

SCAVENGER HUNT



ARC LENGTH AND RADIAN MEASURE

Arc Length: How Far Around?

Radius or diameter · which arc is heavy · answers in terms of π · the cards check the answers

FREE

ANSWER

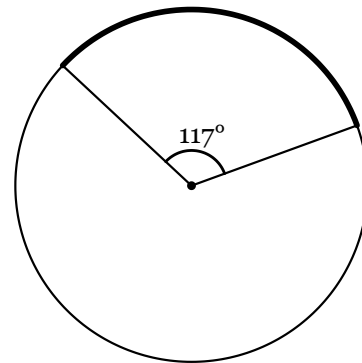
19π cm

The diameter is 40 cm.

Find the length of the heavy arc.

Leave π in your answer.

A diameter goes across the whole circle. Find the radius first.



R

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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: *R K N L G A P B*.
2. **Say this once:** “Find the radius first. Find the angle of the heavy arc. The arc is that fraction of $2\pi \times \text{radius}$. Leave π in the answer, like 8π cm. 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 an arc measure and an arc length as pictures.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card shows a circle with two radii, the arc between them drawn heavy, and an angle at the center with its degrees. The words give the radius or the diameter. The arc length is a fraction of the whole way around: the heavy arc’s angle $\div 360^\circ$, times $2\pi \times \text{radius}$. No calculator is needed, because every answer is a whole number times π . This sheet uses these words: the *measure* of an arc is its angle, in degrees, and the *length* of an arc is a distance, in cm. 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. There are two mistakes. On four ring cards the words give the diameter, and a student who uses it as the radius gets twice the length. On the other four, the angle at the center belongs to the other arc, and a student who uses it without taking it from 360° gets the wrong arc. Each of these lands on a card off the ring. That card sends the group 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, such as always using the printed angle, gets more than eight of the cards. If a group keeps coming back to the same cards, ask: “*Is the length in the words the radius? Put a finger on the heavy arc. Which angle at the center belongs to it?*”



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

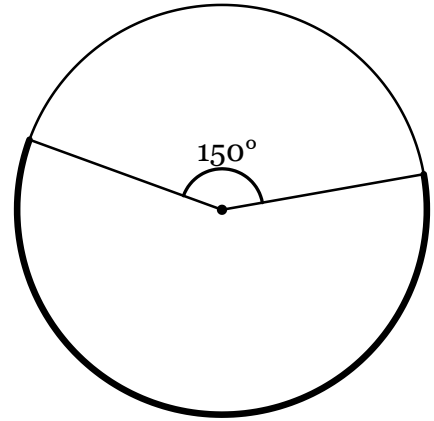
9π cm

The radius is 18 cm.

Find the length of the heavy arc.

Leave π in your answer.

Put a finger on the heavy arc. Is the angle mark on that side?



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A

ANSWER

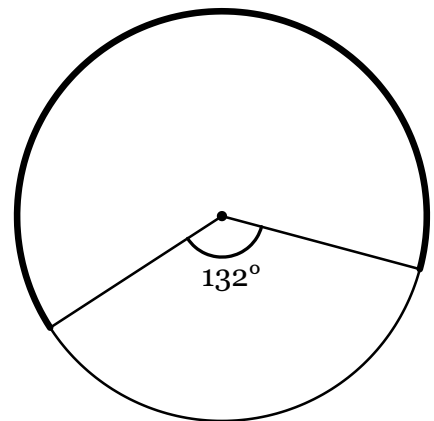
5π cm

The radius is 15 cm.

Find the length of the heavy arc.

Leave π in your answer.

A long arc has an angle over 180° . Check which angle goes in.



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B

ANSWER

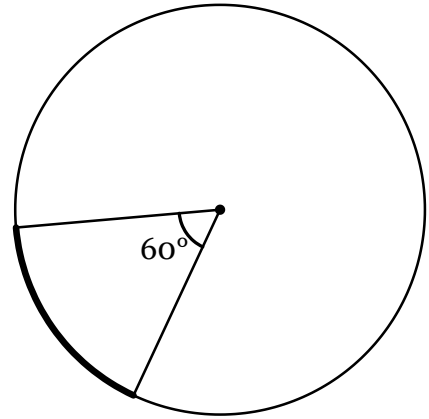
11π cm

The diameter is 30 cm.

Find the length of the heavy arc.

