

MTH 211, Math for Architects, Spring 2014

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QUESTION 1. Draw a circle with radius 4cm, say C, centered at a point, say O. Let Q be a point inside C such that $|OQ| = 2cm$. What is the smallest radius of the circle M, where M is orthogonal (perpendicular) to C and it passes through Q?

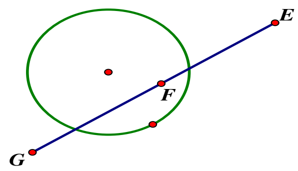
QUESTION 2. Let C and Q as in the previous question. Convince me that there is a circle D with radius $\sqrt{10}$ such that D is orthogonal to C and it passes through Q. Show the steps that you will follow in order to construct such D, you may use marked ruler.

QUESTION 3. Draw a circle with radius 6 cm, say C. Let F and W be points on the circle C such that FW is not a diameter of C. Now consider the line FW. Construct the inversion of the line FW with respect to C. You are allowed to use a marked ruler.

QUESTION 4. Let C be a circle centered at O and with radius 5cm. Let A, B be points on C such that AB is not a diameter of C. First construct a circle, say L, passes through A, B, and O. Construct the inversion of L with respect to C.

QUESTION 5. Let C be a circle centered at O and with radius 4cm. Let A and B be points such that O, A, B are not co-linear, $|OA| = 8cm$ and $|OB| = 2cm$. Construct the inversion of the line SEGMENT AB with respect to C.

QUESTION 6. Given a circle M and a line EG, see below. Construct a circle L such that L is orthogonal to M, L



passes through F, and the line EG is a tangent line to L at F.

QUESTION 7. Let C be a circle with radius 4 centered at O. Let A be a point on C. Let B, D be points on OA such that $|OB| = 1$ and $|OD| = 2$. Construct the inversion of the line segment BD with respect to C. Then find $|inv(B)inv(D)|$.

QUESTION 8. (i) What are the types of lines in the non-Euclidean hyperbolic geometry?

(ii) One of the axioms of the hyperbolic geometry is not true in the Euclidean Geometry. What am I talking about!!!?

(iii) Let H be a circle with radius 6 centered at O. Construct a circle L with radius 4 centered at O. Let A, B be points on L such that AB is not a diameter of L. Inside H, construct the non-Euclidean triangle AOB. Find $d_H(A, B)$, $d_H(O, A)$, and $d_H(O, B)$. To calculate these non-Euclidean distances use marked ruler (give your answer to the nearest one decimal).

QUESTION 9. Let H be a hyperbolic circle with radius 4. Let B be a point on H (so B is a horizon point). Construct two parallel hyperbolic lines, say L_1 and L_2, such that L1 meets L2 at B. State briefly the steps of construction.

QUESTION 10. Let C be a circle of radius 2 cm with CENTER O, and ABC is a triangle such that $|OA| = |OB| = 4$, and $|OC| = 8$. Sketch the inversion of the triangle ABC with respect to the circle C. what is the Euclidean distance between Inv(A) and Inv(C).

QUESTION 11. Let D be a rectangle 6×3. We want to remove the line segments that connect the vertices of D and replace them with SOMETHING you select but no line segments are allowed in order to use many pieces of the new object to tile a plane. DRAW ONE IMAGE of the new object that you selected.

QUESTION 12. We want to tile a plane using pieces of regular 8-gon and pieces of another regular n-gon. STATE ALL POSSIBILITIES of the other regular n-gon. JUSTIFY YOUR ANSWER. If V is a vertex of one piece of a regular 8-gon, How many pieces of regular 8-gon and how many pieces of the other regular n-gon share the vertex V

QUESTION 13. (i) To tile a floor, we may use pieces of a regular 12-gon with pieces of one of the following regular n-gon :

a) regular 4-gon b) regular 6-gon c) regular 5-gon d) regular 3-gon.

(ii) To tile a floor, we may use pieces of regular 12-gon with:

a) pieces of regular 6-gon and pieces of regular 3-gon b) nothing else (only pieces of regular 12-gon) c) pieces of regular 6-gon and pieces of regular 4-gon. d) pieces of regular 4-gon and pieces of regular 8-gon

(iii) To a tile a floor, we may use pieces of regular 8-gon with:

a) pieces of regular 3-gon b) pieces of regular 4-gon c) pieces of regular 12-gon d) nothing else (only pieces of regular 8-gon)

(iv) The measurement of each interior angle of a regular 10-gon is

a) 36 (b) 144 c) 100 108

(v) The measurement of each center angle of a regular 15-gon is

a) 156 b) 12 c) 24 d) 225

(vi) One of the following is constructible by unmarked ruler and a compass:

a) regular 21-gon b) regular 22-gon c) regular 34-gon d) regular 50-gon

(vii) Given C is a circle centered at O and with radius 6 cm. Let A be a point such that $| OA |= 3$. Let $Inv(A)$ be the inversion of A with respect to C. Then $| OInv(A) |$ =

a) 2 b)12 c) 9 d) 4.5

(viii) If a regular n-gon is constructible, then the angle (180/n) is constructible.

a) True b) False

(ix) If an angle α is constructible, then the angle $\alpha/16$ is constructible.

a) True b) False

(x) Let C be a circle centered at O and with radius 3. Given A is a point such that $| OA |= 1$ and D is a circle orthogonal to C and passing through A. Then one of the following values is a possibility for the radius of D:

a)3 b)5 c) 3.5 d) 2

(xi) Let H be the horizon circle (the model for non-Euclidean) with radius 4 and centered at O. Let A be a point in H such that $| OA |= 3$. Then the non-Euclidean distance between O and A is :

a) ln(3) b) ln(7) c) ln(9) = 2ln(3) d) ln(4)

(xii) In non-Euclidean (hyperbolic) geometry, if a, b are two points, then

a) There are infinitely many lines pass through a and b b) There is exactly one circle passes through a and b c) There is exactly one line passes through a but not through b d) There is exactly one line passes through a and b.

Faculty information

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