UNIVERSITY OF MANITOBA

DATE: Aug 8, 2009 — FINAL EXAMINATION
PAPER # 133 — TITLE PAGE
DEPARTMENT & COURSE NO: MATH 1020 / FA1020 — TIME: 2 hours
EXAMINATION: Math in Art — EXAMINER: Various

SURNAME: (Print in ink) _____

GIVEN NAME(S): _____

STUDENT NUMBER: _____

SIGNATURE: (in ink) _____
(I understand that cheating is a serious offense)

A01 slot 10 T,Th, 6- 8:30 D. Kalajdzievska / C. Enns

INSTRUCTIONS TO STUDENTS:

This is a 2 hours exam. **Please show your work clearly.**

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

This exam has a title page, 6 pages of questions and also 1 blank page for rough work. Please check that you have all the pages. You may remove the blank page if you want, but be careful not to loosen the staple.

The value of each question is indicated in the lefthand margin beside the statement of the question. The total value of all questions is 80 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	17	
2	8	
3	12	
4	10	
5	11	
6	11	
7	11	
Total:	80	

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1. For the following, fill in the blank with the word (or words) that best fit in the sentence.

[1] (a) The line connecting two vanishing points in a picture drawn in perspective is called the _____.

[2] (b) If you slice a cone with a plane that passes through all of the slant heights, the resulting cross-section will be a(n) _____ and if that plane is parallel to the base it will be a(n) _____.

Figure 1:

[1] (c) If you slice a cone with a plane that is parallel to some tangent plane of the cone (passes through some slant heights and the base), the resulting cross-section will be a(n) _____.

[1] (d) If you slice a double cone with a plane that goes through both halves of the cone, the resulting cross-section will be a(n) _____.

Figure 2:

[1] (e) If I am building a Golden Rectangle with short side equal to 10 cm, the long side should be equal to _____ cm.

[2] (f) The figure on the left below has a genus of _____ and is _____ to the figure below on the right.

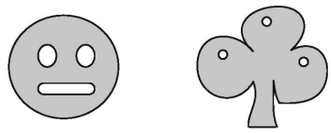

Figure 3:

[2] (g) A 3-D solid with faces all of one kind of regular polyhedra is called a _____ and there are _____ such solids.

[2] (h) The formula that gives a solid's Euler Characteristic from its number of vertices, faces, and edges is _____ and the formula linking a solid's Euler Characteristic to its genus is _____.

[1] (i) In Hyperbolic geometry, for every line l and every point P that does not lie on l, there exists _____ line(s) through P that are parallel to l.

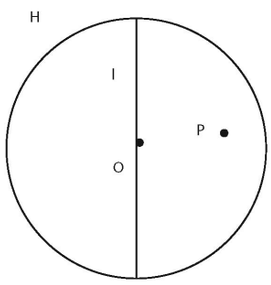

Figure 4:

[2] (j) Again, in Hyperbolic geometry, every point in the circle H has an image or "_____" outside of H. A point closer to the centre (O) than P would have its image closer to / farther than **(circle the one that best fits)** the circle H than the image of P, $i(P)$.

[2] (k) The cube on the left below is drawn in _____ and the cube on the right below is drawn in _____

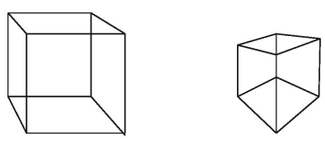

Figure 5:

[8] 2. Use an unmarked ruler and a compass to subdivide the line segment AB given below into 5 equal parts. Do not erase your steps, or give a brief description in words of your steps.

Figure 6:

[12] 3. The following picture depicts a house drawn in two-point perspective. Draw an attic window (on the roof) in perspective, and label the vanishing point(s) as well as the horizon.

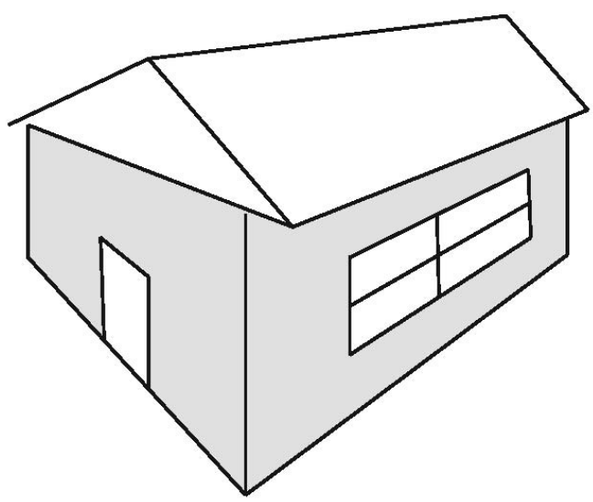

Figure 7:

[10] 4. Using tangents, construct a circle in the square given below, LABELING your points clearly. (HINT: notice that some of the points have been labeled already for you.) Use 8 tangent lines to construct the circle, 2 from each side.

