

SCAVENGER HUNT



INVERSE TRIG RATIOS: FINDING AN ANGLE

Inverse Trig Ratios: Find the Angle

Two sides of a right triangle · $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$ · the cards check the answers

FREE

ANSWER

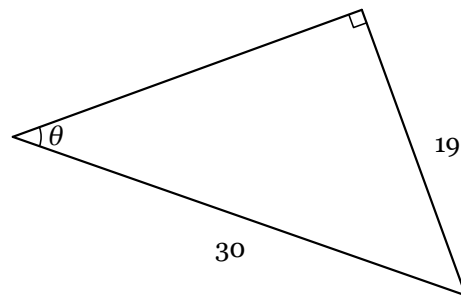
65°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Stand at the corner with θ . The side across from it is the opposite side.



H

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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: *H L J D A R K M*. Every group needs a calculator.
2. **Say this once:** *“Put your calculator in degree mode. Find the ratio of the two sides first, as a decimal. Then use $\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$. Round θ to the nearest degree, like 41° . 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 three ratios on a labeled triangle.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card shows a right triangle drawn to scale, turned a different way. The angle to find is marked with an arc and the letter θ . Two sides have their lengths. Seen from θ , the side across is the opposite side, the leg that touches θ is the adjacent side, and the side across from the right angle is the hypotenuse. Opposite and hypotenuse make the sine, adjacent and hypotenuse make the cosine, and the two legs make the tangent. To check the mode, press $\sin 30$. A calculator in degree mode shows 0.5.

This sheet writes the calculator keys $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$. Read $\sin^{-1}(0.6)$ as “the angle whose sine is 0.6.” It is not $1 \div \sin$. Some textbooks write arcsin, arccos and arctan instead. Some textbooks use other definitions, so tell the class which ones this sheet uses.

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. Two mistakes lead there. The first gives the other acute angle, 90° minus θ : the wrong corner, $\sin^{-1}$ in place of $\cos^{-1}$, or the tangent upside down. The second is the wrong key: $\sin^{-1}$ on two legs, or $\tan^{-1}$ on a leg and the hypotenuse. The card off the ring 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. The line in small type on each card says what to check after a wrong answer. An answer under 2 means radian mode. Keep protractors away, because the triangles are drawn to scale. If a group keeps coming back, ask: *“Which corner has θ ? Which two sides do you know from there?”*



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

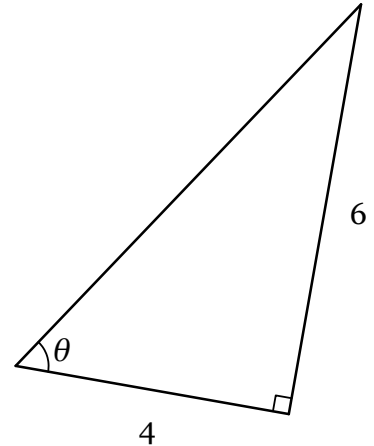
68°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Write both acute angles. They add to 90° . Which one has the arc?



A

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ANSWER

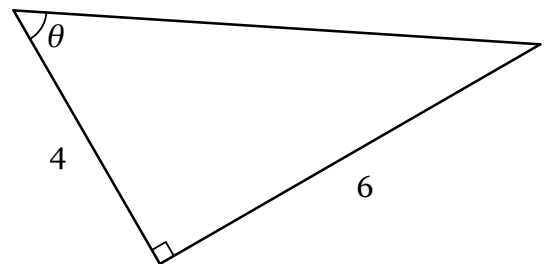
46°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

The key must match the ratio. A tangent needs $\tan^{-1}$.



B

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ANSWER

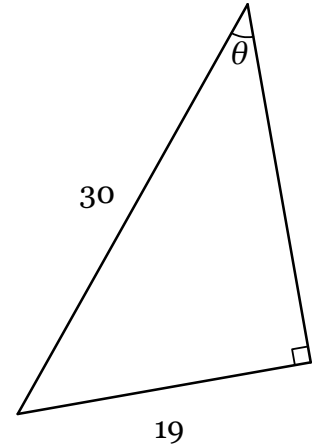
31°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Which two sides have numbers? Name the ratio before the key.



C

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ANSWER

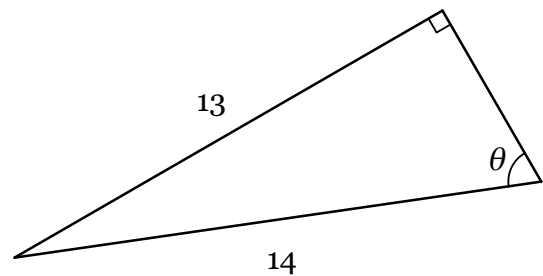
74°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Is the hypotenuse one of your two sides? Then use sine or cosine.



D

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ANSWER

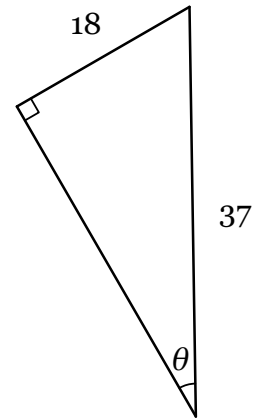
23°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Adjacent over hypotenuse is a cosine. Which key goes with it?



E

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ANSWER

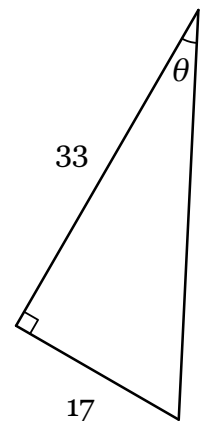
16°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

The other acute angle is 90° minus θ . Which one does this card ask for?



F

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ANSWER

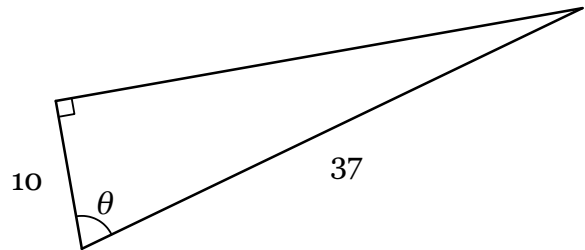
43°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Opposite over hypotenuse is a sine. Opposite over adjacent is a tangent.



G

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ANSWER

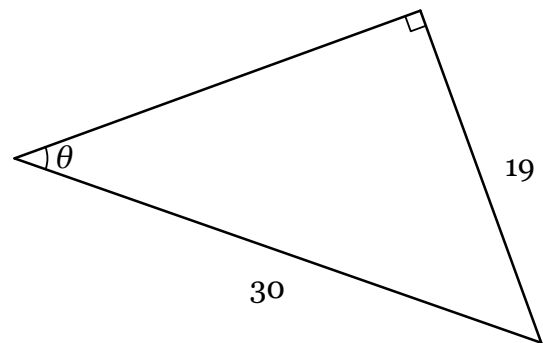
65°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Stand at the corner with θ . The side across from it is the opposite side.



H

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ANSWER

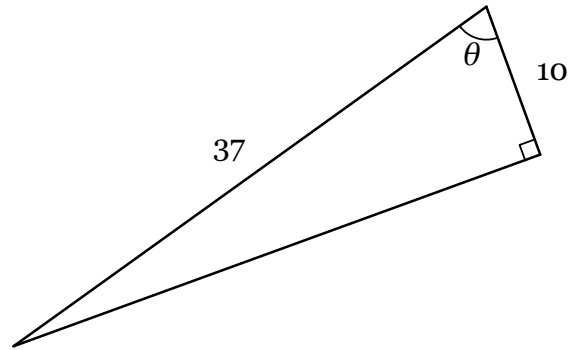
27°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

The adjacent side touches θ . The hypotenuse is across from the square.



J

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ANSWER

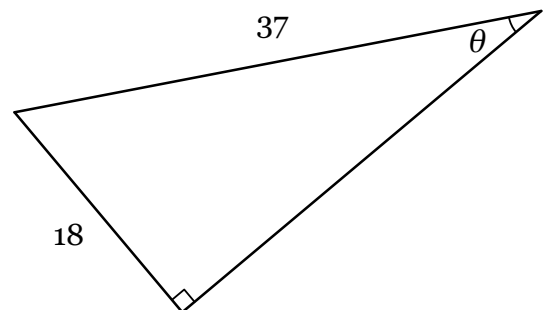
36°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Say it in words: the angle whose sine is this number.



K

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ANSWER

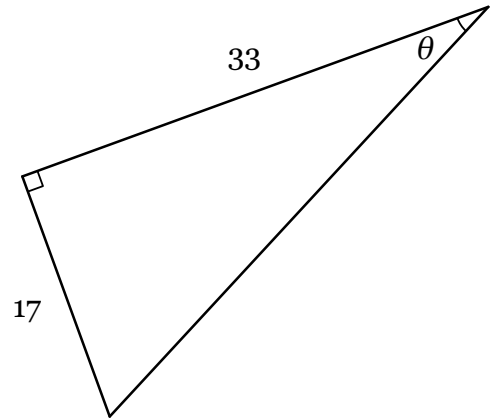
39°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Two legs and no hypotenuse? Then the ratio is a tangent.



L

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ANSWER

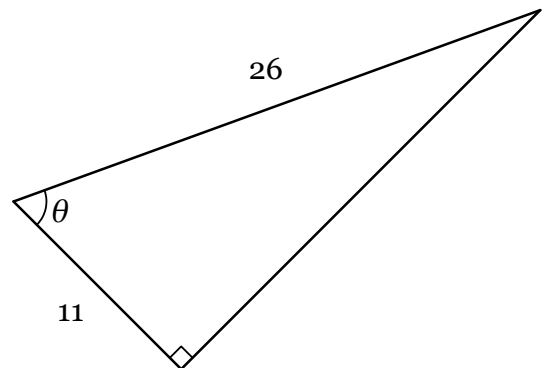
29°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Check the key on the calculator: $\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$?



M

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ANSWER

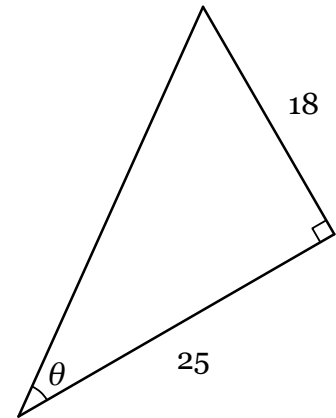
61°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Seen from θ , which side does not touch it? That side is opposite.



N

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ANSWER

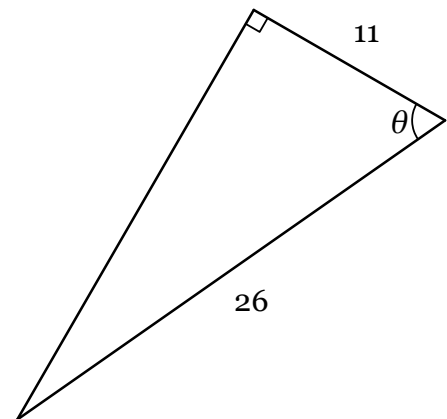
51°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Is θ at the corner you think? Put a finger on the arc.



P

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ANSWER

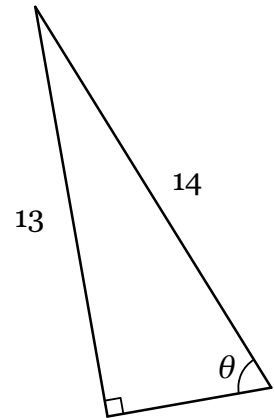
34°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

Opposite and adjacent swap when θ moves. Find the arc first.



Q

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ANSWER

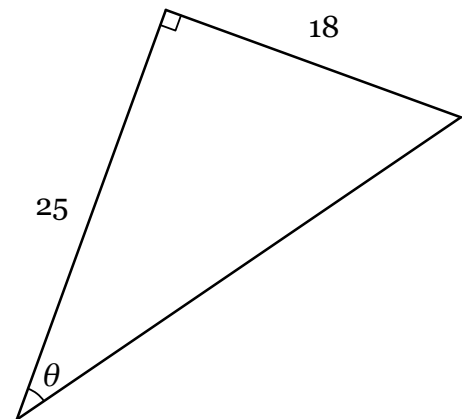
56°

A right triangle. Calculator in degree mode.

Find θ to the nearest degree.

Ratio first, as a decimal. Then the key.

A sine is never more than 1. A tangent can be any size.



R

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Scavenger Hunt — where I went

Inverse trig ratios

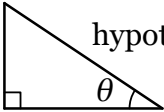
Name _____

Period _____

Date _____

Write the ratio as a decimal, with at least two decimal places. Then use the key and round θ to the nearest degree, like 41° . Find the card with your answer at the top. 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.**

opposite



adjacent

$\sin \theta = \text{opposite} \div \text{hypotenuse}$
 $\cos \theta = \text{adjacent} \div \text{hypotenuse}$
 $\tan \theta = \text{opposite} \div \text{adjacent}$

$\sin^{-1}(0.6)$ means the angle whose sine is 0.6. $\cos^{-1}$ and $\tan^{-1}$ work the same way.

1. Name the ratio of the two sides you know. 2. Write it as a decimal. 3. Use the key $\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$.

Card letter	The ratio, as a decimal	My answer for θ
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

What did θ say when the class found it?

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.**

$16^\circ = \text{T}$ $23^\circ = \text{A}$ $27^\circ = \text{I}$ $29^\circ = \text{A}$ $31^\circ = \text{C}$ $34^\circ = \text{E}$ $36^\circ = \text{M}$ $39^\circ = \text{A}$ $43^\circ = \text{M}$ $46^\circ = \text{U}$ $51^\circ = \text{I}$ $56^\circ = \text{C}$ $61^\circ = \text{A}$
 $65^\circ = \text{U}$ $68^\circ = \text{T}$ $74^\circ = \text{E}$

16°	23°	27°	29°	31°	34°	36°	39°	43°	46°	51°	56°	61°	65°	68°	74°



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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.

H (39°) → L (27°) → J (74°) → D (68°) → A (56°) → R (36°) → K (29°) → M (65°) → H

What did θ say when the class found it? The answer is *I AM ACUTE!* It is read along the boxes of the record sheet, which run from the smallest number to the largest.

Card	The question on the card	Answer, and why	The common wrong answer on this card, and why	Letter of its top
1 H	Find θ . Sides: opposite 19, hypotenuse 30.	39° . The 19 is opposite θ and the 30 is the hypotenuse, so they make the sine: $19 \div 30 = 0.6333$. $\sin^{-1}(0.6333) = 39.30^\circ$, so $\theta = 39^\circ$.	51°. This is the other acute angle: $90^\circ - 39.30^\circ = 50.70^\circ$. It comes from the wrong corner, from $\cos^{-1}$ in place of $\sin^{-1}$.	U
2 L	Find θ . Sides: opposite 17, adjacent 33.	27° . The 17 is opposite θ and the 33 is next to θ (adjacent), so they make the tangent: $17 \div 33 = 0.5152$. $\tan^{-1}(0.5152) = 27.26^\circ$, so $\theta = 27^\circ$.	31°. $\sin^{-1}$ is pressed in place of $\tan^{-1}$: $\sin^{-1}(0.5152) = 31.01^\circ$.	A
3 J	Find θ . Sides: adjacent 10, hypotenuse 37.	74° . The 10 is next to θ (adjacent) and the 37 is the hypotenuse, so they make the cosine: $10 \div 37 = 0.2703$. $\cos^{-1}(0.2703) = 74.32^\circ$, so $\theta = 74^\circ$.	16°. This is the other acute angle: $90^\circ - 74.32^\circ = 15.68^\circ$. It comes from the wrong corner, from $\sin^{-1}$ in place of $\cos^{-1}$.	I
4 D	Find θ . Sides: opposite 13, hypotenuse 14.	68° . The 13 is opposite θ and the 14 is the hypotenuse, so they make the sine: $13 \div 14 = 0.9286$. $\sin^{-1}(0.9286) = 68.21^\circ$, so $\theta = 68^\circ$.	43°. $\tan^{-1}$ is pressed in place of $\sin^{-1}$: $\tan^{-1}(0.9286) = 42.88^\circ$.	E
5 A	Find θ . Sides: opposite 6, adjacent 4.	56° . The 6 is opposite θ and the 4 is next to θ (adjacent), so they make the tangent: $6 \div 4 = 1.5000$. $\tan^{-1}(1.5000) = 56.31^\circ$, so $\theta = 56^\circ$.	34°. This is the other acute angle: $90^\circ - 56.31^\circ = 33.69^\circ$. It comes from the wrong corner, from the fraction upside down.	T
6 R	Find θ . Sides: opposite 18, adjacent 25.	36° . The 18 is opposite θ and the 25 is next to θ (adjacent), so they make the tangent: $18 \div 25 = 0.7200$. $\tan^{-1}(0.7200) = 35.75^\circ$, so $\theta = 36^\circ$.	46°. $\sin^{-1}$ is pressed in place of $\tan^{-1}$: $\sin^{-1}(0.7200) = 46.05^\circ$.	C
7 K	Find θ . Sides: opposite 18, hypotenuse 37.	29° . The 18 is opposite θ and the 37 is the hypotenuse, so they make the sine: $18 \div 37 = 0.4865$. $\sin^{-1}(0.4865) = 29.11^\circ$, so $\theta = 29^\circ$.	61°. This is the other acute angle: $90^\circ - 29.11^\circ = 60.89^\circ$. It comes from the wrong corner, from $\cos^{-1}$ in place of $\sin^{-1}$.	M
8 M	Find θ . Sides: adjacent 11, hypotenuse 26.	65° . The 11 is next to θ (adjacent) and the 26 is the hypotenuse, so they make the cosine: $11 \div 26 = 0.4231$. $\cos^{-1}(0.4231) = 64.97^\circ$, so $\theta = 65^\circ$.	23°. $\tan^{-1}$ is pressed in place of $\cos^{-1}$: $\tan^{-1}(0.4231) = 22.93^\circ$.	A

