

SCAVENGER HUNT



TANGENT SEGMENTS AND INSCRIBED AND CIRCUMSCRIBED CIRCLES

Tangent Segments Round an Inscribed Circle

Two pieces from each corner · sides, pieces and perimeters · the cards check the answers

FREE

ANSWER

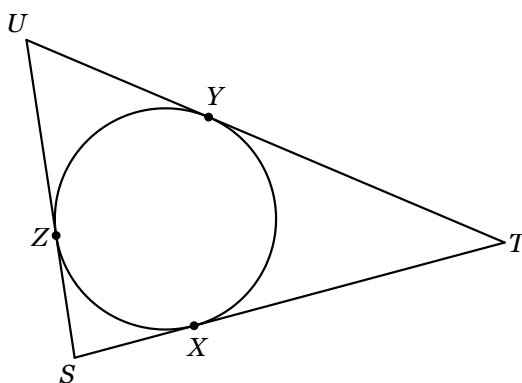
76

The circle is inscribed in triangle STU .
 $ST = 18$, $TU = 21$ and $US = 13$.

Find SX .

Write a whole number, like 17.

The two pieces from one corner are equal. Label each pair before any adding.



G

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1. **Tape the 16 cards around the room**, in any order. Each card has a large letter in its bottom left corner. Start each group at a *different* one of these eight cards: *G J A Q E N R D*.
2. **Say this once:** *“The two pieces from one corner of the triangle are equal. Label them with one letter before you add anything. Every answer is a whole number, like 17. Then walk to the card with that answer at the top.”*
3. **Each group writes one line per card.** Eight right answers bring the group back to its first card.

16 cards	pages 3–10, one copy. There are two cards on each sheet. Cut the whole stack once.
Record sheet	page 11, one per student. It shows the six pieces labeled by corner.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card shows a triangle STU with its inscribed circle. The circle touches ST at X, TU at Y and US at Z, and each side is tangent to it. Two tangent segments from one point are equal, so the two pieces from each corner are equal: $SX = SZ$, $TX = TY$ and $UY = UZ$. Three ring cards give the three sides and ask for one piece. Three give one piece from each corner and ask for the perimeter, which is twice their sum. Two give two sides and one piece, and ask for a piece on the third side. Every triangle is scalene, so no point of tangency is the middle of its side.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer. There are two mistakes. In the first, the student pairs the two pieces of one side, which meet at its point of tangency (the dot X, Y or Z), as if that point were the middle of the side. In the second, the student adds the three given pieces once and forgets that each corner has two. Each of these lands on a card off the ring. That card sends the group back to the card it got wrong.

The check is the length of the group’s list. A clean run is **eight lines**. Each wrong answer adds two. Every card has a line in italics under its question. It tells a group that arrived by a wrong answer what to check. A group that arrived by a right answer skips it. Guessing does not work: no single rule on the printed numbers gets more than six of the cards. If a group keeps coming back to the same cards, ask: *“Which corner does this piece start from? What is the other piece from that corner?”* This sheet calls a circle inscribed in a triangle when it is inside the triangle and each side is tangent to it. Some textbooks use other definitions, so tell the class which ones this sheet uses.



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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ANSWER

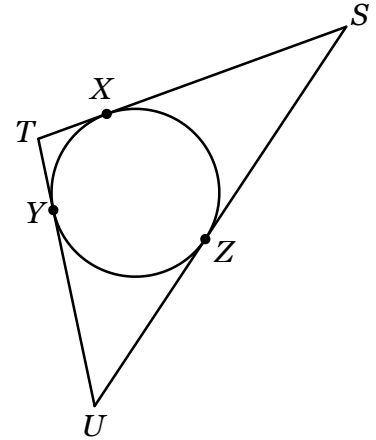
62

The circle is inscribed in triangle STU . $TU = 15$, $US = 25$ and $TY = 4$.

Find SX .

Write a whole number, like 17.

Go round the triangle from corner to corner. Each corner keeps one length.



A

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ANSWER

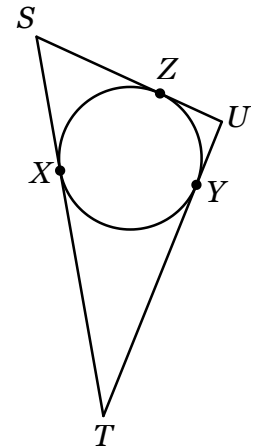
38

The circle is inscribed in triangle STU . $ST = 17$, $TU = 14$ and $US = 9$.

