The test will have five sections:

- Matching
- True or False
- Multiple Choice
- Short Answer
- Long Answer

Section 1. Matching Match term or quantity in left column to the one description that best applies from the numbered columns.

- 1. a polygon whose sides and angles are all equal.
- 2. a tiling.
- 3. a rigid motion.
- 4. a tiling in which there is no repetition of the pattern by translation.
- 5. a tiling that uses a mix of regular polygons with different number of sides but in which are vertex types are alike—the same polygons in the same order at each vertex.
- 6. a triangle with all sides the same length.
- 7. an edge-to-edge tiling that uses only one kind of regular polygon.
- 8. a polygon with four sides.
- 9. for any two points in the polygon (including the boundary), all the points on the line segment connecting the two points lie inside the polygon (including the boundary).
- 10. a parallelogram whose sides are all equal–four equal sides and equal opposite equal angles.
- 11. A pattern that exhibits similarity at ever finer scales.
- 12. a rectangle with sides that have ratio of the golden ratio.
- 13. a polygon with n sides.
- 14. all the tiles are polygons and for every tile, each edge coincides with the entire edge of the bordering tile.
- 15. a tiling with only one size and shape of tile (the tile is allowed to "turn over" or appear in mirror image form).

- regular polygon _____
- quadrilateral _____
- rhombus _____
- tesselation _____
- isometry _____
- monohedral tiling _____
- nonperiodic tiling _____

regular tiling _____

semiregular tiling _____

edge-to-edge tiling _____

Section 2. True or False Circle True (T) or False (F):

| (1) The tiling about a point which is labelled 3,6,3,6 would be a regular tiling | F |
|--|---|
| (2) The numbers 21 and 34 are consecutive Fibonacci numbers. The next Fibonacci number in the sequence 55 | |
| (3) A square has translational rigid motion symmetry | F |
| (4) A strip pattern has translational rigid motion symmetryT | F |
| (5) Commutativity $(a \circ b = b \circ a)$ is one of the properties that is required of a group | F |
| (6) All strip patterns have glide reflection symmetry | F |
| (7) 81 mod $3 = 27$ T | F |
| (8) The integers with addition do not form a group since there are no inverses $\dots \dots \dots$ | F |
| (9) A monohedral tiling is a tiling that uses two different shapes of tiles $\dots \dots \dots$ | F |
| (10) A regular tiling is a tiling that uses two different regular polygons for the tiles \dots T | F |

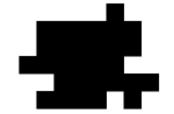
Section 3. Multiple Choice Circle the most appropriate answer:

(1) Assume the following pattern continues in both directions. Which isometries preserve the pattern?



- A) horizontal translation only
- B) horizontal translation and horizontal reflection only
- C) horizontal translation and glide reflection only
- D) horizontal translation, glide reflection, and vertical reflection only
- - A) I only B) II only C) Both I and II D) neither
- (3) Which of the following triangles can tile the plane?I: equilateral triangle II: scalene triangleA) I only B) II only C) Both I and II D) neither
- (4) The interior angle of a decagon (10-gon) is which of the following?
 - A) 36° B) 144° C) 180° D) 324° E) 18°

(5) Can the tile below be used to tile the plane?



A) No

- B) Yes, with translations only
- C) Yes, but with translations and half-turns only
- D) Yes, but reflections must be included

Use the following Cayley table to answer questions (6)-(9). The vertical column on the right is the action which is done first. The Cayley table represents a group.:

| | b | | | |
|---|---|---|---|---|
| b | a | | С | b |
| c | d | b | a | c |
| d | c | a | b | d |
| a | $egin{array}{c} a \\ d \\ c \\ b \end{array}$ | c | d | a |

- (6) The missing entry from the table $c \circ b$ must be:
 - A) a B) b C) c D) d
- (7) The identity operator I is: A) a B) b C) c D) d
- (8) The inverse of c (another way of writing the inverse of c would be c^{-1}) is: A) a B) b C) c D) d
- (9) The quantity $b \circ b \circ c$ is: A) a B) b C) c D) d

Section 4. Short Answer

Given the following Cayley Table, where $a \circ b$ means b is done first and read from the left hand column and a is done second and read from the top row:

| 0 | e | a | b | c | d | f |
|---|--|---|---|---|---|---|
| e | e | a | b | С | d | f |
| a | a | e | d | f | b | c |
| b | b | f | e | d | С | a |
| c | c | d | f | e | a | b |
| d | d | c | a | b | f | e |
| f | $\begin{bmatrix} e \\ a \\ b \\ c \\ d \\ f \end{bmatrix}$ | b | c | a | e | d |

(1) The identity element is: _____

(2) The inverse of a is: _____

- $(3) \ (a \circ b) \circ d = _$
- $(4) \ a \circ a = _$
- (5) $f^{-1} =$ _____

(6) Draw a strip pattern which possesses glide reflection symmetry but not horizontal reflection symmetry.

(7) Draw an example of the tiling about a point which would be labelled 3,3,3,3,3,3.

(8) Draw an example of the tiling about a point which would be labelled 3,6,3,6.

Section 5. Long Answer

- (1) If F_i is the *i*th Fibonacci number show the ratio F_{i+1}/F_i approaches the number $(1 + \sqrt{5})/2$ as *i* gets large.
- (2) List all the rigid motion symmetries of the symmetric group of the strip pattern CCCCCCC.
- (3) A semiregular tiling has two squares and three regular p-gons at each vertex. What number must p be?