Homework #3 Math and the Art of MC Escher

Wallpaper Groups. Due Wednesday September 23, 2009

#1. [30 pts] Decide which of the 17 symmetry groups each of these Escher drawings has. You can ignore colors. For highest degree rotation just write down the number. For the reflections and glide-reflections question, just write down yes or no. One example was done for you.

Print	Highest degree rotation	Are there reflections?	Are there glide-reflections	Symmetry Group
Sketch #3	4	YES	YES	P4G
Sketch #6 (Camels)				
Sketch #13 (Dragonflies)				
Sketch #21 (Men)				
Sketch #67 (Horsemen)				
Sketch #69 (Birds, fish, turtles)				
Sketch #105 (Pegasus)				
Sketch #119 (Fish)				

#2 [20 pts] Find four different patterns used for laying bricks (look around). Sketch them on graph paper, and decide which symmetry group each one has.

Attach your sketches to the back of the assignment.

#3. [20 pts] Flip through Escher's regular division notebook, pages 116-229 of Visions of Symmetry. Find ten sketches featuring four-legged mammals. (A four-legged mammal has four legs, and is a mammal - horse, dog, pegasus, lion, etc. etc. No people, fish, lizards.)

a.. Find the wallpaper symmetry group for each of the ten sketches (see Visions of Symmetry page 330).

Print #	Symmetry Group	Print #	Symmetry Group

b. How does Escher's choice of symmetry group change between the early (low-numbered) prints and the later (high-numbered) prints?

c. Explain why you think he made this deliberate change.

d. Do you find the patterns in the later sketches more satisfying? Why or why not?

#4. [20 pts] In the border pattern section we constructed some borderpatterns by picking a motif and then reflecting, rotating and glide reflecting the motif until we had a pattern with the desired symmetries. Use the letter P as your starting point:

a. The symmetry group p1 has only translations in its symmetry group. Create a p1 tessellation using the letter P. Remember that you need to show a pattern!

b.. The symmetry group pm has only translations and reflections in its symmetry group. Create a pm tessellation using the letter P.

c. The symmetry group p4 has only translations and 4-fold rotations in its symmetry group. Create a p4 tessellation using the letter P.

d. Pick one other symmetry group and create a tessellation with that group. Remember that you need to show a pattern! Label the tessellation with the symmetry group you chose.

#5 [15 pts] The Cosmati were a family of artisans in Medieval Rome who laid beautiful tile floors throughout the city, notably in many of the churches of the period. The examples below are pictures taken at Santa Maria in Cosmedin. Find the symmetry groups of these tilings.
See http://mathcs.slu.edu/escher/index.php/Wallpaper_Exercises Problem 9 on that page.

Floor Pattern	Highest degree of rotation?	Are there reflections? Yes/No	Are there glide-reflections? Yes/No	Symmetry group
Pattern A				
Pattern B				
Pattern C				
Pattern D				

#6 [15 pts] The ancient Egyptians decorated their tombs with some interesting patterns. Find the symmetry groups of these tilings.
See http://mathcs.slu.edu/escher/index.php/Wallpaper_Exercises (problem 10 on that page)

Egyptian Pattern	Highest degree of rotation?	Are there reflections? Yes/No	Are there glide-reflections? Yes/No	Symmetry group
Pattern A				
Pattern B				
Pattern C				
Pattern D				