Remote Learning Packet

NB: Please keep all work produced this week. Details regarding how to turn in this work will be forthcoming.

April 13-17, 2020
Course: 9 Geometry
Teacher(s): Mr. Mooney sean.mooney@greatheartsirving.org

Weekly Plan:

Monday, April 13
☐ Review "Answer Keys" for IV.2 and II.11
☐ Practice IV.2 and II.11

Tuesday, April 14
☐ Prop IV.10 (see alternate instructions)
☐ Write IV.11 in two-column

Wednesday, April 15
☐ Preliminary Constructions (II.11 and IV.10)
☐ Construct IV.11

Thursday, April 16
☐ Construct IV.12-14
☐ Construct IV.15 and the porism construction

Friday, April 17
☐ Construct IV.16
☐ Review and polish

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

I affirm that, to the best of my knowledge, my child completed this work independently

_____
Student Signature

_____
Parent Signature

Monday, April 13

Dear students,

I hope you are receiving this packet in good health and high spirits, and that you are enjoying all of the constructions of Book IV. The constructions will continue to get more complex and to build upon one another. For that reason, I have included in this packet a few construction "answer keys", which are basically just my own constructions with some notes. I hope you find them helpful. It is important to get these constructions right, because, as you can probably guess, some of them will be needed in later constructions. Indeed, they will be used in the most glorious and perfect construction that we will do this year: the construction of the regular pentagon inscribed in a circle.

Three more general things to note.
First of all, with the exception of IV.11 we will not be doing two-column for any of these. This is important, because trying to read and understand all of the proofs that go along with these constructions would likely take you much longer than 40 minutes a day. (If you *want* to read them, and you have the time, go for it! But I want to be clear that I am not requiring it.) As I'm sure you have noticed by now, in construction proofs the first few steps are the actual construction, and the rest of it is the proof. Once you notice that Euclid has shifted into the proof portion, you may stop reading.

Secondly, I will ask you to complete some of these constructions on your own paper, some of them on the paper in this packet. Either way, *save all work that I am assigning to be turned in*.

Lastly, if you are having any trouble with these constructions, please feel free to email me at any time. I miss you all, and I miss teaching you and answering your questions. If you cannot figure something out, do not hesitate to email!

Ok, that's all. Grab your compass and straightedge, and let's get started!

Today, I would like you to:

1) Spend some time reviewing the answer keys that I have made for you, for IV.2 and II.11 (Labeled "IV.2 Construction Answer Key" and "Construction of Golden Ratio (II.11)").

2) Then, practice these constructions 2x each on the papers that I have provided for you in the back of this packet. They are labeled "Practice: IV.2 and II.11."

Tuesday, April 14

Today, I would like you to:

1) Construct IV.10 on a separate sheet of paper. This is a construction of the "Golden Triangle." For this construction, please see attached instructions in the back of this packet, labeled "IV.10 Construction." Euclid's construction is slightly more complicated, but that is for the sake of his proof. You may read it if you'd like to, but you do not need to.

2) Write IV.11 into two-column notes. This is it! The crown of all of our constructions this year: the Regular* Pentagon! But do not *construct* it yet--that is tomorrow's work. As you will see, the construction is very involved, requiring several of the constructions that you have just learned.

*NB: "Regular" means "both equilateral (all equal sides) and equiangular (all equal angles)."

Wednesday, April 15

Today is the big day! It is time to construct your first-ever regular pentagon! Here is what I would like you to do:

1) Follow the guided constructions entitled "Preliminary work for Pentagon Construction," included in this packet. You may have noticed yesterday that IV.11 begins with a IV.10 Golden Triangle in the first step. But the Golden Triangle requires the Golden Ratio (II.11)--thus, these two constructions must be done before you begin on the actual pentagon.

2) Using your preliminary constructions, complete the construction of IV.11 on a separate sheet of paper. When you are done, gaze upon the beautiful shape that you have created.

3) Join the final two vertices of your pentagon. What do you get? Could this pattern be extended? (These are rhetorical questions: please answer them in your mind, or test them out on your construction, but you needn't write a response.)

Thursday, April 16

Today, we have three constructions to do. The first two are about pentagons; the third is about hexagons.

I would like you to:

1) Construct IV.12-14 on the paper provided (entitled "Guided Constructions: IV.12-14 and IV.16"). Do not do IV.16 yet (that will be done on Friday).