Leave π in your answer.

The angle of an arc is the angle on its own side of the center.



C

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ANSWER

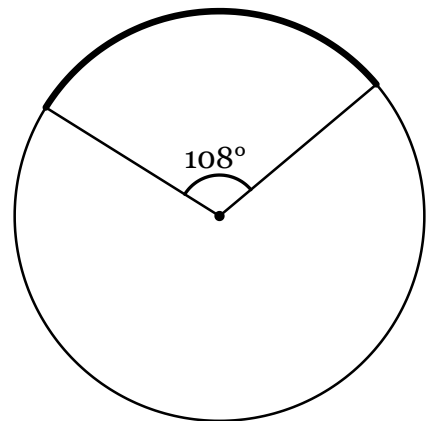
17π cm

The diameter is 20 cm.

Find the length of the heavy arc.

Leave π in your answer.

Two arcs make the whole circle. Which of them is heavy here?



D

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ANSWER

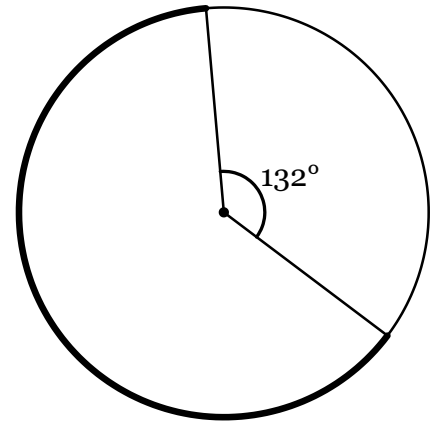
26π cm

The radius is 15 cm.

Find the length of the heavy arc.

Leave π in your answer.

Check the words. Is this length the radius? The radius is half the diameter.



E

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ANSWER

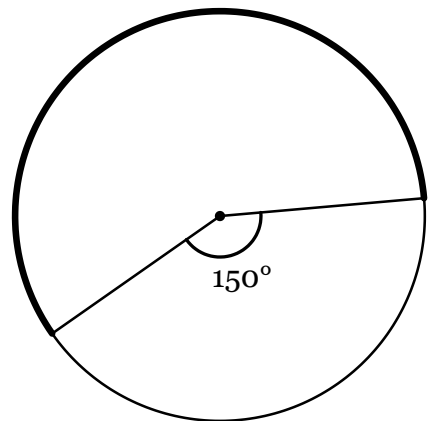
10π cm

The radius is 18 cm.

Find the length of the heavy arc.

Leave π in your answer.

Halve the diameter first. The radius is the length that goes into $2\pi \times$ radius.



F

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ANSWER

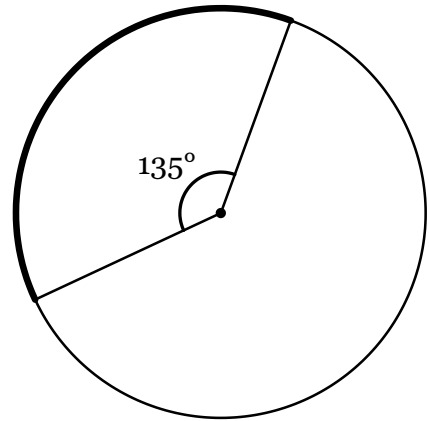
7π cm

The diameter is 24 cm.

Find the length of the heavy arc.

Leave π in your answer.

Half of the diameter is the radius. Put the radius into $2\pi \times \text{radius}$.



G

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ANSWER

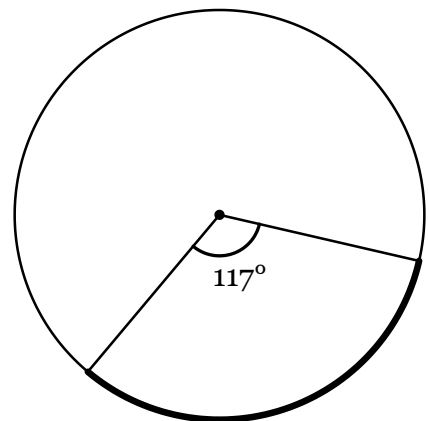
16π cm

The diameter is 40 cm.

Find the length of the heavy arc.

Leave π in your answer.

The angle mark can stand on the other side. Which arc is heavy?



