

SCAVENGER HUNT



SINE, COSINE AND TANGENT RATIOS

Sine, Cosine and Tangent: Find the Ratio

One right triangle on every card · write the ratio as a fraction · the cards check the answers

FREE

ANSWER

$$\frac{80}{39}$$

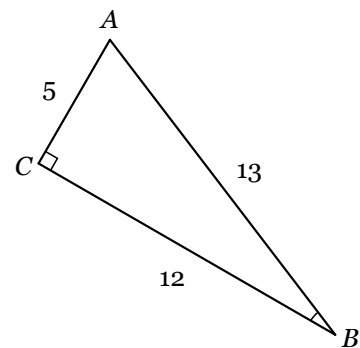
Right angle at C.

The arc marks angle B.

What is $\sin B$?

Find the arc first. Then name the three sides.

P



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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: *P F H M K E L D*.
2. **Say this once:** *“Find the arc first. Then name the hypotenuse, the opposite leg and the adjacent leg for that angle. Write the answer as a fraction of two side lengths from the card. Eight right answers bring you back to your first card.”*
3. **Each group finds the ratio, then walks to the card with that fraction at the top.** Nothing else is needed.

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 three definitions, with the same triangle drawn twice.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card shows one right triangle with its three sides and an arc at one acute angle. The card asks for the sine, cosine or tangent of that angle: $\sin = \text{opposite leg} \div \text{hypotenuse}$, $\cos = \text{adjacent leg} \div \text{hypotenuse}$, $\tan = \text{opposite leg} \div \text{adjacent leg}$. The ring asks for the sine three times, the cosine two times and the tangent three times. The answer is a fraction of two printed lengths, exactly as the card top shows it. The lengths on each card share no factor, so the fraction cannot be simplified. It is never written as a decimal.

The common mistake is to swap the opposite and adjacent legs. That gives the ratio of the other acute angle, and it is the number at the top of one of the other cards. On four of the eight ring cards the arc is at the larger acute angle, so “the short leg is opposite” fails there. No triangle has a level side: a group that calls the more upright leg “opposite” gets only seven of the sixteen cards right.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer, but all the cards look the same. The answer to such a card sends the group back to the card it got wrong. **A clean run is eight lines**, and each wrong answer adds two. Every card has a line in small type under the question. It tells a group that arrived by a wrong answer what to check. If a group keeps coming back to the same cards, ask: *“Which leg touches the angle with the arc?”*



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

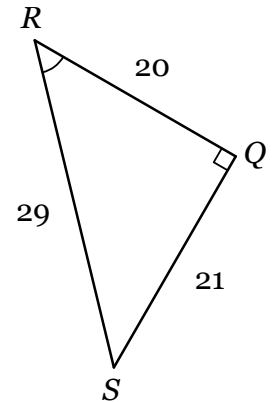
$$\frac{35}{37}$$

Right angle at Q.

The arc marks angle R.

What is $\cos R$?

Put a finger on the arc. Which leg does it touch?



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A

ANSWER

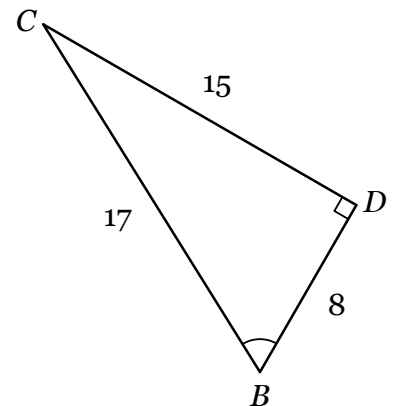
$$\frac{21}{29}$$

Right angle at D.

The arc marks angle B.

What is $\tan B$?

Which side is across from the arc?



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B

ANSWER

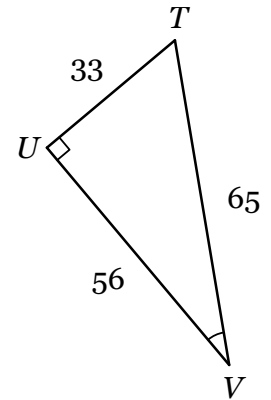
$$\frac{48}{73}$$

Right angle at U.

The arc marks angle V.

What is $\cos V$?

The adjacent leg touches the arc and the right angle.



