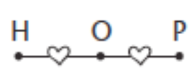
# Girls Get Curves

## Solution Guide for Chapter 4

Here are the solutions for the "Doing the Math" exercises in *Girls Get Curves*!

**DTM from p. 63-65**

2. See HOP. Given: $\overline{HO} \cong \overline{OP}$. Prove: $O$ is the midpoint of $\overline{HP}$.



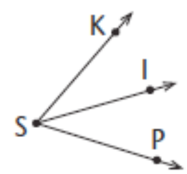

Okay, this might seem obvious, since the very definition of midpoint is that the point divides a segment into two congruent halves – and that's exactly what we'll use in this mini-proof – the *definition of midpoint*!

We'll start by writing down the Given in the left column and write "Given" for its reason in the right column. Next – how do we link from the Given? We need the "if" part of the Reason to say something about two congruent segments, right? Luckily, the definition of midpoint ("If a point divides a seg into two congruent segments, then the point is the midpoint") fits the bill. And its "then" part just so happens to be the thing we're wanting to prove.

| Statements | Reasons |
|---|---|
| 1. $\overline{HO} \cong \overline{OP}$ | 1. Given |
| 2. $\therefore$ $O$ is the midpoint of $\overline{HP}$. | 2. If a point divides a seg into two $\cong$ seg's, then the point is the midpoint. |

Just to keep track of the linking, we used dots for the matching "congruent segments" parts, and underlines for the "midpoint" parts. Done!

3. See SKIP. Given: $\overrightarrow{SI}$ is the angle bisector of $\angle KSP$. Prove: $\angle KSI \cong \angle ISP$.

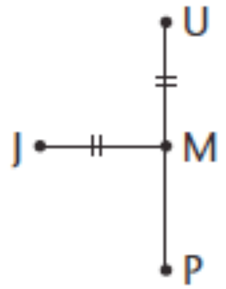



Again, it might seem obvious because this IS the definition of angle bisector (If a ray divides an angle into two congruent parts, then it's the angle bisector). However, in order to link from the Given to the "if" part of our Reason, we'll need to use the converse of the definition ("If a ray is an angle bisector, then it divides its angle into two congruent parts"). Let's do it, and underline like parts to make sure our logic is airtight:

| Statements | Reasons |
|---|---|
| 1. $\overrightarrow{SI}$ is the angle bisector of $\angle KSP$. | 1. Given |
| 2. $\therefore$ $\angle KSI \cong \angle ISP$ | 2. If a ray is an $\angle$ bisector, then it divides the $\angle$ into two $\cong$ $\angle$'s. |

Done!

4. Use the JUMP diagram below. Given: $\overline{JM} \perp \overline{UP}$. Prove: $\angle JMP$ is a right angle.




How do we link from something being perpendicular to it being a right angle? Well, we have the Rule "If two segments are perpendicular, then they create right angles." Great! We'll come up with some creative underlines to link like parts, and we're done with this mini-proof!

| **Statements** | **Reasons** |
|---|---|
| 1. $\overline{JM} \perp \overline{UP}$ | 1. Given |
| 2. $\therefore \angle JMP$ is a right angle. | 2. If two seg's are $\perp$, then they create right $\angle$'s. |

Questions 5–8: Complete the fill-in-the-blank proof, and include the underlines.

Given: $\overline{JM} \cong \overline{UM}$, and $M$ is the midpoint of $\overline{UP}$.

Prove: $\overline{JM} \cong \overline{MP}$.

## Proof

| Statements | Here's WHY we can say the Statements → | Reasons |
| --- | --- | --- |
| 1. $\overline{JM} \cong \overline{UM}$ | (How do we know?) | 1. (#5) |
| 2. M is the midpoint of $\overline{UP}$. | (Why can we say this?) | 2. (#6) |
| 3. $\overline{UM} \cong \overline{MP}$ | (How do we know?) | 3. (#7) |
| 4. $\therefore \overline{JM} \cong \overline{MP}$ | (Why can we say this?) | 4. (#8) |

Well, #5 and #6 are easy – those were the Givens! And the word "Given" never needs any underlines.

5. **Given**

6. **Given**

7. So the Reason that goes here will be the "if…then" statement that links us from "M is the midpoint of $\overline{UP}$" to "$\overline{UM} \cong \overline{MP}$", right? And hey, the converse of the definition of midpoint does just that! "If a point is a midpoint, then it divides a segment into two congruent segments."

Since "M is the midpoint of UP" has squiggle underlines, we'll use that for its matching "if" part of our Reason, and since "$\overline{UM} \cong \overline{MP}$" has single underlining, we'll use that kind of underlining for the "then" part of our Reason!

