

**Math 1020 Math in Art**  
**Midterm Exam, February 24, 2009**  
**BRIEF SOLUTIONS OR EXPLANATIONS**

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

1.	<i>max=10</i>	
2.	<i>max=10</i>	
3.	<i>max=6</i>	
4.	<i>max=14</i>	
5.	<i>max=10</i>	

*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.*

Total=50

**[10 points] 1. (a)** Construct the line passing through the given point  $A$  and that is parallel to the given line  $l$  (see the picture below).

$A$   
◦




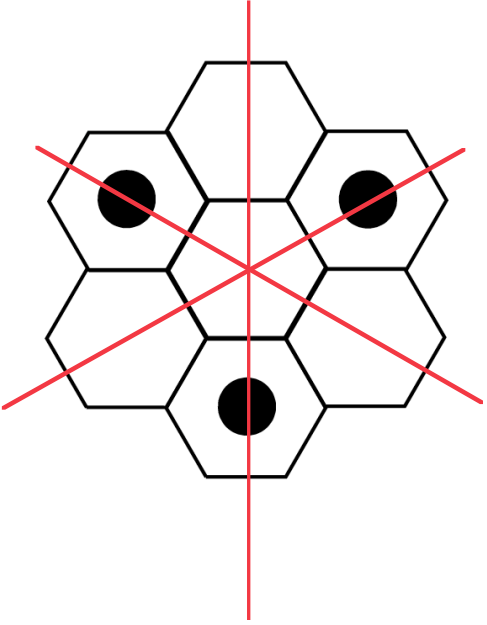

**(b)** Construct one line passing through the point  $A$  and intersecting the given line at an angle of  $60^\circ$ .

- [10 points]** 2. (a) Construct a golden rectangle over the line segment  $AB$  (so, the line segment  $AB$  should be the largest side of the golden rectangle).  
(b) Construct a golden spiral within the golden rectangle you have constructed in part (a).



- [6 points]** 3. (a) State precisely the definition of the sequence of Fibonacci numbers.  
(b) The 19<sup>th</sup> Fibonacci number is 4181, and the 22<sup>nd</sup> Fibonacci number is 17711. Find the 20<sup>th</sup> and the 21<sup>st</sup> Fibonacci numbers.

**[14 points]** 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, drawing **precisely** at least one of them. [In all three cases the object is defined by the (black or gray) coloured points.]

OBJECT	THE GROUP OF SYMMETRIES
	
	
 <p data-bbox="190 2220 906 2292">[This is a Frieze pattern and it extends without end both to the left and to the right. ]</p>	

[10 points] 5. We know that the point  $f(A)$  is obtained from the point  $A$  by applying to it a central similarity  $f$  of stretching factor  $\alpha = \frac{1}{2}$ .

- (a) Construct the center  $O$  of the central similarity  $f$ .
- (b) Construct the image of the line segment  $CB$  under the central similarity  $f$ .

$C$  —————  $B$

$f(A)$        $A$