C

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ANSWER

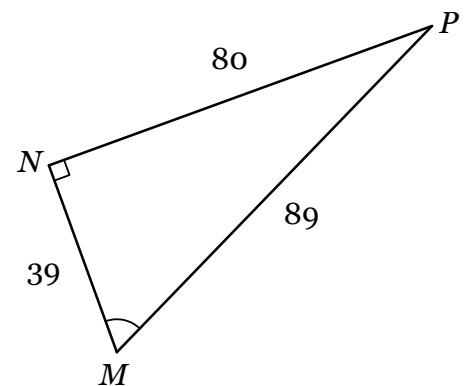
$$\frac{55}{73}$$

Right angle at N.

The arc marks angle M.

What is $\tan M$?

Turn the page until the arc is at the bottom. Read the sides again.



D

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ANSWER

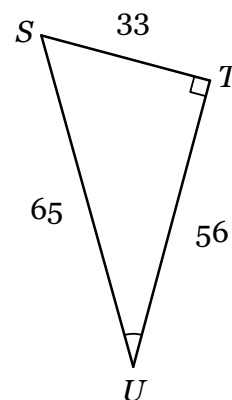
$$\frac{28}{45}$$

Right angle at T.

The arc marks angle U.

What is $\cos U$?

Cosine is the adjacent leg over the hypotenuse.



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E

ANSWER

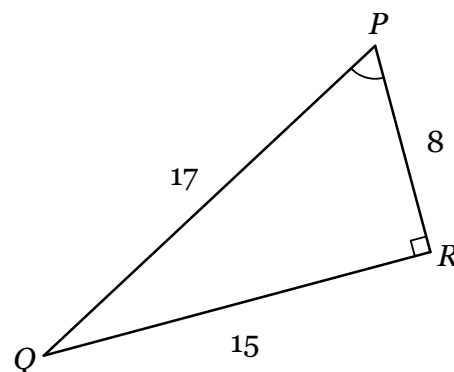
$$\frac{5}{13}$$

Right angle at R.

The arc marks angle P.

What is $\tan P$?

The tangent uses the two legs and never the hypotenuse.



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F

ANSWER

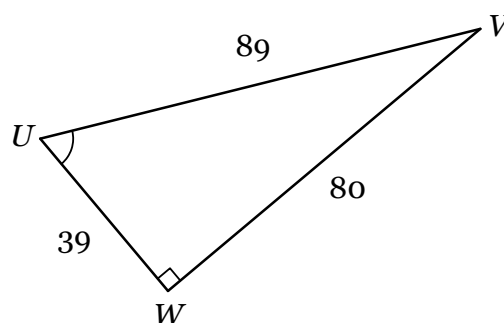
$$\frac{12}{13}$$

Right angle at W.

The arc marks angle U.

What is $\tan U$?

The leg opposite an angle does not touch it.



G

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ANSWER

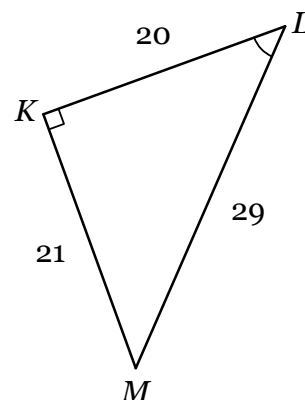
$$\frac{15}{8}$$

Right angle at K.

The arc marks angle L.

What is $\cos L$?

Which leg touches the angle with the arc?



H

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ANSWER

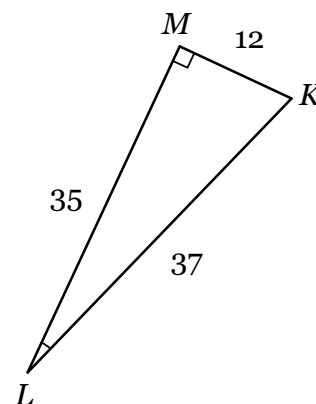
$$\frac{45}{28}$$

Right angle at M.

The arc marks angle L.

What is $\sin L$?

Sine is the opposite leg over the hypotenuse.



J

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ANSWER

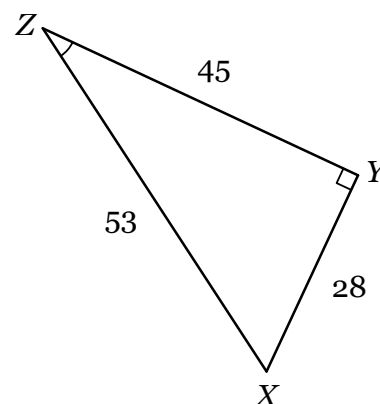
$$\frac{12}{37}$$

Right angle at Y.

The arc marks angle Z.

What is $\tan Z$?

Is the opposite leg for the angle with the arc, or the other angle?



