Here is a partial sample exam so that you can have some practice with some diverse examples of the formatting and questions. **The actual test will differ. See also the study guide**.

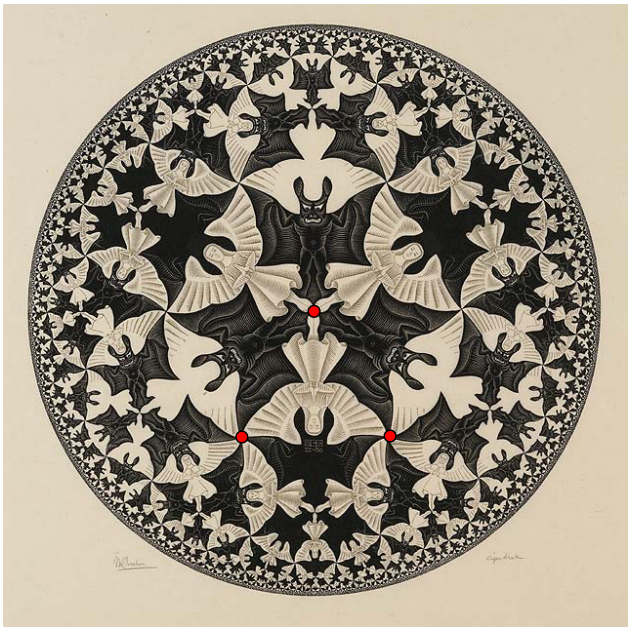
Exam 2 Math 1010 - NAME _____

I'll fill out: exam grade_____ ASULearn missed_____ classes missed_____ expected course letter grade____
expected value of course grade: .50exams +.30ASULearn engagement +.05class engagement +.15final project

Follow the directions carefully. Your grade will be based on the **quality and depth** of your responses in this timed environment. Please note that informal phrasing and bullet points are fine.

Part 1: Individual Work

In *Heaven and Hell,* from 1960, M.C. Escher has created creatures "living" in a 2-dimensional space, which may or may not be flat, onto the page, which is definitely flat. The creatures are all the same size in their own world. In the picture below, I have labeled three points. Calculate the sum of the angles in the triangle formed by these and then use the sum to determine whether this space is Euclidean, spherical or hyperbolic. Show your calculation work too.



Angle 1 calculation:

Angle 2 calculation:

Angle 3 calculation:

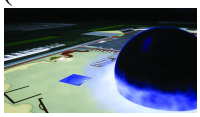
Sum of the angles:

Euclidean, spherical, or hyperbolic space?

Are there any intrinsically straight parallels (i.e. from the perspective of someone inside the space – parallels that feel straight) in the geometry you selected? Briefly explain why or why not.

In class and lab we explored what life would be like for a carp, Arthur Square or other 2D creatures from *Flatland* or elsewhere. How could Arthur Square pass another creature in *Flatland*?

Now imagine a **sphere** passing through the *Flatland* plane. **Sketch a few pictures** that reflect what **Arthur Square would actually see in the 2-D universe** at different times of the dunking of Spherius (assume that Arthur Square can only see in the 2-D universe).



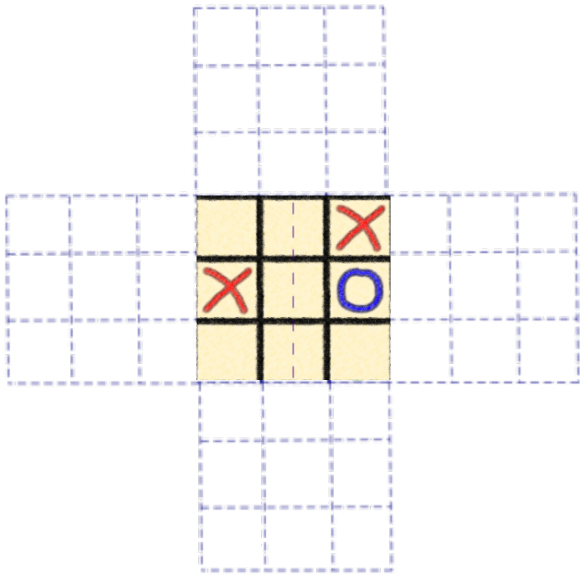
Next, what is the full cross sectional view?

Choose one experiment researchers have conducted to determine whether our universe satisfies the laws of Euclidean, spherical, or hyperbolic geometry and describe it briefly.

Discuss at least 2 of our **classroom critiques** of this experiment.

In Klein bottle tic-tac-toe, we identify the left and right sides of the board straight across. The top and bottom are glued via a **reflection** in the vertical line through the middle of the game board. This would then form the Klein bottle.

- First draw a tiling view of the original game pieces, above, below, and to the right and left of the main game board.
- Next, I am "X" in the game and I can win Klein bottle tic-tac-toe with my next move. Mark off where I can go to win on the center board.



Part 2: Group Time

Work alone until I say it is ``group time." Then you may work alone or in groups (or a combination!). The idea is to give you opportunities to communicate course content with your peers, since this is one of ASU's main educational goals: ``Successful communicators interact effectively with people of both similar and different experiences and values." The only guidelines are that each person must eventually write up and turn in their own, the only resources you are allowed to use is each other, and you should spend the time inside the classroom effectively engaging.

John Playfair's (1748-1819) postulated that there is only one parallel to a line or symmetric path through a given point. Is this true on the Euclidean plane, in hyperbolic geometry, and/or the sphere? Briefly explain what happens in each geometry.

What is a probability and how does it relate to truth in mathematics and statistics?

Analyze the role of probability and chance in computing the density and geometry of the universe.

Discuss an instance from the geometry segment where the theme of local to global played a role. Be sure to specify what was local, what was global, and how these perspectives related or differed.

See the study guide for additional concepts to review, including:

- computational questions related to geometric equations and spaces (Eratosthenes, angle sum, straight feeling, parallel, Pythagorean theorem, inverse square law…)
- directed questions related to geometric spaces (wraparound spaces, earth, universe, cross sectional views, analyzing experiments to determine the geometry of the universe, folding and gluing spaces…)
- other (real-life applications, changes in world view, themes, and other questions)