Find UY .

Write a whole number, like 17.

Add the three sides of the triangle. Each side is a sum of two pieces.



B

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ANSWER

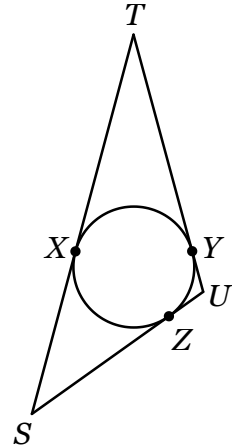
21

The circle is inscribed in triangle STU. $SZ = 12$, $TX = 16$ and $UZ = 3$.

Find the perimeter of triangle STU.

Write a whole number, like 17.

Do the two pieces at a dot match? Only the pieces at one corner match.



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C

ANSWER

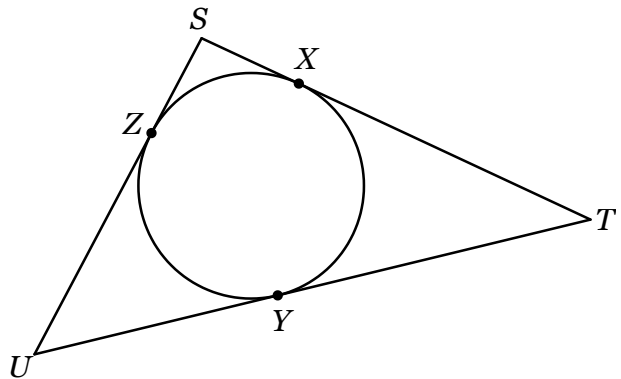
3

The circle is inscribed in triangle STU. $SZ = 6$, $TX = 18$ and $UY = 14$.

Find the perimeter of triangle STU.

Write a whole number, like 17.

The perimeter is twice the sum of the three corner lengths. Check yours.



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D

ANSWER

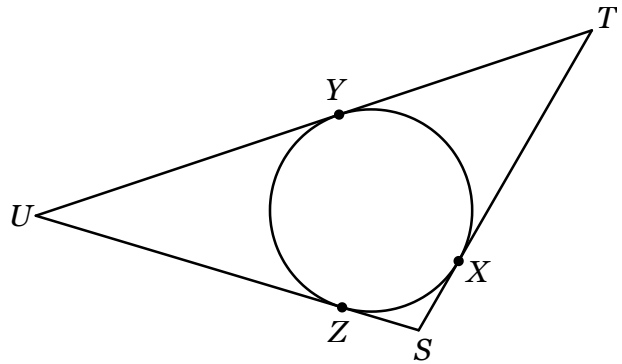
16

The circle is inscribed in triangle STU . $SZ = 3$, $TX = 10$ and $UY = 12$.

Find the perimeter of triangle STU .

Write a whole number, like 17.

Six pieces go round the triangle, two from each corner. Count them all.



E

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ANSWER

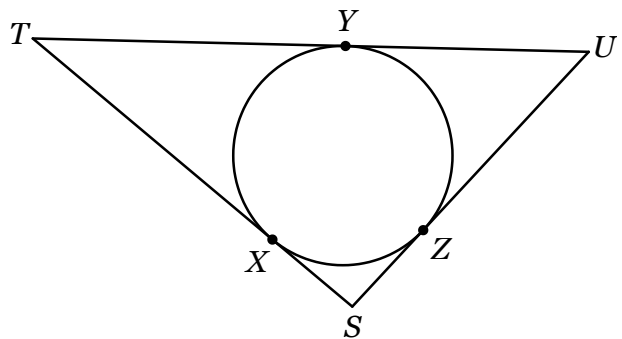
9

The circle is inscribed in triangle STU . $SZ = 6$, $TX = 18$ and $UY = 14$.

Find the perimeter of triangle STU .

Write a whole number, like 17.

Is the dot in the middle of its side? Find the corner each piece runs from.