2) Perform IV.15, the construction of the regular hexagon on a separate sheet of paper. Then, *on the same construction*, perform one of the three constructions mentioned in the porism: namely, circumscribe a regular hexagon about the circle that contains your original hexagon. This can be done by drawing tangents at each of the vertices of your hexagon, using the III.16.porism method of drawing perpendiculars to the radii at those points. The result will be a hexagon *in* the circle *and* a hexagon *around* the circle.

Friday, April 17

This is it--the last day in Book IV! I hope you have enjoyed all these wonderful constructions.

Today, I would like you to:

1) Perform the IV.16 construction, using the construction guide to be found in this packet under the title "IV.16 Construction Guide."

2) Use any time you have left to finish up and perfect any of the constructions from Book IV that still need some work.

Congratulations! You have finished Book IV and are construction masters! Next week, we will begin our journey into Books V and VI, on *Ratio and Proportion*.

IV. 2 Construction Answer Key

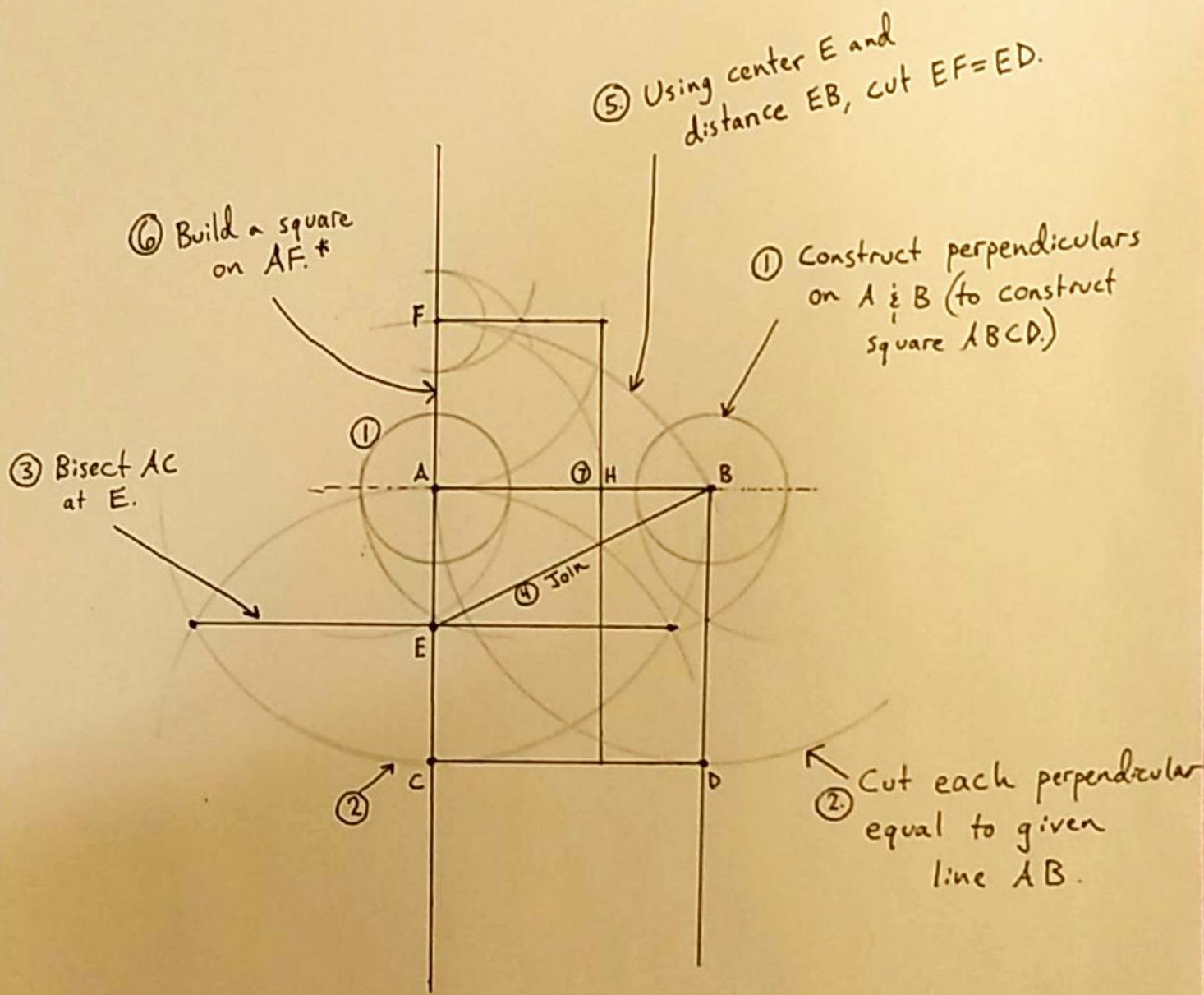④ Join
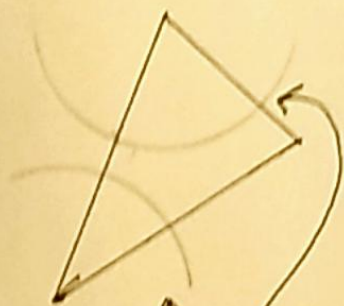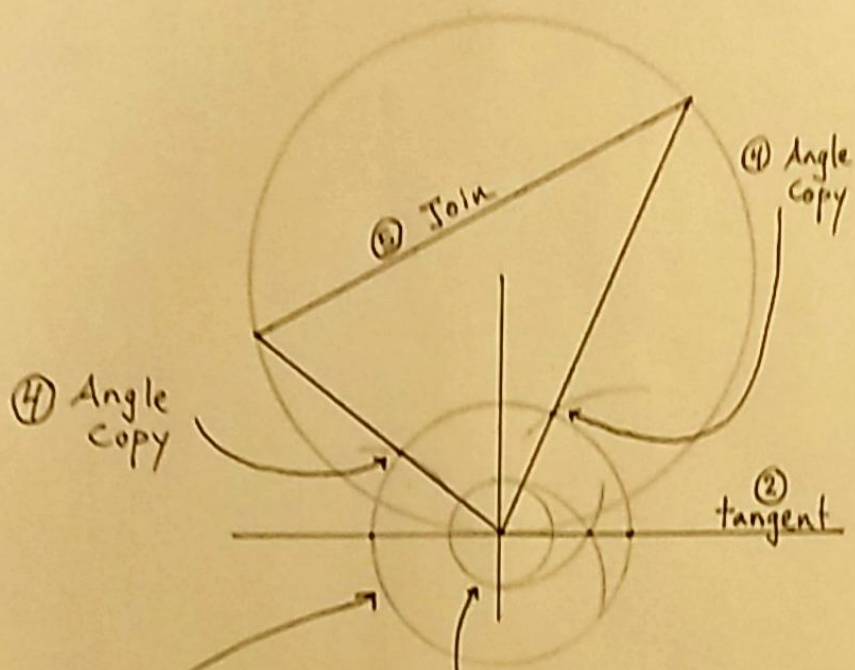
④ Angle Copy