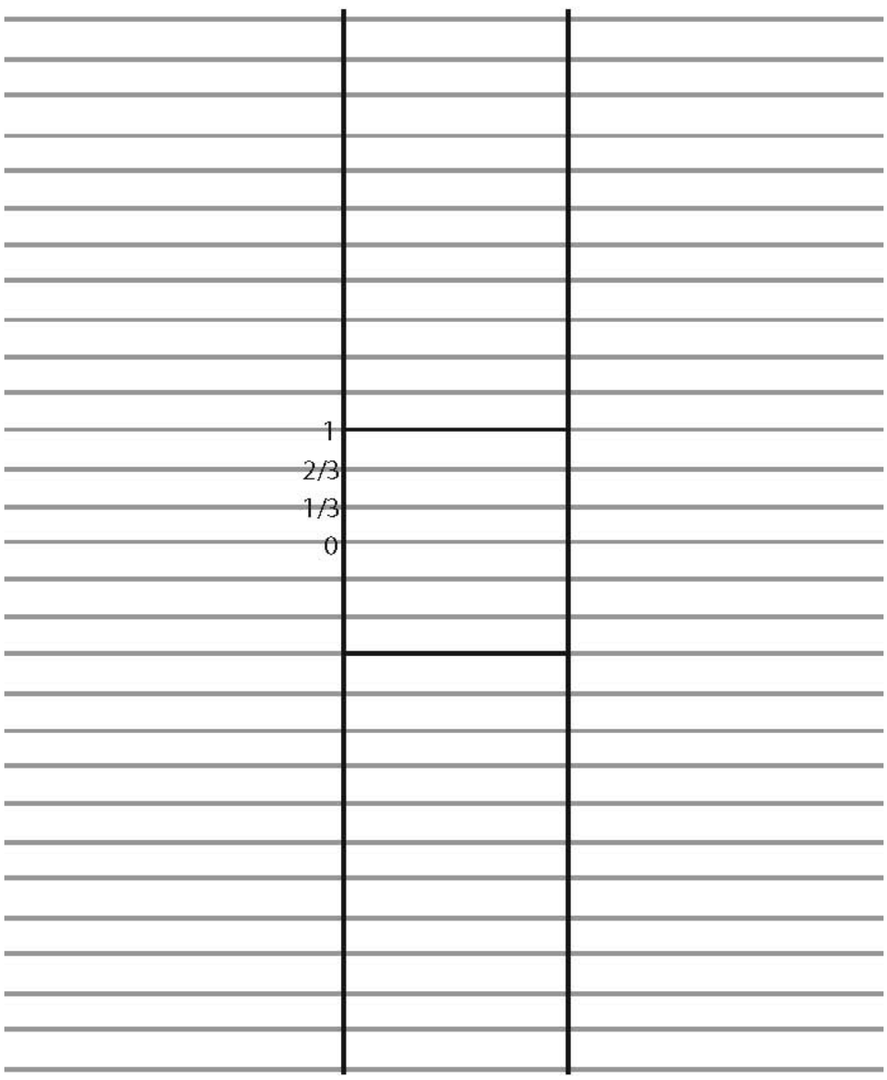

Figure 8:

[7] 5. (a) Subdivide into homotopy classes; which of these symbols are mutually homotopic (ie, topologically equivalent) and which are not?

A B C D E 2 4 6 8 0

Figure 9:

[4] (b) The two surfaces given below are topologically equivalent. Demonstrate their topological equivalence by drawing at least 3 in-between images which continuously transform one image into the other.

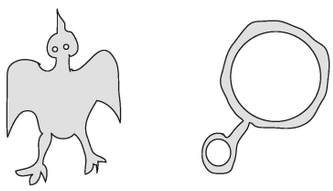

Figure 10:

[11] 6. Using an unmarked ruler and compass, identify the line l which gives the centre of every circle that gives a hyperbolic line passing through the point A, if the hyperbolic plane is the interior of the circle given below and O is the centre of the circle.

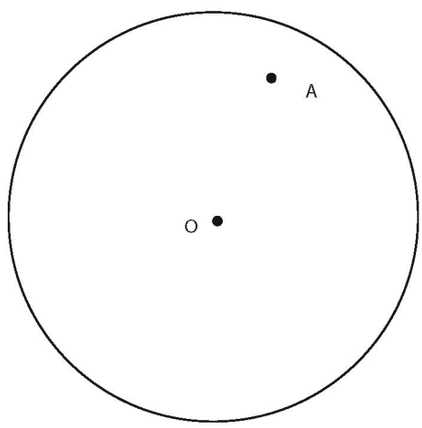

Figure 11:

[2] 7. (a) Is the figure below a platonic solid (if so, give its name)? What is its genus?

[5] (b) State how many edges, vertices, and faces it has, and use these values to calculate its Euler's characteristic.

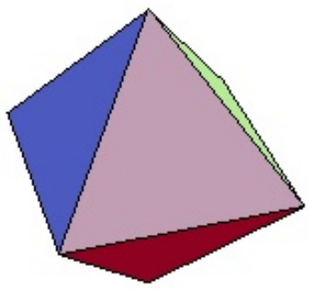

Figure 12:

[4] (c) Is the figure below a platonic solid (if so, give its name)? What is its genus? What is the value of its Euler's characteristic?

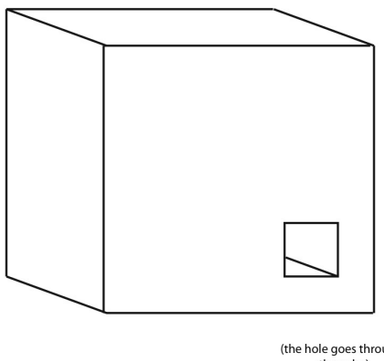

Figure 13: