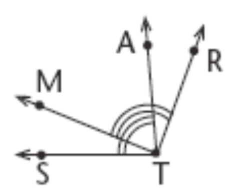
Girls Get Curves

Solution Guide for Chapter 5

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

DTM from p. 74-75

2. Use the SMART diagram. Given: $\angle STA \cong \angle MTR$, $m\angle ATR = 23°$, $m\angle MTA = 81°$. Find $m\angle STR$.



Okay, make sure to tap out the letters with your pencil or finger – otherwise this stuff can be hard to follow… Let's locate the angle we're supposed to find the measure of: $\angle STR$ - it's the great big one! The middle one, $\angle MTA$, is 81°, and the upper small one, $\angle ATR$, is 23°. Since we're also given that $\angle STA \cong \angle MTR$, we can use the Subtraction Property: If an angle ($\angle MTA$) is subtracted off of two congruent angles ($\angle STA$ & $\angle MTR$) then the differences ($\angle ATR$ & $\angle STM$) are congruent. Therefore, we know that $\angle STM$ measures 23°. And now we can add up all three angles making up the big angle to get our answer!

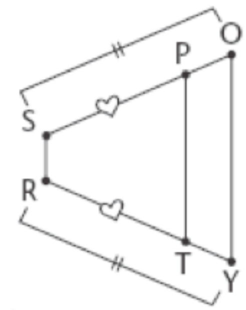
$m\angle STM + m\angle MTA + m\angle ATR = m\angle STR$

→

$23° + 81° + 23° = 127°$

Answer: 127°

3. Use the SPORTY diagram. Given: $\overline{SP} \cong \overline{RT}$, $\overline{SO} \cong \overline{RY}$, $PO = 3x$ cm, $TY = (x + 4)$ cm. Find TY.



Okay, we want to find that little segment, *TY*. Since those big segments are congruent to each other, $\overline{SO} \cong \overline{RY}$, and the medium "heart" segments are congruent to each other, then the Subtraction property tells us that if we subtract the "heart" segments from the big segments, we get congruent small segments, $\overline{PO} \cong \overline{TY}$. And that since we've been given expressions for *PO* and *TY*, now we know those expressions are <u>equal</u> to each other! So we can set up the equation and solve it:

$$PO = TY$$
$$\rightarrow 3x = (x + 4)$$
$$\rightarrow 3x = x + 4$$
$$\rightarrow 2x = 4$$
$$\rightarrow x = 2$$

But that's not the answer! We've been asked to find *TY*, which is $x + 4$, so $TY = 2 + 4 =$ **6**.

Answer: *TY* = 6 cm

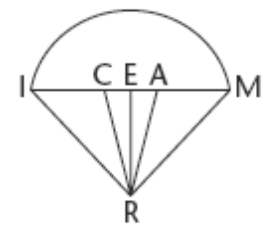
4. Use the WAVE diagram to the right. Given: $\overline{WV} \cong \overline{AE}$. Which other segments can we say are congruent?

Again, it's the Subtraction Property at work! Since those overlapping segments are congruent ($\overline{WV}$ & $\overline{AE}$), if we subtract the same segment ($\overline{AV}$) from both of them, then we know that the leftover pieces, $\overline{WA}$ & $\overline{VE}$, must be congruent. Done!

Answer: $\boldsymbol{\overline{WA} \cong \overline{VE}}$

5. Part a. In the "ice cream" diagram to the right, if $\angle IRE \cong \angle ERM$ and $\overrightarrow{RE}$ bisects $\angle CRA$ (meaning that $\angle CRE \cong \angle ARE$), name the other two sets of angles at the vertex R (that's 4 angles total) that must be congruent.

Part b. If $m\angle IRA = 65°$, find $m\angle MRC$.



Part a: So, what other two sets of angles must be congruent? We're told that the two "halves" of the big angle are congruent, $\angle IRE \cong \angle ERM$, and we're also told that the two skinny triangles are congruent, $\angle CRE \cong \angle ARE$. Then we could use the Subtraction Property to know that those "outside" angles are congruent to each other: $\boldsymbol{\angle IRC \cong \angle MRA}$. Good progress!

And now we can use the Addition property to get congruent *overlapping* triangles, right? We just add the "halves" to the "skinny" triangles on the other side of each half (so, for example, $m\angle IRE + m\angle ARE = m\angle IRA$)

And here are the two congruent overlapping triangles we end up with: $\boldsymbol{\angle IRA \cong \angle MRC}$.

For the next part, if $m\angle IRA = 65°$, then what is $m\angle MRC$? Well we just saw that those two angles are congruent to each other, so that means $\boldsymbol{m\angle MRC = 65°}$, too!

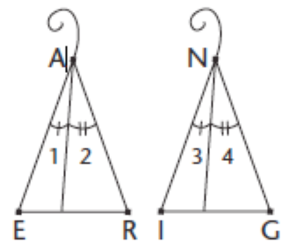
Answer:

Part a. $\boldsymbol{\angle IRC \cong \angle MRA}$ **and** $\boldsymbol{\angle IRA \cong \angle MRC}$

Part b. $\boldsymbol{m\angle MRC = 65°}$

DTM from p. 75-77

2. Mini-proof! In EARING, Given: $\angle 1 \cong \angle 3$ and $\angle 2 \cong \angle 4$. Prove: $\angle EAR \cong \angle ING$.



This sure looks like the Addition property: All we're doing is adding together the angles in each "earring," each of which are congruent to the corresponding angles in the other "earring," so we get two congruent "earrings"! We'll state our Given, pick some underlines to make the matching parts more obvious, use the Addition property, and that's all there is to it:

Statements	Reasons
1. $\angle 1 \cong \angle 3$	1. Given
2. $\angle 2 \cong \angle 4$	2. Given
3. $\therefore$ $\angle EAR \cong \angle ING$	3. If two $\cong$ angles ($\angle 1$ & $\angle 3$) are added to two other $\cong$ angles ($\angle 2$ & $\angle 4$), then the sums ($\angle EAR$ & $\angle ING$) are $\cong$.

3. Mini-proof! In DARK, Given: $\overline{DR} \cong \overline{AK}$. Prove: $\overline{DA} \cong \overline{RK}$.

Hm, we have two long, overlapping congruent segments – looks like the Subtraction property. And yep, we're being asked to prove that those two outside segments are congruent. Well, when we subtract that center segment, $\overline{AR}$, off each of the overlapping congruent segments, we indeed get two other congruent segments: $\overline{DA} \cong \overline{RK}$. Let's pick some underlines to make sure our logic is airtight, and we're done!

Statements	Reasons
1. $\overline{DR} \cong \overline{AK}$	1. Given
2. $\therefore$ $\overline{DA} \cong \overline{RK}$	2. If a segment ($\overline{AR}$) is subtracted from two $\cong$ segments ($\overline{DR}$ & $\overline{AK}$), then the differences ($\overline{DA}$ & $\overline{RK}$) are $\cong$.

For #4–7, fill in the blanks for this proof using BLUE. Given: L is the midpoint of $\overline{BU}$ and U is the midpoint of $\overline{LE}$. Prove: $\overline{BU} \cong \overline{LE}$.

Proof

Statements	Reasons
1. L is the midpoint of BU.	1. Given
2. $\overline{BL} \cong \overline{LU}$	2. (#4)
3. U is the midpoint of LE.	3. Given
4. (#5)	4. If a point is a midpoint, then it divides the seg into two $\cong$ seg's.
5. $\overline{BL} \cong \overline{UE}$	5. (#6)
6. $\therefore$ $\overline{BU} \cong \overline{LE}$	6. (#7)

4. Okay, so to link from the first statement to this one, we just need is the definition of midpoint (well, its converse), right? And we'll match underlining styles, which means the "if" part must match a previous statement (squiggles) and the "then" part must match the current Statement (single underline).

Answer:

If a point is a midpoint, then it divides the segment into two ≅ segments.

5. We know that every Statement must match the Reason's "then" part, which in this case talks about two segments being congruent (from being on either side of a midpoint). That means that the missing information is probably a statement saying that two segments are congruent. But in the Statement #2, we already stated that $\overline{BL} \cong \overline{LU}$. So hm, those are probably not the two congruent segments. How about $\overline{LU} \cong \overline{UE}$? Sounds good, because we do know that U is the midpoint of $\overline{LE}$, so it's totally true, and we'll write it down! (Technically, we won't know this is the correct thing to write until we finish the proof. But it's a darn good guess!) And we know it would need double underlines, so it matches the "then" part of the Reason on this line.

Answer:

$\overline{LU} \cong \overline{UE}$

6. Well gosh, since we know that $\overline{BL} \cong \overline{LU}$ and $\overline{LU} \cong \overline{UE}$, then the Transitive Property tells us that $\overline{BL} \cong \overline{UE}$, doesn't it? Looks like we were right in #5 after all! This is all working out very nicely, if I do say so myself…

Notice that we'll need "stars" underlines for the "then" part of our Reason, since that's what the current statement uses.

Transitive Property: If $\overline{BL} \cong \overline{LU}$ and $\overline{LU} \cong \overline{UE}$, then $\overline{BL} \cong \overline{UE}$.

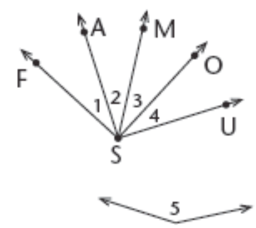
7. Now we need the final Reason for the final Statement. Well, we've just proven (in the previous step) that $\overline{BL} \cong \overline{UE}$, and if we just add the center segment, $\overline{LU}$, to each of those,

then by the Addition property, we get two new congruent segments: $\overline{BU} \cong \overline{LE}$ (be sure to locate those on the diagram yourself). Ta-da! And we'll need to use triple underlines for the "then" part of our Reason to match with the Statement on this line (and we'll match from previous statements for the appropriate terms of the "if" part, too).

Answer:

Addition Property: *If* a segment ($\overline{LU}$) is added to two $\cong$ segments ($\overline{BL}$ and $\overline{UE}$), *then* the sums are $\cong$.

DTM from p. 83-84



2. In the FAMOUS diagram from #1, if $\angle 5 = 150°$, what is $\angle FSU$? (Hint: We know that $\angle 1$ is supp. to $\angle 5$.)

Notice that if $\angle 1$ is supp. to $\angle 5$, that means

$$\angle 1 + \angle 5 = 180°$$

And since $\angle 5 = 150°$, that means:

$$\angle 1 + 150° = 180°$$

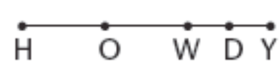
$$\rightarrow \angle 1 = \mathbf{30°}$$

Great progress! Notice in #1 on p. 83, that because $\overrightarrow{SA}$ & $\overrightarrow{SM}$ trisect $\angle FSO$, that means $\angle 1 \cong \angle 2 \cong \angle 3$. And because $\overrightarrow{SM}$ & $\overrightarrow{SO}$ trisect $\angle ASU$, that means $\angle 2 \cong \angle 3 \cong \angle 4$. With me so far? Then by the Transitive Property, we also know that $\angle 1 \cong \angle 4$, so all of those angles are actually congruent: $\angle 1 \cong \angle 2 \cong \angle 3 \cong \angle 4$.

We're being asked to find $\angle FSU$, and notice that $\angle FSU = \angle 1 + \angle 2 + \angle 3 + \angle 4$. And hey, since we just learned that $\angle 1 = 30°$, and all those little angle are equal in measure, then: $\angle FSU = 30° + 30° + 30° + 30° = \mathbf{120°}$.

Answer: $\angle FSU = 120°$

3. For HOWDY, Given: O & W trisect $\overline{HY}$, and D is the midpoint of $\overline{WY}$. If $DY = 2$, what is HY?



Alright – if O & W trisect $\overline{HY}$, that means $\boldsymbol{HO = OW = WY}$, right? And if D is the midpoint of $\overline{WY}$, that means $\boldsymbol{WD = DY}$. We're told that $DY = 2$, which means that $WD = 2$, and that means their sum, $WY = 4$. So far, so good? Well, since $WY = 4$, and $\boldsymbol{HO = OW = WY}$, then all three of those segments equal 4. And since $HY = HO + OW + WY$, we know that $HY = 4 + 4 + 4 = \mathbf{12}$. Pant, pant. Nice!

Answer: $\boldsymbol{HY = 12}$

4. For IWANTLOVEU, Given: $\overline{WT} \cong \overline{LE}$, W is the midpoint of $\overline{IT}$, and E is the midpoint of $\overline{LU}$. Prove: $\overline{IT} \cong \overline{LU}$.