K

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ANSWER

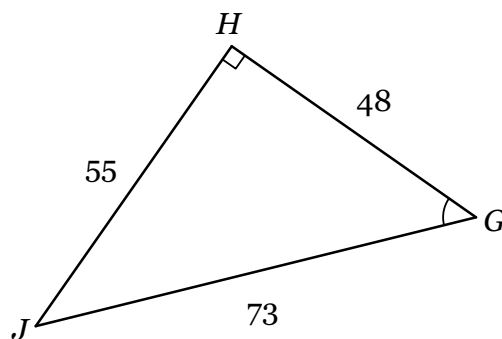
$$\frac{56}{65}$$

Right angle at H.

The arc marks angle G.

What is $\sin G$?

Sine and cosine are always less than 1.



L

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ANSWER

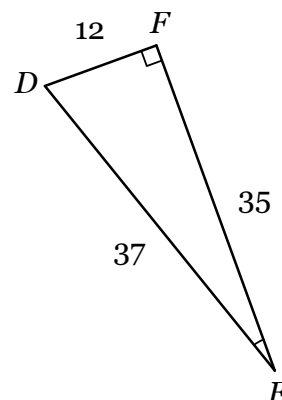
$$\frac{20}{29}$$

Right angle at F.

The arc marks angle E.

What is $\sin E$?

The hypotenuse is across from the right angle.



M

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ANSWER

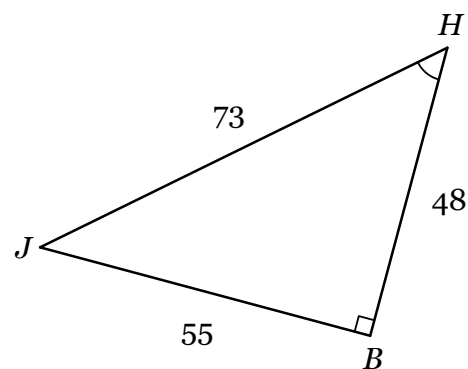
$$\frac{39}{80}$$

Right angle at B.

The arc marks angle H.

What is $\sin H$?

Tangent is the opposite leg over the adjacent leg.



N

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ANSWER

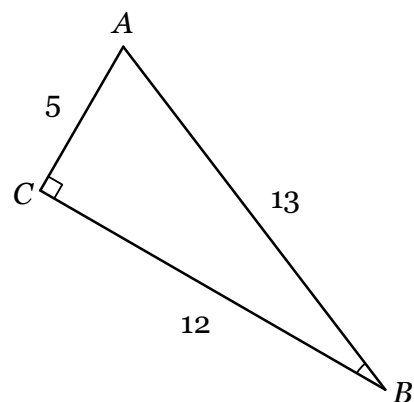
$$\frac{80}{39}$$

Right angle at C.

The arc marks angle B.

What is $\sin B$?

Find the arc first. Then name the three sides.



P

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ANSWER

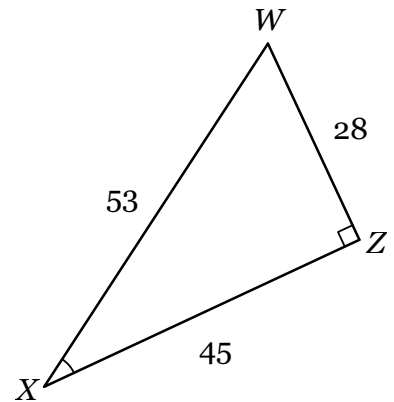
$$\frac{33}{65}$$

Right angle at Z.

The arc marks angle X.

What is $\tan X$?

Read the letter at the arc before any side.



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Q

ANSWER

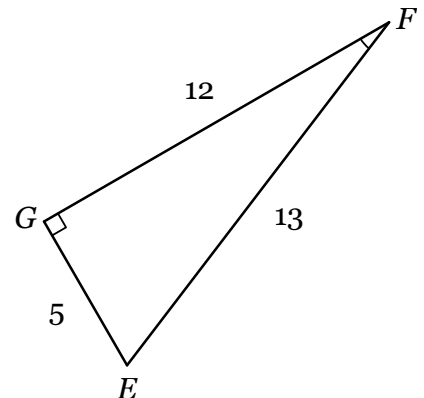
$$\frac{8}{15}$$

Right angle at G.

The arc marks angle F.

What is $\sin F$?

Opposite and adjacent change places when the angle moves.



