UNIVERSITY OF MANITOBA

DATE: February 25, 2010 — 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	10	
4	10	
5	10	
Total:	50	

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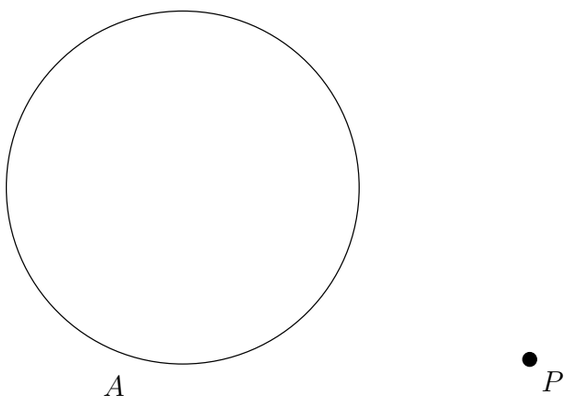
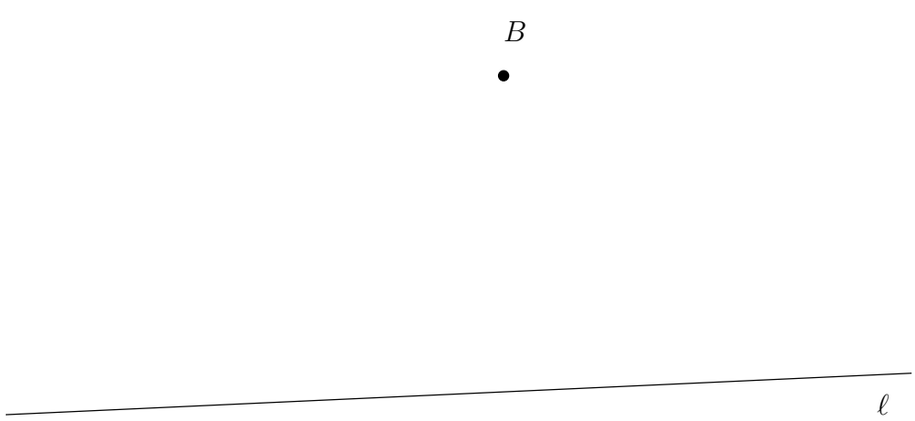
Important: "Construct" means "construct using an unmarked ruler and compass." The phrase "unmarked ruler" stands for any ruler that may be used only as a straight edge to draw straight line segments. When you use a compass, show the (intermediate) circular arcs you draw in your constructions (do not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

[6] 1. (a) Find (construct) the center of the circle A given below. Construct a circle centered at point P that touches circle A in exactly one point.



[4] (b) Draw a line that passes through the point B and intersects that line ℓ at an angle of 60 degrees.



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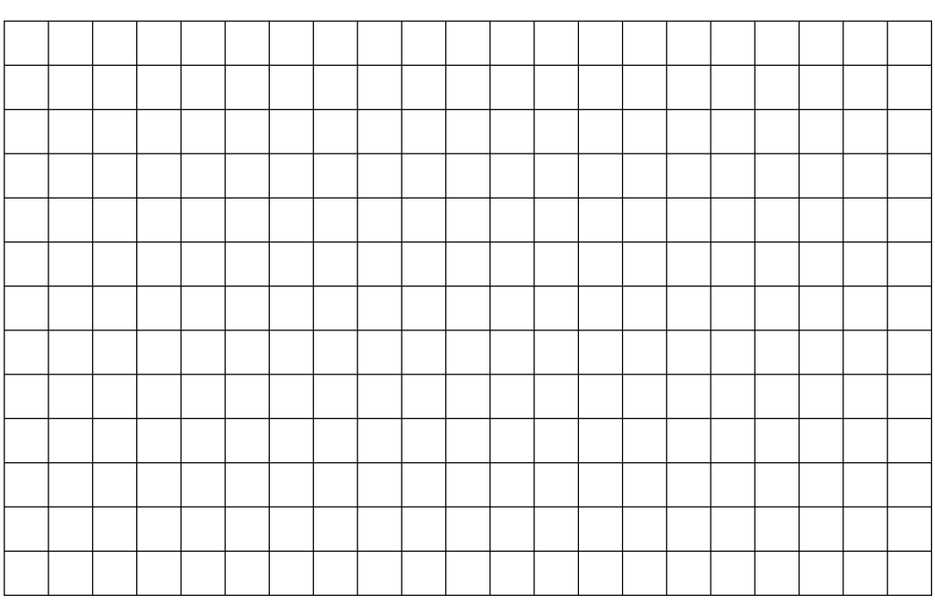
[3] 3. (a) What are the Fibonacci numbers? (Give a definition)

