

ANSWER MAZE



ANGLE BISECTORS AND THE INCENTER

How Far, and How Big?

One page · 10–15 minutes · nothing to prepare

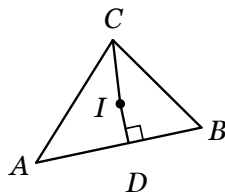
FREE

3

I is the incenter. $ID = 5$ and $IC = 8$. How far is I from side BC?

8 → go to 2

5 → go to 6



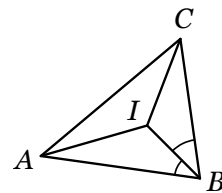
Find the small square. Which segment ends on a side?

6

I is the incenter. $m\angle ABC = 74^\circ$. Find $m\angle IBC$.

37° → go to 1

74° → go to 5



Put a finger on the arcs at B. Which part does the question name?

1. **Hand out page 3**, one per student. Nothing else is needed.
2. **Say this once:** *“Start at box 3. A distance to a side ends on the side, at a right angle. The line from a corner to the incenter cuts that angle into two equal parts. Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **3 6 1 8 4 7**: six boxes, then out.

Student sheet	page 3, one per student. It shows the incenter and the circumcenter as two small marked drawings.
Answers	page 4.

Every wrong answer comes from one of two mistakes. The first is measuring a distance to the wrong place. The incenter is the same distance from the three *sides*, and that distance is measured along a segment perpendicular to the side. Students measure to a corner instead, or along a slanted segment. At the circumcenter it is the other way round: the three *corners* are the same distance away, and the distance to a side tells nothing. These wrong answers send the student to box 2.

The second mistake is with the halves. The line from a corner to the incenter cuts that angle into two equal parts. Students use the whole angle where the question names one part, or one part where it names the whole angle. In triangle BIC the two angles at B and C are both halves. These wrong answers send the student to box 5. Boxes 2 and 5 ask the same kind of question again, and both of their answers lead back to the route.

The row at the bottom is the check. A clean run is six numbers. Each wrong answer adds at least one more. Guessing does not get a student out: every simple guessing rule, such as always taking the smaller number, goes wrong within the first three boxes.

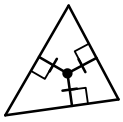


This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
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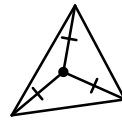
Name _____

Period _____

Date _____



The **incenter**: the same distance from the three **sides**. It is where the angle bisectors meet.



The **circumcenter**: the same distance from the three **corners**. It is where the perpendicular bisectors meet.

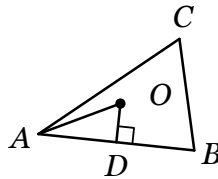
A small square marks a right angle. Angles with the same number of arcs are equal. **Choose an answer, and go to the box it names.**

1

O is the circumcenter. $OA = 9$ and $OD = 4$. How long is OC ?

9 → go to **8**

4 → go to **2**



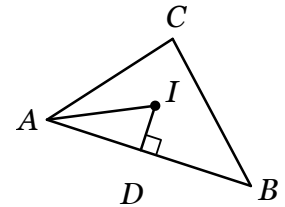
Is O the same distance from the sides, or from the corners?

2

I is the incenter. $ID = 3$ and $IA = 7$. How far is I from side CA ?

3 → go to **6**

7 → go to **3**



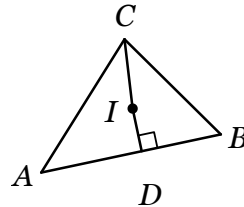
A distance to a side ends on that side. Trace each segment from I.

3

I is the incenter. $ID = 5$ and $IC = 8$. How far is I from side BC ?

8 → go to **2**

5 → go to **6**



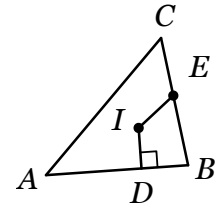
Find the small square. Which segment ends on a side?

4

I is the incenter. $ID = 6$ and $IE = 7$. Find the radius of the circle that touches all three sides.