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R

Scavenger Hunt — where I went

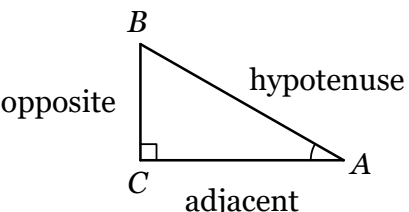
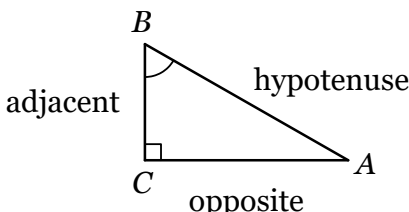
Sine, cosine and tangent

Name _____

Period _____

Date _____

Do the card you are at. Fill in one line. Then find the card with your answer at the top. **Find the arc first. Write the answer as a fraction of two side lengths from the card.** A clean run is eight lines. Each card has a line in small type under the question. **If you are on a card because you went wrong, its line says what to check. If you were right, skip it.**

 The arc marks angle A.	 The arc marks angle B.	$\sin A = \frac{\text{leg opposite A}}{\text{hypotenuse}}$ $\cos A = \frac{\text{leg adjacent to A}}{\text{hypotenuse}}$ $\tan A = \frac{\text{leg opposite A}}{\text{leg adjacent to A}}$
The leg opposite an angle does not touch it. The leg adjacent to an angle touches it. The hypotenuse is never the adjacent leg.		

Card letter	The two sides I use (opposite, adjacent or hypotenuse)	My answer
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

A tiny right triangle and a huge one have the same sine. Who decides it?

Every fraction stands for a letter. Write the letter for each of your answers in the box above that fraction. Leave the other boxes empty. Then read the boxes you filled, left to right. **If they do not spell the answer, one answer is wrong.**

$\frac{12}{37} = T$ $\frac{5}{13} = H$ $\frac{39}{80} = G$ $\frac{33}{65} = N$ $\frac{8}{15} = A$ $\frac{28}{45} = E$ $\frac{48}{73} = T$ $\frac{20}{29} = A$ $\frac{21}{29} = H$ $\frac{55}{73} = N$
 $\frac{56}{65} = G$ $\frac{12}{13} = E$ $\frac{35}{37} = L$ $\frac{45}{28} = E$ $\frac{15}{8} = L$ $\frac{80}{39} = E$

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

$\frac{12}{37}$ $\frac{5}{13}$ $\frac{39}{80}$ $\frac{33}{65}$ $\frac{8}{15}$ $\frac{28}{45}$ $\frac{48}{73}$ $\frac{20}{29}$ $\frac{21}{29}$ $\frac{55}{73}$ $\frac{56}{65}$ $\frac{12}{13}$ $\frac{35}{37}$ $\frac{45}{28}$ $\frac{15}{8}$ $\frac{80}{39}$



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Scavenger Hunt — answers

For the teacher

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

P → F → H → M → K → E → L → D → P

A tiny right triangle and a huge one have the same sine. Who decides it? The answer is *THE ANGLE*. The ring's answers, in the order of the boxes on the record sheet (smallest fraction first), with their letters: **12/37 T • 5/13 H • 28/45 E • 20/29 A • 55/73 N • 56/65 G • 15/8 L • 80/39 E**.

Card	The question on the card	Answer, and why	Wrong answer from the common mistake	Joke letter for the fraction at its top
1 P	Right angle at C. CA = 5, CB = 12, AB = 13. Arc at B. What is sin B?	5/13 . AC = 5 is the leg opposite B (it does not touch the arc), and AB = 13 is the hypotenuse. So sin B = 5/13.	12/13, from swapping the opposite and adjacent legs	E
2 F	Right angle at R. RP = 8, RQ = 15, PQ = 17. Arc at P. What is tan P?	15/8 . QR = 15 is the leg opposite P (it does not touch the arc), and PR = 8 is the leg adjacent to P. So tan P = 15/8.	8/15, from swapping the opposite and adjacent legs	H
3 H	Right angle at K. KL = 20, KM = 21, LM = 29. Arc at L. What is cos L?	20/29 . KL = 20 is the leg adjacent to L (it touches the arc), and LM = 29 is the hypotenuse. So cos L = 20/29.	21/29, from swapping the opposite and adjacent legs	L
4 M	Right angle at F. FD = 12, FE = 35, DE = 37. Arc at E. What is sin E?	12/37 . DF = 12 is the leg opposite E (it does not touch the arc), and DE = 37 is the hypotenuse. So sin E = 12/37.	35/37, from swapping the opposite and adjacent legs	A
5 K	Right angle at Y. YX = 28, YZ = 45, XZ = 53. Arc at Z. What is tan Z?	28/45 . XY = 28 is the leg opposite Z (it does not touch the arc), and YZ = 45 is the leg adjacent to Z. So tan Z = 28/45.	45/28, from swapping the opposite and adjacent legs	T
6 E	Right angle at T. TS = 33, TU = 56, SU = 65. Arc at U. What is cos U?	56/65 . TU = 56 is the leg adjacent to U (it touches the arc), and SU = 65 is the hypotenuse. So cos U = 56/65.	33/65, from swapping the opposite and adjacent legs	E
7 L	Right angle at H. HG = 48, HJ = 55, GJ = 73. Arc at G. What is sin G?	55/73 . HJ = 55 is the leg opposite G (it does not touch the arc), and GJ = 73 is the hypotenuse. So sin G = 55/73.	48/73, from swapping the opposite and adjacent legs	G
8 D	Right angle at N. NM = 39, NP = 80, MP = 89. Arc at M. What is tan M?	80/39 . NP = 80 is the leg opposite M (it does not touch the arc), and MN = 39 is the leg adjacent to M. So tan M = 80/39.	39/80, from swapping the opposite and adjacent legs	N

