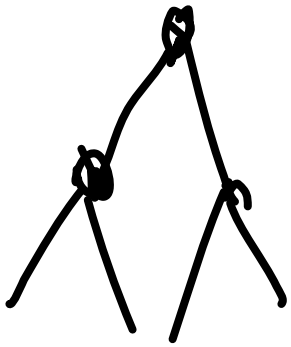
M106 Summer 2020 Recitation Lectures: Symmetries

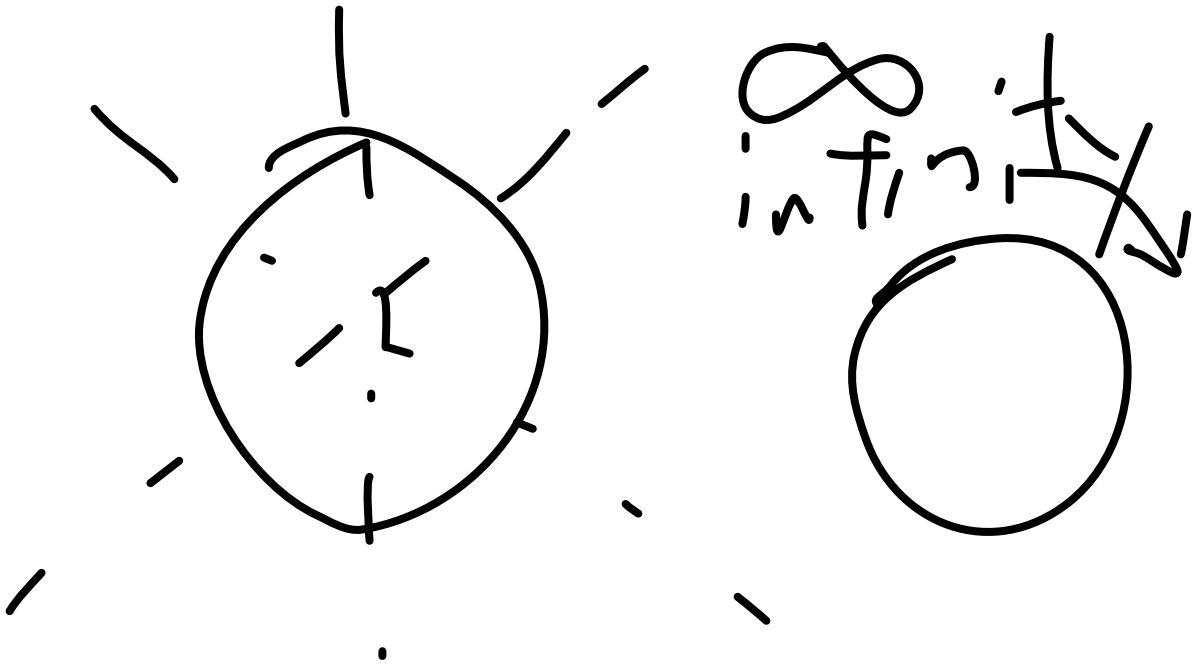
6/6 Practice Lecture

Alex Goodlad

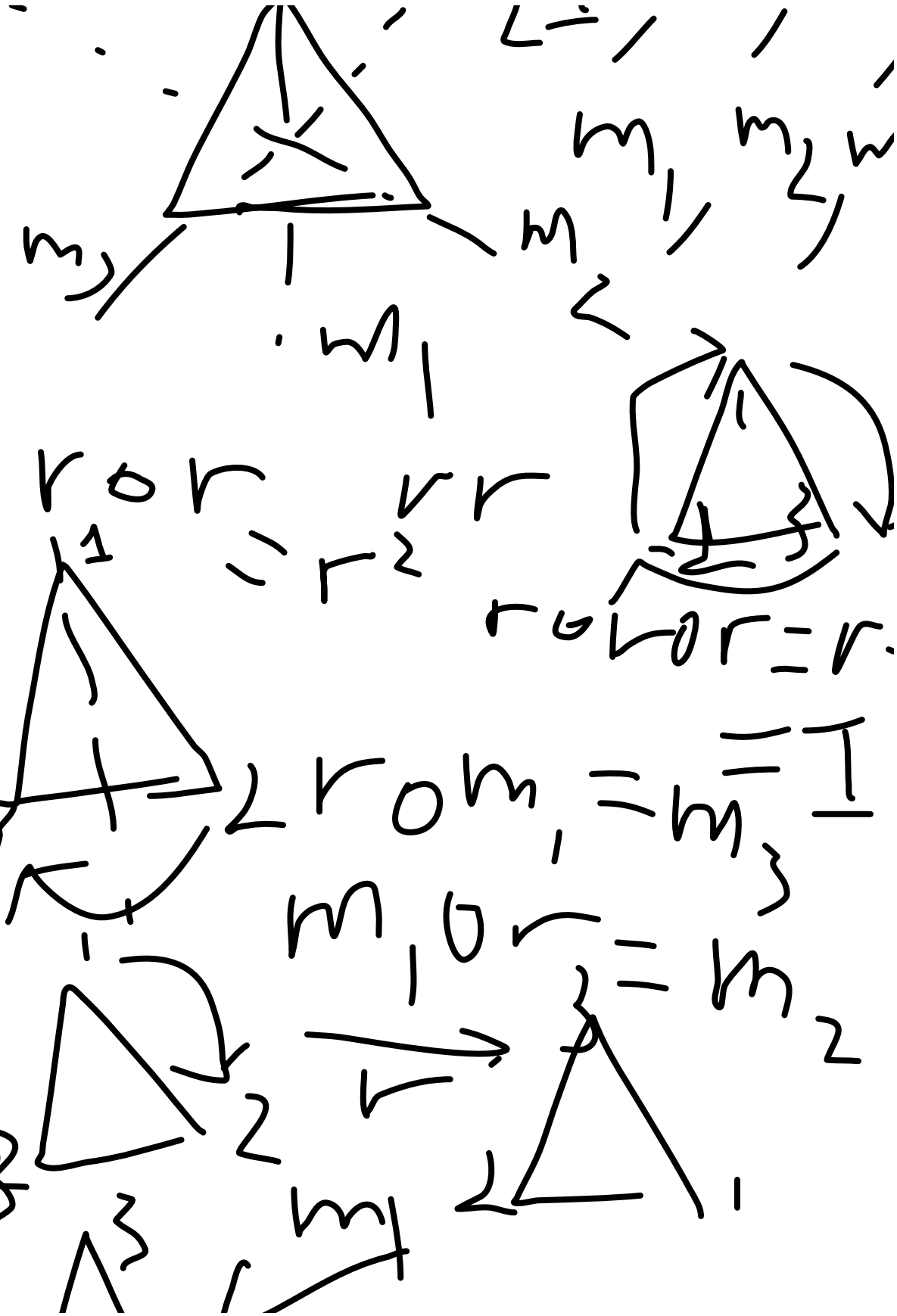
M106



6/9 Lecture

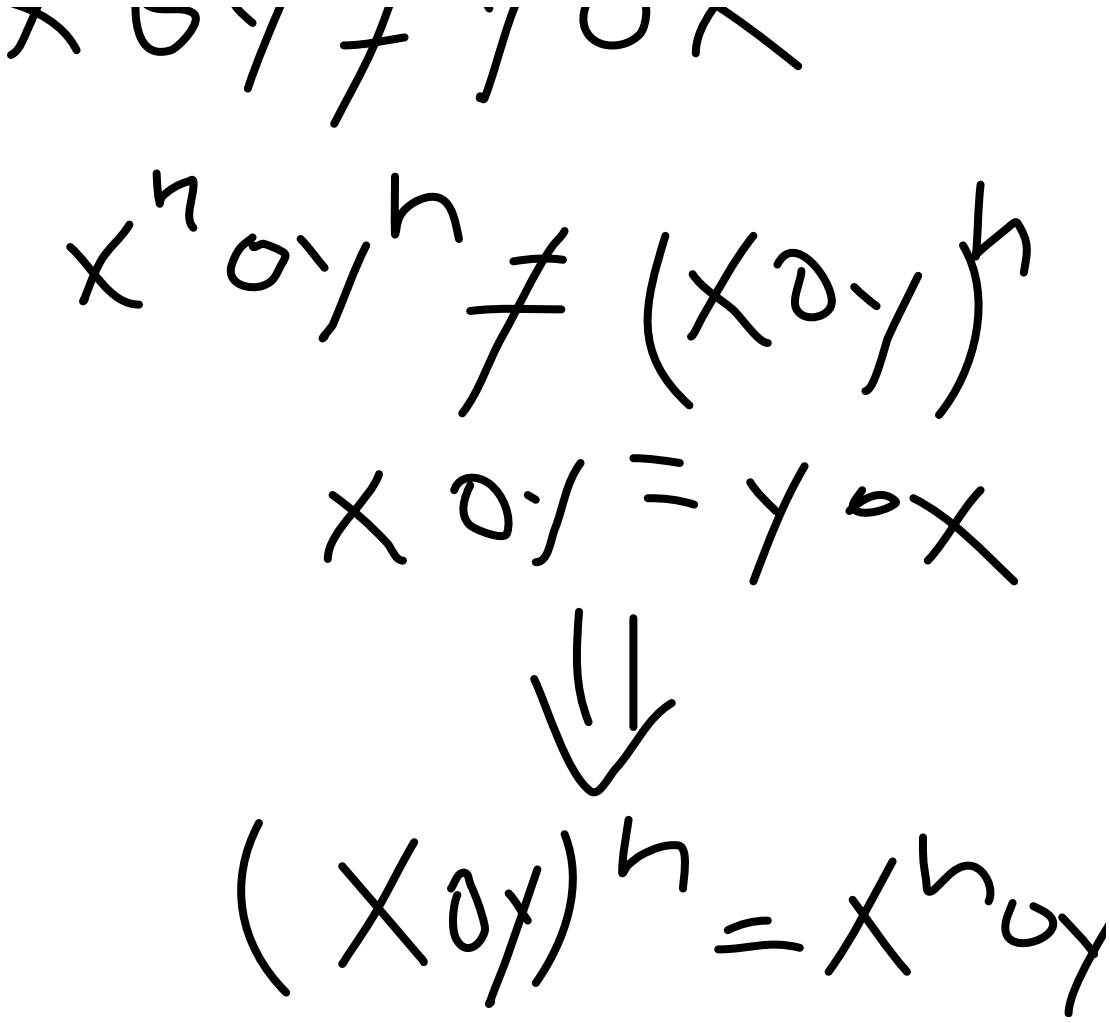


Theorem 2.6 (Symmetries of Finite 2D Figures).Every symmetry of a finite 2D-figure is one of the following:□Trivial symmetry□Rotation□Reflection


m1 m2 m
m1
r o r = r²
r o r = r
r o m1 = m3
m1 o r = m2
r

the columns apply first

rows go second



6/10 Lecture:

SHUT DOWN STEM STRIKE

6/11 Lecture:

Recap (on 6/9):
-Compositions (Class 3)
-Composition Tables (Class 4)

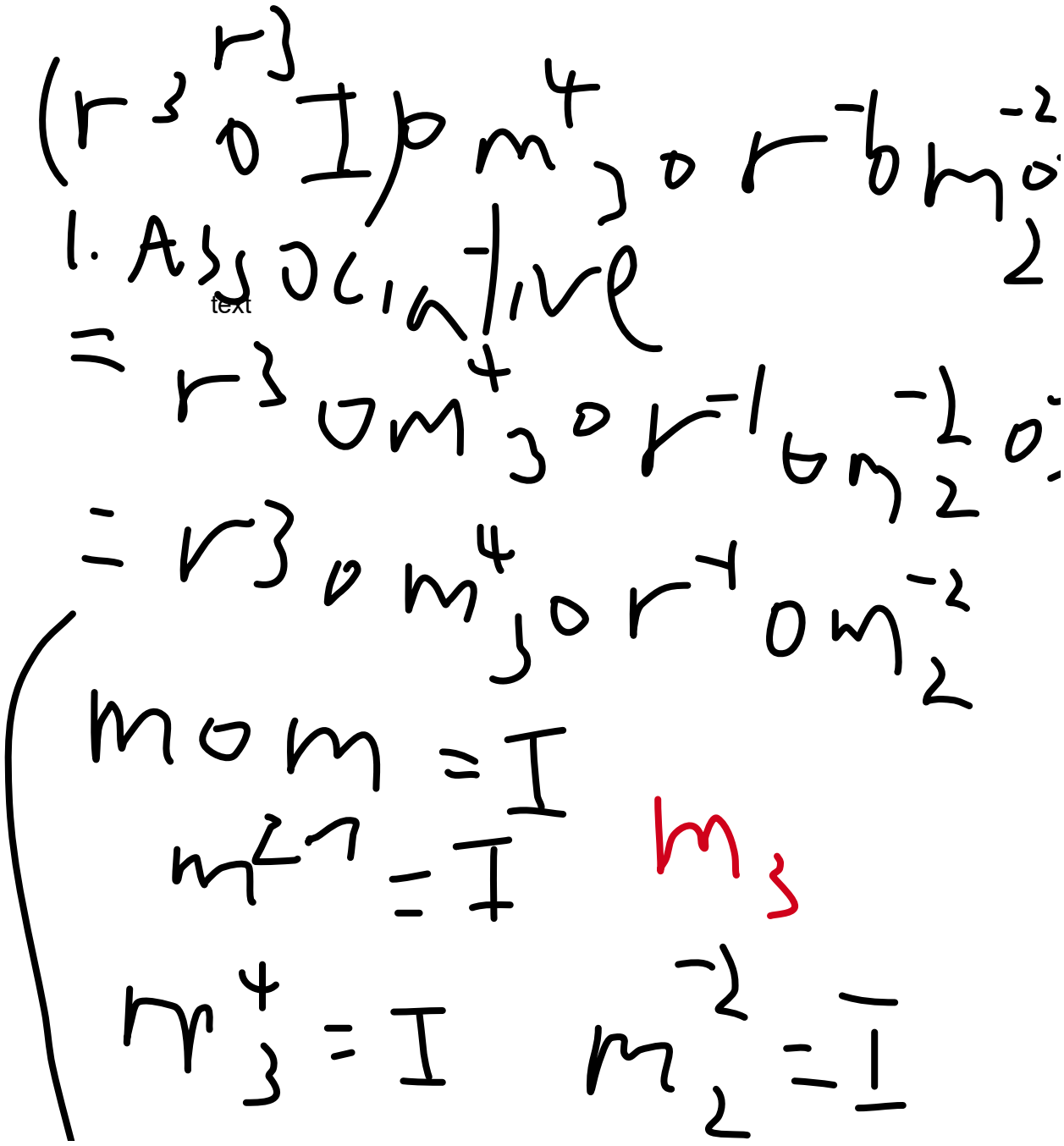
Homework/Exam:
-Homework 1 due TONIGHT (11:59 pm)
-Homework 2 due TOMORROW NIGHT
-EXAM on Monday (6/15)

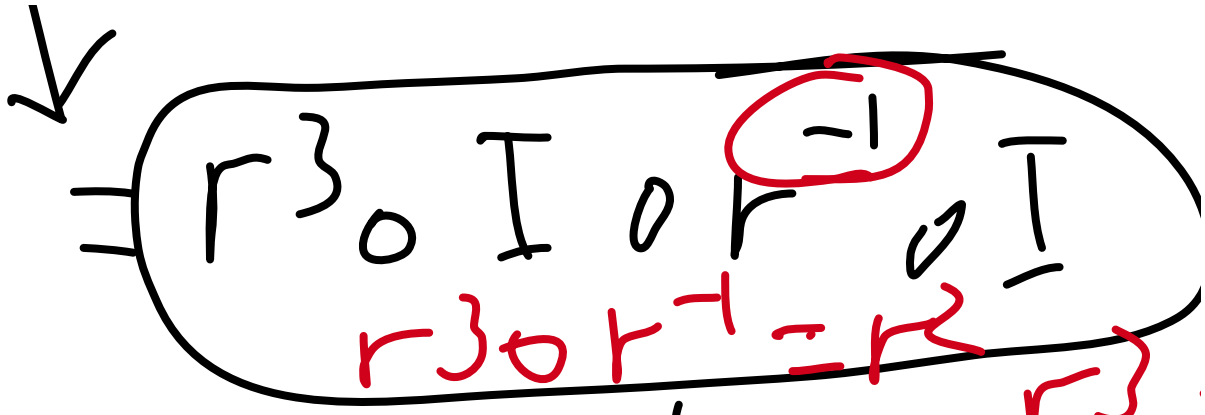
-Homework 3 due MONDAY (6/15)

Questions on ANY homework?

-Homework 2 question 1

r3◦I ◦ m43◦ r−1◦ m−22◦ I
$r^3 * I * m^3$

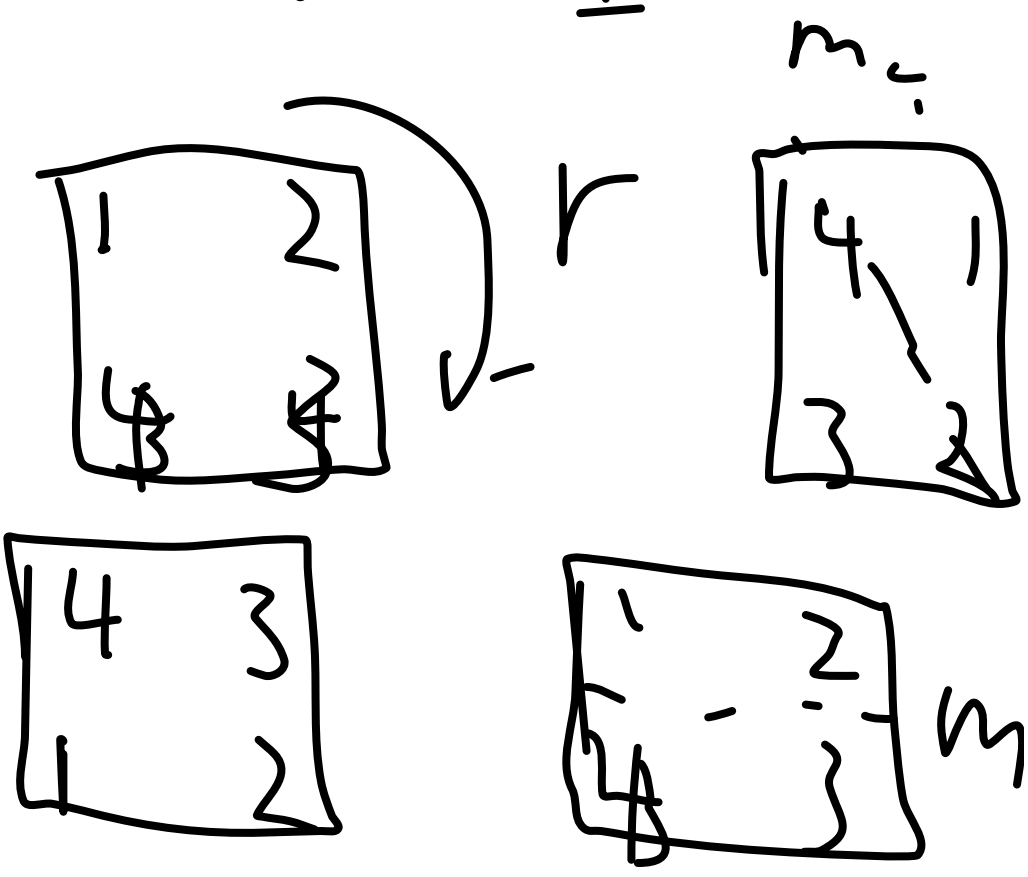




$r \circ r^{-1} = T = I$

$r^3 \circ$

$x \circ x^{-1} = T$

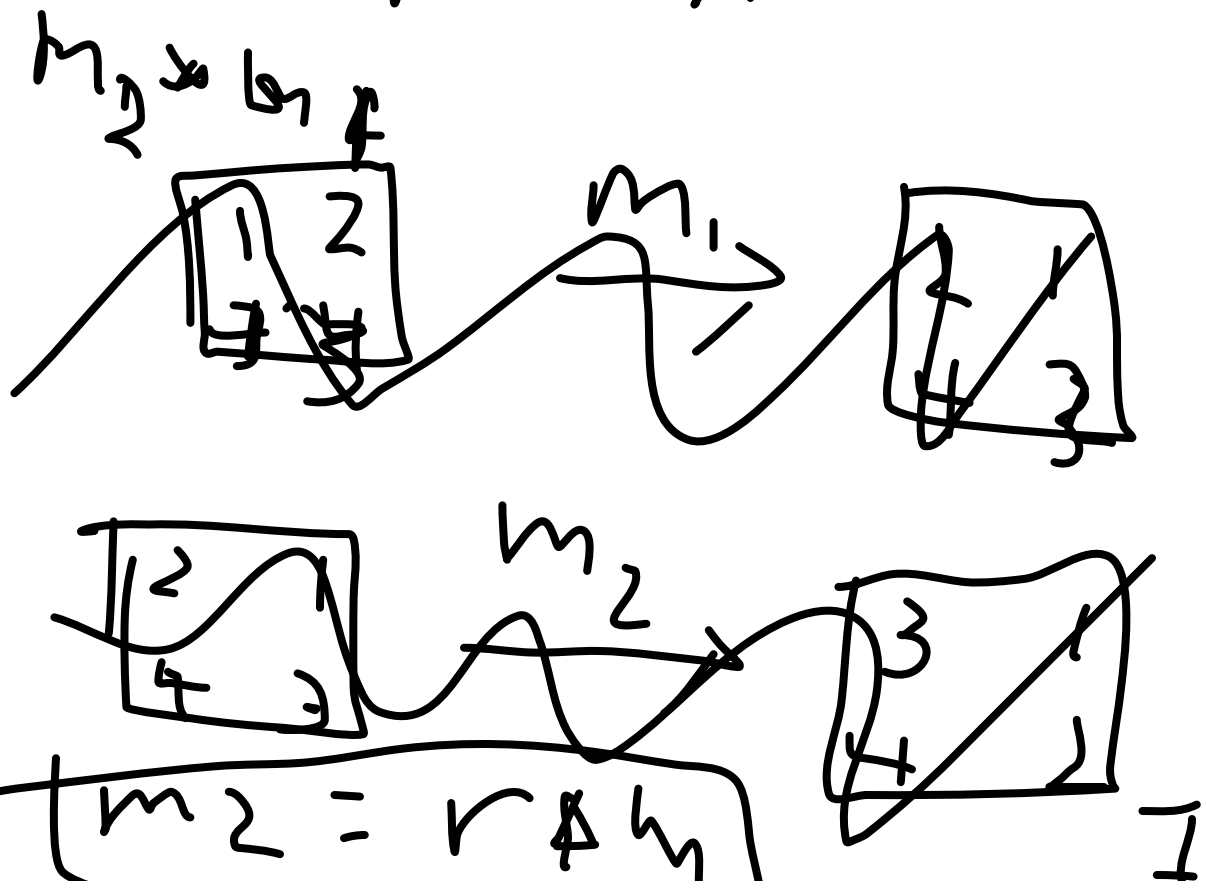


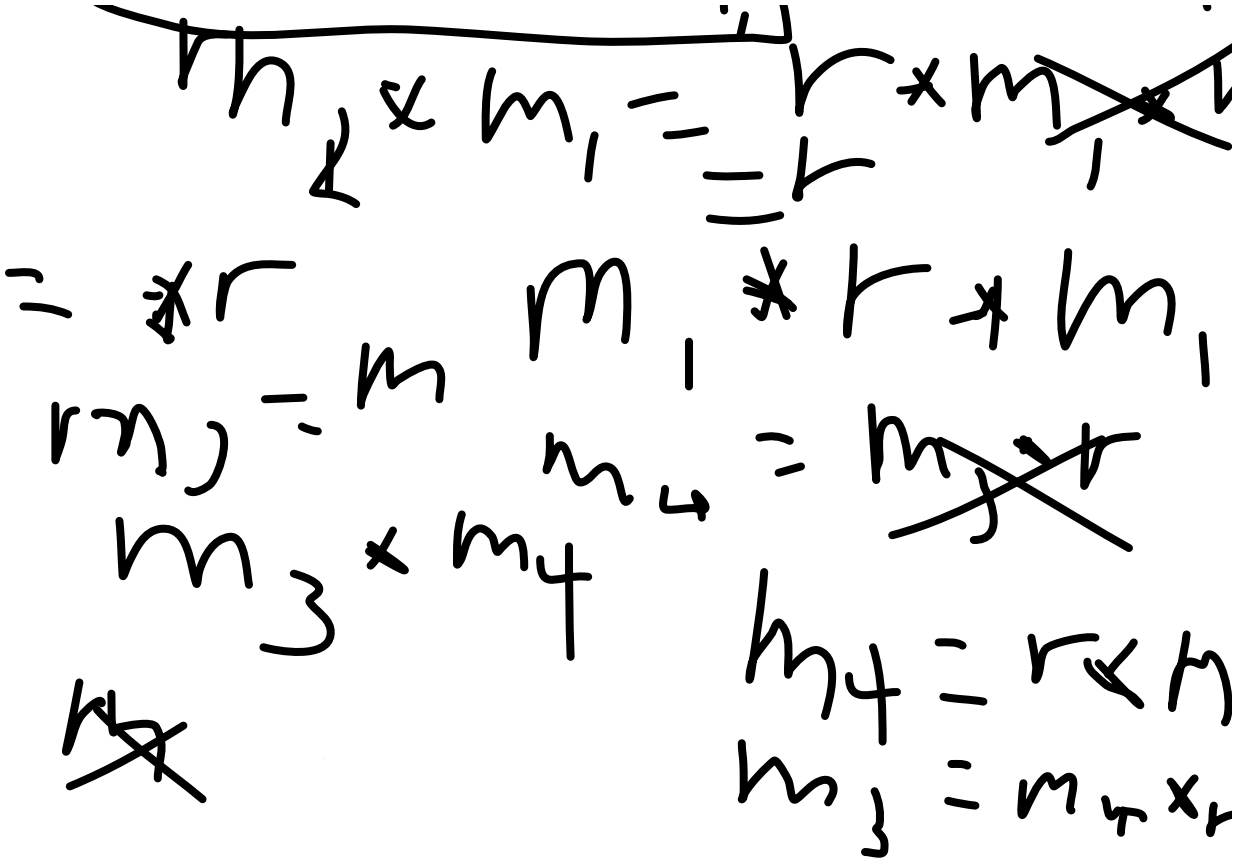
$\{1, r, r^2, r^3$

$r^3 * r = r^4 = I$

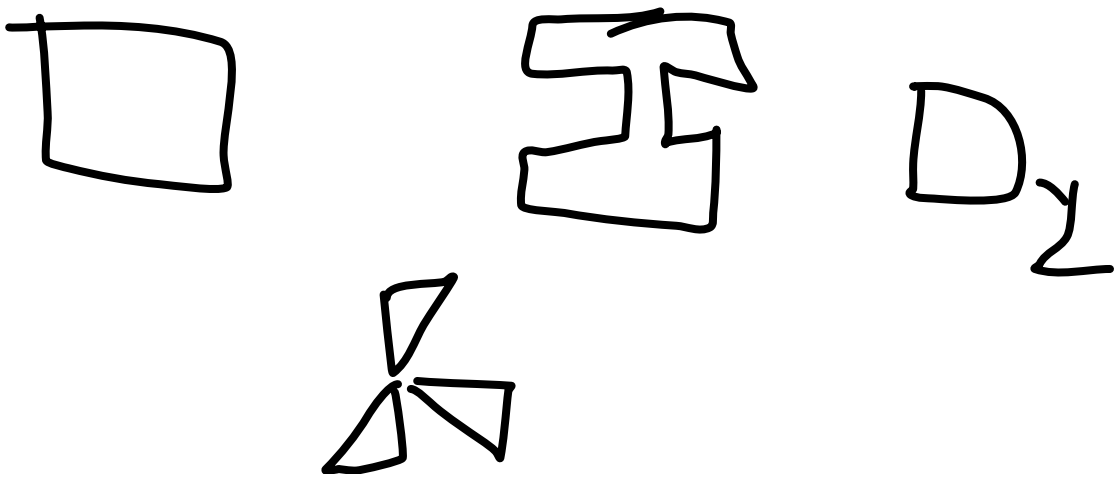
$r^m * r^n = r^{m+n}$

$x^m * x^n = x^{m+n}$





