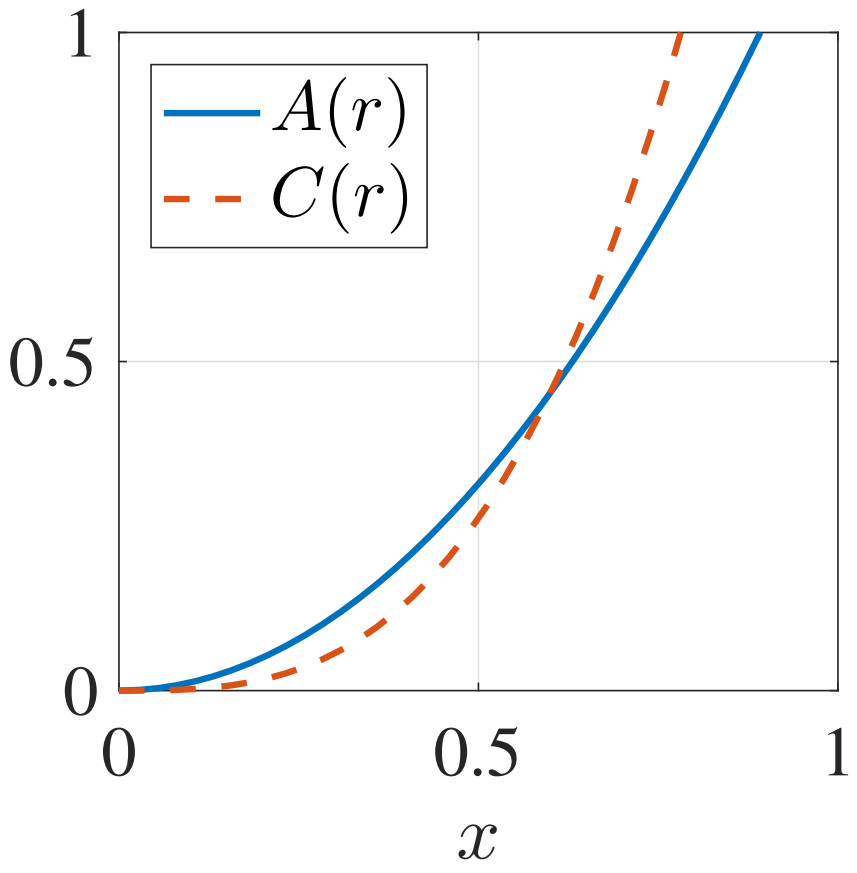
D. Don't know, please explain.



Cell shape

$$A(r) = 4\pi k_1 r^2$$
$$C(r) = \frac{4}{3}\pi k_2 r^3$$

Consumption is greater than absorption for sufficiently large cells and vice versa for small cells.



Limit on cell size

- When is the absorption rate greater than the consumption rate?
- i.e., for which values of r is the absorption rate $A(r)$ bigger than the $C(r)$?

$$A(r) = 4\pi k_1 r^2 > \frac{4}{3} k_2 \pi r^3 = C(r)$$

$$r < 3\frac{k_1}{k_2}$$

Does this agree with our prediction?

Limit on cell size

Q3. Which of the following cells can survive?

A. $r < 3\frac{k_1}{k_2}$

B. $r = 3\frac{k_1}{k_2}$

C. $r > 3\frac{k_1}{k_2}$

What about bigger cells, such as neurons or *Caulerpa prolifera* or Eggs?

Today...

- Course info!
- Math is a language.
- Cell shape and mathematical models
- Power functions: $f(x) = ax^2$ versus $g(x) = bx^3$. Which is bigger? For which x?
- It was a pleasure to meet you all! See you on Friday.

Answers

1. B
2. A
3. A,B

Acknowledgements

The slides are based on those of:

- Eric Cytrynbaum
- Leah Edelstein-Keshet
- Cole Zmurchok