

# Math 202 notes

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*Notes also available as PDF.*

## 1 Syllabus and class mechanics

The original syllabus is available.

## 2 Introductions

- Backgrounds
- Goals? (*i.e.* which grade levels?)

Remember: I'm a mathematician, not an elementary educator. help keep me on track for what **you** need.

Reminder that elementary is not a judgement, it's a description. when a mathematician or scientist uses "elementary", they mean to understand or solve a problem almost from first principles.

(*e.g.* Elementary functions like sine and cosine cannot be built simply from other functions.)

### 3 First "homework"

After checking the table of contents, for which topics in chaps 2-7 would you like the most review?

Via email, please. I'd like to have them while planning the next few classes.

## 4 Problem solving

- Goal is to build up mathematical "common sense"

### 4.1 Categories

- Problems to find
- Problems to prove

Emphasis for early years is the first, problems to find.

### 4.2 Pólya's stages

- Understand the problem
- Divise a plan
  - We will explore a taxonomy of plans
- Carry out the plan
- Examine the solution

Continuing example from Plya; uses the geometry of right triangles. A bit past elementary level, but it illustrates the right aspects.

### 4.3 Understand the problem

- What is known, the data?
- What is unknown?
- What is the relation or condition linking the data with the unknown?
- initial guess: is it possible to satisfy the condition?

Find the diagonal of a box (rectangular parallelepiped, like the classroom) of which the length, width, and height are known.

#### **draw the figure**

(dialog not including additional prodding, etc)

**Me** What is the unknown?

**class** length of diagonal

**Me** What is the data?

**class** length, width, and height

**Me** Help me write it. What notation should be use?

**class**  $x$  for the unknown,  $a$ ,  $b$ ,  $c$  for the sides.

**Me** So what is the relationship between  $x$ ,  $a$ ,  $b$ , and  $c$  in words? Don't be fancy, *etc.*

**class**  $x$  is the diagonal of the box with side lengths  $a$ ,  $b$ , and  $c$ .

**Me** Does the problem sound reasonable? Can the condition be satisfied at all?

**class** yes,  $a$ ,  $b$ , and  $c$  completely determine the box, and so also the diagonal

### 4.4 Devise a plan

Do you know of a related problem?

(tea kettle joke about reducing to an already solved problem)

Look at the unknown. Do you know of a similar problem with the same type of unknown? It's a length.

If remembering length of a hypotenuse, good!

Otherwise: can you think of a similar but simpler problem?

Keep close to the actual problem by checking that all relevant data are used, and that the entire condition is used.

(most explicit hint to use: Can you find a triangle?)

## 4.5 Carry out the plan

Add additional notation for the new length,  $d$ .

Apply Pythagorus.

Smaller triangle:  $a^2 + b^2 = d^2$ .

Apply to larger triangle:  $d^2 + c^2 = x^2$ .

So:  $a^2 + b^2 + c^2 = x^2$ .

## 4.6 Looking back

Can you check or verify the result? Test it?

Did you use all the data?

Can you reach the same conclusion differently?

Does this reduce to the simpler case? Do the dimensions match?

Can you think of similar problems to which this may apply? (*e.g.* distance from the center to a corner)