④ Angle Copy

② tangent

③

① Construction of tangent (perpendicular to radius)

This circle is used for **both** angle copies. Notice the equal circles about the angles of my triangle.

(You may use different-sized circles; it is just cleaner if you use one circle for both.)

Construction of Golden Ratio (II.11)

⑤ Using center E and distance EB, cut EF=ED.

⑥ Build a square on AF.*

① Construct perpendiculars on A & B (to construct square ABCD.)

③ Bisect AC at E.

④ Join

⑦ H

② Cut each perpendicular equal to given line AB.

⑦ The point H is what we have been after this whole time. It cuts AB in the Golden Ratio so that $AB:AH = AH:HB$.

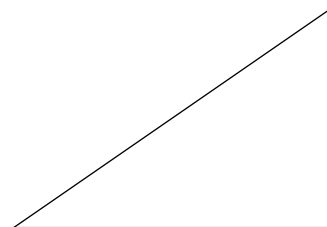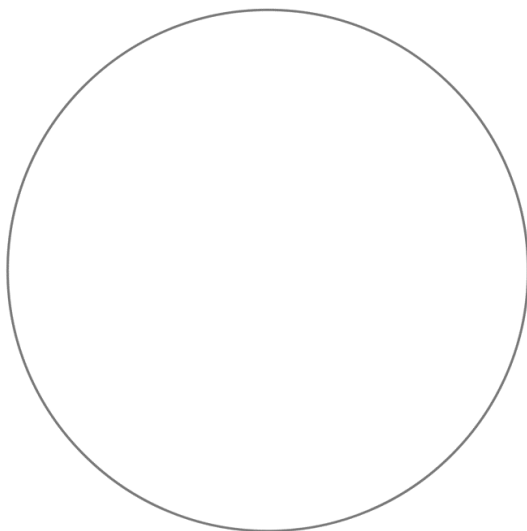* NB: A square is actually only needed for the proof. You may simply copy AF onto line AB.

