Midterm

TMath 106

Winter 2019

Key

45

Show *all* your work. Reasonable supporting work must be shown to earn credit. Remember that *communicating* worth as much as the correct answer (and often more!).

1. [4] (1/15 Discussion) The book *Flatland* gives social commentary on Victorian society through metaphors. Choose an aspect/story/characteristic of the book *Flatland* and explain how it is either still relevant today or how it no longer works.

start +.5
intent +1
connect to today +1
clear/communicate +1.5

So many to choose from?
How about the shapes of Flatland judging each other by the shape of their bodies - like we do today. Superficial looks are still used as stand in's for a person's worth. Think skin color, body size, gender, etc.

2. [4] (HW3 #1) True or False and *brief* justification:
There are an infinite number of unique tiling signatures (such as 3*3).

start +.5
false +.5
~~true~~
reasoning sound +1
clear/communicate +1.5

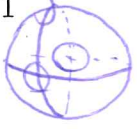
False?
Each symbol in a tiling signature has a 'cost' associated with it. A theorem from Conway's book indicates that tiling signatures tile the plane if and only if the total 'cost' is $2. Given that there are only a finite number of ways that the set of costs can total $2 we know there are only a finite # of tilings.
In fact, there are only 17?

3. [4] (Weeks §1) Explain how A Square's used thread in the book *The Shape of Space* to determine that he was *not* living on a sphere.

start +.5
intent +1.5
why works +.5
clear/comm +1

A. Square had some friends go east (or west - not remembering exactly) and after a while they returned from the west. His friends dropped string behind them. (think it was blue).
A second party traveled north/south dropping string as well. This party also returned from the opposite direction.

The string from the 2nd party never crossed the string from the 1st's except at the start?



on a sphere there should be 2 crossings?

4. [3] (HW3 #3) Draw an object that has the same topology but different geometry as the figure to the right.

start +.5
Same top +1.5
dif geom +1

Lots of right answers?

8 ∞ B

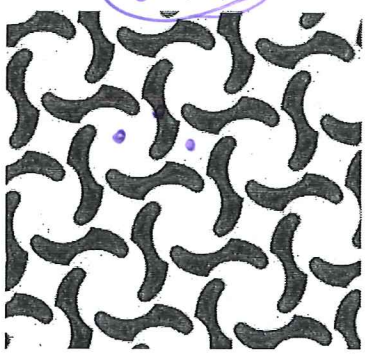
5. [6] (TilingActivity's) Find the signature for each of the following. Note the "cost" for symbols are given.

Symbol	Cost ($)	Symbol	Cost ($)
○	2	* or ×	1
2	$\frac{1}{2}$	2	$\frac{1}{4}$
3	$\frac{2}{3}$	3	$\frac{2}{6}$ or $\frac{1}{3}$
4	$\frac{3}{4}$	4	$\frac{3}{8}$
5	$\frac{4}{5}$	5	$\frac{4}{10}$ or $\frac{2}{5}$
6	$\frac{5}{6}$	6	$\frac{5}{12}$
...	...	...	...
n	$\frac{n-1}{n}$	n	$\frac{n-1}{2n}$

start +.5

+.5 +.5 +.5

244



4 2 4

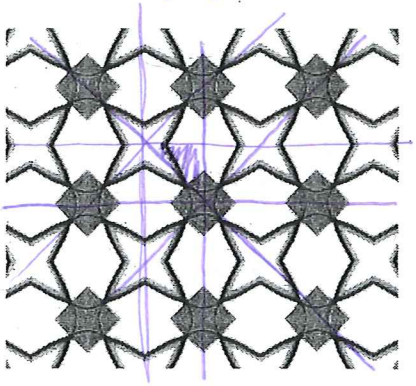
Cost $2 +2

$\frac{3}{4} + \frac{1}{2} + \frac{3}{4} = \frac{3}{4} + \frac{2}{4} + \frac{3}{4} = \frac{8}{4}$

= $2 ✓

+.5 +.5 +.5 +.5

*442

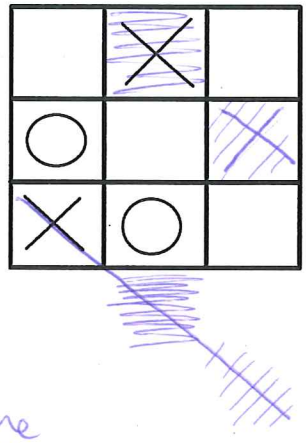


*442

$1 + \frac{3}{8} + \frac{3}{8} + \frac{1}{4} = 1 + \frac{3}{8} + \frac{3}{8} + \frac{2}{8}$

= $2 ✓

6. [3] (Weeks §2) A tic-tac-toe board being played on a flat torus is shown to the right. The game was started by X and now it is X's turn.
What is X's best move? Justify your choice.

