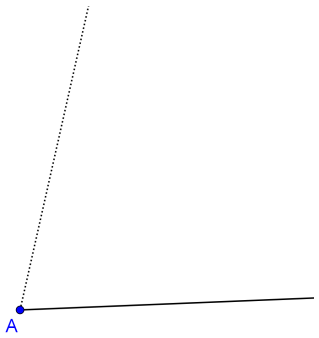
Math 340: Geometry

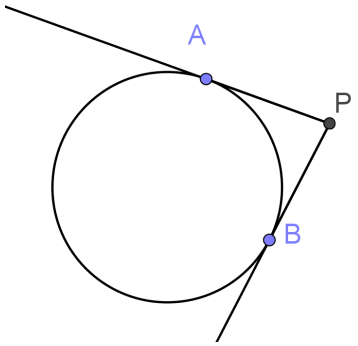
Homework 1

In the problems involving straightedge and compass constructions, you may take for granted the construction of perpendicular line bisectors, angle bisectors, equilateral triangles and squares. In other words, you can describe a step as "we draw the angle bisector at ___" as opposed to also describing how you find the angle line bisector. You may also take for granted that given a point P and a line ℓ, you can construct a perpendicular line to ℓ through P.

1. Given a point A and a line ℓ through A. Describe how you would create, using only straightedge and compass, a line k that goes through A that satisfies that the small angle between k and ℓ is $75°$. In the figure below, the dotted line is what k should be and ℓ is the solid line.



2. Given two points A and B on a circle Γ, describe how you can find, using only straightedge and compass, a point P such that the rays PA and PB are tangent to Γ.



3. Given a regular n-gon, describe how you can find using only straightedge and compass, a regular $2n$-gon.

4. Given a regular n-gon and a regular m-gon satisfying that n and m are relatively prime[1], show that you can create a regular nm-gon using only straightedge and compass.

5. Exercise 1.3.5 from the book.

6. Exercises 1.3.6, 1.4.1 and 1.4.2.

7. Exercises 1.4.3 and 1.4.4.

8. Exercises 1.5.1, 1.5.2, 1.5.3 and 1.5.4.

BONUS In class I mentioned that given two points A and B, one can find using only compass (without the straightedge) a point C such that $\triangle ABC$ is equilateral. One can also find points to make an hexagon using only compass. Prove or disprove that you can find, using only a compass, points C and D such that $ABCD$ is a square.

[1] this means that there is no integer $d > 1$ such that $d|n$ and $d|m$