_____
_____
_____
_____
Practice #1:

<u>IV.2</u>: Inscribe the given triangle in the given circle.
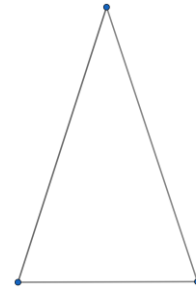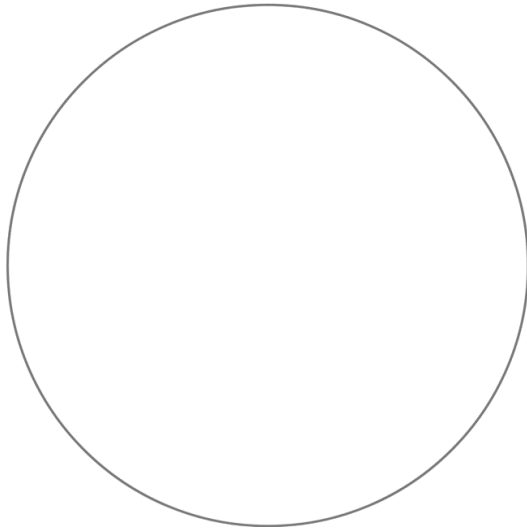
Practice #2:

<u>IV.2</u>: Inscribe the given triangle in the given circle.

<u>Practice #1</u>:

<u>II.11</u>: Cut the given line in the Golden Ratio.

_____

<u>Practice #2</u>:

<u>II.11</u>: Cut the given line in the Golden Ratio.

_____

IV. 10 Construction

The purpose of this construction is to construct a Golden Triangle, △ABC. A "Golden Triangle" is an isosceles triangle whose base angles are each double the remaining peak angle, and whose sides are in the Golden Ratio. That is, AB : BC is the golden ratio.
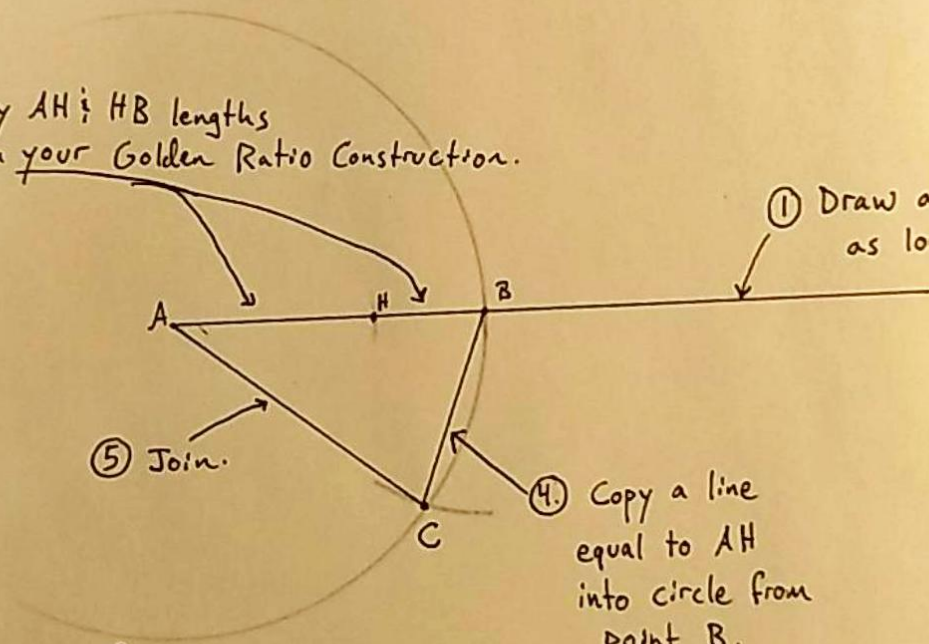
② Copy AH : HB lengths from your Golden Ratio Construction.

① Draw a straight line, as long as you'd like.

⑤ Join.

④ Copy a line equal to AH into circle from point B.