6 → go to **7**

7 → go to **2**



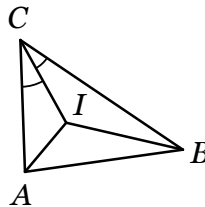
A radius ends on a side. Which segment has the small square?

5

I is the incenter. $m\angle ACB = 54^\circ$. Find $m\angle ICB$.

54 → go to **6**

27 → go to **1**



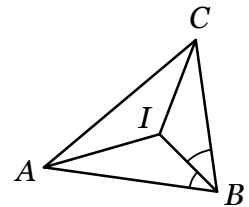
Look at the arcs at C. The line from C to I splits that angle.

6

I is the incenter. $m\angle ABC = 74^\circ$. Find $m\angle IBC$.

37 → go to **1**

74 → go to **5**



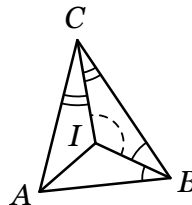
Put a finger on the arcs at B. Which part does the question name?

7

I is the incenter. $m\angle ABC = 62^\circ$ and $m\angle ACB = 48^\circ$. Find $m\angle BIC$.

70 → go to **5**

125 → you are out



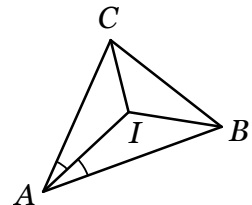
In triangle BIC , which arcs do the angles at B and C carry?

8

I is the incenter. $m\angle IAC = 23^\circ$. Find $m\angle BAC$.

23 → go to **5**

46 → go to **4**



Which angle does the question name? How many arcs does it hold?

Write each box number as you reach it:

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The route, in order. Boxes 2 and 5 are not on it. A student reaches them only by a wrong answer. They are the last two rows of the table.

3 → 6 → 1 → 8 → 4 → 7 → out

	Box	Right answer, and why	Wrong answer, and why a student picks it
1	Box 3	5. I is the incenter, so it is the same distance from all three sides. ID has the small square, so it is that distance: 5. IC = 8 goes to a corner, not to a side.	8 goes to box 2. A student who measures to a corner instead of to the side picks this.
2	Box 6	37°. The line from B to the incenter cuts the angle at B into two equal parts. $\angle IBC$ is one part: half of 74 is 37.	74° goes to box 5. A student who does not cut the angle in two picks this.
3	Box 1	9. O is the circumcenter, so it is the same distance from all three corners. OA = 9, so OC = 9 too. OD = 4 is the distance to a side, which tells nothing about OC.	4 goes to box 2. A student who mixes up the two points uses the distance to a side.
4	Box 8	46°. $\angle IAC$ is one of the two equal parts of the angle at A. The whole angle $\angle BAC$ is two parts: $23 + 23 = 46$.	23° goes to box 5. A student who copies the part and forgets the other part picks this.
5	Box 4	6. The radius of that circle is the distance from I to a side, measured at a right angle. ID has the small square, so the radius is 6. IE = 7 is slanted, so it is not a distance.	7 goes to box 2. A student who measures along a slanted segment picks this.
6	Box 7	125°. In triangle BIC, the angle at B is half of 62, which is 31, and the angle at C is half of 48, which is 24. So $m\angle BIC = 180 - 31 - 24 = 125$.	70° goes to box 5. A student who uses the whole angles at B and C in triangle BIC picks this.
	Box 2	3. I is the incenter, so it is the same distance from all three sides. ID has the small square, so it is that distance: 3. IA = 7 goes to a corner, not to a side.	7 goes to box 3. A student who still measures to a corner picks this.
	Box 5	27°. The line from C to the incenter cuts the angle at C into two equal parts. $\angle ICB$ is one part: half of 54 is 27.	54° goes to box 6. A student who still does not cut the angle in two picks this.

How to check any box. For a distance, find the point first. The incenter is the same distance from the three sides, measured along a segment with a small square. The circumcenter is the same distance from the three corners. For an angle, the line from a corner to the incenter cuts that angle into two equal parts.

A student can find the last four boxes of the route by following the arrows backward from “you are out.” So ask a student with a clean row to explain one box.