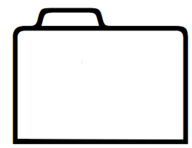
Final **TMath 221** Spring 2017

NAME:

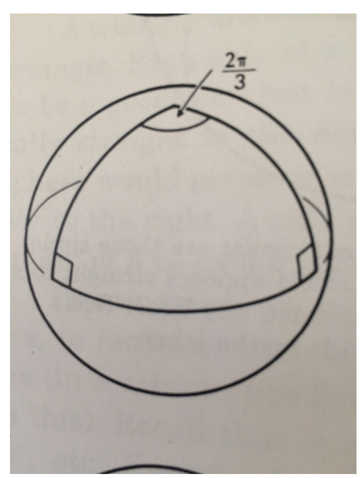
1. [3] (4/3 Class) Describe one key difference between Flatland the book and Flatland the movie. Explain why you think the movie makers made this change.

2. [2] (HW3 #3) Draw an object that has the same topology as the figure to the right but a different geometry.

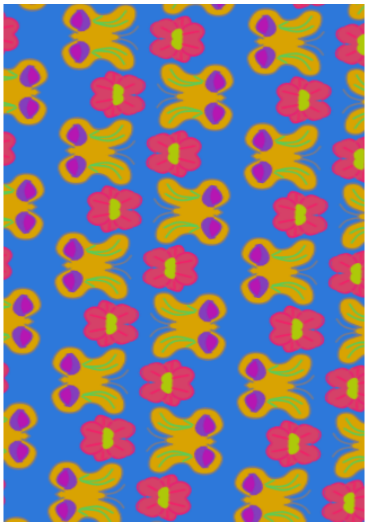


3. [2] (§5 #1) What do you get when you form the connected sum of a six-holed doughnut surface and a eleven-holed doughnut surface?

4. [3] (HW5 #4) Find the area of the triangle to the right given that the sphere has radius 1 (which we usually assume!)



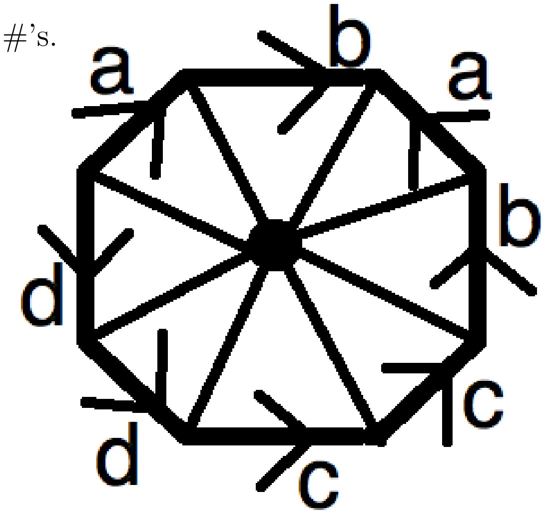
5. [2] (HW2 #1) Find the signature for the figure on the right and determine it's "cost".



6. [2] (Class 5/18) Describe a winning strategy for a game of Brussels Sprouts.

7. (Euler Practice Wks) Consider the object shown to the right.

   (a) [3] Identify the surface using only $\mathbb{P}^2$, $\mathbb{T}^2$, and #'s.

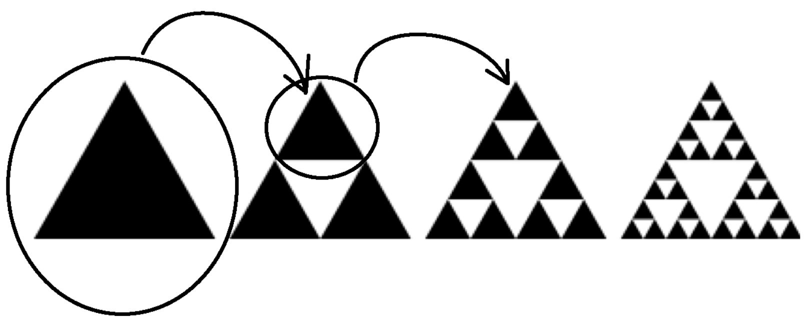


   (b) [1] Find the number of edges with the skeleton structure given.

   (c) [2] Compute the Euler number χ

8. [3] (§4 #14) A Flatlander knows he lives on either a sphere or a projected plane. How can he tell which it is?

9. [2] Identify two "applications" for origami.



10. [3] (Fractals Wks) Sierpinski's triangle is shown above. Find the fractional (Hausdorff) dimension. Clearly show your steps!

11. [4] Consider a strip of paper whose opposite edges:

    (a) are connected with no twists.
    How many edges (1 dimensional boundaries) are there?

    (b) are connected with one half twists.
    How many edges (1 dimensional boundaries) are there?

    (c) are connected with n half twists.
    How many edges (1 dimensional boundaries) are there?

12. [3] Choose only *ONE* of the following. Clearly identify which of the two you are answering and what work you want considered for credit. Answering more questions can earn you up to 4 points extra credit.

    (a) (Hyperbolic Space Talk) In hyperbolic space, do objects look closer or farther than they actually are? Briefly explain why.

    (b) (Universe Talk) Describe one possible shape of the universe and briefly describe how this shape could have come about.

Final Group

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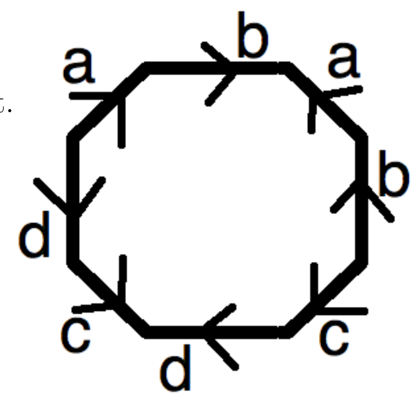
Spring 2017

NAMES:

Polygons in Strange Spaces

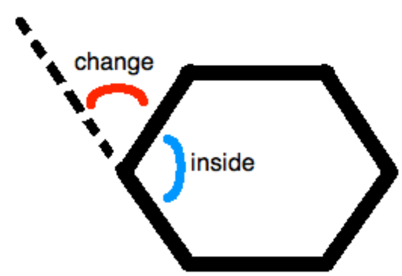
1. [2] Identify the topological surface shown to the right.

2. [6] Consider the point between side a and b (which is also the point between c and d). Determine the total angle around this point. Justify your computations.



3. [2] Deduce if this surface has Euclidean, Spherical, or Hyperbolic geometry.

   Recall that we can define the "change" angle be the angle of rotation when pivoting or changing from one side to another as we travel clockwise around the polyg



4. [5] Find the sum of "change" angles for a polygon with n sides in this space. *Justify* your answer on the back of this sheet.