This is just the Multiplication property at work! Because W is the midpoint of $\overline{IT}$ and E is the midpoint of $\overline{LU}$, the upper and lower parts of this diagram are divided into exact halves, right? We're then told that a "half" from the top is congruent to a "half" from the bottom ($\overline{WT} \cong \overline{LE}$), and the Multiplication property tells us that those "wholes" must be congruent, too! Let's write it out in a proof:

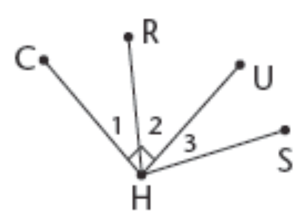
Statements	**Reasons**
1. $\overline{WT} \cong \overline{LE}$	1. Given
2. W is the midpoint of $\overline{IT}$	2. Given
3. E is the midpoint of $\overline{LU}$	3. Given
2. $\overline{IT} \cong \overline{LU}$	4. Multiplication property: If seg's are congruent ($\overline{WT} \cong \overline{LE}$), then their like multiples (doubles) are congruent.

5. Again, for IWANTLOVEU, Given: A & N trisect $\overline{WT}$, O & V trisect $\overline{LE}$, and $\overline{WT} \cong \overline{LE}$. Prove: $\overline{LO} \cong \overline{AN}$.

This time, we'll ONLY be looking at the "WANT" and "LOVE" parts of the diagram, and we're told that "WANT" is trisected into three equal parts (A & N trisect $\overline{WT}$), and so is "LOVE" (O & V trisect $\overline{LE}$). Then we're told that the entire "WANT" is congruent to the entire "LOVE" ($\overline{WT} \cong \overline{LE}$), and we're asked to prove that one third of "LOVE" ($\overline{LO}$) is congruent to one third of "WANT" ($\overline{AN}$). That's just the Division property – the "like" thirds must be congruent!

Statements	**Reasons**
1. A & N trisect $\overline{WT}$	1. Given
2. O & V trisect $\overline{LE}$	2. Given
3. $\overline{WT} \cong \overline{LE}$	3. Given
4. $\therefore\ \overline{LO} \cong \overline{AN}$	4. Division Property: If segments are congruent ($\overline{WT} \cong \overline{LE}$), then their like divisions (thirds) are $\cong$.

6. For CRUSH, Given: $\overline{CH} \perp \overline{UH}$, $\angle 1 \cong \angle 3$. Do a paragraph proof to explain why $\angle 2$ is complementary to $\angle 3$. *(Hint: Use the definition of $\perp$ from p. 52 to figure out the measurement of $\angle CHU$, then say something about the relationship between $\angle 1$ and $\angle 2$, and then use the Substitution Property.)*



Alright, so let's see what information we already know – we're told that $\overline{CH} \perp \overline{UH}$, and that means (as we can see by the right-angle marker), that $\angle CHU$ is a right angle – it equals 90°. Since $\angle 1$ and $\angle 2$ add up to create $\angle CHU$, that means $\angle 1$ and $\angle 2$ add up to 90°. In other words, $\angle 1$ and $\angle 2$ are complementary. What do we want to prove? That $\angle 2$ is complementary to $\angle 3$, right? Well, since we've also been given that $\angle 1 \cong \angle 3$, we can use the Substitution Property to stick $\angle 3$ where we see $\angle 1$ in this statement: "$\angle 1$ and $\angle 2$ are complementary" and we get: "$\angle 3$ and $\angle 2$ are complementary." In other words, we've proven that:

$\therefore$ $\angle 2$ **is complementary to** $\angle 3$

As a bonus, here's that proof in two-column form, in case you'd like to see it!

Statements	**Reasons**
1. $\overline{CH} \perp \overline{UH}$, $\angle 1 \cong \angle 3$	1. Given
2. $\angle CHU$ is a right angle	2. If two segments are $\perp$, they create a right angle.
3. $\angle 2$ is complementary to $\angle 1$	3. If two angles add up to create a right angle, then they are complementary.
4. $\therefore$ $\angle 2$ is complementary to $\angle 3$	4. Substitution Property ($\angle 3$ in the place of $\angle 1$)