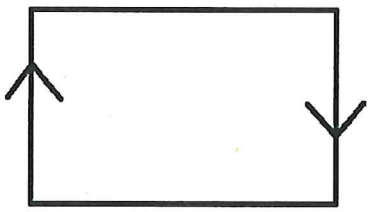


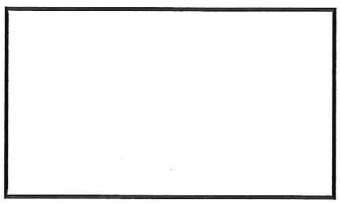
start +5

(+1) [The middle right would be a winning move?

(+1) [Because of the gluings, the X's on the board 'reappear' below and will form a diagonal 3 in a row

7. [4] Match the items on the left to items with the same topology on the right.





Möbius Strip?

where all edges are identified/glued.

8. Examine the Origami instructions below.

(a) [2] (1/29 Class) Describe what the instruction circled above means.

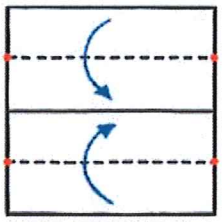
+1 [flip over

start +.5
on shape +.5

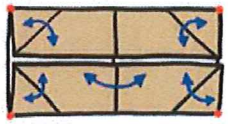
(b) [5] Fold the Wombat and turn it in with your exam!

start +.5
pretty +.5

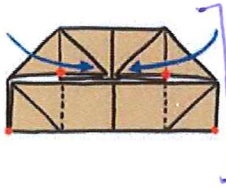
F.W.'s Origami Wombat



Crease the paper along the middle. Fold the top and bottom edges in to meet the crease.

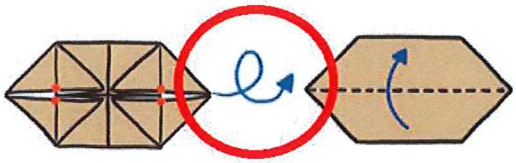


Crease this shape up the middle. Fold all the corners over creasing them, and then unfold them again.



+2

Bring the corners down while folding where I've made dotted lines. This will create four new points that meet in the middle.

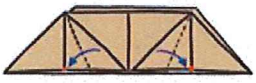


Flip this shape over so that you are looking at the smooth side.

Fold the shape along the middle so that you bring the bottom edge up to meet the top edge.

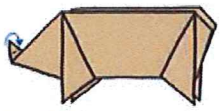
+1

This is the body of the wombat. Now it's time to give it some legs!



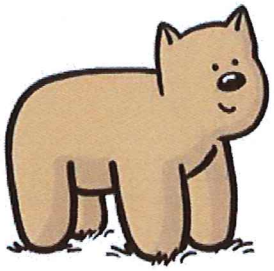
Fold the triangles that meet in the middle down so that they now extend down past the bottom of the body.

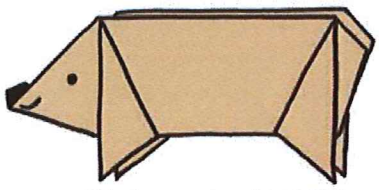
On one end of the wombat fold the point up for the nose. On the other end fold the point in.



+1

Now fold the nose over one more time. Then use the marker to color it in and to add eyes and a mouth.





He's almost as cute as the real thing!

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NAMES:
A single copy of this problem can be turned in per group if interested.

Halving the Area of a Patty Square

1. [10] Use Patty Paper Rules to find a square that has half the area of the original patty paper.

   (a) Explain your process.

   (b) *Justify* why your method works.

   This is a patty paper exercise so the only tools you may use are patty paper(s) and a pencil.

(a) start +.5
process works +2
clearly explained +2

(b) start +.5
reasoning is sound +2
clearly explained +2

12 21
9 14
7 10
4 5
10