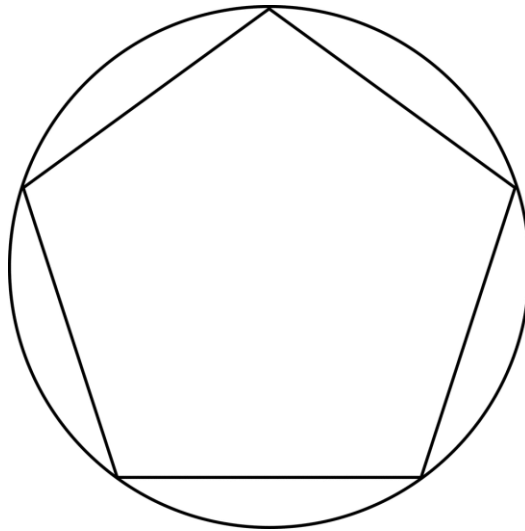③ Draw a circle about point A, with distance AB.

_____

_____

_____

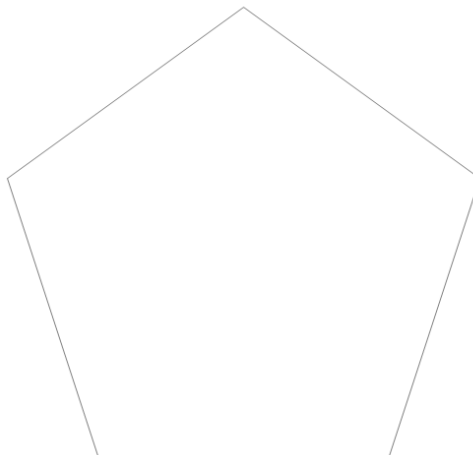_____

<u>_____</u>:

<u>Given</u>:

<u>To Prove</u>:

Statements	Reasons
1. _____	1.
2. _____	2.
3. _____	3.
4. _____	4.
5. _____	5.
6. _____	6.
7. _____	7.
8. _____	8.
9. _____	9.
10. _____	10.
11. _____	11.
12. _____	12.
13. _____	13.
14. _____	14.
15. _____	15.
16. _____	16.
17. _____	17.
18. _____	18.
19. _____	19.
20. _____	20.

_____
_____
_____
_____

IV.12: About the given circle, circumscribe a regular pentagon.
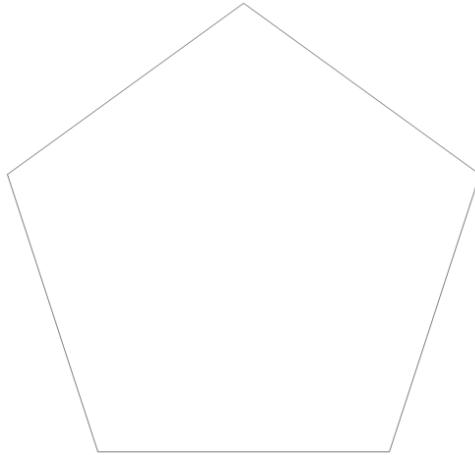
(The first step has been done for you, inscribing a regular pentagon into the given circle—IV.11)

IV.13: In the given regular pentagon, inscribe a a circle.
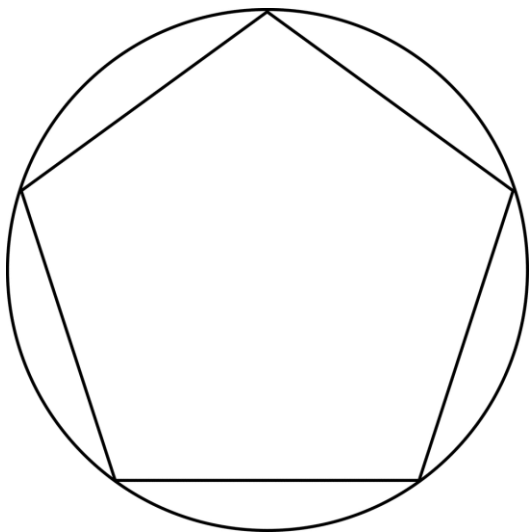
_____
_____
_____
_____

IV. 14: About the given regular pentagon, circumscribe a circle.

IV.16: In the given circle, inscribe a fifteen-angled regular figure.

(The pentagon has been done for you. You must construct your own equilateral triangle [I.1] and then inscribe it in the circle [IV.2]).

Pentagon Preliminary Work:

Construct the Golden Ratio on the given line [II.11].

Then, either directly on top of your Golden Ratio construction, or in the space below, construct a Golden Triangle [II.11]. (If you construct it below, just use your compass to copy the lengths of the Golden Ratio onto a line below.)