A polygon has the same SYMMETRY TYPE if it has the same composition table



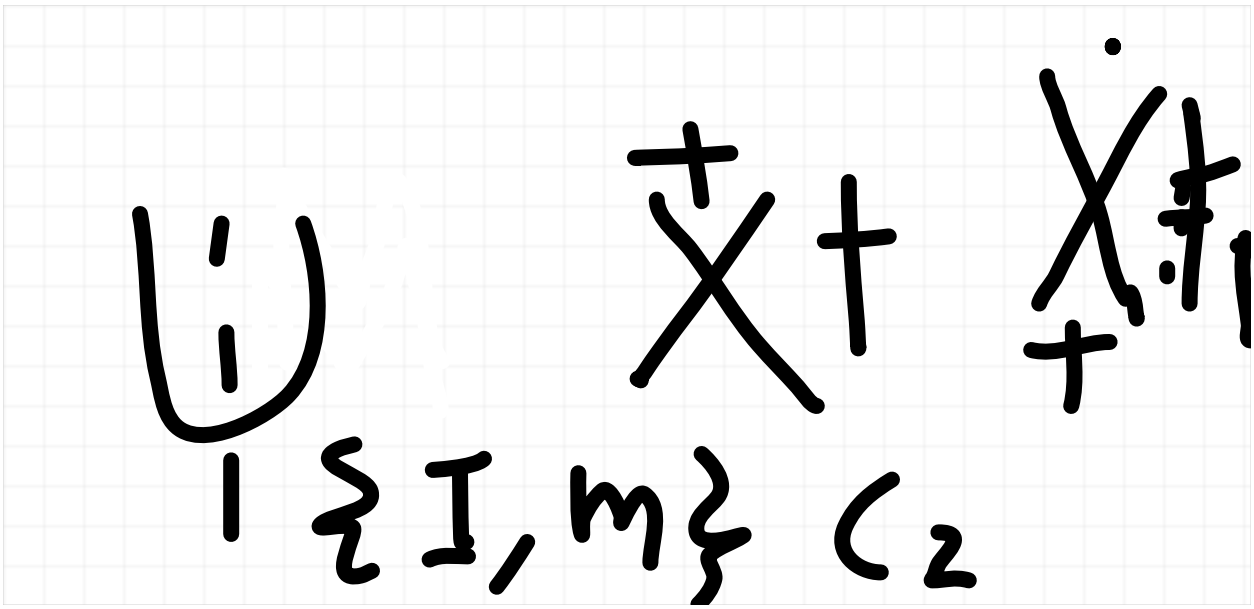
D_n is an n-gon
C_n the symmetry type of an n-pinwheel

Theorem: Every finite figure has symmetry type D_n or C_n

C_1

In Homework 2 Question 2:
Any letter has symmetry type D_n or C_n

Symmetry type of letter A: $\{I,\ m_1\}$ C_2



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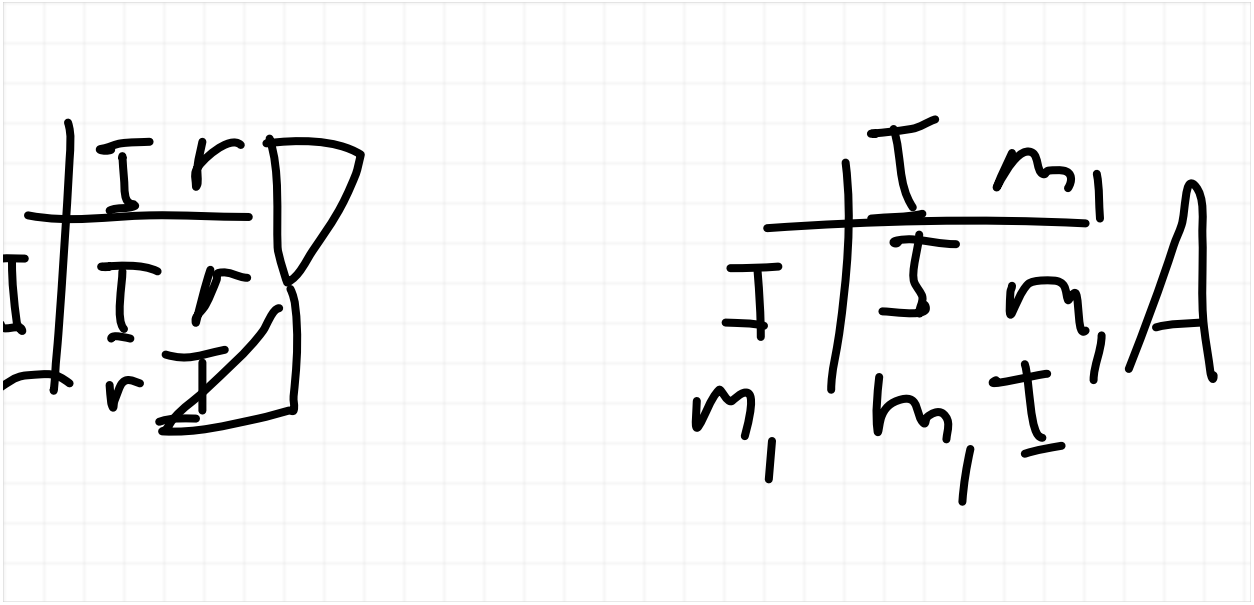


C_2 is a special case of the "pinwheel" symmetry type, where any shape containing only one reflection OR only one rotation has that same symmetry type.

Plan for Tomorrow:
Infinite symmetries (Class 6-7)
Frieze patterns (Class 8)
Homework 3 is based on those classes

6/12 Lecture

Announcements:
Office hour doodle poll AFTER CLASS
Review Session THIS WEEKEND (doodle poll for that AFTER CLASS as well)
Game Theory is up

Upcoming Assigments:
-Homework 2 (due Tonight)
-EXAM ON MONDAY AT CLASS TIME
  *Given on Canvas (you will download PDF)
  *2 hours AFTER USUAL CLASS TIME (factoring in for any tech difficulties)
  *WILL NOT BE PROCTORED
  *DON'T CHEAT

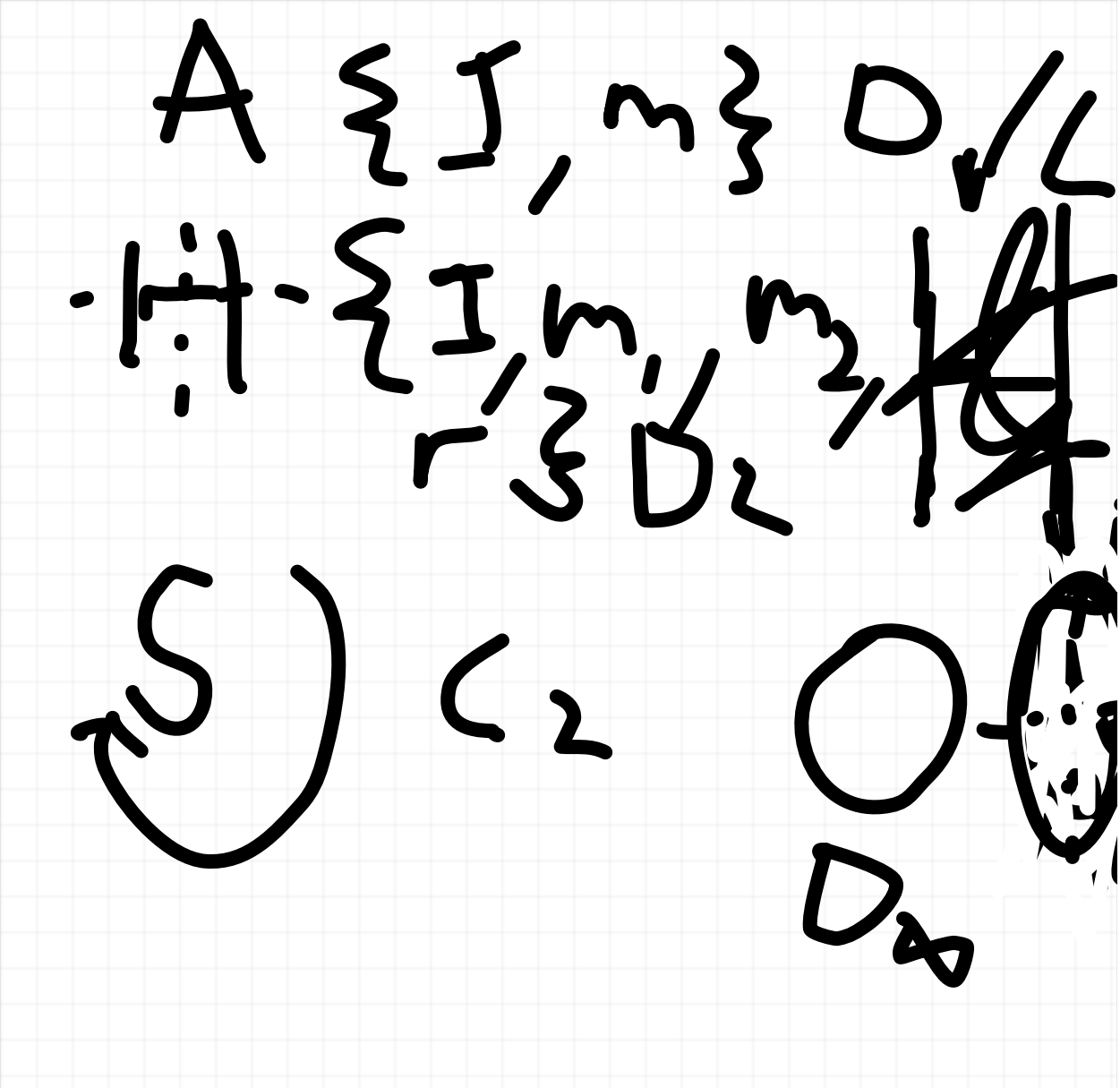
-Homework 3 (due Monday night)

Previously (on the exam):
*Symmetries of finite figures (class 2)
*Composing symmetries (class 3)
*Composition Tables (class 4)
*Symmetry Types (class 5)

Upcoming:
*Infinite Symmetries (class 6-7)
*Frieze Patterns (class 8)

Questions Homework 2&3?
Expect grades for Homework 1&2 Saturday

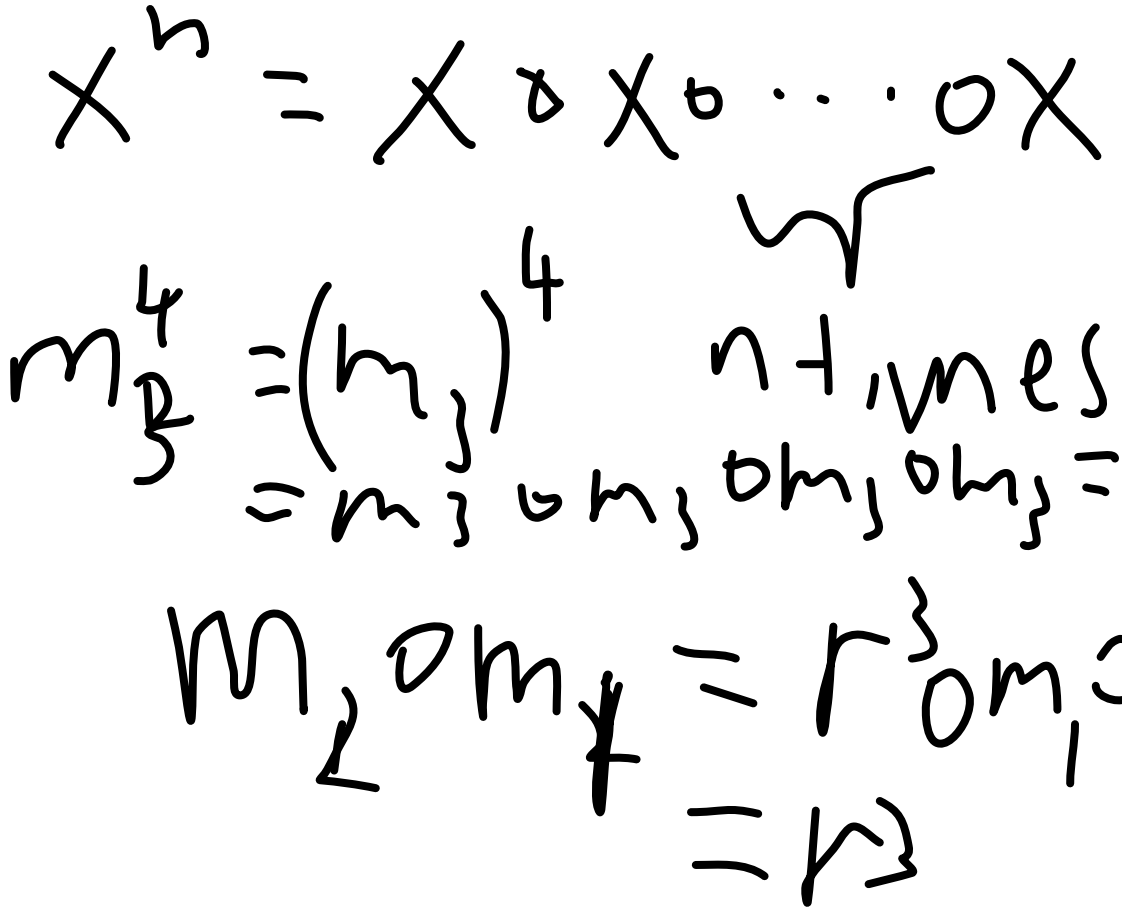
Homework 2 Question 2



NOTE: Symmetry types WILL be used more than once

NOTE FOR HOMEWORK 1 QUESTION 1 B: The trivial symmetry will only be used only once. More generally speaking,

M106 Study Sesh



Infinite Symmetries:

Classes 1-5 talked symmetries of finite shapes
Classes 6-8 deal with infinite symmetries
As before infinite symmetries have rotations (including trivial symmetry and nontrivial rotations) and reflections
With infinite symmetries, THERE IS TWO MORE KINDS OF SYMMETRIES
-Translation symmetries
-Gliding symmetries

Theorem: Symmetries of an xy-plane consist of the following
*trivial
*translations

*reflections (with respect some line)
*rotations (within a single center)
*glide reflections

Theorem: Every frieze pattern always has the trivial and translational symmetries. Only possible additional symmetries include the following:

-(R) Rotation by 1/2-turn
-(V) Reflection in vertical lines
-(H) Reflection in horizontal line
-(G) Glide reflection in the horizontal line

-Symmetry represented sub-string of TRVHG

-T
-TR
-TV
-TRVH
-TRVHG
-And so on...