H

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ANSWER

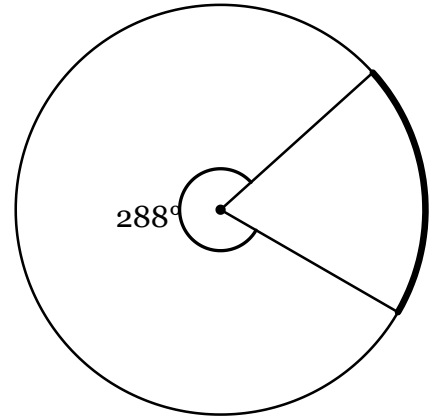
12π cm

The radius is 10 cm.

Find the length of the heavy arc.

Leave π in your answer.

Find the radius before anything else. Is it the length in the words?



J

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ANSWER

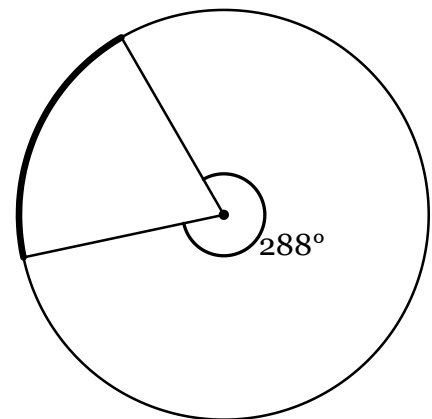
13π cm

The radius is 10 cm.

Find the length of the heavy arc.

Leave π in your answer.

Which arc is heavy? Find the angle at the center on its side.



K

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ANSWER

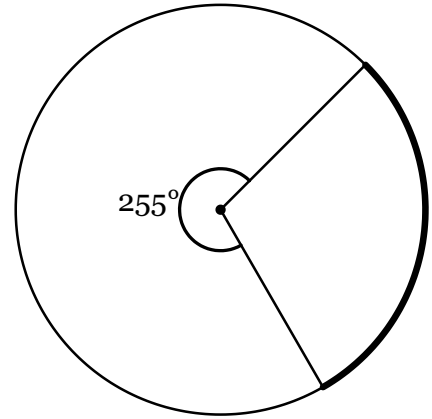
6π cm

The radius is 12 cm.

Find the length of the heavy arc.

Leave π in your answer.

The two arcs share one circle. Their angles add up to 360° .



L

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ANSWER

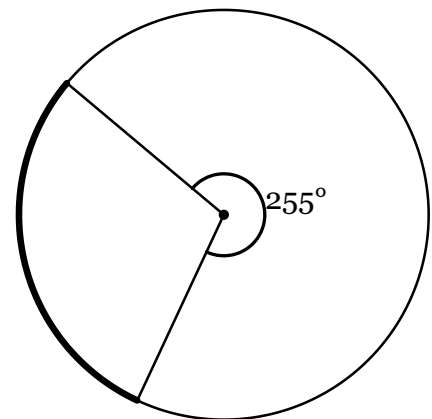
18π cm

The radius is 12 cm.

Find the length of the heavy arc.

Leave π in your answer.

A diameter is two radii. Which one goes into $2\pi \times \text{radius}$?



M

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ANSWER

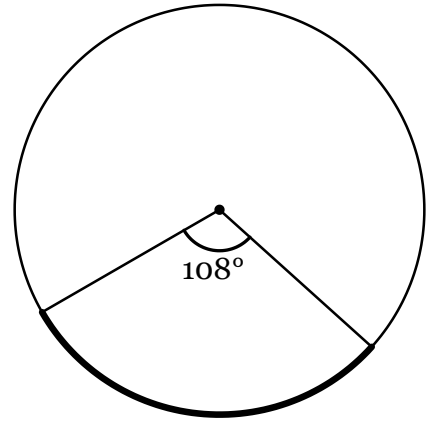
4π cm

The diameter is 20 cm.

Find the length of the heavy arc.

Leave π in your answer.

Is the length the radius or the diameter? Read the words again.



N

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ANSWER

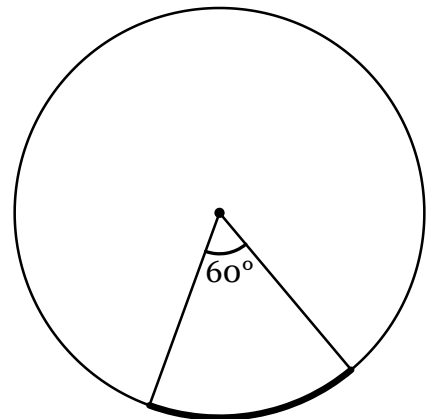
21π cm

The diameter is 30 cm.

Find the length of the heavy arc.

Leave π in your answer.

Estimate first. Half the circle is half of $\pi \times$ diameter.



P

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ANSWER

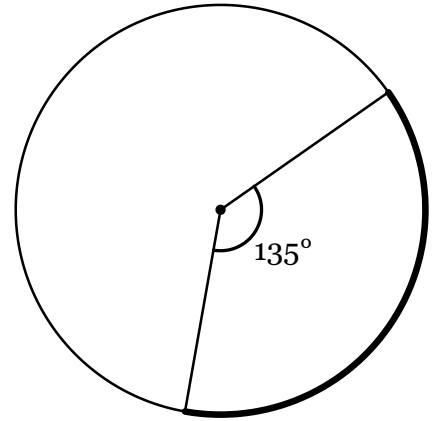
15π cm

The diameter is 24 cm.

Find the length of the heavy arc.

Leave π in your answer.

Trace the heavy arc with a pencil. Which angle belongs to it?



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Q

ANSWER

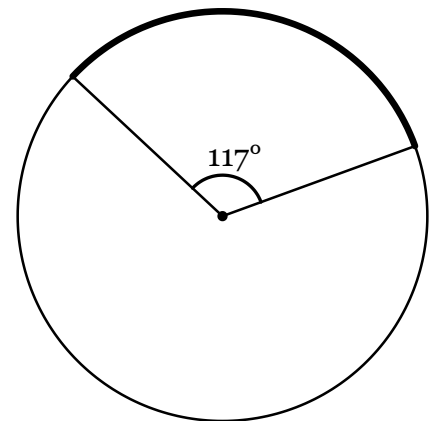
19π cm

The diameter is 40 cm.

Find the length of the heavy arc.

Leave π in your answer.

A diameter goes across the whole circle. Find the radius first.



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R

Scavenger Hunt — where I went

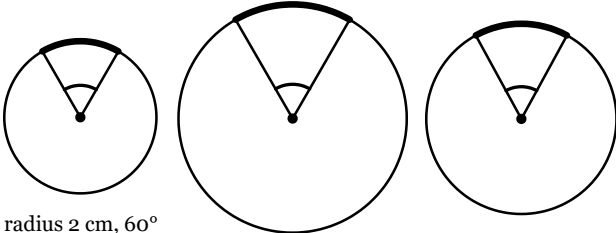
Arc length

Name _____

Period _____

Date _____

For each card, write the radius, then the angle of the heavy arc, then the arc length. **Leave π in your answer, like 8π cm. No calculator is needed.** 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.**



radius 2 cm, 60°

radius 3 cm, 60°

1 radian

Arc measure is in degrees. **Arc length** is a distance, in cm.
 The whole circle is 360°. The whole way around is $2\pi \times$ radius. We use this today. Why it is true comes later in the course.
 An arc is a fraction of the circle. Its fraction is its angle $\div 360^\circ$.
 The diameter is twice the radius.
Radian measure of an angle = arc length $\div$ radius. It has no unit.
 π radians = 180°.

Card letter	The radius	The angle of the heavy arc	Arc length, in terms of π
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Why is a radian so easy to carry?

Every answer 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.**

$4\pi = \text{U}$ $5\pi = \text{N}$ $6\pi = \text{I}$ $7\pi = \text{T}$ $9\pi = \text{L}$ $10\pi = \text{U}$ $11\pi = \text{S}$ $12\pi = \text{S}$ $13\pi = \text{E}$ $15\pi = \text{N}$ $16\pi = \text{T}$ $17\pi = \text{L}$ $18\pi = \text{I}$ $19\pi = \text{S}$
 $21\pi = \text{S}$ $26\pi = \text{E}$

4π	5π	6π	7π	9π	10π	11π	12π	13π	15π	16π	17π	18π	19π	21π	26π



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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.

R (13 π cm) → K (4 π cm) → N (6 π cm) → L (7 π cm) → G (9 π cm) → A (21 π cm) → P (5 π cm) → B (19 π cm) → R

Why is a radian so easy to carry? The answer is *UNITLESS!* It is read along the boxes of the record sheet, which run from the smallest number to the largest. Every answer is exact, in terms of π .

	Card	What the card shows	Answer, and why	The common wrong answer on this card, and why	Letter of its top
1	R	A circle, diameter 40 cm, 117° marked at the center. The heavy arc turns 117°.	13π cm. The diameter is 40 cm, so the radius is 20 cm. The whole way around is $2\pi \times 20 = 40\pi$ cm. The arc is $117/360 = 13/40$ of the circle, so it is $13/40 \times 40\pi = 13\pi$ cm.	26 π cm. The diameter 40 is used as the radius: $13/40 \times 2\pi \times 40 = 26\pi$ cm, twice the length.	S
2	K	A circle, radius 10 cm, 288° marked on the other side, the long way round. The heavy arc turns 72°.	4π cm. The heavy arc is the short arc. Its angle is $360^\circ - 288^\circ = 72^\circ$. The whole way around is $2\pi \times 10 = 20\pi$ cm. The arc is $72/360 = 1/5$ of the circle, so it is $1/5 \times 20\pi = 4\pi$ cm.	16 π cm. The 288° belongs to the other arc: $4/5 \times 20\pi = 16\pi$ cm.	E
3	N	A circle, diameter 20 cm, 108° marked at the center. The heavy arc turns 108°.	6π cm. The diameter is 20 cm, so the radius is 10 cm. The whole way around is $2\pi \times 10 = 20\pi$ cm. The arc is $108/360 = 3/10$ of the circle, so it is $3/10 \times 20\pi = 6\pi$ cm.	12 π cm. The diameter 20 is used as the radius: $3/10 \times 2\pi \times 20 = 12\pi$ cm, twice the length.	U
4	L	A circle, radius 12 cm, 255° marked on the other side, the long way round. The heavy arc turns 105°.	7π cm. The heavy arc is the short arc. Its angle is $360^\circ - 255^\circ = 105^\circ$. The whole way around is $2\pi \times 12 = 24\pi$ cm. The arc is $105/360 = 7/24$ of the circle, so it is $7/24 \times 24\pi = 7\pi$ cm.	17 π cm. The 255° belongs to the other arc: $17/24 \times 24\pi = 17\pi$ cm.	I
5	G	A circle, diameter 24 cm, 135° marked at the center. The heavy arc turns 135°.	9π cm. The diameter is 24 cm, so the radius is 12 cm. The whole way around is $2\pi \times 12 = 24\pi$ cm. The arc is $135/360 = 3/8$ of the circle, so it is $3/8 \times 24\pi = 9\pi$ cm.	18 π cm. The diameter 24 is used as the radius: $3/8 \times 2\pi \times 24 = 18\pi$ cm, twice the length.	T
6	A	A circle, radius 18 cm, 150° marked on the other side. The heavy arc turns 210°.	21π cm. The heavy arc goes the long way round. Its angle is $360^\circ - 150^\circ = 210^\circ$. The whole way around is $2\pi \times 18 = 36\pi$ cm. The arc is $210/360 = 7/12$ of the circle, so it is $7/12 \times 36\pi = 21\pi$ cm.	15 π cm. The 150° belongs to the other arc: $5/12 \times 36\pi = 15\pi$ cm.	L
7	P	A circle, diameter 30 cm, 60° marked at the center. The heavy arc turns 60°.	5π cm. The diameter is 30 cm, so the radius is 15 cm. The whole way around is $2\pi \times 15 = 30\pi$ cm. The arc is $60/360 = 1/6$ of the circle, so it is $1/6 \times 30\pi = 5\pi$ cm.	10 π cm. The diameter 30 is used as the radius: $1/6 \times 2\pi \times 30 = 10\pi$ cm, twice the length.	S
8	B	A circle, radius 15 cm, 132° marked on the other side. The heavy arc turns 228°.	19π cm. The heavy arc goes the long way round. Its angle is $360^\circ - 132^\circ = 228^\circ$. The whole way around is $2\pi \times 15 = 30\pi$ cm. The arc is $228/360 = 19/30$ of the circle, so it is $19/30 \times 30\pi = 19\pi$ cm.	11 π cm. The 132° belongs to the other arc: $11/30 \times 30\pi = 11\pi$ cm.	N

