UNIVERSITY OF MANITOBA

DATE: October 22, 2009 — MIDTERM TITLE PAGE

COURSE: MATH 1020 — TIME: 70 minutes

EXAMINATION: Math in Art — EXAMINER: M. Davidson

FAMILY NAME: (Print in ink) _____

GIVEN NAME(S): (Print in ink) _____

STUDENT NUMBER: _____

SIGNATURE: (in ink) _____

(I understand that cheating is a serious offense)

INSTRUCTIONS TO STUDENTS:

This is a 70 minute exam. **Please show your work clearly.**

A compass and straight edge (ruler) are required for this exam.

No texts, notes, or other similar aids are permitted. There are no calculators,cellphones or electronic translators permitted.

This exam has a title page and 5 pages of questions. Please check that you have all the pages.

The value of each question is indicated in the lefthand margin beside the statement of the question. The total value of all questions is 50 points.

Answer all questions on the exam paper in the space provided beneath the question. If you need more room, you may continue your work on the reverse side of the page, but CLEARLY INDICATE that your work is continued.

Question	Points	Score
1	10	
2	10	
3	6	
4	6	
5	8	
6	10	
Total:	50	

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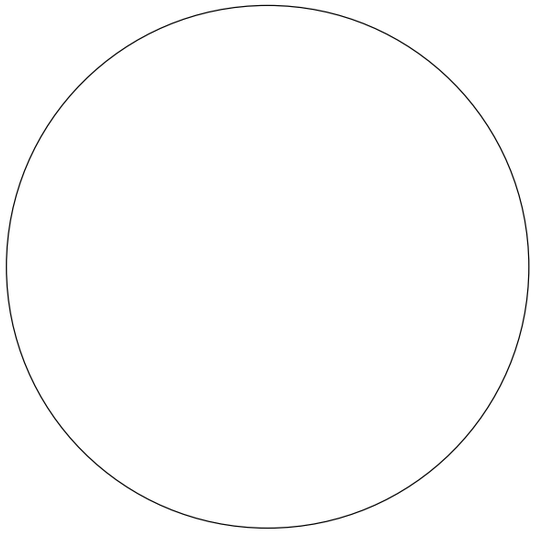
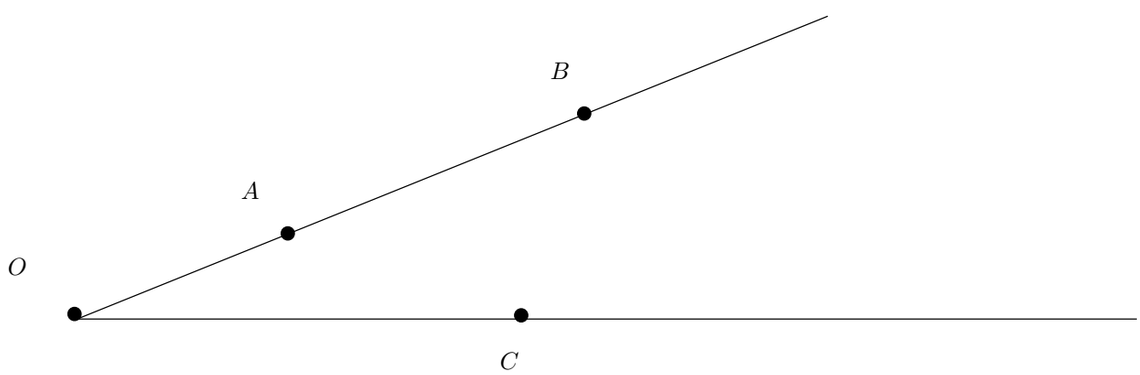
Important: "Construct" means "construct using an unmarked ruler and compass." The phrase "unmarked ruler" stands for any ruler that may be used only as a straight edge to draw straight line segments. When you use a compass, show the (intermediate) circular arcs you draw in your constructions (do not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

[5] 1. (a) Find (construct) the center of the circle given below. Construct a hexagon in the circle.