[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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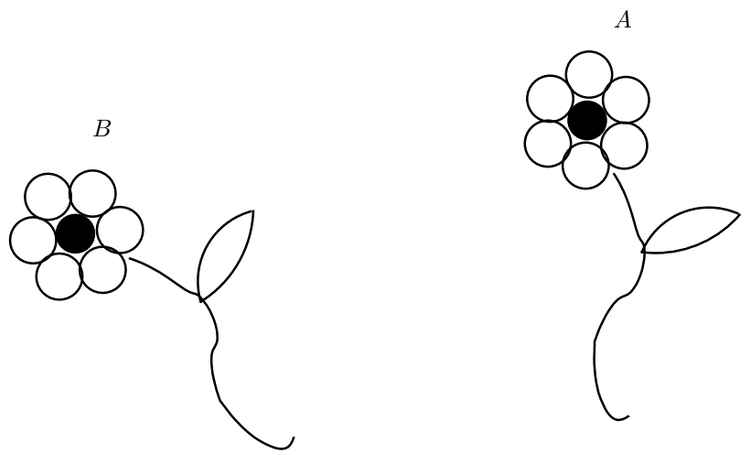
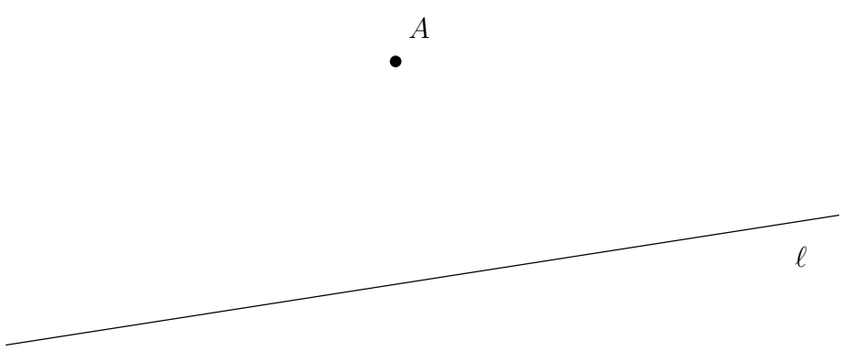
[6] 4. (a) In the diagram, if flower B is the image of flower A under a rotation, find the center (label it C) and angle (label it θ) of this rotation .



[4] (b) Find the image of the point A under the symmetry $f = \text{refl}(\ell)$.



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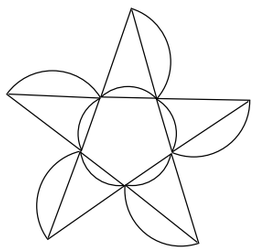
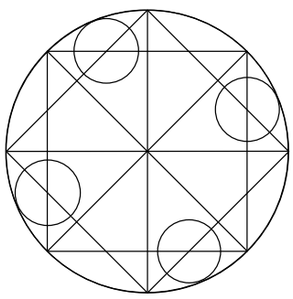
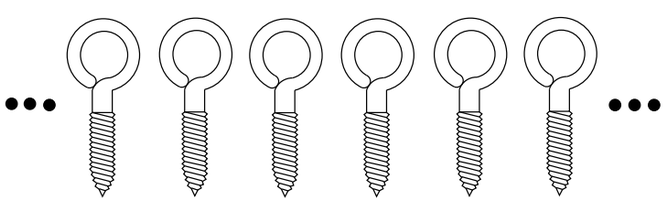
[10] 5. Find the group of symmetries for each of the three objects shown below. Be sure to indicate **in the object** any **centers of rotation**, **lines of reflection** or **vectors of translation**. If you are indicating a rotation, be sure to include to **angle of rotation**.

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