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 shows	Answer, and why	The common wrong answer on this card, and why	Letter of its top
E	A circle, radius 15 cm, 132° marked on the other side. The heavy arc turns 228° .	19π cm. The heavy arc goes the long way round. Its angle is $360^\circ - 132^\circ = 228^\circ$. The whole way around is $2\pi \times 15 = 30\pi$ cm. The arc is $228/360 = 19/30$ of the circle, so it is $19/30 \times 30\pi = 19\pi$ cm.	11 π cm. The 132° belongs to the other arc: $11/30 \times 30\pi = 11\pi$ cm.	E
H	A circle, diameter 40 cm, 117° marked at the center. The heavy arc turns 117° .	13π cm. The diameter is 40 cm, so the radius is 20 cm. The whole way around is $2\pi \times 20 = 40\pi$ cm. The arc is $117/360 = 13/40$ of the circle, so it is $13/40 \times 40\pi = 13\pi$ cm.	26 π cm. The diameter 40 is used as the radius: $13/40 \times 2\pi \times 40 = 26\pi$ cm, twice the length.	T
J	A circle, radius 10 cm, 288° marked on the other side, the long way round. The heavy arc turns 72° .	4π cm. The heavy arc is the short arc. Its angle is $360^\circ - 288^\circ = 72^\circ$. The whole way around is $2\pi \times 10 = 20\pi$ cm. The arc is $72/360 = 1/5$ of the circle, so it is $1/5 \times 20\pi = 4\pi$ cm.	16 π cm. The 288° belongs to the other arc: $4/5 \times 20\pi = 16\pi$ cm.	S
D	A circle, diameter 20 cm, 108° marked at the center. The heavy arc turns 108° .	6π cm. The diameter is 20 cm, so the radius is 10 cm. The whole way around is $2\pi \times 10 = 20\pi$ cm. The arc is $108/360 = 3/10$ of the circle, so it is $3/10 \times 20\pi = 6\pi$ cm.	12 π cm. The diameter 20 is used as the radius: $3/10 \times 2\pi \times 20 = 12\pi$ cm, twice the length.	L
M	A circle, radius 12 cm, 255° marked on the other side, the long way round. The heavy arc turns 105° .	7π cm. The heavy arc is the short arc. Its angle is $360^\circ - 255^\circ = 105^\circ$. The whole way around is $2\pi \times 12 = 24\pi$ cm. The arc is $105/360 = 7/24$ of the circle, so it is $7/24 \times 24\pi = 7\pi$ cm.	17 π cm. The 255° belongs to the other arc: $17/24 \times 24\pi = 17\pi$ cm.	I
Q	A circle, diameter 24 cm, 135° marked at the center. The heavy arc turns 135° .	9π cm. The diameter is 24 cm, so the radius is 12 cm. The whole way around is $2\pi \times 12 = 24\pi$ cm. The arc is $135/360 = 3/8$ of the circle, so it is $3/8 \times 24\pi = 9\pi$ cm.	18 π cm. The diameter 24 is used as the radius: $3/8 \times 2\pi \times 24 = 18\pi$ cm, twice the length.	N
F	A circle, radius 18 cm, 150° marked on the other side. The heavy arc turns 210° .	21π cm. The heavy arc goes the long way round. Its angle is $360^\circ - 150^\circ = 210^\circ$. The whole way around is $2\pi \times 18 = 36\pi$ cm. The arc is $210/360 = 7/12$ of the circle, so it is $7/12 \times 36\pi = 21\pi$ cm.	15 π cm. The 150° belongs to the other arc: $5/12 \times 36\pi = 15\pi$ cm.	U
C	A circle, diameter 30 cm, 60° marked at the center. The heavy arc turns 60° .	5π cm. The diameter is 30 cm, so the radius is 15 cm. The whole way around is $2\pi \times 15 = 30\pi$ cm. The arc is $60/360 = 1/6$ of the circle, so it is $1/6 \times 30\pi = 5\pi$ cm.	10 π cm. The diameter 30 is used as the radius: $1/6 \times 2\pi \times 30 = 10\pi$ cm, twice the length.	S

Other mistakes lead to no card. A group might use the area $\pi \times \text{radius} \times \text{radius}$ in place of the whole way around, use $\pi \times \text{radius}$ for the whole way around, multiply the angle by the whole way around without dividing by 360, or multiply the degrees by the radius. Its answer is then not the number at the top of any card.