F

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ANSWER

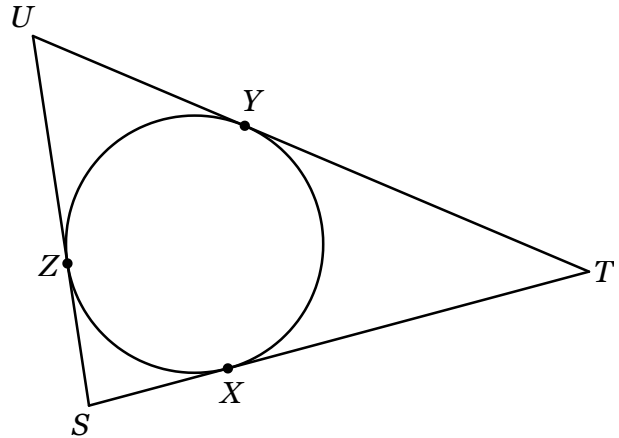
76

The circle is inscribed in triangle STU . $ST = 18$, $TU = 21$ and $US = 13$.

Find SX .

Write a whole number, like 17.

The two pieces from one corner are equal. Label each pair before any adding.



G

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ANSWER

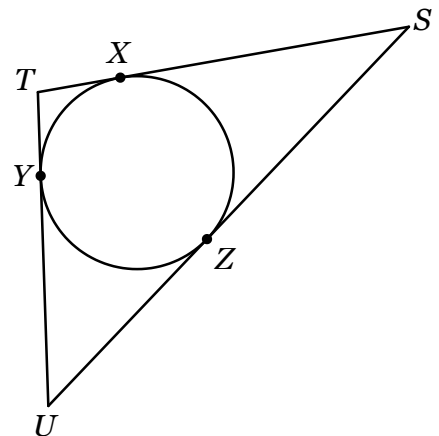
12

The circle is inscribed in triangle STU . $TU = 15$, $US = 25$ and $TY = 4$.

Find SX .

Write a whole number, like 17.

Half the perimeter minus the side across from a corner is its length.



H

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ANSWER

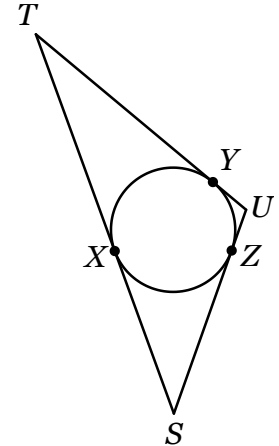
5

The circle is inscribed in triangle STU . $SZ = 12$, $TX = 16$ and $UZ = 3$.

Find the perimeter of triangle STU .

Write a whole number, like 17.

Each side is two pieces. Does your total count all six pieces?



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J

ANSWER

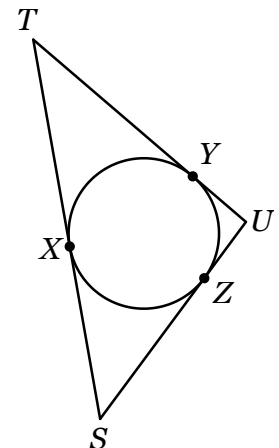
7

The circle is inscribed in triangle STU . $US = 21$, $ST = 33$ and $UZ = 6$.

Find TY .

Write a whole number, like 17.

Label the pieces x , y and z by corner. Then write each side as a sum.



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K

ANSWER

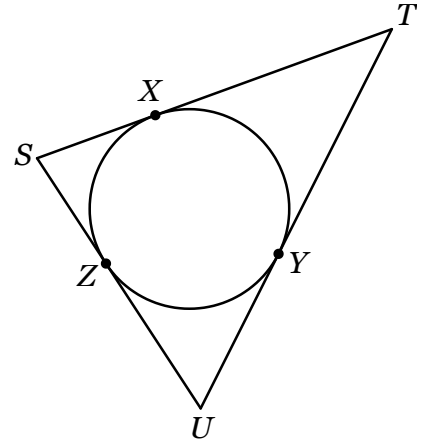
25

The circle is inscribed in triangle STU . $ST = 24$, $TU = 27$ and $US = 19$.

Find TX .

Write a whole number, like 17.

Each corner length goes round the triangle twice. Add each one twice.



