

UNIVERSITY OF MANITOBA

DATE: February 25, 2010

MIDTERM

PAGE: 2 of 5

COURSE: MATH 1020

TIME: 70 minutes

EXAMINATION: Math in Art

EXAMINER: M. Davidson

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[6] 2. (a) Construct a golden rectangle having (shorter) side as given.



[4] (b) Using the above, construct two golden obtuse triangles of different sizes.

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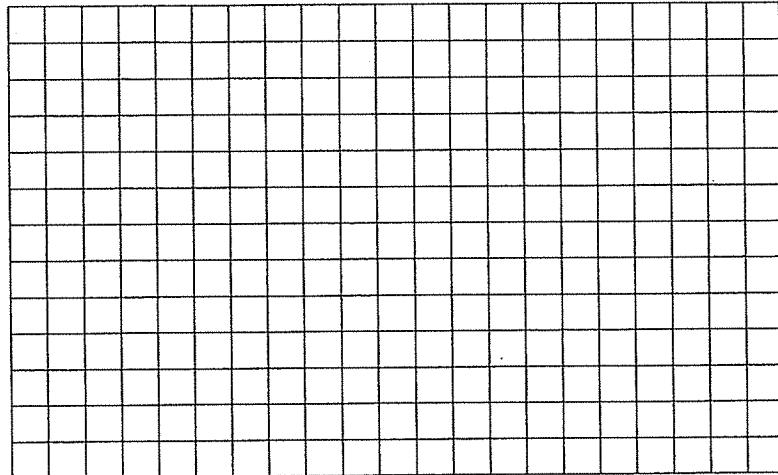
EXAMINER: M. Davidson

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[3] 3. (a) What are the Fibonacci numbers? (Give a definition)

[3] (b) Given that  $f_{14} = 377$  and  $f_{16} = 987$  find  $f_{15}$ .

[4] (c) In the rectangular grid below, use squares of side lengths corresponding to the Fibonacci numbers to construct an approximation of the golden spiral.



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[6] 2. (a) Construct the golden cut of the line segment below.

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[4] (b) Construct a golden obtuse triangle on the line below. (Note, this is the same length as the line given above). Divide it into a smaller golden obtuse triangle and a golden acute triangle. Label the smaller triangles.

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3. (a) What are Fibonacci numbers? (Write down the definition.)

(b) It can be verified that  $f_{25} = f_{24} + 28657$  and that  $f_{22} = 17711$  (no need to check that).

Find  $f_{24}$ .

(In this question, as usual,  $f_n$  is the  $n$ -th Fibonacci number in the list of Fibonacci numbers.)

4. Find the group of symmetries for each of the three objects shown below. If you claim a rotational symmetry, indicate the center of the rotation and the angle of rotation. If there are reflections, show the line of reflection. If there are translational symmetries show or describe the vectors of translation.

OBJECT	THE GROUP OF SYMMETRIES

MT1

**Math 1020 Math in Art**  
**Midterm Exam, February 28, 2008**

Name: \_\_\_\_\_ Student Number: \_\_\_\_\_

1.	max=7	
2.	max=6	
3.	max=9	
4.	max=11	
5.	max=7	

*Important:* "Construct" means "construct using an unmarked ruler and a compass". The phrase "unmarked ruler" stands for any ruler that may be used only as a straight edge to draw straight line segments. When you use a compass, show the (intermediate) circular arcs you draw in your constructions (do **NOT** erase them). Use words to describe BRIEFLY what you have done.

[7 points] 1. (a) Construct (using an unmarked ruler and a compass) an angle of  $30^\circ$  with a corner at O and over the given semi-line.

(b) Bisect the angle constructed in part (a) of this exercise.

(Do not forget to briefly describe your steps.)



[6 points] 2. Construct one of the two golden cuts of the line segment given below.



[9 points] 3. (a) Construct a golden rectangle with the line segment given below representing the base of the rectangle (so that it is one of the larger sides of the rectangle).



(b) Construct a golden spiral within the golden rectangle shown below.