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The top of each one is the wrong answer from one ring card. Its triangle has the same two sides as the ring card before that one, turned another way, so its right answer is the top of the card the group got wrong. 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	The question on the card	Answer, and why	The common wrong answer on this card, and why	Letter of its top
P	Find θ . Sides: adjacent 11, hypotenuse 26.	65° . The 11 is next to θ (adjacent) and the 26 is the hypotenuse, so they make the cosine: $11 \div 26 = 0.4231$. $\cos^{-1}(0.4231) = 64.97^\circ$, so $\theta = 65^\circ$.	23° . $\tan^{-1}$ is pressed in place of $\cos^{-1}$: $\tan^{-1}(0.4231) = 22.93^\circ$.	I
C	Find θ . Sides: opposite 19, hypotenuse 30.	39° . The 19 is opposite θ and the 30 is the hypotenuse, so they make the sine: $19 \div 30 = 0.6333$. $\sin^{-1}(0.6333) = 39.30^\circ$, so $\theta = 39^\circ$.	51° . This is the other acute angle: $90^\circ - 39.30^\circ = 50.70^\circ$. It comes from the wrong corner, from $\cos^{-1}$ in place of $\sin^{-1}$.	C
F	Find θ . Sides: opposite 17, adjacent 33.	27° . The 17 is opposite θ and the 33 is next to θ (adjacent), so they make the tangent: $17 \div 33 = 0.5152$. $\tan^{-1}(0.5152) = 27.26^\circ$, so $\theta = 27^\circ$.	31° . $\sin^{-1}$ is pressed in place of $\tan^{-1}$: $\sin^{-1}(0.5152) = 31.01^\circ$.	T
G	Find θ . Sides: adjacent 10, hypotenuse 37.	74° . The 10 is next to θ (adjacent) and the 37 is the hypotenuse, so they make the cosine: $10 \div 37 = 0.2703$. $\cos^{-1}(0.2703) = 74.32^\circ$, so $\theta = 74^\circ$.	16° . This is the other acute angle: $90^\circ - 74.32^\circ = 15.68^\circ$. It comes from the wrong corner, from $\sin^{-1}$ in place of $\cos^{-1}$.	M
Q	Find θ . Sides: opposite 13, hypotenuse 14.	68° . The 13 is opposite θ and the 14 is the hypotenuse, so they make the sine: $13 \div 14 = 0.9286$. $\sin^{-1}(0.9286) = 68.21^\circ$, so $\theta = 68^\circ$.	43° . $\tan^{-1}$ is pressed in place of $\sin^{-1}$: $\tan^{-1}(0.9286) = 42.88^\circ$.	E
B	Find θ . Sides: opposite 6, adjacent 4.	56° . The 6 is opposite θ and the 4 is next to θ (adjacent), so they make the tangent: $6 \div 4 = 1.5000$. $\tan^{-1}(1.5000) = 56.31^\circ$, so $\theta = 56^\circ$.	34° . This is the other acute angle: $90^\circ - 56.31^\circ = 33.69^\circ$. It comes from the wrong corner, from the fraction upside down.	U
N	Find θ . Sides: opposite 18, adjacent 25.	36° . The 18 is opposite θ and the 25 is next to θ (adjacent), so they make the tangent: $18 \div 25 = 0.7200$. $\tan^{-1}(0.7200) = 35.75^\circ$, so $\theta = 36^\circ$.	46° . $\sin^{-1}$ is pressed in place of $\tan^{-1}$: $\sin^{-1}(0.7200) = 46.05^\circ$.	A
E	Find θ . Sides: opposite 18, hypotenuse 37.	29° . The 18 is opposite θ and the 37 is the hypotenuse, so they make the sine: $18 \div 37 = 0.4865$. $\sin^{-1}(0.4865) = 29.11^\circ$, so $\theta = 29^\circ$.	61° . This is the other acute angle: $90^\circ - 29.11^\circ = 60.89^\circ$. It comes from the wrong corner, from $\cos^{-1}$ in place of $\sin^{-1}$.	A

Other mistakes lead to no card. A group might press another wrong key, turn the fraction upside down, work in radian mode (an answer under 2), or read $\sin^{-1}$ as $1 \div \sin$. Its answer is then not the number at the top of any card.