L

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ANSWER

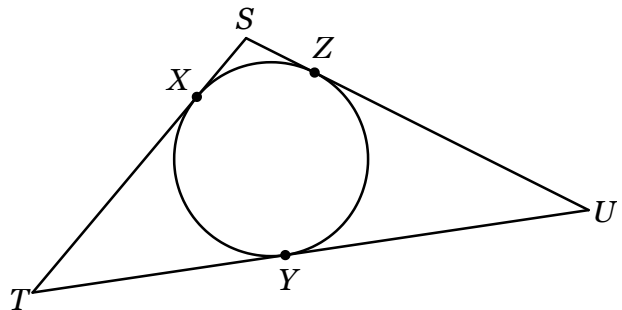
27

The circle is inscribed in triangle STU . $SZ = 3$, $TX = 10$ and $UY = 12$.

Find the perimeter of triangle STU .

Write a whole number, like 17.

Two pieces that meet at a dot are not a pair. Pair the pieces at each corner.



M

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ANSWER

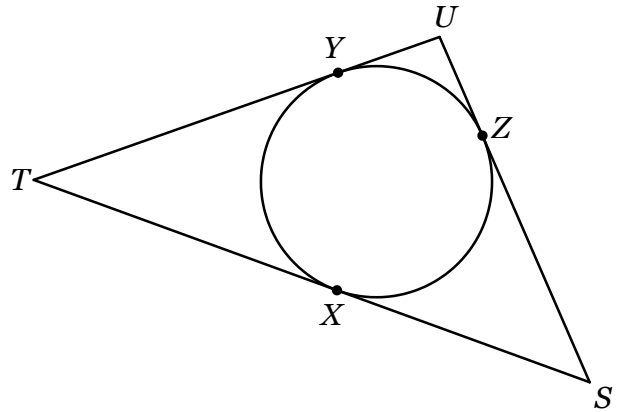
50

The circle is inscribed in triangle STU . $US = 21$, $ST = 33$ and $UZ = 6$.

Find TY .

Write a whole number, like 17.

Which corner does each piece start from? The two pieces at that corner match.



N

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ANSWER

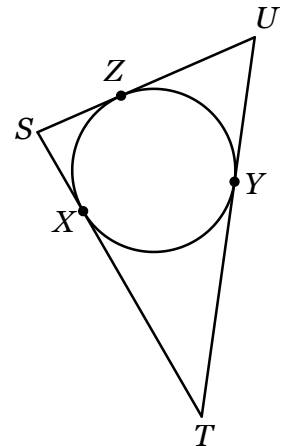
31

The circle is inscribed in triangle STU . $ST = 18$, $TU = 21$ and $US = 13$.

Find SX .

Write a whole number, like 17.

Three numbers are given, and the triangle has six pieces. Where are the other three?



P

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ANSWER

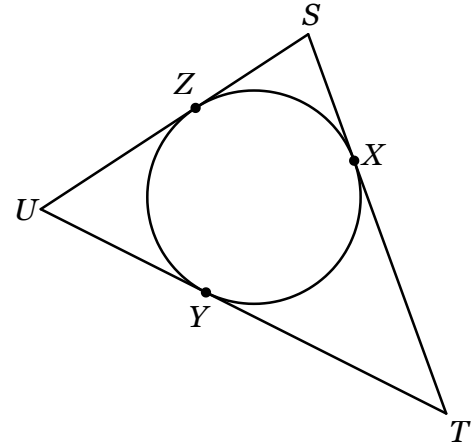
14

The circle is inscribed in triangle STU . $ST = 24$, $TU = 27$ and $US = 19$.

Find TX .

Write a whole number, like 17.

A dot is not the middle of its side. Check your piece with the other two sides.



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Q

ANSWER

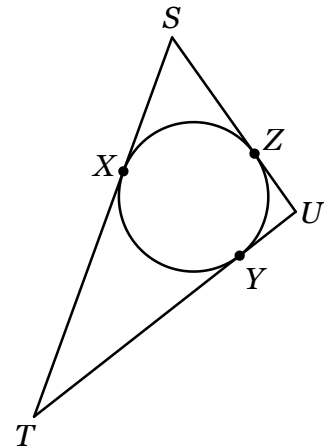
18

The circle is inscribed in triangle STU . $ST = 17$, $TU = 14$ and $US = 9$.

Find UY .

Write a whole number, like 17.

Rebuild all three sides from your three lengths. Do they match the card?



