

## 3 Tuesday Agenda

Firstly, let's complete the agenda from yesterday!

1. We can use coordinates to describe transformations of the plane. For each of the given transformations, describe their effect on points of the plane, coordinate axes, and characteristics they leave invariant. To pre-emptively strike: Yes, I know. I should have two sets of parentheses. But why bother?

Try to make predictions about what will happen before you "graph" these.

$$f(x, y) = (x^3, y^3)$$

$$h(x, y) = (\sqrt[3]{x}, e^y)$$

$$j(x, y) = (-x, x + 3)$$

$$m(x, y) = (3y, x + 2)$$

$$p(x, y) = (0.6x - 0.8y, 0.8x + 0.6y)$$

$$g(x, y) = (2x, 3y)$$

$$i(x, y) = (\cos x, \sin x)$$

$$l(x, y) = (x^3 - x, y)$$

$$n(x, y) = (x + 2, y - 3)$$

$$q(x, y) = (-0.6x + 0.8y, 0.8x + 0.6y)$$

2. Lines, distances and angles

- Lines

- Thales
- Slope
- Equations

Descartes viewed equations of lines as information deduced from Euclid's axioms. But we could do it in the opposite direction! Use equations to define lines (gasp!) and then you can deduce some of Euclid's axioms, eg:

- there is a unique line through any two distinct points,
- for any line  $\ell$  and point  $P$  outside  $\ell$ , there is a unique line through  $P$  not meeting  $\ell$ .

- Distances: Pythagora tells us what it ought to be: or define it then Pythagora comes for free....
- Angles: tricky business... Hello, trigonometry.

3. Drama Club: Going round in circles

4. Problem set #1.

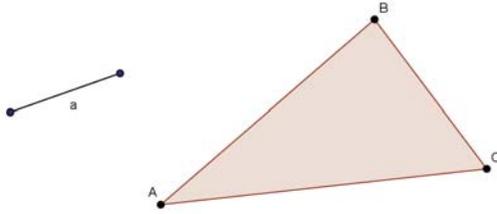
So, remember that problem of coordinate plane having a special point and two special lines whereas Euclid's plane did not have those (that was some socialist country, right there: all points made equal...)

### 3.1 Translations

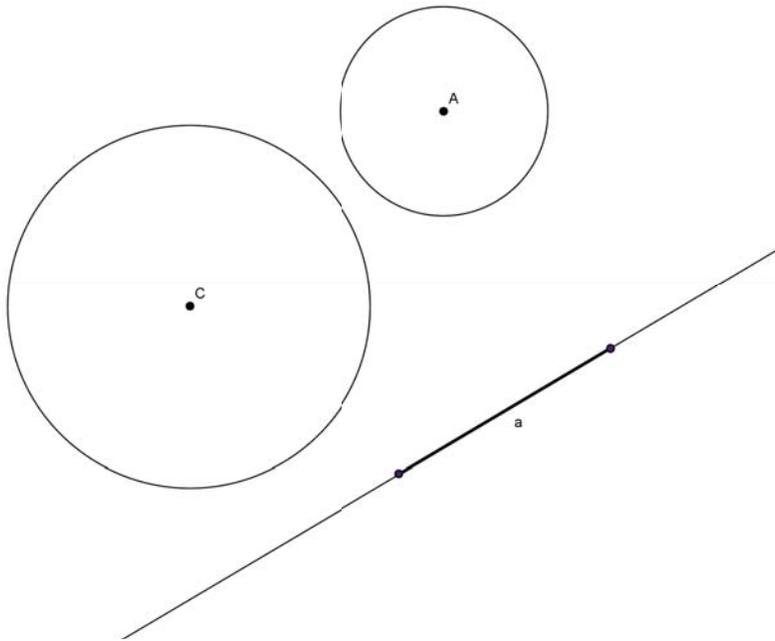
1. Definition
2. How do we show that translations preserve length?

3. What else do translations preserve?
4. Group of translations  $\mathcal{T}$
5. Students often think of translations as translating in the left/right direction, then up/down direction. Why might this be a problem, and why isn't it?

**Question 3.1.** In  $\triangle ABC$  "inscribe" a line segment equal and parallel to the given segment  $a$ .



**Question 3.2.** Two circles  $c_1$  and  $c_2$  and a line  $\ell$  are given. Locate a line, parallel to  $\ell$ , so that the distance between the points at which this line intersects  $c_1$  and  $c_2$  is equal to a given value  $a$ .



**Question 3.3.** This is one of those: what's the shortest path between two points kind of problems that we dress up with a little context:

Two cities, Parallelofield and Circleville, are separated by a river. They'd like to build a road between the two for the most efficient travel and you're the engineer. Or whoever builds bridges. As always, this context is totally unimportant :) So, umm, where would you build the bridge?

*Extension* What if there are several rivers between the two cities?