Each wrong answer in the table is the fraction at the top of a card off the ring. Those cards are on the next page. This sheet uses these definitions: sin = opposite leg ÷ hypotenuse, cos = adjacent leg ÷ hypotenuse, tan = opposite leg ÷ adjacent leg. Some textbooks use other definitions, so tell the class which ones this sheet uses.

Scavenger Hunt — the cards off the ring

For the teacher

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

Card	The question on the card	Answer, and why	Wrong answer from the common mistake	Joke letter for the fraction at its top
G	Right angle at W. $WU = 39$, $WV = 80$, $UV = 89$. Arc at U. What is $\tan U$?	80/39. $VW = 80$ is the leg opposite U (it does not touch the arc), and $UV = 39$ is the leg adjacent to U. So $\tan U = 80/39$.	39/80, from swapping the opposite and adjacent legs	E
R	Right angle at G. $GE = 5$, $GF = 12$, $EF = 13$. Arc at F. What is $\sin F$?	5/13. $EG = 5$ is the leg opposite F (it does not touch the arc), and $EF = 13$ is the hypotenuse. So $\sin F = 5/13$.	12/13, from swapping the opposite and adjacent legs	A
B	Right angle at D. $DB = 8$, $DC = 15$, $BC = 17$. Arc at B. What is $\tan B$?	15/8. $CD = 15$ is the leg opposite B (it does not touch the arc), and $BD = 8$ is the leg adjacent to B. So $\tan B = 15/8$.	8/15, from swapping the opposite and adjacent legs	H
A	Right angle at Q. $QR = 20$, $QS = 21$, $RS = 29$. Arc at R. What is $\cos R$?	20/29. $QR = 20$ is the leg adjacent to R (it touches the arc), and $RS = 29$ is the hypotenuse. So $\cos R = 20/29$.	21/29, from swapping the opposite and adjacent legs	L
J	Right angle at M. $MK = 12$, $ML = 35$, $KL = 37$. Arc at L. What is $\sin L$?	12/37. $KM = 12$ is the leg opposite L (it does not touch the arc), and $KL = 37$ is the hypotenuse. So $\sin L = 12/37$.	35/37, from swapping the opposite and adjacent legs	E
Q	Right angle at Z. $ZW = 28$, $ZX = 45$, $WX = 53$. Arc at X. What is $\tan X$?	28/45. $WZ = 28$ is the leg opposite X (it does not touch the arc), and $XZ = 45$ is the leg adjacent to X. So $\tan X = 28/45$.	45/28, from swapping the opposite and adjacent legs	N
C	Right angle at U. $UT = 33$, $UV = 56$, $TV = 65$. Arc at V. What is $\cos V$?	56/65. $UV = 56$ is the leg adjacent to V (it touches the arc), and $TV = 65$ is the hypotenuse. So $\cos V = 56/65$.	33/65, from swapping the opposite and adjacent legs	T
N	Right angle at B. $BH = 48$, $BJ = 55$, $HJ = 73$. Arc at H. What is $\sin H$?	55/73. $BJ = 55$ is the leg opposite H (it does not touch the arc), and $HJ = 73$ is the hypotenuse. So $\sin H = 55/73$.	48/73, from swapping the opposite and adjacent legs	G

Other mistakes lead to no card at all. A group might write the fraction upside down (a sine or cosine more than 1), use the hypotenuse as the adjacent leg, or write opposite over adjacent for a sine. Its answer is then not at the top of any card, and the group knows to check its work.

Guessing does not work. Every simple rule that uses only the printed numbers, such as always putting the shortest side over the longest, answers at most eight of the sixteen cards correctly.