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R

Scavenger Hunt — where I went

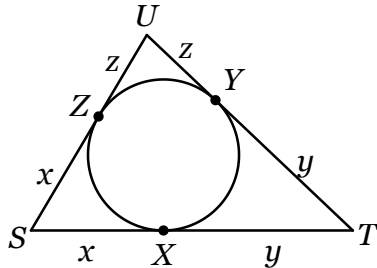
Tangent segments

Name _____

Period _____

Date _____

For each card, label the six pieces by corner first. Then find the answer. **Every answer is a whole number, like 17.** Then find the card with your answer at the top. A clean run is eight lines. Each card has a line in italics under its question. **If you are on a card because you went wrong, its line says what to check. If you were right, skip it.**



The circle is inscribed in the triangle. It is inside the triangle and each side is tangent to it. The dots X, Y and Z are the points of tangency.

Two tangent segments from one point are equal. So the two pieces from S are both x , the two from T are both y , and the two from U are both z .

Each side is its two pieces added. So $ST = x + y$.

Check: your three corner lengths must rebuild every number on the card.

Card letter	My three corner lengths x, y, z	My answer
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

What do the two tangent segments from one point believe in?

Every number stands for a letter. Write the letter for each answer in the box above its number. Read the boxes you filled, left to right. **If they do not spell the answer, one of your answers is wrong.**

3 = E	5 = Q	7 = E	9 = L	12 = I	14 = U	16 = A	18 = L	21 = Q	25 = A	27 = Y	31 = U	38 = T	50 = I	62 = T	76 = Y
3	5	7	9	12	14	16	18	21	25	27	31	38	50	62	76



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Scavenger Hunt — answers

For the teacher

The ring in order, with the answer found on each card. A group may begin anywhere on it. Wherever it begins, eight right answers bring it back to that card.

G (5) → J (62) → A (14) → Q (16) → E (50) → N (18) → R (3) → D (76) → G

What do the two tangent segments from one point believe in? The answer is *EQUALITY*! It is read along the boxes of the record sheet, which run from the smallest number to the largest. On every card, the two pieces from one corner are equal: $SX = SZ$, $TX = TY$ and $UY = UZ$.

Card	What the card gives and asks	Answer, and why	The common wrong answer on this card, and why	Letter of its top
1 G	$ST = 18$, $TU = 21$ and $US = 13$. Find SX .	5. Half the perimeter is $(18 + 21 + 13) \div 2 = 26$. SX is a tangent segment from S, and the side across from S is $TU = 21$. So $SX = 26 - 21 = 5$.	9. 9 is half of $ST = 18$. It treats the dot as the middle of ST , which it is not: the two pieces of one side belong to two different corners.	Y
2 J	$SZ = 12$, $TX = 16$ and $UZ = 3$. Find the perimeter of triangle STU .	62. Each corner has two equal pieces, so each of 12, 16 and 3 is used twice: $2 \times (12 + 16 + 3) = 62$.	31. 31 adds each length once. The triangle has six pieces, two from each corner.	Q
3 A	$TU = 15$, $US = 25$ and $TY = 4$. Find SX .	14. The other piece of TU is $15 - 4 = 11$. It is from U, so $UZ = 11$ too. Then the rest of US is $25 - 11 = 14$, and it is from S, so $SX = 14$.	21. $21 = 25 - 4$. It pairs TY with the piece next to it on TU , the two pieces that meet at a dot. They belong to two different corners.	T
4 Q	$ST = 24$, $TU = 27$ and $US = 19$. Find TX .	16. Half the perimeter is $(24 + 27 + 19) \div 2 = 35$. TX is a tangent segment from T, and the side across from T is $US = 19$. So $TX = 35 - 19 = 16$.	12. 12 is half of $ST = 24$. It treats the dot as the middle of ST , which it is not: the two pieces of one side belong to two different corners.	U
5 E	$SZ = 3$, $TX = 10$ and $UY = 12$. Find the perimeter of triangle STU .	50. Each corner has two equal pieces, so each of 3, 10 and 12 is used twice: $2 \times (3 + 10 + 12) = 50$.	25. 25 adds each length once. The triangle has six pieces, two from each corner.	A
6 N	$US = 21$, $ST = 33$ and $UZ = 6$. Find TY .	18. The other piece of US is $21 - 6 = 15$. It is from S, so $SX = 15$ too. Then the rest of ST is $33 - 15 = 18$, and it is from T, so $TY = 18$.	27. $27 = 33 - 6$. It pairs UZ with the piece next to it on US , the two pieces that meet at a dot. They belong to two different corners.	I
7 R	$ST = 17$, $TU = 14$ and $US = 9$. Find UY .	3. Half the perimeter is $(17 + 14 + 9) \div 2 = 20$. UY is a tangent segment from U, and the side across from U is $ST = 17$. So $UY = 20 - 17 = 3$.	7. 7 is half of $TU = 14$. It treats the dot as the middle of TU , which it is not: the two pieces of one side belong to two different corners.	L
8 D	$SZ = 6$, $TX = 18$ and $UY = 14$. Find the perimeter of triangle STU .	76. Each corner has two equal pieces, so each of 6, 18 and 14 is used twice: $2 \times (6 + 18 + 14) = 76$.	38. 38 adds each length once. The triangle has six pieces, two from each corner.	E

