Math 1020 Math in Art
Midterm Exam, February 25, 2010

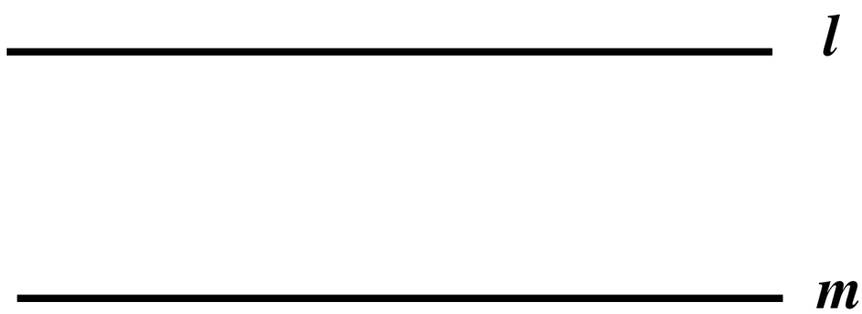
Name: _____ Student Number: _____

1.	*max=10*	
2.	*max=10*	
3.	*max=6*	
4.	*max=14*	
5.	*max=10*	

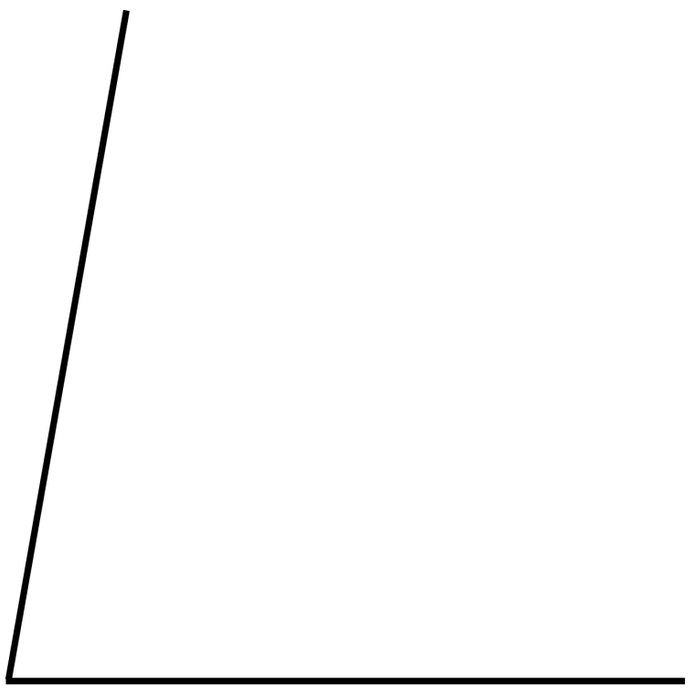
Total=50

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 <u>NOT</u> erase them). Use words to describe BRIEFLY what you have done.**

[8 points] 1. **(a)** The lines l and m shown below are parallel. Construct any line that is parallel to both l and m.



(b) In the picture below we show an angle of 80º. Construct an angle of 20º.