[5] (b) Given the diagram below; If OA has length 1, OB has length n and OC has length m, find the point D on OC such that OD is length mn.



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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. Explain how each of the following is related to the golden ratio ϕ.

[2] (a) golden rectangle

[2] (b) golden acute triangle

[2] (c) regular pentagon

(d) [bonus/2] Fibonacci numbers

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

[3] (b) Given that $f_{13} = 233$ and $f_{15} = 610$ find f_{14}.

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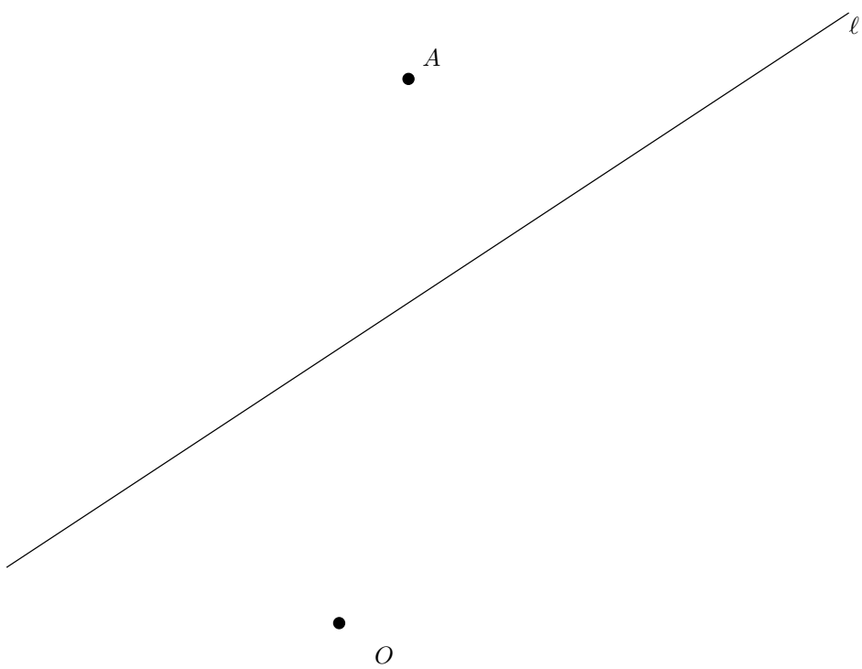
[5] 5. (a) Given the diagram below, we define $f = refl(\ell)$ and $g = rot(O, 60°)$. Find the image of A after first applying f, then applying g.



[3] (b) Give a reasonable accurate drawing of an object that has exactly 5 symmetries (including Id). List the symmetries.

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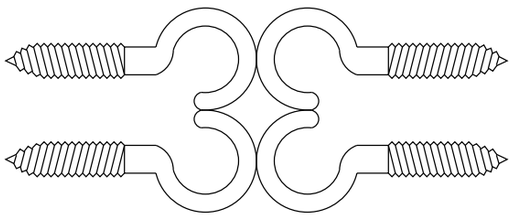
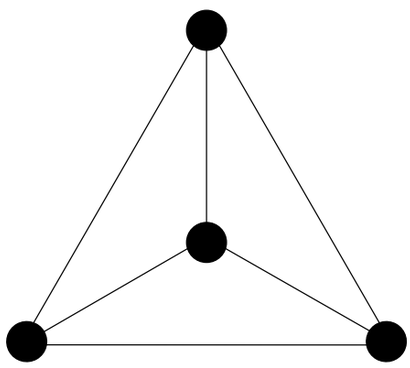
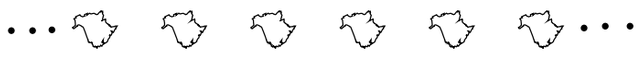
[10] 6. Find the group of symmetries for each of the three objects shown below. Be sure to indicate in the object any centers of rotation, lines of reflection or vectors of translation. If you are indicating a rotation, be sure to include to angle of rotation.

OBJECT	SYMMETRIES
	
	
 This is a Frieze pattern. It continues infinitely in both directions.	