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The number at the top of each one is the wrong answer from one ring card. Its right answer is the number at the top of that ring card, so the group goes to the card it got wrong and tries it again. If the group makes the same mistake here, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	What the card gives and asks	Answer, and why	The common wrong answer on this card, and why	Letter of its top
F	$SZ = 6$, $TX = 18$ and $UY = 14$. Find the perimeter of triangle STU .	76. Each corner has two equal pieces, so each of 6, 18 and 14 is used twice: $2 \times (6 + 18 + 14) = 76$.	38. 38 adds each length once. The triangle has six pieces, two from each corner.	L
P	$ST = 18$, $TU = 21$ and $US = 13$. Find SX .	5. Half the perimeter is $(18 + 21 + 13) \div 2 = 26$. SX is a tangent segment from S, and the side across from S is $TU = 21$. So $SX = 26 - 21 = 5$.	9. 9 is half of $ST = 18$. It treats the dot as the middle of ST , which it is not: the two pieces of one side belong to two different corners.	U
C	$SZ = 12$, $TX = 16$ and $UZ = 3$. Find the perimeter of triangle STU .	62. Each corner has two equal pieces, so each of 12, 16 and 3 is used twice: $2 \times (12 + 16 + 3) = 62$.	31. 31 adds each length once. The triangle has six pieces, two from each corner.	Q
H	$TU = 15$, $US = 25$ and $TY = 4$. Find SX .	14. The other piece of TU is $15 - 4 = 11$. It is from U, so $UZ = 11$ too. Then the rest of US is $25 - 11 = 14$, and it is from S, so $SX = 14$.	21. $21 = 25 - 4$. It pairs TY with the piece next to it on TU , the two pieces that meet at a dot. They belong to two different corners.	I
L	$ST = 24$, $TU = 27$ and $US = 19$. Find TX .	16. Half the perimeter is $(24 + 27 + 19) \div 2 = 35$. TX is a tangent segment from T, and the side across from T is $US = 19$. So $TX = 35 - 19 = 16$.	12. 12 is half of $ST = 24$. It treats the dot as the middle of ST , which it is not: the two pieces of one side belong to two different corners.	A
M	$SZ = 3$, $TX = 10$ and $UY = 12$. Find the perimeter of triangle STU .	50. Each corner has two equal pieces, so each of 3, 10 and 12 is used twice: $2 \times (3 + 10 + 12) = 50$.	25. 25 adds each length once. The triangle has six pieces, two from each corner.	Y
K	$US = 21$, $ST = 33$ and $UZ = 6$. Find TY .	18. The other piece of US is $21 - 6 = 15$. It is from S, so $SX = 15$ too. Then the rest of ST is $33 - 15 = 18$, and it is from T, so $TY = 18$.	27. $27 = 33 - 6$. It pairs UZ with the piece next to it on US , the two pieces that meet at a dot. They belong to two different corners.	E
B	$ST = 17$, $TU = 14$ and $US = 9$. Find UY .	3. Half the perimeter is $(17 + 14 + 9) \div 2 = 20$. UY is a tangent segment from U, and the side across from U is $ST = 17$. So $UY = 20 - 17 = 3$.	7. 7 is half of $TU = 14$. It treats the dot as the middle of TU , which it is not: the two pieces of one side belong to two different corners.	T

Other mistakes lead to no card, or one step back. A group might give the other piece of the same side, add the two sides at a corner and take away the third without halving, give half the perimeter, give one side as the perimeter, or stop the walk round the triangle one corner early. Its answer is then not the number at the top of any card.