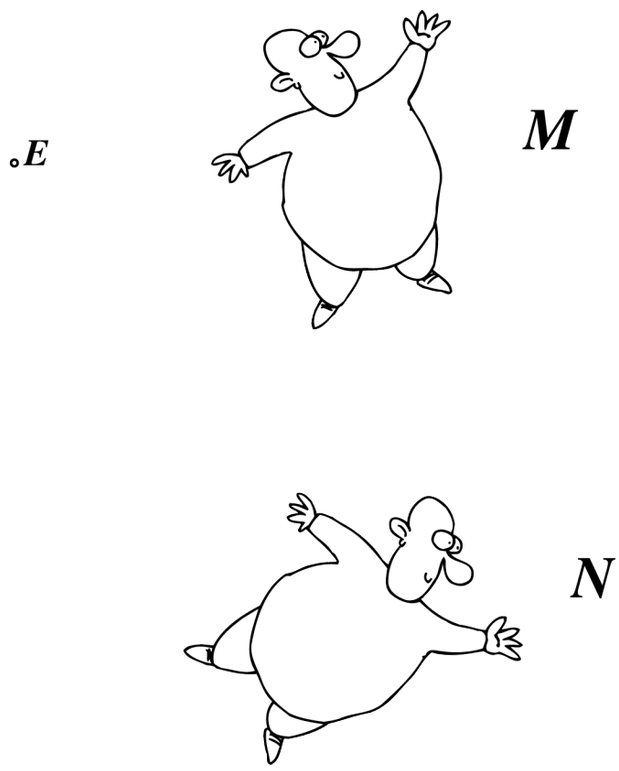


[10 points] **2.** **(a)** Find the golden cut C of the line segment AB shown below (with C closer to B than to A), then construct an acute golden triangle with the base of that triangle being the line segment CB.

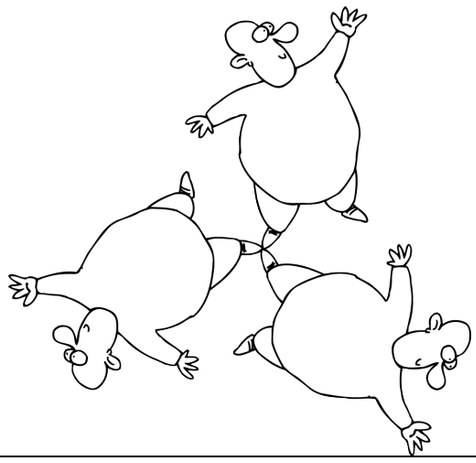
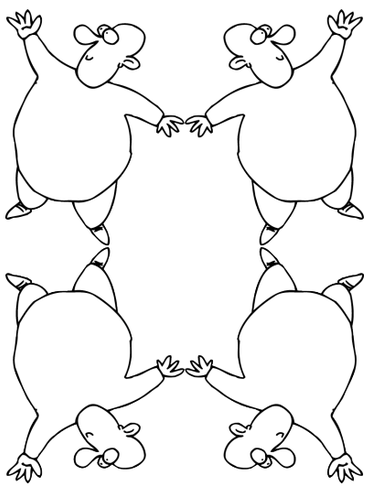
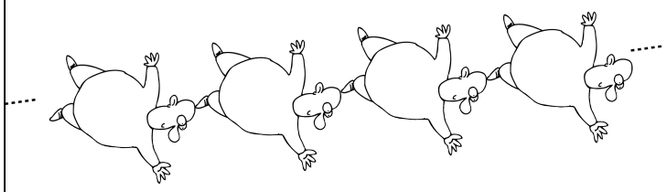
(b) Construct a regular pentagon with one side being the line segment DE shown below. (Note and hint: You may use the acute golden triangle constructed in part (a) in the construction of the regular pentagon.)

[10 points] **3.** **(a)** The object M is obtained from the object N by rotating the latter around a point O and through an angle α. Construct the center of the rotation and an angle of the rotation.

(b) Find the image of the point E shown below under the rotation defined in part (a) of this question. (Hint: you would need to duplicate an angle here!)



[12 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 describe the vectors of translation, drawing **precisely** at least one of them. [In all three cases the object is defined by the black points.]

OBECT	THE GROUP OF SYMMETRIES
	
	
 [This is a Frieze pattern and it extends without end both to the left and to the right.]	

[10 points] 5. (a) The object shown below (except for the point E given to the right and above it; ignore *E* in this part) shows an infinite sequence of cartoon-like characters, each twice smaller than the one immediately preceding it (from left to right). Show that this is a complete fractal by describing a central similarity *f* that sends this object within itself. (Note: to get the full mark here you only need to indicate the position of the center of *f* and to write down the number that is the stretching factor of *f*.)

(b) Using the central similarity *f* that you have described in part (a) of this question, construct the image $f(E)$ of the point *E* shown below.