**Answer:** (this is the thing we'd stick in the "#7" spot above in the proof)

*If* a point is a midpoint, *then* it divides a segment into two $\cong$ segments.

8. So the Reason that goes in the #8 spot will be the "if…then" statement that links us from "$\overline{UM} \cong \overline{MP}$" to "$\overline{JM} \cong \overline{MP}$," right?

Hm, how do we even conclude that $\overline{JM} \cong \overline{MP}$, anyway? Well, since $\overline{UM} \cong \overline{MP}$ and $\overline{JM} \cong \overline{UM}$, we can get to $\overline{JM} \cong \overline{MP}$ with the Transitive Property!

We'll make sure we're matching up the "if" parts of the Transitive property with Statements happening on previous lines, and matching up the "then" part of the Transitive property with the statement on the current line. Then we'll know our logic is airtight. And this is what we'd put in the Reasons column, as the last line of this proof:

**Answer:**

Transitive Property: If $\overline{JM} \cong \overline{UM}$ and $\overline{UM} \cong \overline{MP}$, then $\overline{JM} \cong \overline{MP}$.

For exercises #9–#13, use the TWIRL diagram and the proof below to fill in the blanks.


Given: $\overrightarrow{TI}$ is the angle bisector of $\angle WTR$, and $\angle 1 \cong \angle 3$.

Prove: $\overrightarrow{TR}$ is the angle bisector of $\angle ITL$.

Proof

| Statements | | Reasons |
|---|---|---|
| 1. $\overrightarrow{TI}$ is the angle bisector of $\angle WTR$. | (Why?) | 1. (#9) |
| 2. (#10) | (Why?) | 2. If a ray is an $\angle$ bisector, then it divides the $\angle$ into two $\cong$ $\angle$'s. |
| 3. (#11) | (Why?) | 3. Given |
| 4. $\angle 2 \cong \angle 3$ | (Why?) | 4. (#12) |
| 5. $\therefore$ $\overrightarrow{TR}$ is the angle bisector of $\angle ITL$. | (Why?) | 5. (#13) |

9. Again, this is the easy part! We just write "Given."

**Answer: Given**

10. We know that the "then" part of a reason must match up with the Statement on the *same line*, so that means the Statement of this line has to match up with "then it divides the angle into two congruent angles." So we need to write a congruency statement between two angles. Which ones? The ones on either side of the angle bisector we established in our Given ($\overrightarrow{TI}$), of course! So that would be $\angle 1 \cong \angle 2$. (We could also use letters to describe the same letters, if we really wanted to.) And since the "then" part that we're matching used a single underline, that's what we'll use here, too.

(Here's what we'd fill in at #10 above!)

**Answer:**

$\underline{\angle 1 \cong \angle 2}$ (or $\underline{\angle WTI \cong \angle ITR}$)

11. This is easy – it's just the Given that we haven't used yet: $\angle 1 \cong \angle 3$. But what type of underline should we use? Notice that it hasn't been established yet! There's no "if" part in any future Reasons that match up to this which have already been written down. So we can pick whatever we want, as long as we are consistent later in the proof. How about double underlines?

**Answer:**

$\underline{\underline{\angle 1 \cong \angle 3}}$

12. Hm, okay, so the Statement on this line says that $\angle 2 \cong \angle 3$. Notice that earlier in the proof, we already established that $\angle 1 \cong \angle 2$ and $\angle 1 \cong \angle 3$. So then to get to $\angle 2 \cong \angle 3$, we just use the Transitive property! We'll make sure to match up the underlines (including the double underline style we decided to give "$\angle 1 \cong \angle 3$").

Transitive Property: If $\underline{\angle 1 \cong \angle 2}$ and $\underline{\underline{\angle 1 \cong \angle 3}}$, then $\angle 2 \cong \angle 3$.

13. Here, we need a Reason that links us from $\angle 2 \cong \angle 3$ (or something else from a previous Statement) to the current Statement: $\overrightarrow{TR}$ is the angle bisector of $\angle ITL$. Taking a look at $\overrightarrow{TR}$ on the diagram, we see that it is between $\angle 2$ & $\angle 3$. Since $\angle 2 \cong \angle 3$, then by definition, that means $\overrightarrow{TR}$ must be the angle bisector of the big angle made up from $\angle 2$ & $\angle 3$, in other words: $\angle ITL$. We'll make sure to match up the underlines so that the "then" part of this Reason matches the current Statement, and the "if" part matches the appropriate previous Statement, and we're done! Here's what we'd fill in above, as the last Reason of our proof:

**Answer:**

If a ray ($\overrightarrow{TR}$) divides an $\angle$ into two $\cong \angle$'s, then it's the $\angle$ bisector.